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Editor: HUGH S. POCOCK.
Assistant Editor: F. H. HAYNES.
Editorial Offices: 116-117, FLEET STREET, LONDON, E.C.4.
Editorial Telephone: City 9472 (5 lines)
Advertising and Publishing Offices:
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THE CONTROL ROOM.

THE control room of a broadcasting station has always been a subject for dispute, for it is here that, no matter what the rendering in the studio performance may be, the operator in the control room is able to insure (if he pleases) that a rendering with very different contrasts in volume will go out to listeners.

There is a story that in the early days of broadcasting, when the orchestra was playing the "Turkish Patrol," the engineer in the control room, who was not a musician, was puzzled at the softness of the reproduction when the marching column is heard in the distance coming gradually closer and closer, and so he adjusted his controls to bring the strength up to normal. Then, as the music increased in volume, as the marching column came nearer and nearer, the engineer found that, to avoid overloading, he had to diminish the intensity, and, again, as the music faded with distance, the engineer again brought up the strength and was very puzzled as to what was happening. The net result was that to the listener the "Turkish Patrol" came through at the same level throughout.

This story merely provides an illustration of the responsibility which rests with the operator in the control room, and shows to what an extent the original performance can be changed.

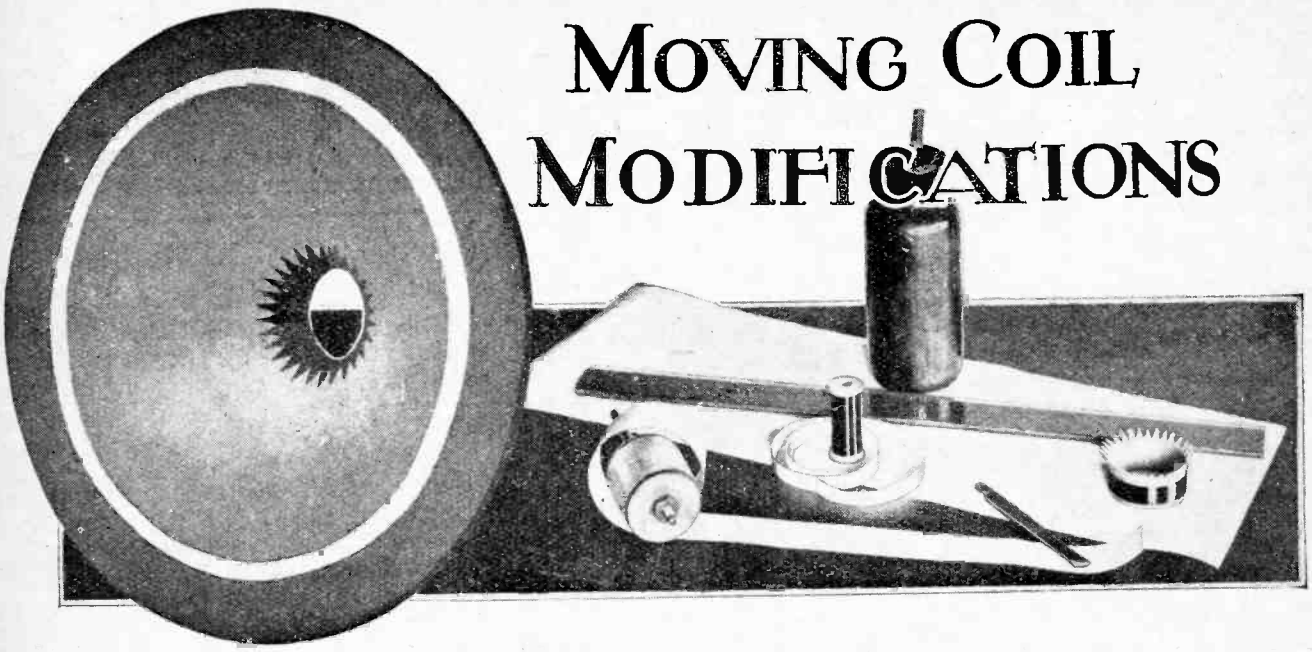
The Ideal Control.

The ideal control would seem to be one where a receiver could be set so as to reproduce satisfactorily the loudest passages or noises broadcast without blasting, and that the controls at the transmitter should remain at that point, so that at the receiving end listeners would hear all performances with the intensity of sound more or less correctly proportioned. This, however, is an ideal which it would be difficult to carry out in practice at the transmitting end, because in the case of outside broadcasts in particular the source of sound may move with respect to the microphone, and allowance has, therefore, to be made for such contingencies in the control room. Listeners are probably well aware, from their experience, that it is the practice of the B.B.C. to amplify speech out of all proportion to music. One may have a set suitably adjusted for an orchestral performance, but if this is followed by a speech we find that the intensity of the speaker's voice is likely to be at least equal to some of the loudest passages of the orchestral music. The B.B.C., we understand, consider that this is necessary, in order that speech shall come through clearly on crystal receivers or on stations at some distance, where signal strength is weak, an explanation quite unsatisfactory to the increasing numbers of listeners who employ valve receivers giving them adequate volume.

Making Up for Inefficiency.

We had hoped that some solution of the control room trouble might have been arrived at before now, but, unfortunately, the position seems to have improved very little, if at all, in the past year or more. With a very large section of the public, the practice is growing of setting the receiver correctly for reception of the local station and leaving it at that, making no further adjustments during the transmission of a programme. The net result, from our experience, is that much of the reproduction is then unpleasantly out of balance, even if one is fortunate enough to avoid actual distortion. This means that the control room is spoiling the effect of the programmes to a very large proportion of listeners who have gone to the trouble and expense of trying to get the utmost in quality of reproduction, in order to make up for the inefficiency of crystal and some other types of receivers.

MOVING COIL MODIFICATIONS



An Improved Speech Coil for the Coil-driven Loud Speaker.

By L. E. T. BRANCH, B.Sc.

THE response of a moving coil loud speaker changes with varying frequency due to the alteration of the impedance of the moving coil. At the very low and very high frequencies the impedance of the coil is greatest, consequently there is a falling off of power at both ends of the musical range. At the very low frequencies the actual movement of the coil is relatively considerable, and there is set up a back electromotive force (due to the cutting of the magnetic lines in the air-gap) which opposes the current driving the coil so that the vibration of the cone and coil is not so strong as it would be were this back E.M.F. absent. At the very high frequencies the movement is so small that this factor is of no account, but the inductance of the coil now impedes the current. On the other hand, at about middle C electrical resonance occurs when neither of the above two mentioned factors have any influence, so that at about 500 cycles the current, and consequently the power output is a maximum.

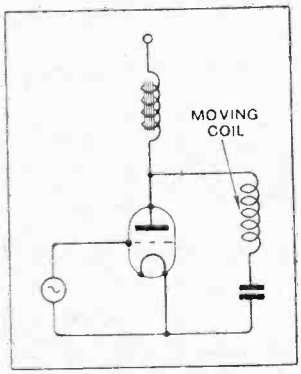


Fig. 1.—The equivalent circuit of an output valve coupled to a moving coil loud speaker.

The improvement to be dealt with in this article consists in wrapping round the inside or outside of the moving coil a strip of copper the dimensions of which should be 6¼in. by ⅜in., and two-thousandths of an inch in thickness. We thus virtually short-circuit the inductance of the moving coil, and, moreover, at the low frequencies the back E.M.F. referred to is practically eliminated. It must always be remembered that the coil does not operate because of its inductance, but in spite of it. The result is that the impedance of the improved moving coil is, for all practical purposes, constant at all frequencies. Hence the response curve is very close indeed to a straight line. The author has used this device with distinctly improved results.

Constructing the Copper Band.

The ends of the copper strip must, of course, be soldered together where they meet in order to ensure a complete circuit, otherwise the desired effect of a nearly linear response is not produced at all.

As an example, the strip is illustrated in Fig. 3 at A, where it is placed inside an existing coil B. When making a new coil it is advisable for convenience to incorporate the strip on the former in the winding space before commencing to wind the coil. A thin strip of waxed tissue paper should be stuck over the copper strip with shellac varnish in order to insulate it from the winding.

In order to consider this arrangement theoretically we have to remember that the power given out by a moving coil loud speaker depends upon the A.C. voltage produced across the anode and filament of the valve, the weight and size of the cone, the total impedance of the circuit, etc. Now the impedance of the circuit (Fig. 1) is given by

$$Z = \sqrt{(\rho + R_0)^2 + X^2}$$

where ρ is the resistance of the valve, R_0 the D.C. resistance of the coil and X the impedance of the coil due to its inductance and motional capacity. It is well known[1] that at low frequencies the impedance of L is

Moving Coil Modifications —

negligible, and Cm has an equivalent impedance in the neighbourhood of several thousand ohms, while at high frequencies the impedance of Cm is negligible, and L has an impedance of round about several thousand ohms. At resonance (about 500 cycles for a 1,000-turn coil of diameter 2in. working a cone weighing (with coil) about 18 grams in a field of 10,000 lines) the circuit L Cm has zero impedance and the impedance of the whole circuit may be taken as $\rho + R_0$. Therefore, there is a falling off of power at the higher and lower frequencies due to the factor X. In other words, any arrangement which is capable of lowering the value of X without materially affecting any other factor would increase the power of the loud speaker at both ends of the musical register, and bring the response curve more nearly to a straight line, and this will be true for the moving coil described by the author under "A New Method of Push-Pull Amplification." The insertion of a strip A of copper, either stuck on the inside of the moving coil former B using any suitable adhesive, e.g., Le Page's liquid glue, shellac, etc., or wrapped round the winding space of the former before the windings are put on, accomplishes this object to a marked extent.

Galvanometer Analogy

In a previous article[2] it was shown that where several valves are used in parallel in the last stage, without redesigning the moving coil the power output at 500 cycles is very greatly increased in comparison with the high and the low frequencies, this being due to the reduction of ρ while X remains unaffected.

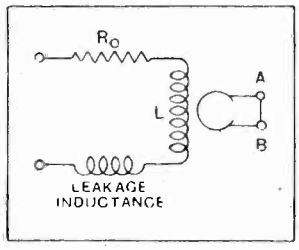


Fig. 2.—The copper band around the moving coil can be considered as a one-turn short-circuited secondary of a transformer, the primary of which is the moving coil.

We can consider our copper strip as a one-turn secondary winding of a transformer, of which the moving coil is the primary. The ratio of this transformer is then 1000 : 1 (step down) and its secondary is permanently short-circuited, as shown in Fig. 2. In other words, the load across the ends AB is infinitely great, and can be considered for convenience as being either an infinitely large-capacity load or an infinitely large-inductance load. While a load on the secondary is equivalent to $\frac{1}{(1,000)^2}$ of this on the primary, nevertheless a direct short is so great a load that the equivalent on the primary is still very large indeed, in fact, so large that the working inductance of the moving coil is reduced to merely the leakage inductance between the primary and secondary. The coupling between the primary and secondary is very tight, so that this leakage inductance is negligibly small, at most only a small percentage of L. Also, the back E.M.F. induced by the motion of the coil at low frequencies is very much reduced, with the consequence that the value of the motional capacity Cm becomes very great. In the ordinary way considerable energy has to be expended to drive the current against this opposing E.M.F. The net result is the reduction of the factor X to a comparatively low figure, so that the overall impedance of the output circuit remains substantially constant at all frequencies.

The insertion of this copper strip has another effect which also is just discernible aurally. Without the strip the moving coil can be likened to a ballistic galvanometer, which depends for its operation upon the kick produced in the coil by a momentary current, the swinging of the needle continuing after the current has ceased. The new moving coil with the copper strip in position can be compared with a dead-beat galvanometer, the coil of which is wound upon a copper or phosphor-bronze frame. This frame introduces electrical damping and the movement of the coil is aperiodic. Hence the tendency for the moving coil to vibrate in any way other than that corresponding to the electrical vibrations imposed upon it is very much lessened.

It should be mentioned that the copper strip weighs very little more than half a gram, so that the effect of its mass is practically inappreciable.

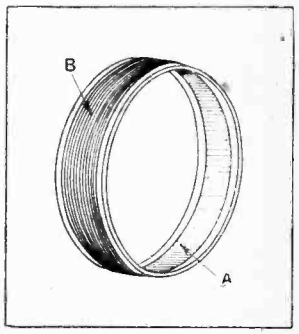


Fig. 3.—A modified moving coil in which B represents the existing coil and A a copper band around the inner diameter

There are cases in which the presence of the copper strip is even more important than would appear from the above considerations. In the calculations we have taken the total mass of the coil and cone as 18 grams, thus giving[3]

$$Cm = \frac{18 \times 10^{15}}{2.5 \times 10^{16}} = 0.72 mf$$

It is obvious from this formula that the less the weight of the coil and cone the smaller will be the value of Cm and the greater the impedance $\frac{1}{2\pi f.Cm}$ of the moving coil at very low frequencies. For instance, at 55 cycles the impedance is 4,000 ohms, and then the total impedance of the circuit is

$$Z = \sqrt{(2,500 + 1,000)^2 + (4,000)^2} = 5,300 \text{ ohms.}$$

(assuming that the internal resistance of the valve is 2,500 ohms). Now, at electrical resonance the factor X does not enter into the calculation of Z for that frequency (500 cycles) and the power given out, that is, the amount of electrical energy transferred into sound is inversely proportional to the weight of the coil and cone, and if this decrease in weight did not cause a lowering in Cm it would be advantageous to make a lighter coil and cone. For example, the author has been able to construct a coil and cone of exactly the same diameters as those considered above (2in. and 8in. respectively), but by the use of a very light former and special thin paper only weighing in all 9 grams. At resonance, therefore, the power is quadrupled[4], while at low frequencies the advantage introduced by the small weight is nullified by the effect of the decrease in the value of Cm, which becomes

$$\frac{9 \times 10^{15}}{2.5 \times 10^{16}} = 0.36 \text{ mf}$$

Moving Coil Modifications.—

Hence, at 55 cycles the factor X now becomes 8,000 ohms and the impedance of the whole circuit is, therefore

$$\sqrt{(2,500+1,000)^2+(8,000)^2}=8,700 \text{ ohms.}$$

Since the impedance of the circuit has risen from 5,300 ohms with the 18-gram cone to 8,700 ohms for the 9-gram cone, the current flowing in the loud speaker will *decrease* in a similar proportion, and in consequence this factor alone will cause a decrease in the power output (at 55 cycles) in the ratio

$$\frac{1}{(5,300)^2} : \frac{1}{(8,700)^2}$$

i.e., 3 : 1 (very nearly).

This means that with the substitution of the 18-gram cone by the 9-gram cone the volume of sound remains practically unaffected at the very low frequencies but is quadrupled at and above 500 cycles.

With a copper strip built into this coil, however, the factor X remains small, even at the very low frequencies, and the impedance Z of the circuit is not appreciably altered at any frequency by the decrease in weight of the coil and cone, and consequently the power at *all* frequencies is approximately quadrupled. Even where a loud speaker is giving all the power its owner requires, this light coil and cone with the copper strip is worth installing because it means that for the same power output as before the valves are operated at half the original grid swing, and, therefore, less H.T. is necessary for the same output as hitherto; or with the H.T. unaltered the tendency to overload the last valve on very occasional heavy sounds is minimised.

The coil was wound on a paper former weighing only 1.4 grams and with the copper strip 2.1 grams. When wound, the coil and former weighed 6.2 grams. For the cone a sheet of paper normally made for running off copies on a Roneo (cheaper grade) was used. This paper is a little under $\frac{5}{1000}$ths of an inch in thickness, and the cone itself weighed 2.7 grams. The coil and cone, therefore, when stuck together ready for mounting on the suspending leather weighed just 9 grams.

Although the cone was made of paper barely $\frac{5}{1000}$ths of an inch in thickness it was found to be exceedingly strong when completed, and the increase in power was very obvious indeed.

Two more such moving coil loud speakers have been modified in this way by friends of the author with exactly the same improved results.

[1] *Wireless World*, March 30th, 1927, p. 374, and June 6th, 1928, p. 601. [2] June 6th, 1928, p. 601. [3] March 30th, 1927, p. 373. [4] April 13th, 1927, pp 443-4.

TRANSMITTERS' NOTES

General Notes.

Mr. H. L. O'Heffernan (G 5BY), 2, Chepstow Road, Croydon, was in two-way communication for three-quarters of an hour, on the 20-metre waveband, with the Japanese station, 1AW, on April 28th. This was stated by 1AW to be the first direct amateur contact on this wavelength between Japan and Great Britain.

G 5BY was also in communication on April 1st, on the same waveband, with 7ADY in Alaska, and this is stated to be the first amateur contact between Alaska and this country.

On April 13th G 5BY was in touch with NC 5AU, Vancouver, British Columbia, who informed him that this was the first contact between that district of Canada and Great Britain. Mr. O'Heffernan, however, believes that other transmitters have a prior claim, and will be glad to hear from any who have been in two-way communication with the Canadian 5th District at an earlier date.

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New Zealand Notes.

The New Zealand Association of Radio Transmitters has presented a shield for competition among those using transmitting sets not exceeding 45 volts. The first test, which consisted of sending four messages in code to four separate members in different parts of the Dominion, was won by Mr. R. V. Roberts (OZ 2AH), who was successful with three messages and was heard with the fourth. The test attracted a large number of entrants from all over the country. It is hoped to carry the tests out every six months in future.

Mr. C. V. Blucher, of Waihopu, New Zealand, has within the last few months picked up on a four-valve set forty-nine American stations, sixteen Australian, and four Japanese, besides all the N.Z. stations. Of these, thirteen American, ten Australian, and one Japanese were up to loud speaker strength, the remainder being heard through the phones.

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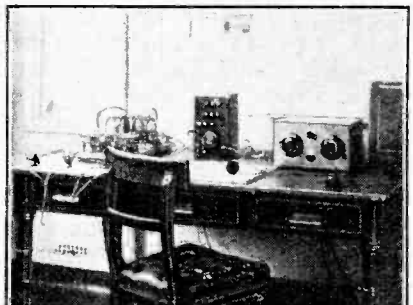
Broadcasting from Mexico.

The Mexican station, XC 51, is broadcasting every evening, on the 44-metre wavelength, talks about the history and culture of the country in Spanish and



Short-wave transmitter at the Royal Military College, Sandhurst (G 5PM), constructed by Mr. J. Beeton from the particulars given in the "Wireless World" of June 29th, 1927.

English. These transmissions begin at 9 p.m. Mexican time (about 4 a.m. G.M.T.). The Consul-General of Mexico will be glad to have reports from any listeners receiving these signals, which should be addressed to him at Bush House, Aldwych, W.C.2. He is trying to arrange with the authorities in Mexico to alter the time of these transmissions to a more convenient hour for European reception.

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A South African Station.

FO A9A, Mr. F. E. Frost, Box 320, Bloemfontein, reports that signals from European stations have been coming in at good strength on 45 metres. Spain and Portugal especially were heard at R7-R8. A9A transmits on 35.75 metres daily from 17.30 to 21.00 G.M.T., and listens for European stations replying on 32 to 45 metres.

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Forwarding Agents

Esthonia.—V. Suigusaar, Höbe t. 4 Pernau (in place of Mr. Leesment); he will also forward cards for Lettland and Lithuania; all should be sent under cover.

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Q.R.A.s Wanted.

JZR, BQS, EB 4GW, ORU, ED 7AK, ED 7AE, EI 1GD, 54RA, WOXX, FS1.

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New Call Signs.

2 AFG	(ex BRS 31), V. G. Mellor, 1, Guildford Lawn, Dover, Kent.
2 AYO	R. Brettell, 3A, Hartshorn Rd., Bilston, Staffs.
5 BX	(ex 2 BXG), "Hill Close," Berkswell, Warwickshire.
5 LT	E. S. Elliott, 13, Marlin Way, Sheffield.
6 MO	(ex 2 AOV), A. E. Apps, 322, High St., Chatham.
6 QA	(ex 2 BPJ), T. A. Whiteley, 13, Haslam St., Rochdale, Lancs.
6 WT	J. R. Wortley-Talbot, Broadsands House, Churlston-Ferrars, S. Devon.
EB 4FQ	A. Legrand, 44, Rue Darchis, Liège, Belgium.
ET-1F	W. Hinentalis, Aukst. Karin, Kursai, Kaunas.
ES-2NQ	Armas Häckkänen, Linnank 16A, Helsinki.
EX 1AW	MM. Assa and Wagner, Diekirch, Luxembourg.

Hints on Choosing and Winding Coils.

By "RADIOPHARE."

IT seems likely that questions pertaining to tuning coils are responsible for more uncertainty in the mind of the amateur than is any other technical matter which directly concerns every owner of a receiving set. Possibly the situation has been aggravated by the fact that we have slipped into the habit of classifying plug-in and other coils by a figure corresponding either exactly or approximately to the number of turns which they comprise, instead of by more helpful and scientific units of inductance. It may be considered that "microhenry" is rather a forbidding word to put before the beginner, but it seems to the writer that the use of its familiar abbreviation of "mic" would go a long way towards establishing confidence.

Now the statement that a coil has a certain number of turns, unqualified by particulars as to their diameter and disposition with respect to each other, gives no definite information as to the wavelength to which the oscillatory circuit of which the coil forms a part may be tuned, although a most useful rule of thumb, sufficiently accurate for many purposes, will be given later. Even the adoption of the "microhenry" rating might well leave us in the air, as it involves working out a somewhat complicated formula, although this task can be avoided by making use of the Abacs now appearing in *The Wireless World*. However, we are still left with the task of estimating the inductance of our home-made coils. This is not altogether easy, although it can be done by following the procedure described in several wireless text-books.

A Useful Rule of Thumb.

Is there no simple way of deciding what size of coil will be required to tune to a given wavelength? Fortunately for those who do not care to spend much time in going deeply into the subject, there is; every amateur knows by experience that the use of a certain coil enables him to receive his local station, and with this knowledge as a basis he can readily estimate the relative number of turns necessary for any other wavelength. The simple rule is that wavelength is directly proportional to turns, assuming the diameter to be sensibly constant, and not less than the winding length. This will hold good over a wide band of wavelengths, and errors are likely to creep in only if the tuning condenser has a disproportionately small maximum capacity. To see how it works in practice, let us imagine that a certain receiver, with a directly coupled aerial, tunes to a 400-metre transmission with a 40-turn coil, and the variable condenser set at about half its maximum capacity. Applying our rule, we find that for the reception of Daventry on 1,600 metres—a four-fold increase in wavelength—a coil of $40 \times 4 = 160$ turns will be required; the nearest standard winding, with 150 turns, is almost certain to be suitable. Turning to the shorter waves, a coil having $40 \div 2 = 20$ turns would be correct for tuning to 200 metres—half the basic wavelength.

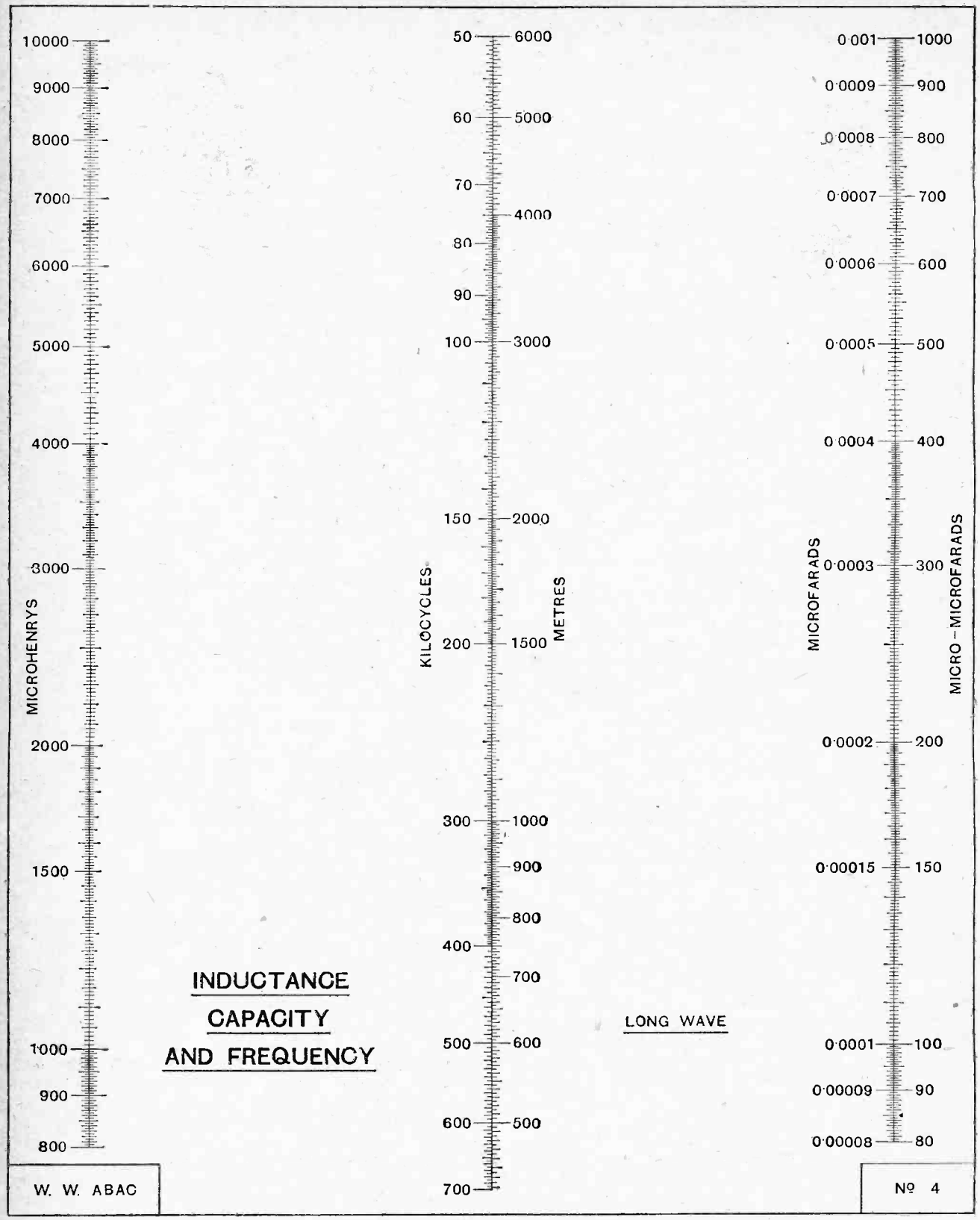
Data for "Best" Coils.

There is another rule, which, though not so helpful in practice as the foregoing, is nevertheless of some value on occasions; it is to the effect that wavelength is directly proportional to coil diameter if the number of turns are constant.

The very involved question of coil design cannot be touched upon here, but data for winding efficient inductances to cover the normal broadcast band with a condenser of from 0.0003 mfd. upwards may be useful to those who find it necessary to make a coil of some specific diameter for use in tuned anode circuits, as H.F. transformer secondaries, or as aerial-grid inductances—in fact, for any purpose except for use in a directly coupled aerial circuit.

Assuming a diameter of 2½in., the winding should have 72 turns of No. 28 D.C.C. wire. The 3in. coil may be wound with 66 turns of No. 24 D.C.C., while for a diameter of 3½in., 62 turns of No. 24 D.C.C. will be correct. All the coils are single-layer solenoids, with adjacent turns touching.

In spite of the fact that these coils are made with wire of a standard gauge which is readily obtainable from the majority of wireless dealers, their dimensions approach closely to the ideal for inductances wound with solid wire, although in the case of the first two described a slight improvement could be effected by using double silk-covered wire of the gauge specified, slightly spacing the turns to occupy a winding length equal to eight-fifteenths of the diameter. It should be made clear that a greater diameter means increased efficiency, but coils larger than 3½in. are apt to be cumbersome, and their use may lead to excessive interaction between circuits.



USEFUL DATA CHARTS (No. 4).

Inductance, Capacity and Frequency: Long-wave band. Reference should be made to last week's issue for an explanation of how to use this abac

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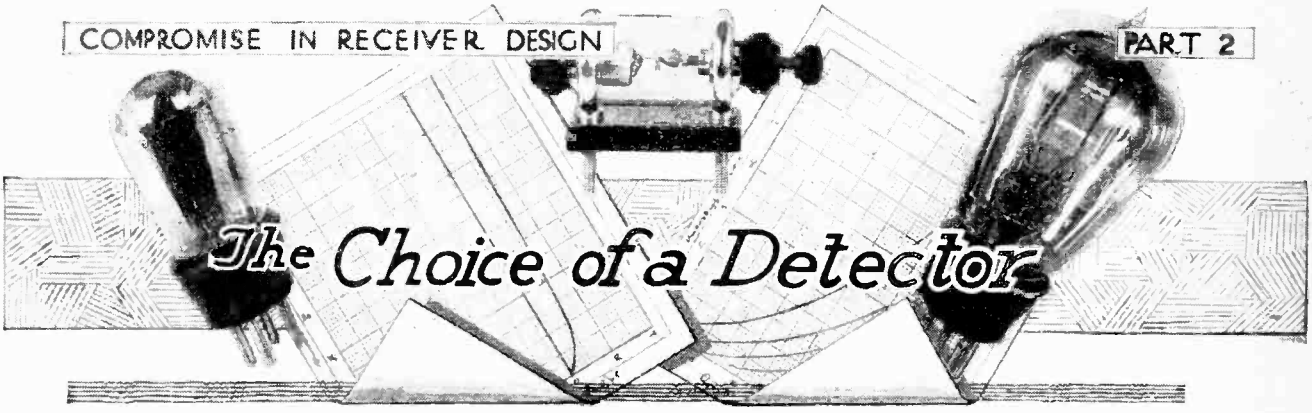
COMPROMISE IN RECEIVER DESIGN — PART 2



The Choice of a Detector

THE question of the choice of a detector in a wireless receiver brings us for the first time into contact with the need for making compromises on technical grounds alone. In the case of the output stage, discussed in the preceding article of this series, compromise really only came into question in view of the need for keeping expenditure within the means or inclination of the user, whereas in the matter we are now to discuss there are important technical reasons in favour of keeping each of the four possible types of detector. There are also excellent reasons for disliking and deciding to discard each type, so that the final choice must inevitably become something of a personal matter. Some will think that the advantages of a grid rectifier outweigh those of the anode rectifier, and others, who estimate differently the relative importance of the factors involved, will come to exactly the opposite conclusion when considering this vexed point.

In Part I the relative merits of the many alternative forms of output stage were carefully discussed. This instalment deals with the detector and clearly indicates the limitations of the four methods of detection—the crystal detector, the two-electrode valve, the leaky-grid and anode-bend detector.

The four types of rectifier to which reference has just been made are the crystal, in all its many forms, the grid rectifier, the anode rectifier, and finally the diode rectifier. Each of these four has its own particular virtues and its own particular defects, with the result that each has a sphere that it has made peculiarly its own.

When it is Better to Use a Crystal.

Where, owing to the proximity of the local station, no high-frequency amplification is required, and reception in telephones is considered sufficient, the crystal stands supreme, in spite of its many disadvantages. In any valve receiver the power that operates telephones or loud speaker is derived from the high-tension battery and the energy picked up by the aerial has to do no more than control this local source of power. In vivid contrast to this stands the crystal receiver, which is operated entirely by the energy collected by the aerial, and supplied by the broadcasting station itself. The ability to employ directly this source of free energy is at once the crystal's greatest recommendation and its greatest limitation. By virtue of this peculiar action, so different in its very nature from that of the valve, there is removed entirely the necessity for installing, and replacing or recharging at intervals, batteries or accumulators of some kind. This means that the crystal set costs far less to instal than even the smallest receiver employing valves, while upkeep costs are limited to the expenditure of about a shilling a year on new crystals. In return for this modest outlay any listener dwelling within ten or a dozen miles of a main station can hear that station in telephones whenever it is transmitting, and the standard of quality is for all practical purposes limited only by the excellence of the telephones used.

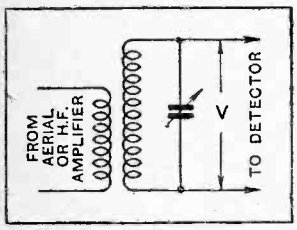
When reception is required from a greater distance, or at a greater strength, than is possible with an unaided crystal, it becomes necessary to employ valves for amplification. If this is done most of the crystal's superiority as a rectifier vanishes. If valves are to be used at all the various batteries have to be installed and maintained, so that there is very little advantage in being able to dispense with them in one particular part of the receiver; the addition of one more valve consuming but little from the anode battery and in these days an almost negligible filament current, makes so little difference to the cost of installing or running a receiver as to be hardly worth considering. In such circumstances the extra difficulty that is introduced by the use of the crystal into the problems of designing the high-frequency amplifier is generally considered sufficient grounds for replacing it by a valve. As has already been mentioned, the crystal, unlike the valve detector, requires high-frequency power in appreciable amounts for its operation. As a result the design of the tuning circuits from which it is fed has to be considerably modified to suit this condition. This does not appear at first sight a very grave difficulty, nor would it be so but for the fact that the power consumed cannot be depended upon for constancy, even within wide limits; the damping introduced by the crystal varies not only with every different crystal but from point to point on the same crystal. Even "permanent" detectors are not free from these variations, and with the best of them the design of the circuits has by no means the certainty that is associated with designing for a valve amplifier.

Where the valves in use with the crystal are employed as low-frequency amplifiers only, magnifying up the

Compromise in Receiver Design.—

signals for loud speaker reproduction, the variability in behaviour is again a serious drawback. If telephones are attached directly to a simple crystal set, variations in strength of perhaps twenty to one are not really serious unless signal strength is at its best very low, for the adaptability of the ear compensates to a large extent for these changes. When a loud speaker is in use, however, matters are very different. The usual loud speaker equipment requires to be run at very nearly its maximum output to give acceptable strength, so that any decrease below this value is resented by the listener. Similarly, any increase above it is resented by the output valve, which promptly delivers signals distorted through overloading. Add to this that the process of resetting the crystal causes the loud speaker to emit a series of cracks and bangs of sufficient violence to annoy the average listener beyond endurance, and we have completed the case against the crystal.

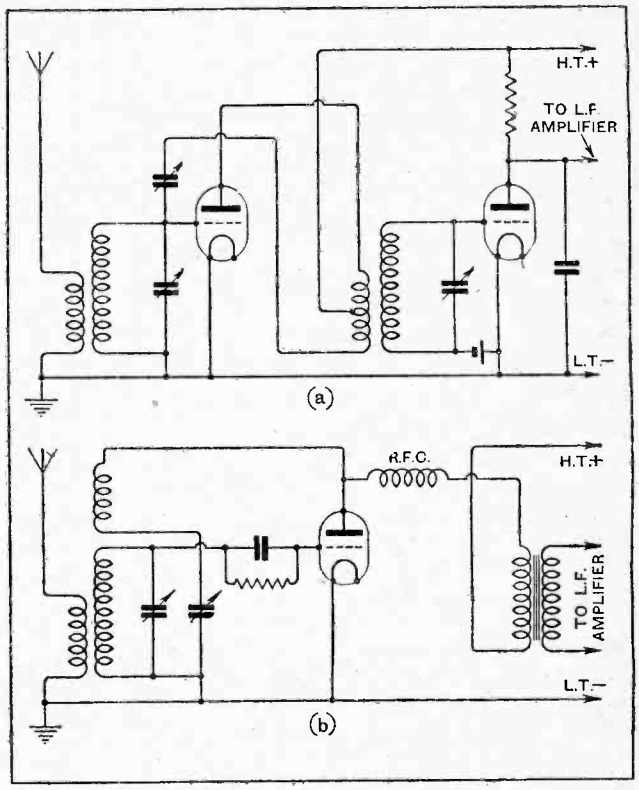
Summing up both sides of the case, we have seen that the cheapness and simplicity of the crystal set renders it supreme for local reception on telephones, while the small saving that is rendered possible by its incorporation in a receiver employing valves for purposes other than detection is handsomely outweighed in most cases by the difficulties, both of design and operation, that its use entails. The use of a crystal in conjunction with valves is therefore practically limited to receivers which are primarily designed for extreme economy; such receivers make use in most cases of reflex amplification in order to obtain the very maximum of useful work from each valve. The reduction in the price of valves, and, still more, the reduction of filament current to little more than one-tenth of the amount consumed by the old bright-emitter has resulted in the almost complete disappearance of receivers of this class, for the motives leading to the utmost economy in valves have lost most of their force. At the present time it is safe to regard the use of a crystal for rectification in a receiver which employs valves for amplification as outside current practice, and receivers of this type will not receive further consideration here on that account.



The tuned input circuit to the detector. Grid detection though more sensitive than anode detector, reduces the available radio frequency potentials by imposing a load on the tuned circuit.

The Diode Rectifier.

Passing to the use of the valve as a rectifier, we may dismiss in a few words the diode rectifier. Its sensitivity is so low that if it is substituted for either an anode-bend or a leaky-grid detector it is necessary to add two extra valves to the receiver. One of these must be employed as a high-frequency amplifier, in order that the high-frequency input that this type of rectifier requires may be provided, and the other is needed to make up for the fact that the diode rectifier is a rectifier only, and contributes no amplification whatever. In return for this expenditure of apparatus we obtain a perfection of rectification, combined with perfect reliability, that cannot easily be equalled in any other way. The gain in quality that results is but small compared with an anode rectifier, and is difficult to detect by ear even when a perfect amplifier and the most nearly perfect loud speaker available are in use, so that diode rectification is not worth while save under rather exceptional circumstances. It is never likely to be popular, and is certainly not of sufficient interest to the average set builder to be treated here at any greater length.



(a) and (b) represent the type of circuits made necessary by the characteristics of the anode and grid rectifiers respectively. It is particularly to be noted that (a) has the same number of controls as (b) but gives much greater selectivity. Although both have about the same effective range of reception (a) gives a much greater output to the L.F. amplifier than (b).

Leaky Grid *v.* Anode Bend.

There remain for discussion the anode-bend and the leaky-grid rectifiers, which, so far as popularity is concerned, hold the field almost exclusively. In practically every receiver one or other of these two methods of detection is adopted, so that in the vast majority of cases it is only necessary to make a choice between these two.

Of recent months much has been written on their relative merits, and the topic has been much ventilated in wireless circles. Each mode of rectification has its own staunch adherents who will have nothing to do with the rival method, and both sections are perfectly justified in their preferences. Those who prefer grid rectification point out that they can receive as many stations with three valves as their rivals can with four—what possible reason can there be to forsake so highly efficient

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a rectifier? The users of anode rectification counter this by drawing attention to the superior selectivity of their receivers, and to the fact that there is no reaction control, and by demanding due appreciation of the improved quality of reproduction that they generally seem to attain. They count the expenditure of an extra valve a small thing in comparison with all these advantages.

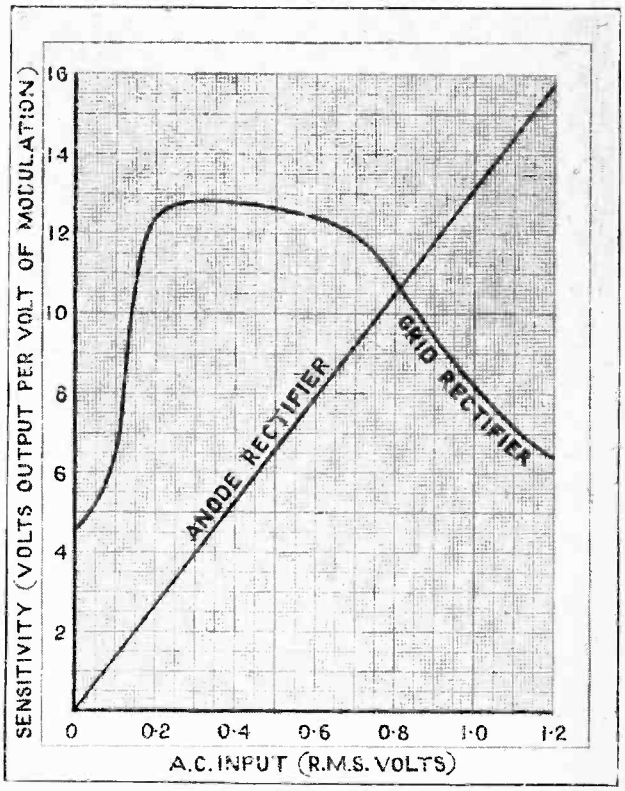
In making these claims neither school has indulged in any greater exaggeration than is usual when attempting to prove a case; there is no doubt whatever that greater sensitivity in a simple set can be obtained with the grid rectifier, nor is it possible to challenge seriously the statement that the anode rectifier provides in general both better selectivity and better quality than its rival. In choosing a rectifier it is, therefore, necessary to take into consideration the conditions under which the set is to be used, the degree of selectivity likely to be required, and the standard of quality implied by the design of the low-frequency amplifier and the loud speaker to be used, before a final decision between the two can be reached.

A discussion of the behaviour of the two rectifiers, so far as it affects receiver design, will bring into prominence the main differences between them. Let us imagine that a tuned circuit is supplied from an aerial, or from the plate circuit of a preceding high-frequency amplifier. If this tuned circuit is of low enough resistance quite large high-frequency voltages may be developed across it. If any high-frequency power is drawn from this circuit, however, the voltage will immediately drop to a very much lower value; the "voltage regulation," as it is called by designers of power transformers, is almost unbelievably bad. The absorption of power from such a tuned circuit is equivalent to increasing its resistance to a higher value, because this also would result in a lowering of the voltage available at its terminals.

With this clearly in mind, let us compare the effects produced on this tuned circuit by connecting across it in turn each of the rectifiers under discussion. In the case of the anode rectifier, the grid of which is held at a negative potential with respect to the filament during the whole time of operation, no current flows between grid and filament, so that no power is consumed in the grid circuit; the potential variations of the grid are called upon to do no more than control the electron stream between filament and plate. Consequently the connection of an anode-bend rectifier to our low-resistance circuit will result in no decrease in the high-frequency voltage developed across it, except for the effects of any small absorption of power due to the imperfections of the dielectric from which the valve-holder and the base of the valve are built up. Thus the signal voltage applied to the grid of the valve under operating conditions will be very nearly equal to that developed across the circuit when no connections are made to it.

The mode of operation of the grid rectifier is fundamentally different. In this case the grid of the valve is set to a small positive potential, so that a small current flows from grid to filament all the while, *i.e.*, electrons from the filament are collected by the positive grid. It is quite clear that if any high-frequency voltage is applied to the grid it will drive a high-frequency current through the valve by varying from moment to moment the number of electrons being caught by the grid. A moment's thought will reveal the fact that at any instant when the grid is made more positive than usual by the high-frequency voltage, an extra large number of electrons will flow to it, while at any instant when it is more negative than usual the number of electrons will be smaller than the normal. In both cases the change in the electron stream will tend to neutralise the effect of the high-frequency voltage being applied. We have already seen that our low-resistance tuned circuit is very susceptible indeed to such effects, so that the voltage developed across it will be materially reduced by connecting to it a grid rectifier. In effect, its resistance is very largely increased.

So far as signal strength is concerned, we shall obtain about the same volume (assuming an average value for the input) irrespective of the type of rectifier that we



The curves show graphically the way in which the sensitivity of both anode and grid rectifiers varies with the input voltage. It will be seen that the sensitivity of the anode-bend detector increases rapidly as the input voltage is increased. In practice the output of rectified signals is approximately proportional to the square of the input potential.

connect to our tuned circuit, for the anode rectifier, which is for small inputs comparatively insensitive, will be operated by the full voltage across the circuit, while the more sensitive grid rectifier will be able to make the very most of what remains of the voltage that it has itself reduced. Under the conditions that we have been discussing there is, therefore, but little to choose between the efficiency of the two.

Now suppose that reaction is introduced into the tuned

Compromise in Receiver Design.—

circuit from the plate circuit of the detector. The effect of this is to reduce the resistance of the tuned circuit, and therefore to augment the voltage across its terminals. In the case of the grid detector, which has increased the effective resistance of the tuned circuit by a large amount, the introduction of reaction will permit a very large increase in the signal voltage before the effective resistance of the coil is reduced to a value which makes tuning too sharp for quality, or oscillation becomes imminent. Signal strength can, therefore, be increased many times by using reaction.

In the case of the anode rectifier the resistance of the tuned circuit remains low even with the valve connected to it, so that if reaction is applied there is only scope for a very small increase in signal strength before the limit of low resistance is reached. In this case the reaction control is of almost no practical value, provided always that the tuned circuit is of low resistance without it.

It will be seen then that if we wish to take advantage of the sensitivity of the grid rectifier we shall be compelled to include in our receiver a reaction device of some kind, and that this reaction must of necessity be applied to the tuned circuit that immediately precedes the detector. It is not sufficient to obtain reaction effects by partial deneutralisation, or by any other method that reduces the resistance of the aerial circuit, for this does not counteract in any way the damping effect of the grid rectifier, and so leaves the sensitivity of the receiver at a much lower level than it need be.

The Question of Selectivity.

If an anode rectifier is employed, reaction into its grid circuit is of so little practical value that it is not worth while to fit a special control for it; it is necessary in this case to obtain the voltage required to operate the detector by high-frequency amplification.

We must make our choice, then, between two alternatives. One of these is a grid detector with reaction, helped, if necessary by a small amount of amplification at high frequency; the other is an anode rectifier, plenty of high-frequency amplification, and no reaction. A well-thought-out design based on either of these will lead to a set having sensitivity up to any desired standard; of the two the receiver employing the anode rectifier will probably need one high-frequency stage more than the other.

This last statement is made with the intention of providing in either case a high-frequency input suited to the particular characteristics of each detector. The anode detector gives an output of rectified signals which is approximately proportional to the square of the input voltage. This means that if we increase the high-frequency input applied to the detector from one-tenth of a volt to one volt, we obtain in return for this increase about a hundred times the output of actual signals. A stage of high-frequency amplification that magnifies thirty times will increase the sound in the loud speaker some nine hundred times. Since we cannot hope to obtain an amplification of anything like this last figure in a single stage of low-frequency amplification, it will clearly pay us to do as much amplifying as possible before detection, and as little as need be afterwards. In any receiver in which an anode rectifier is to be used we should try, if we do not wish to multiply valves unnecessarily, to provide the detector with an input of not less than one volt, or more, if there is available sufficient anode voltage to enable it to deal with a greater input without overloading.

The case of the grid rectifier is totally different. Here the sensitivity is very considerable at even the smallest input, rises to its greatest value at an input of about one-fifth of a volt, and remains at this value up to an input of some two-thirds of a volt, after which it falls away rapidly. At this point there occurs overloading, accompanied by bad distortion. If we propose to use a grid rectifier we must, therefore, design for a much lower degree of amplification at high frequency, for two reasons: Firstly, we are going to use reaction, and this will to some extent take the place of H.F. amplification, and secondly, we must remember than an H.F. stage amplifying thirty times may only increase the sound in the loud speaker some five to ten times. The same valve transferred to the L.F. amplifier can do much more than this, so that it will be more profitable to employ it there. On a good aerial adequate sensitivity can be obtained from a grid rectifier with reaction, using no H.F. amplification at all, while if only a small aerial is available the addition of one moderately efficient stage will fulfil all requirements in this direction.

So far we have been discussing sensitivity, and the most economical methods of attaining it with each type of detector. We have still to consider selectivity, and to see how it is influenced by the choice of detector.

First, there is the obvious corollary from the conclusions at which we have already arrived. We have found that where an anode detector is to be employed it is advisable to use a high degree of H.F. amplification in order to work the detector at its most sensitive point. Such an amplifier as is here implied will necessarily contain several tuned circuits, each of which, in the interests of efficiency, will be given as low a resistance as is considered safe from other points of view. The number of tuned circuits actually employed in the receiver will, of course, depend on a number of factors, but it is clear that the general trend of the design will be towards a receiver of high selectivity.

The Anode Rectifier and Interference.

If a grid rectifier is to be used, we have an exactly opposite state of affairs; we have seen that it then becomes desirable to keep the amount of amplification at high frequency down to a small value, relying upon reaction for the bulk of the sensitivity. The tuned circuits will thus be few, so that the selectivity may be considered poor in comparison with a companion receiver incorporating an anode rectifier and giving an identical range of reception.

In addition to the variations in selectivity imposed by the necessity for designing the high-frequency amplifier to suit the detector, there is another cause of difference between the two, less potent, perhaps, but still considerable, which tends to emphasise the distinction already made. An anode rectifier, though highly sensitive to strong signals, is relatively insensitive to weak ones, so that if the signals from two stations reach the grid of

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the detector at the same time any difference in strength between them will be emphasised by the detector. The grid rectifier, on the other hand, is not very much less sensitive to weak signals than to those of normal strength, so that in this case the difference in strength between the two stations will not be materially affected by the detector.

Let us suppose, for example, that we tune in a station A which we wish to hear, and that signals from a nearer station B, to which the receiver is not tuned, force themselves through as far as the detector. If our tuning is sufficiently selective to reduce the voltage due to station B to one-thirtieth of that due to station A, then, if we are using an anode detector we shall hear A nearly a thousand times more loudly than B—which means in practice that B will not be heard at all. But if a grid detector is in use we shall be deprived of this artificial aid to selectivity, and as a result A is not likely to be more than fifty times louder than B. Here, then, we have another reason, apart altogether from its influence on the design of the receiver, for anticipating a higher measure of selectivity when an anode rectifier is used.

Limitations of the Grid Rectifier.

The question of the relative merits of the two detectors from the point of view of quality is one that has exercised many. The case of the anode rectifier is simple; it yields quality that is only slightly imperfect under all conditions of input. Assuming correct adjustment of grid bias, the degree of imperfection is dependent solely upon the percentage modulation of the received carrier wave becoming greater as the modulation increases for a loud passage of music. The impression is then produced as of slightly overloading the output stage of the receiver. The quality is not affected in any way by varying the high-frequency voltage applied to the detector, so long as grid current does not flow. It is, therefore, possible to make an anode rectifier deal with very large signal voltages indeed, providing that adequate high-tension voltage and grid bias are available, and there is no need, so far as quality is concerned, to take any interest in the signal voltages applied other than to make sure that overloading due to insufficient anode voltage does not occur.

The case of the grid rectifier is very much more complicated. For small inputs the quality is quite good, though the use of too much reaction often gives the opposite impression. As the signal voltage is increased, there follows a small region in which quality is poor, immediately after which, beginning at an input of about a fifth of a volt, there is a narrow range within which the quality is better than the best that the anode detector can provide. As soon as the upper limit of this range is exceeded, at a little over half a volt, the detector overloads, and quality becomes extremely bad. These effects correspond to the various regions on the grid rectifier curve shown, the nearly horizontal part of which corresponds to the range within which high quality is obtained.

Although it would, perhaps, be possible to arrange to work a grid rectifier always within the limits of perfect quality just mentioned, there are practical considerations which render it safer to work at rather lower input voltages in order to avoid the possibility of overloading, and to accept the slight falling off in quality thereby brought about. If this is done the quality will not rise quite to the standard of the anode rectifier. It will not, perhaps, be out of place to remark here that the grid rectifier has earned its bad reputation for quality largely because it is habitually overloaded by most of its users; properly handled, it will give very acceptable quality indeed.

To sum up, one may conclude that a typical receiver built to suit an anode rectifier gives slightly better quality and much better selectivity than one built round a grid rectifier, but that the former receiver must of necessity be rather more complicated and more expensive. Each user must decide for himself whether he will have simplicity with cheapness, or quality with selectivity, and must make his choice of rectifier accordingly.

* * *

The detail design of the detector stage has not been touched upon here, partly because the choice of the type of rectifier to be employed is so large a subject, and has so far-reaching an influence upon the whole of the rest of the receiver that it has been considered worthy of a section all to itself. After all, the grid circuit of the detector valve is really part of the high-frequency amplifier, so that for design purposes at least it must be treated under that head. Similarly, the plate circuit of the detector will be regarded as the first part of the low-frequency amplifier, which will be the subject of the third article of this series.

BROADCASTING CHANGES IN AUSTRALIA.

FAR-REACHING changes in the management of Australian broadcasting will probably occur next year, when practically all the existing broadcasting licences will have expired. In a statement made last week, Mr. Bruce, the Australian Prime Minister, announced the Government's new policy arising out of the widespread complaints regarding the quality of programmes sent out by the existing "A" class stations, which, to all intents and purposes, are controlled by a combine covering the entire Commonwealth.

The Government contemplates taking over the plant and equipment of all privately owned "A" class stations, with the object of placing the complete programme and news arrangements in the hands of private contractors who will be invited to submit tenders.

General supervision of the service will be vested with the Postmaster-General, who will be empowered to ensure the maintenance of the standard of programmes by withholding part of the licence fees payable or by cancelling the contract. The contractors will be paid a percentage on each licence fee.

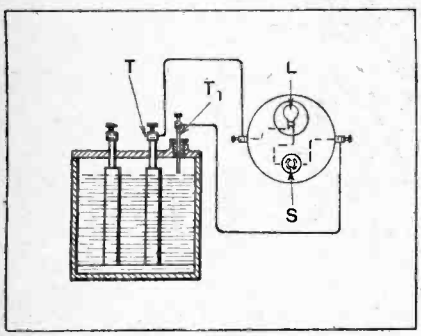
An advisory committee will assist the Postmaster-General in all questions requiring technical consideration and in the supervision of programmes. Research work will be financed from the balance of licence fees after the contractors have been paid.

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

Battery Testing.
(No. 285,622.)

Application date: January 7th, 1927.

A flash-lamp automatically indicates when the surface of the electrolyte in an accumulator has fallen below a certain level, the necessary current for energising the flash-lamp being drawn from the accumulator under test, and not from a separate source. As shown, the flash-



Electrolyte level indicator for accumulators. (No. 285,622).

lamp L is mounted in a casing provided with a window and a push-button switch S. The lamp is connected across a terminal T on one of the plates of the accumulator and a terminal T_1 on a short rod of metal insoluble in the electrolyte. So long as the end of the rod touches the electrolyte the lamp L will glow in response to the operation of the switch S. As soon, however, as the level of the electrolyte falls below the ends of the rod, the lamp L is open-circuited and remains inactive.

Patent issued to E. Elwess.

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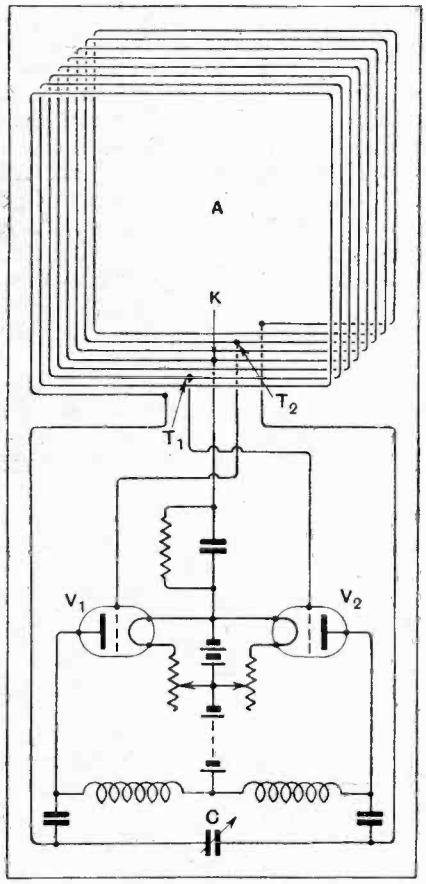
Directional Signalling.
(No. 285,169.)

Application date: November 17th, 1926.

When using a frame aerial, either for reception or transmission, errors in the well-known directional effect are liable to arise owing to a possible lack of symmetry in the distribution of the current in the windings of the frame caused by some unbalance in the circuit connections. In order to prevent this, special precautions are taken in coupling the frame windings to the associated valve or valves.

As shown in the figure, the tuning condenser C is shunted across the ends of the windings A, the centre point K of



Method of obtaining perfect symmetry in frame aerial connections. (No. 285,169.)

which is connected through a grid leak and condenser to the filament circuit of a pair of valves V_1, V_2. Tappings from the grid of each valve are then made to points T_1, T_2 symmetrically related to the centre point K of the windings. The leads are however "crossed" so that the grid tapping of the valve V_1 lies on the same side of the point K as the plate connection from the valve V_2, and *vice versa*.

Patent issued to Captain J. K. im Thurn and others.

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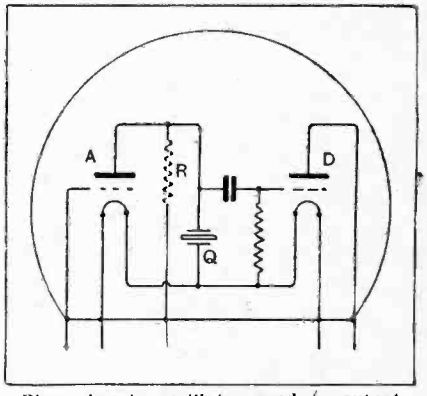
Selective Multi-stage Valve.
(No. 261,013.)

Convention date (Germany): November 4th, 1925.

In order to facilitate selective reception, a piezo-electric oscillator is intimately associated with either the input or output circuits of a valve, so that signals corresponding to the fundamental crystal frequency are passed through and amplified whilst undesired frequencies are blocked by the action of the crystal.

As shown in the figure, a multi-stage unit comprising a high-frequency ampli-



Piezo-electric oscillator used in output stage of valve to give selective reception. (No. 261,013.)

fier A and a detector D are mounted in the same glass bulb. The selective crystal Q is included in the output circuit from the amplifier, in shunt with the high-resistance coupling R. An input voltage corresponding to the crystal frequency will pass to the grid of the detector in amplified form, whereas an undesired frequency will be damped out.

Patent issued to S. Loewe.

CURRENT TOPICS

Events of the Week in Brief Review.

HIGH SPEED PICTURE TRANSMISSION.

Professor Tchernysheff, a Soviet scientist, claims to have invented a rapid wireless picture transmission system in which a picture of four square inches can be sent and received in less than 40 seconds. Official tests are to take place in October.

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DX HUNT IN REAL LIFE.

A "hidden transmitter hunt," more exciting even than a wireless club field day, was enacted in Quebec last week when Arsena Nelna, a young Russian, was arrested and charged with illegally possessing dynamite.

Following the arrest, two detectives began a search resulting in the discovery of a powerful and fully-equipped transmitter which is believed to have been the cause of persistent interference to many Canadian and U.S. wireless stations in the past few weeks. The detectives also found 50lb. of dynamite.

It is alleged that the hidden transmitter had been used as a distribution centre for Soviet instructions to secret agents, and that it had been stolen from the Canadian Marconi Company.

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WHY NOT DYNAMITE?

The above provides a useful hint for club secretaries who are seeking a means of enlivening field days.

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MARCONI ROYALTIES CASE.

The hearing was concluded on Thursday last of the case before the Comptroller-General of Patents (Mr. William Smith Jarratt) in which the Brownie Wireless Company (of Great Britain), Limited, applied for a compulsory licence under some of the Marconi patents. The applicants complained that restrictive conditions imposed by the Marconi Company's standard licence were unreasonable, and they put in a plea for the reduction of royalties.

In reserving judgment for a week, the Comptroller-General said that he hoped in the meantime the parties would get together and see if they could arrive at an agreement.

GRAMOPHONES AND WIRELESS.

It is understood that negotiations now in progress between the Radio Corporation of America and the Victor Talking Machine Company will probably result in a merger within the next few months.

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INDEX AND BINDING CASE.

The index for Volume XXII. of *The Wireless World* is now ready and copies are obtainable, price 4d. post free from the publishers, Dorset House, Tudor Street, E.C.4. Cloth binding covers for the same volume can also be supplied, price 2s. 10d., post free.

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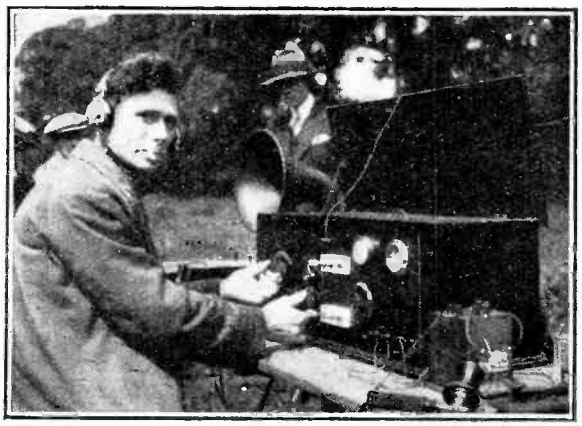
CORRECTING A 30-YEAR OLD ERROR.

The reception of wireless time signals from many different parts of the world has resulted in the discovery of a 70-ft. error in the computed position of the Lick Observatory on Mt. Hamilton, according to an announcement by the University of California. The new calculations have been based on a series of experiments in time signal reception in October and November, 1926. It is stated that the original error was due to faults inherent in the instruments used to determine the position of the observatory in 1897.



A TRANSMITTER-RECEIVER.—The combined transmitting and receiving equipment used by the Southend and District Radio Society on field days.

THE LONDON REGIONAL STATION.

The contract for the new London regional broadcasting station at Brookman's Park has been awarded by the B.B.C. to the Anglo-Scottish Construction Co. in competition with several other firms (writes our Broadcasting Correspondent), and work is now started.

The design for the building has been prepared by Messrs. Wimperis, Simpson and Guthrie. The specification has been made by the Corporation's engineers, who will directly supervise the construction of the building. The new building will be single story except at one end, which will house the offices.

A small part of the apparatus has already been ordered and tenders for the remainder will go out shortly. There will be two transmitters, and the two aerials, each 200ft. in height, will be about 500ft. apart. The aerial power will be 30 kW. It is expected that the station will be ready for test next April.

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THE BIG FIGHT RELAY.

One of the best transatlantic relays yet achieved by the B.B.C. was that which took place on Friday morning last when WGY Schenectady broadcast a running commentary on the Tunney-Heeney fight. The signals were picked up by Keston and relayed by stations of the B.B.C.

Not only were the words of the commentators heard with exceptional clarity, but listeners were able to distinguish the sounds of ringside enthusiasm.

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BROADCASTING FROM THE CENOTAPH.

Our Parliamentary Correspondent writes:—Sir William Johnson-Hicks, the Home Secretary, has informed Major Cohen that permission has been given to the British Broadcasting Corporation to broadcast the service at the Cenotaph on Armistice Day.

It will be remembered that the B.B.C. were able to conduct an experimental broadcast from the Cenotaph on Whit-Sunday last,

when the British Legion memorial service was held. The method used to conceal the microphone and the accompanying landlines was illustrated in our issue of May 16th.

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BROADCAST RELAYS BY CARRIER CURRENT.

The improvement of the general standard of broadcasting in Canada is the aim of a new organisation—the Trans-Canada Broadcasting Company—which has just been formed in Toronto. The company is shortly to make its ether debut with transmissions from the key station CKGW, which operates on 312.3 metres with a power of 5 kilowatts.

It is understood that, during the early period of the company's existence the programmes will be relayed across the Dominion by the stations of the Canadian National Railways, the carrier current system being employed for linking the various stations.

from the transmitting point. Transmissions of morse and telephony continued from 3 to 5.30 p.m. with brief intervals. Before the location of the transmitter was finally announced three members succeeded in tracking it.

The first prize winner was Mr. R. Heaton, who "checked in" at 4.35. The award, presented by the Marconi Company, was a heavy duty choke.

Any amateurs who succeeded in picking up the signals from 2AK on July 15th are requested to communicate with the Hon. Secretary of the Slade Radio Society at 8, Victoria Road, Erdington, Birmingham.

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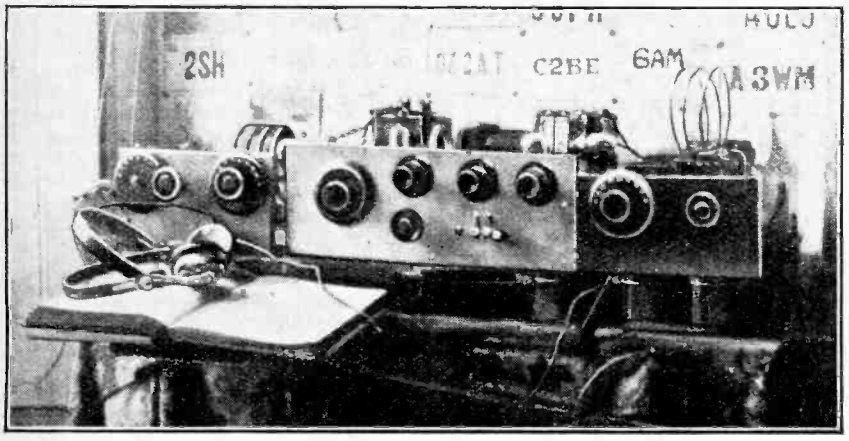
A CHANCE TO RISE.

The Air Ministry announces that about 120 officers will be required by the Royal Air Force for flying duties during the next few months. Applications are accordingly invited from suitable candi-



THREE-IN-ONE RECEIVER.—Interesting equipment designed and constructed by Mr. H. K. Bourne, of Bristol. On the left is the short-wave receiver, tunable from 15 to 50 metres, while in the centre is the receiver for the broadcast hand. The instrument on the right is an ultra-short wave receiver for wavelengths below 10 metres.

IMPORTED WIRELESS APPARATUS: AN ENQUIRY.

The Board of Trade have referred to the Standing Committee an application for an Order in Council to require the marking with an indication of origin of imported wireless receiving sets and components.

The Committee will consider whether these articles should be marked on sale or exposure for sale, and they may, at their discretion, also consider whether the articles should be marked on importation.

The date of the Committee's public enquiry will be announced later, and communications regarding it should be addressed to the secretary, Mr. E. W. Reardon, Board of Trade, Great George Street, London, S.W.1, as early as possible, and in any case not later than August 24th, 1928.

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DID YOU HEAR 2AK?

In a "mystery run" conducted by the Slade Radio Society of Birmingham on July 15th no fewer than 40 members and friends hunted a wily transmitter (2AK) over an area extending sixteen miles

dates, who must be between the ages of 18 and 25, well educated and of good eyesight and physique.

Short service commissions are granted for five years' service on the active list and four in the reserve.

Application forms and full details of the conditions of service can be obtained from the Secretary, Air Ministry, Kingsway, London, W.C.2.

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TWO STATIONS: ONE LICENCE.

A provision of the Wireless Act which is sometimes overlooked came up for consideration in the Torquay Police Court recently when a local resident was fined 10s. for maintaining two wireless sets at different addresses while possessing only one receiving licence. The defendant stated that he was under the impression that one licence was sufficient.

A wireless licence covers one receiving "station," although several receiving instruments may be employed, but two different addresses imply the existence of two stations, and it is on this assumption that the magistrates convicted.

OVERCOMING INTERFERENCE AT SEA.

The new Canadian Pacific liner *Duchess of Atholl* has been equipped with the newly-designed Marconi M.C.6 2 kW. valve set, capable of communication on wavelengths of from 600 to 850 metres and from 2,000 to 2,750 metres.

The receiving apparatus is of the latest Marconi design, type M.R.4F, having a wave range extending up to 28,000 metres. This incorporates a recent development in the form of a note filter, which has been found to be of great advantage in minimising delay when receiving telegrams in places where wireless interference is prevalent.

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CALL LETTERS FOR AIRCRAFT.

All aeroplanes fitted with wireless have now been assigned five-letter call signs by the International Bureau at Berne. The first letter is the nationality designation, and the remaining four letters are the registration mark of the plane.

Where several countries have the same nationality prefix, such as Haiti, Hungary, and Holland, the first letter for the group of four letters also signifies nationality. Thus, Haiti begins its four-letter group with H, Holland with N, and Hungary with M. A Dutch plane could be registered as H-NADY.

British aeroplanes carry the prefix G, and the general call for all R.A.F. machines is GEZAA. French machines are distinguished by the prefix F, and the general call is FOZ.

An exception to the general rule occurs in the case of Italy, whose aeroplanes embody numerals in their registration signs. For this reason the radio calls are specially assigned, the prefix being the letter I.

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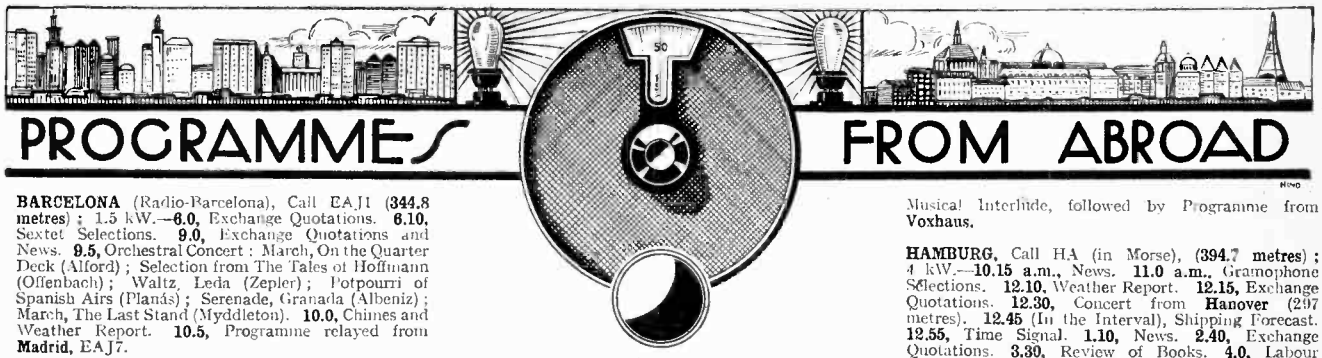
A WIRELESS DRAMA IN PORTUGAL.

What must have been one of the most peculiar experiences in the annals of amateur wireless recently befell Dr. Carlos Pimentel, a Lisbon experimenter, who has been conducting receiving tests on the Atlantic coast.

For one of the tests, Dr. Pimentel and several friends took a receiver to the most westerly point of Europe—the Chapel of the Peninha—situated 2,500ft. above sea level. This lonely spot was chosen with the idea of testing reception in fog, which abounds in this district. Just before tuning-in, the party was approached by the aged chapel-keeper and his wife, who showed great curiosity about the apparatus. To avoid lengthy conversation, it was hurriedly explained that the instrument was intended to communicate with "another world."

The experimenters then tuned-in, and immediately obtained excellent reception from Toulouse, Madrid, Daventry, Stuttgart, and Barcelona. From the last-named they secured wonderful reproduction of an organ recital. Dr. Pimentel thus describes the scene: "As soon as the two old people heard the sound of the organ, they thought we had indeed got into touch with 'another world'; and, falling on their knees, they buried their faces in their hands, overcome with superstitious awe."



PROGRAMMES FROM ABROAD

SATURDAY, AUGUST 4th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

BARCELONA (Radio-Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**6.0,** Exchange Quotations. **6.10,** Sextet Selections. **9.0,** Exchange Quotations and News. **9.5,** Orchestral Concert: March, On the Quarter Deck (Alford); Selection from The Tales of Hoffmann (Offenbach); Waltz, Leda (Zepler); Potpourri of Spanish Airs (Planás); Serenade, Granada (Albeniz); March, The Last Stand (Myddleton). **10.0,** Chimes and Weather Report. **10.5,** Programme relayed from **Madrid,** EAJ7.

BERGEN (**370.4 metres**); 1.5 kW.—**8.0.** Orchestral Selections; Potpourri of 1913, So tanzen wir heut (Oldhaus); Swedish Sketches (Torsten Petre); The Scorcher March (Rosey). **8.30.** Talk: Domestic Industry. **9.0** Orchestral Selections: Potpourri, Der Zigeunerprimas (Kalman); Roses of the South (Strauss). **9.30,** Talk: The Tropical Paradise of Ceylon. **10.0,** Weather Report, News and Time Signal. **10.15,** The Janitschar Orchestra from the Exhibition. **12.0 Midnight** (approx.); Close Down.

BERLIN (Königswusterhausen) (**1,250 metres**); 40 kW. —**4.30,** Talk: Civil Rights. **5.0,** Programme relayed from **Hamburg.** **6.0,** Talk by Dr. Otto Neurath. **6.30,** Talk: The Antique in Germany—The Roman Cologne. **6.55,** Talk: The Duet. **7.20,** Talk: Goethe. **8.30,** Programme relayed from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**); 4 kW.—**6.0 a.m.,** Morning Gymnastics. **10.10 a.m.,** Market Prices. **10.15 a.m.,** Weather Report, News and Time Signal. **11.0 a.m.,** Programme of Gramophone Records. **11.30 a.m.,** Exchange Quotations. **12.55,** Time Signal. **1.30,** Weather Report and News. **3.10,** Agricultural Prices and Time Signal. **3.30,** Programme of Gramophone Records. **4.30,** Dr. Ing. Seewald, Talk: Present-day Questions in Aviation. **5.0,** Concert from the Ostseebad Swinemunde: Selection from Dalibor (Smetana); Selection from Von der Erde (Mahler). Rheinlegendchen (Mahler); Berceuse from Der Schatzgräber (Schreker); Prelude and Serenade from Der Schneemann (Korngold); Selection from Klein Idas Blumen (Klenau); Selection from The Merry Widow (Lehár); Selection from Madame Butterfly (Puccini). **7.0,** Paula Foerster, Talk: Travelling Through the Mark. **7.30,** Dr. Arno Schirokauer, Talk: The Poet and the Shore. **8.0,** Ing. Petersen, Talk: The Technical Employee. **8.30,** "Grossstadtluft," Sketch (Blumenthal and Kadelburg), followed by Weather Report, News, Time Signal and Sports Notes. **10.30,** Dance Music. **12.30 a.m.** (approx.) (Sunday), Close Down.

BERN (**411 metres**); 1.5 kW.—**8.0,** Time Signal and Weather Report. **8.5** (approx.), Popular Programme: Zither Duets, Readings in Dialect and Yodel Songs. **9.20,** Selections by the Bern Orchestra, News and Weather Report in the Interval. **10.35,** Dance Music. **12.0 Midnight** (approx.), Close Down.

BRESLAU (**322.6 metres**); 4 kW.—**4.0,** Reading from New Books. **4.30,** Orchestral Concert: March, Immer schneidig (Kockert); Waltz, Sommerlust (Lincke); Potpourri on Der Opernball (Heuberger); Pianoforte Solo, Suite in Old Style (d'Albert); Serenade, Op. 7 (R. Strauss); Humoreske (Reger); Strauss Melodies, Bunte Blätter (Komzak); Auf der Wartburg blühn wiederum die Rosen so rot (Erwin); Bei der Lindenwirtin am Rhein (Gütze). **6.0,** Shorthand Instruction. **6.15,** Talk in Esperanto. **6.30,** Talk by Heinrich Koitz, from **Gleiwitz** (250 metres). **6.55,** Talk by Hellmut Lehmann. **7.20,** Advanced English Lesson. **8.15,** Rund um die Liebe, Operetta (Oscar Straus). **10.0,** News. **10.30,** Orchestral Selections and Dance Music, relayed from **Gleiwitz.** **12.0 Midnight** (approx.), Close Down.

BRÜNN (**441.2 metres**); 3 kW.—**6.0,** German Transmission. **6.25,** Talk. **6.40,** Talk: Spain. **7.0,** Concert: Overture to Athalie (Mendelssohn); Tiefland (d'Albert); Barcarolla (Grünfeld); Selection from Rigoletto (Verdi); Air from The Demon (Rubinstein); Triumphal March (Grieg). **8.15,** Recital of Czech Songs from the Works of Janáček, Novotný, Smetana and Axman Novotný. **9.0,** Orchestral Selections. **10.0,** Programme relayed from **Prague.** **10.25,** Exhibition Programme.

BRUSSELS (**508.5 metres**); 1.5 kW.—**5.0,** Dance Music from the St. Sauveur Palais de Danse. **6.0,** Talk: La Bruyère's Life and Work. **6.15,** M. Carl Goebel, Talk: Some Large European Towns. **6.45,** Orchestral Concert: Retour au camp (Antreas); Coquetterie (de Taye); Do, do, do (Ager); Enigma (Popy); The Main Love (Gerschwin); 'Cello Solo, Andante (Tartini); Selection from William Tell (Rossini); Violin Solo, Romance in F (Beethoven); Yzeil (Pierné); The Second Ballet (Luigini). **7.30,** "Radio-Chronique." **8.15,** Gramophone Selections. **8.30,** Violin Selections. **8.45,** Talk: August 4th, 1914. **9.0,** Symphony Concert from the Kursaal, Ostend, followed by News. **10.30** (approx.), Close Down.

BUDAPEST (**555.6 metres**); 35 kW.—**5.45,** Concert from the Works of Puccini. **7.0,** H. A. Gaibel, Talk: Gulliver's Travels. **7.45,** Cabaret Concert. **9.15,** Time Signal and News, followed by Military Band Concert and Tzigane Music from the Café Emke. **12.0 Midnight** (approx.), Close Down.

COLOGNE (**283 metres**); 4 kW.—**10.15 a.m. to 1.5,** see **Langenberg.** **1.5,** Orchestral Concert. **3.40,** see **Langenberg.** **4.0,** Talk for Book-Lovers. **4.30,** Programme from **Königswusterhausen.** **5.0,** Dr. Edda Tille, Talk for Women: Students and Study in America. **5.30,** see **Langenberg.** **7.15,** Special Notice on the Olympic Games. **7.20,** Talk for Workers. **7.45,** Dr. Lips, Talk: The Sports of Primitive Peoples. **8.15,** Variety Programme, including "Die Hasenpfote," One-Act Play (Brennert), followed by News, Sports Notes, Light Music and Dance Music. **1.0 a.m.** (approx.) (Sunday), Close Down.

CRACOW (**566 metres**); 1.5 kW.—**7.30,** Review of Foreign Affairs for the Past Week. **7.55,** Agricultural Report and News. **8.15,** Programme from **Warsaw.** **10.30,** Concert from a Restaurant. **11.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**1.30,** Weather Report and Gramophone Selections. **7.20,** News. **7.30,** Health Talk by Mrs. Russell, M.B. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Orchestral Selections. **8.30,** Gaelic Offerings by Mighread Ni Annagain. **8.45,** A New Series by H. O'Donovan and Company. **9.15,** Soprano Solos by Hilda Dobbs. **9.25,** Orchestral Selections. **9.40,** Songs with the Harp, by Charles O'Connor. **9.55,** String Orchestral Selections. **10.5,** Songs with the Harp, by Charles O'Connor. **10.15,** Orchestral Selections. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**428.6 metres**); 4 kW.—**1.0,** Gramophone Records. **3.30,** Children's Corner. **4.15,** Reading by Alfred Scherzer. **4.35,** Orchestral Concert; Waltz Programme, Kaiserwalzer (Joh. Strauss), La Barcarolle (Offenbach), Delirien (Joh. Strauss), Tesoro mio (Becucci), Nachtschwärmer (Ziehrer), Gold and Silver (Lehár), Les Millions d'Arlequin (Drigo), Donauwellen (Ivanovici), Manöverklänge (Kalman), Morgenblätter (Joh. Strauss). **6.15,** Wireless Notes and Announcements. **6.30,** The Letter Box. **6.45,** Dr. Ludwig Schütz, Talk: The Love theme in the poetic works of the East. **7.15,** Shorthand Dictation. **8.15,** Concert from **Bad Wildungen,** followed by a Gustav Jacoby Programme; Musical Introduction: Im Tempo unserer heutigen Zeit (Things heard, experienced and invented); When one goes travelling (Bavaria and Swabia); Musical Interlude, The Journey proceeds (via Frankfurt to Berlin, with a trip through the beautiful land of Saxony); Rhine, Wine, and Beautiful Women; Musical Interlude, followed by Programme from **Voxhaus.**

HAMBURG, Call HA (in Morse), (**394.7 metres**); 4 kW.—**10.15 a.m.,** News. **11.0 a.m.,** Gramophone Selections. **12.10,** Weather Report. **12.15,** Exchange Quotations. **12.30,** Concert from **Hanover** (297 metres). **12.45** (In the Interval), Shipping Forecast. **12.55,** Time Signal. **1.10,** News. **2.40,** Exchange Quotations. **3.30,** Review of Books. **4.0,** Labour Exchange Report. **4.15,** Talk and Reading of Poems. **5.0,** Concert of Johann Strauss Overtures, Das Spitzentuch der Königin; Indigo und die vierzig Räuber, Der lustige Krieg; Eine Nacht in Venedig; Waldmeister, A Carnival in Rome. **6.0,** Request Programme. **7.0,** Theatre Talk by Ernst Held. **7.30,** Baurat Böttcher, Talk: Friedrich Harkort, a German Economist. **7.55,** Weather Report. **8.0,** "Kyritz-Pyritz," Musical Sketch in Three Acts (Wilken and Justinus), followed by Weather Report, News, Sports Notes and Norag Programme.

HILVERSUM (**1,071 metres**); 5 kW.—**11.40 a.m.,** Police News. **12.10,** Concert of Trio Music. **1.40,** Concert, relayed from the Tuschinski Theatre, **Amsterdam.** **5.40,** Time Signal. **5.42,** Concert, Overture to Marinella (Fucik), Swedish Sketches (Torsten Petre); Waltz, Les Sirènes (Waldteufel), Stelzenläuger (Murzilli); Fantasia on the Works of Grieg (Urbach); An Evening in Toledo (Schmeling), Ave Maria (Gounod-Bach); Selections from Die geschiedene Frau (Fall) Foxtrot, Susie's Sister; Finale. **7.25,** Police News. **7.40,** Programme organised by the Workers' Radio Society. **11.10** (approx), Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits from **5.40 p.m.** on 1,950 metres. **12.10,** Concert of Trio Music. **5.10,** Gramophone Selections. **7.25,** Talk by Mme. Hülksen. **7.55,** Concert of Songs and Music.

JUAN-LES-PINS (Radio L.L.) (**244.5 metres**); 1.5 kW.—**9.0,** News, Weather Report, and Fashion Talk by Mme. la Comtesse de Fremeuge. **10.0,** Dance Music. **10.30** (approx.), Close Down.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres). **7.30 a.m.,** Morning Gymnastics. **11.0 a.m.,** Weather Report. **3.0,** Trio Concert: Foxtrot, Halleluja (Youmans); Slow Foxtrot; Tango; Waltz from The Count of Luxemboug (Lehár); Fantasia on Danish Vaudeville Melodies; 'Cello Solo, Adagio (Somis), Brudedansen (Kroman-Jacobsen), Den lille Nisses Bryllup (Köpping); Recitation of Chinese Poems; Polka, Kneip (Fahrbach); Waltz, Immer oder nimmer (Waldteufel); Violin Solo, Méditation (Glazounov); Violin Solo, Valse triste (von Vecsey); Klovnens Sang (Schröder); Foxtrot, Pierrette (Johnstone). **6.20,** Frederik Schyberg, Talk: Chr. Winther's Woodcuts. **6.50,** Weather Report. **7.0,** News and Exchange Quotations. **7.15,** Time Signal. **7.20,** Programme Announcements for the Coming Week. **7.30,** Kort K. Kortsen, Talk: Reykjavik. **8.0,** Chimes from the Town Hall. **8.2,** Cabaret Concert. **10.45,** Dance Music. **12.0 Midnight,** Chimes from the Copenhagen Town Hall, and Close Down.

KATOWITZ (**422 metres**); 10 kW.—**7.30,** Talk. **7.55,** Agricultural Report. **8.15,** Concert from **Warsaw.** **10.0,** Time Signal, Weather Report and News. **10.30,** Dance Music.

KAUNAS (**2,000 metres**); 7 kW.—**7.0,** Gramophone Selections. **9.0.** Orchestral Concert by War-Disabled Men. **10.0,** Dance Music.

LAHTI (**1522.8 metres**); 35 kW.—**5.0,** Orchestral Selections: Heil Europa (Blon); Frühlingsstimmen (Strauss); Melodies from La Poupée (Audran). **5.30,** Recitation of Poems. **5.57,** Time Signal, Weather Report and News. **6.15,** Orchestral Concert: Melodies from The Little Dutch Girl (Kalman); Révérence de Poupée (Bucceri); Serenata mignonne (Becce); Valse (Waldteufel); Secret d'amour (Larento); Wiener Volkmusik (Leopold); Soldier Songs (Similä). **7.30,** Recital of Songs. **7.50,** Orchestral Concert: Elegie (Sohlström); Chants des iles (Kauppi); Quintessenzen (Morena); Offenbach Melodies (arr. Conradi); Liébestanz (Hoschna); March (Sousa). **8.45,** News given in Finnish and Swedish, and Concert from a Restaurant **10.0** (approx.) Close Down.

Programmes from Abroad.—

LANGENBERG (468.8 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres), and **Münster** (250 metres). 10.15 a.m., Transmission for Experimental Purposes. **10.30 a.m.** (In the Interval), News and Tides Report. **11.15 a.m.**, Programme for Schools. 12.10, Gramophone Selections. 12.50, Weather Report. 12.55 Time Signal. 1.5, Programme from **Cologne**. 3.30, Finance Report. 3.40, Technical Wireless Talk from **Elberfeld**. 4.0, Programme from Cologne. 4.30, Programme from **Königswusterhausen**. 5.0, Programme from **Cologne**. 5.30, Elementary English Lesson from **Münster**. 6.0, Concert from **Münster**. March, Reiterlust (Blon); Waltz Wiener Blut (Strauss); Selection from Rigoletto (Verdi); Torch Dance in C Minor (Meyerbeer); Song, An der Weser (Pressel); Preismarsch (Ailbout); March, San Lorenzo (Sylva). 7.15, Programme from **Cologne**. 7.45, Talk (**Münster** only). 8.15 to 1.0 a.m. (Sunday), Programme from **Cologne**.

LEIPZIG (365.8 metres); 4 kW.—3.0, Orchestral Concert. 4.30, Orchestral Concert. 6.30, Wireless Talk. 6.45 Taxation Talk. 7.0, Dr. Wetzel, Talk: Plant Life of our Homeland. 7.30, Talk by Dr. Weygand. 8.0, Weather Report and Time Signal. 8.15, Recital of Berlin Songs: Eckensteher Nante (Clauberg); Der Reroluzzer (Clauberg); Ballade vom nützlichen Soldaten (Meisel); Der schanderöse Ferdinand (Meisel); Der Jutz-Zwieback (Clauberg); Weest' de wat? (Kroner); Knock out (Meisel); Die fromme Helene (Meisel). 10.0, News, Programme Announcements for Sunday and Sports Notes. 10.30, Programme from **Voxhaus**.

MADRID (Union Radio), Call EAJ7 (375 metres); 3 kW.—2.0, Orchestral Concert: Overture to Rosamunde (Schubert); Serenata china (Siede); Selection from Tosca (Puccini); Interlude by Luis Medina: Waltz and Fox-Trot from Las dos Princesas (Caballero); Weather Report, Exchange Quotations and News: Dance from La Gioconda (Ponchielli). 7.0, Sextet Selections: Selection from La alsaciana (Guerrero); Selection from Dinorah (Meyerbeer); Selection from Las Corsarias (Alonso); Interlude by Luis Medina. 8.0, Dance Music. 9.45, Agricultural Report. 10.0, Chimes and Time Signal. 10.2, Symphony Concert. Overture to A Carnival in Rome (Berlioz); Chorale from Cantata No. 140 (Bach); Symphonic Illustrations (Bacarisse); Symphony in C Major (Mozart); Petite Suite (Debussy); L'Apprenti Sorcier (Dukas); News. 12.0 (Midnight), Dance Music. 12.30 a.m. (approx.) (Sunday), Close Down.

MILAN, Call 1MI (526.3 metres); 7 kW.—8.35, Time Signal. 8.37, Talk: India. 8.45, News. 8.50 (approx.) Concert: Selection from Hansel and Gretel (Humperdinck); Selection from Samson and Delilah (Saint-Saëns); Selection from Sadko (Rimsky-Korsakoff); Tenor Solo from Mignon (Thomas); Pianoforte Selection, Sonata in A Major (Vidusse); Soprano Solo from Mireille (Gounod); Mezzo Soprano Solos, (a) Gipsy Song (Rubinstein); Aria (Arensky); Tenor Solos, (a) Aria from The Pearl Fishers (Bizet); (b) The Dream, from Manon (Massenet); Fantasia in D Minor (Vidusse); Soprano Solos, (a) Aria from Dinorah (Meyerbeer); (b) Lirica (Guarino); Norma (Bellini); News. 10.0, Dance Music relayed from the Fiaschetteria Toscana. 11.30 (approx.), Close Down.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres). 12.35, Weather Report. 12.45, Exchange Quotations. 12.55, Time Signal. 5.30, Concert of Light Music. 6.0, Children's Corner. 6.30, Concert from **Helsingborg** (229 metres). 7.15, Pianoforte Recital: Prelude and Fugue (Bach); Sonata (Sclarlatti); Variations (Paderewski); Intermezzo in E Major (Brahms); Perpetuum mobile (Weber); Musical Box (Woodward); Etude (Chopin); Waltz (Chopin). 7.45, Talk: Professions and Professionals. 8.0, Topical Talk. 8.15, Concert from the Trädgårdsföreningen, **Göteborg**. 9.15, News and Weather Report, followed by Report of the Olympic Games in Amsterdam. 10.0, The Viktor Rydberg Jubilee from **Jönköping** (201.3 metres). 11.0, Dance Music. 12.0 **Midnight** (approx.), Close Down.

NAPLES, Call 1NA (333.3 metres); 1.5 kW.—8.45, News and Time Signal. 8.50, Orchestral Selections: Air de Ballet, La Livry (Chaminade); Berceuse (Castelnuovo); The Arab Dancer (Santoliquido); Venetian Vision (Brogi); The First Norwegian Rhapsody (Svendsen). 9.30, Relay from a Naples Theatre; Dance Music in the Interval. 10.0, Topical Review. 10.55, Calendar Programme Announcements and Close Down.

OSLO (461.5 metres); 1.5 kW.—Programme relayed by **Fredrikstad** (434.8 metres), **Hamar** (555.5 metres) **Notodden** (411 metres), **Porsgrund** (500 metres) and **Rjukan** (448 metres). 7.45 Weather, Report, News and Agricultural Prices. 8.0, Time Signal, and Talk from **Porsgrund**. 8.30, Concert: Overture to Light Cavalry (Suppé); Torch Dance (Meyerbeer); Minuet (Boccherini); Fantasia on two Russian Songs: Kamarinskaja (Glinka); Hymn to Venus (d'Albert); Selection from La Vie Parisienne (Offenbach); Ballet Suite, Namouna (Lalo). 9.30, Weather Report, News, and Topical Talk. 10.0, Accordion Recital. 10.30, Dance Music relayed from the Grand Hotel. 12.0 (Midnight) (approx.) Close Down.

PARIS (Eiffel Tower), Call FL (2,650 metres); 5 kW.—6.45, "Le Journal Parlé," Talks: "Accession to Family Property" and "The Law." 8.10, Weather Report. 8.30, Concert: Pastorale (Moreau); Songs, Duets, Pianoforte Solos, (a) The Tenth Dance (Granados); (b) Caprice Arabe (Tarrega); Songs (Delibes), (a) Air from Lakmé; (b) Pourquoi?; Song, L'Image de ma mie (Selz); Désésperance (Levadé); Danse du souper (Levadé); Popular Spanish Songs and Duets; Danse du feu (de Falla); L'Amour Sorcier (de Falla); Pianoforte Solo, Rumeurs de Caletta (Albeniz); Nuit d'Etoiles (Widor); Le Bonheur est chose légère (Saint-Saëns); Popular Songs and Duets of Czecho-Slovakia; La rue, le guitariste et le vieux Cheval (Monpa); Granda (Albeniz); Serenade (Albeniz); Pianoforte Solos, (a) Berceuse (Gaubert); (b) Gavotte (Gossec); (c) Le Timbre d'argent (Saint-Saëns).

PARIS (Petit Parisien) (349.9 metres); 0.5 kW.—8.45, Gramophone Selections, Talk and News. 9.0, Concert: Overture to La Vie Joyeuse (Hirschman); Tristesse (le Borne); Le Caid (Thomas); Sur l'eau (Lazzari); Procession nocturne (Rabaud); Sophie's Aria from Werther (Massenet); Interlude des Roitelets (Humperdinck); Song, Ariette (Frescobaldi); Ballet Music from Bacchus (Massenet); Song, Les Cigales (Chabrier); Première Aubade (Lacombe); L'Auberge de Capri, from Arlequin (d'Ollone); Danse bressanne from La Chanson de Paris (Casadesus); News at Intervals during the Programme.

PARIS (Radio-Paris), Call CFR (1,750 metres); 6 kW.—12.30, Gramophone Concert: Stenka Razine (Glazounov); Under the Lime Trees, from Alsatian Scenes (Massenet); Ballet Egyptien (Luigini); 'Cello Solo, Goyescas (Granados-Cassado); Selection from Lakmé (Delibes); Selection from Marouf (Rabaud); La Caravane, from Marouf (Rabaud); Invocation to Nature, from Werther (Massenet); Ol' Man River, from The Show Boat (Kern), sung by Layton and Johnstone; News in the Interval. 1.50, Market Prices and Exchange Quotations. 3.45, Dance Music, followed by News. 8.0, Agricultural Report. 8.15, Talk, Exchange Quotations and News. 8.30, Concert of Melodies and Dance Music; News in the Interval.

PITTSBURGH, Call KDKA (63 and 27 metres); 25 kW.—11.0, Time, Baseball Scores and "Crowder Bros." Programme. 11.25, KDKA Theatrical Calendar. 11.30, Concert by the Westinghouse Band, conducted by T. J. Vastine, from the Palm Room of the William Penn Hotel. 11.55, Baseball Scores. 12.0 **Midnight**, Time Signal. 12.2 a.m. (Sunday), Concert (continued). 12.30 a.m., The Meeting of the Home Radio Club. 12.45 a.m., Gems of American Literature, by Elbert R. Moses, President of the Pittsburgh School of Speech. 1.0 a.m., Programme from WJZ, **New York**. 1.30 a.m., Concert by the Goldman Band, from WJZ, **New York**. 3.15 a.m., Time Signal. 4.0 a.m., Weather Report, Time Signal and Baseball Scores. 4.15 a.m. (approx.) Close Down.

POSEN (344.8 metres); 1.5 kW.—7.30, Programme from **Warsaw**. 7.55, Finance Report. 8.15, Programme from **Warsaw**. 10.0, Time Signal, Weather Report and News. 10.20, Variety Selections. 10.40, Dance Music, relayed from the Palais Royal Café. 12.0 **Midnight**, Maison Philips Concert. 2.0 a.m. (approx.) (Sunday), Close Down.

PRAGUE (348.9 metres); 5 kW.—6.0, German Transmission. 6.25, Agricultural Report. 6.35, Talk for Workers. 7.15, Orchestral Concert. 7.45, Concert. 8.40, Dramatic Programme. 10.0, Time Signal, News and Programme from the Exhibition, **Brünn**.

RIGA (526.3 metres); 4 kW.—7.0, Concert: Overture to The Flying Dutchman (Wagner); Gipsy Dance (Saint-Saëns); Livia Quintilla (Noskovski); Kaiser March (Wagner); Songs; Violin Solo; Overture to Ruslan and Ludmilla (Glinka); Waltz from Eugen Onegin (Tchaikovsky); Am Meer (Schubert); Selection from Faust (Gounod). 9.0, Weather Report, News and Dance Music. 11.0 (approx.), Close Down.

ROME, Call 1RO (447.8 metres); 3 kW.—5.30, Concert: Pianoforte Solo, Gavotte in D Minor (Scarlatti); Pianoforte Solo, Giue (Martucci); Soprano Solos, (a) Hebrew Song (Rimsky-Korsakoff), (b) Berceuse (Gretchaninoff); Bass Solos, (a) Al tuo trono (Ponchielli), (b) The Two Grenadiers (Schumann); Pianoforte Solos, (a) Nocturne in F Minor (Chopin), (b) La danza d'Olaf (Mangiagalli); Bass Solos, (a) Romance from Mignon (Thomas), (b) Aria from Simon Boccanegra (Verdi); Soprano Solos, (a) The Princess (Grieg), (b) M'ama, non m'ama (Mascagni). 8.30, Sports Notes, News and Weather Report. 8.59, Time Signal. 9.0, "L'Elisir d'amore," Opera (Donizetti); in the First Interval: Review of Art and Literature, in the Second Interval: Talk. 11.5, News. 11.30 (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF (31.96 and 31.4 metres); 30 kW.—11.25, Baseball Scores. 11.30, Dinner Music. 12.25 a.m. (Sunday), Baseball Scores. 12.30 a.m., Concert by Statler's Pennsylvanians, directed by Johnny Johnson, from **New York**. 1.0 a.m., Keystone Duo with Balladeers, from **New York**. 1.30 a.m., Time Signal. 1.32 a.m., Concert by the New York Philharmonic Orchestra, conducted by Willem Van Hoogstraten, from the Lewissohn Stadium. 3.29 a.m., Organ Recital by Robert Berentsen, from Rochester. 4.0 a.m., Dance Music from the Hotel Ten Eyck, Albany. 5.9 a.m. (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—4.30, Orchestral Concert. 5.30, Market Prices. 6.15, Concert of Turkish Music. 8.30, Weather Report and Time Signal. 8.40, Concert: Overture to The Barber of Seville (Rossini); Concerto for Two Violins (Bach); Songs (Bach); Wotan's Farewell and Fire Magic, from The Valkyrie (Wagner). 10.0, News and Close Down.

STUTTGART (379.7 metres); 4 kW.—3.0, Concert of Travel and Wander Songs. 6.0, Time Signal and Weather Report. 6.15, Programme from **Freiburg** (577 metres), Dr. Bergell, Talk: Everyday Events and Chemistry. 6.45, Herr Lukas Müller, Talk: Man and the Sun. 7.15, Josef Eberle, Talk: Montmartre. 7.45, Report of the Labour Exchange for South-West Germany; Time Signal, Weather Report and Sports Notes. 8.15, Concert from the Silberburg Park Restaurant, Stuttgart; Programme of Blankenburg's Marches, followed by News, Sports Notes and Dance Music from the Café-Restaurant Wilhelmsbau.

TALLINN (408 metres); 2.2 kW.—5.30, Children's Corner. 6.0, Talk and News. 7.0, Gramophone Selections. 8.30, Dance Music, relayed from the Estonia Veissemi Saal.

TOULOUSE (Radiophonie du Midi), (391 metres); 3 kW.—8.30, Concert of Hawaiian Guitar Music. 9.0, Concert: German March, Alte Kamaraden (Teike); Overture to The Mute of Portici (Auber); Orchestral Suite, Nymphes au bois (Boyer); Waltz, Sobre las olas (Becussi); Suite, Toreador et Andalouse (Rubinstein), Chant sans paroles (Tchaikovsky), Pizzicato de concert (Gillet); Clair de lune, Fantasia with variations; Song of the Volga Boatmen; Overture to Les Mousquetaires au Couvent (Varney); Ballet Music from Faust (Gounod); Bolero, Brise d'Espagne (Gabutti); March, Paris (Tavan). 11.0, North African News.

VIENNA (577 and 517.2 metres); 1.5 and 5 kW.—4.15, Orchestral Concert. 6.10, Concert: Two Bergerettes, Si vous n'avez rien à me dire (Rothschild); Violin Solos, (a) Rondino (Cramer-Brown), (b) From the Canebrake (Gardner), (c) Molly on the Shore (Grainger), (d) Alvation (Borowsky), (e) Selection from Czardas Scenes (Hubay); Aria from The Force of Destiny (Verdi); Aria from Tannhäuser (Wagner); Aria from Der Kuhreigen (Kienzl); Aria from Faust (Gounod); Pianoforte Solos, (a) March (Dohnanyi), (b) Perpetuum mobile (Weber), (c) Rondo (Hummel). 7.10, Jens Friedrich, Talk: Travelling Adventures in the Tropics. 8.5, "Der lachende Ehemann" Operetta in Three Acts (Eysler), followed by Dance Music.

WARSAW (1,111 metres); 10 kW.—8.15, Concert: March, Dratewka (Namyslowski); Overture to Le Roi d'Yvetot (Adam); Waltz, Gipsy Love (Lehár); Songs, Overture to Flis (Moniuszko), Le Rouet d'Omphale (Saint-Saëns), Mélodie élégiaque (Grieg); Ballet Music from Faust (Gounod); Selection from Pique Dame (Tchaikovsky), The Mill in the Black Forest (Eilenberg); March, Prince Joseph Poniatowski (Noskowski); in the Interval, News in French. 10.0, Time Signal and Weather Report. 10.5, News. 10.20, Sports and Police Notes. 10.30, Dance Music from the Oaza Restaurant. 11.30 (Approx.) Close Down.

Saturday, August 4th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

Programmes from Abroad.—

AGEN (310 and 45 metres) ; 0.5 kW.—**12.40,** Weather Forecast, Market Prices, News Bulletin. **8.30,** Exchange Quotations and Weather Forecast. **8.45** (approx.), Close Down.

BARCELONA (Radio-Barcelona), Call EAJ1 (344.8 metres) : 1.5 kW.—**12.0 Noon,** Chimes relayed from the Cathedral, Regional and General Weather Report. **1.30,** Concert by the Iberia Instrumental Trio. **2.45 to 9.0,** Interval. **9.0,** Opening Signal followed by Sports Notes, Agricultural and Cereal Market Prices. **9.15,** Selections by the Station Orchestra. **9.30,** Pianoforte Recital by Senor Julio Del Rio : Programme of Argentine Tangos. **9.50,** Orchestral and Vocal Concert. **11.0** (approx.), Close Down.

BERGEN (370.4 metres) : 1.5 kW.—**10.30 a.m.,** Outside Relay of a Divine Service. **12.30,** Weather Forecast. News Bulletin. **8.0,** Orchestral Selections. **9.0,** Talk. **9.30,** Recital of Pianoforte Music by Oskar Adler. **10.0,** Weather Forecast, News Bulletin and Time Signal. **10.15,** Musical Programme. **12.0 Midnight** (approx.), Close Down.

BERLIN (Königswusterhausen) (1,250 metres) : 40 kW.—**6.30 a.m.,** Orchestral Concert relayed from **Voxhaus.** In the Interval about 7.0 a.m. Gymnastic Exercises. **9.0 a.m.,** Chimes from the Potsdam Garrison Church followed by Vocal and Instrumental Concert from **Voxhaus** and Berlin Cathedral Chimes. **11.30 a.m.,** Concert relayed from **Voxhaus. 2.0,** Children's Programme relayed from **Voxhaus. 3.0,** Talk for Photographers by Jens Lützen. **3.30,** Agricultural Programme, Talks and Music, relayed from **Voxhaus. 6.30,** Talk on Literature followed by Programme relayed from **Voxhaus. 12.30 a.m.** (approx.) (Monday), Close Down.

BERLIN (Voxhaus) (484 metres) ; 4 kW.—**3.30 to 8.0 a.m.,** Orchestral Concert, in the Interval about 7.0 a.m., Gymnastic Exercises. **9.0 a.m.,** Potsdam Garrison Church Chimes followed by Vocal and Instrumental Concert and Chimes from the Berlin Cathedral. **11.30 a.m. to 12.50,** Orchestral Concert. **2.0,** Children's Programme arranged by Hans Bodenstedt and Fritz Jöde. **3.30,** Programme of Agricultural Talks, followed by Musical Selections. **7.0,** Programme of Talks and Musical Programme. **10.30,** Dance Music by the Gerhard Hoffmann Orchestra. **12.30 a.m.** (approx.) (Monday), Close Down.

BERN (411 metres) ; 1.5 kW.—**10.30 a.m.,** Divine Service relay. **1.0,** Time Signal and Weather Forecast. **1.5,** Orchestral Concert. **3.30,** Concert by an Orchestra. **8.0,** Time Signal and Weather Forecast, followed by Talks and Music, including Trumpet Solos. **9.45,** Sports Notes and News Bulletin. **10.0,** Selections by the Bern Municipal Orchestra. **10.35** (approx.), Close Down.

BEZIERS (158 metres) ; 0.6 kW.—**8.15,** News Bulletin and Sports Notes. **8.30,** Instrumental Concert. **9.0,** Programme of Dance Music.

BRATISLAVA (300 metres) ; 1 kW.—**9.30 a.m.** (approx.) to **11.0** (approx.), Progcamme of Talks and Music, with relay at intervals of the **Prague** and **Brünn** Programmes.

BREMEN (272.7 metres) ; 0.7 kW.—**6.30 a.m.**—Orchestral Concert relayed from **Voxhaus. 8.25 a.m.,** Time Signal, Weather Forecast and News Bulletin from **Hamburg. 11.30 a.m.,** Open Air Concert relayed from the Opera House Square in **Hanover. 12.55,** Nauen Time Signal. **1.0,** Instrumental Concert. **2.0,** Children's Programme from **Hamburg,** followed by Programme of Talks and Music. **8.0,** Musical Programme followed by Weather Forecast, News Bulletin, and Concert relayed from the Georgspalast. **11.0** (approx.), Close Down.

BRESLAU (322.6 metres) ; 4 kW.—**8.15 a.m.,** Relay of Chimes from Christchurch, Breslau. **11.0 a.m.,** Catholic Morning Recital. **12.0 Noon,** Orchestral Concert. **2.0,** Talk for Amateur Gardeners. **3.0,** Fairy Tale Recital for Children. **3.30,** Agricultural Talk. **4.0,** Running Commentary by Dr. Fritz Wenzel on the Steeplechase and Flat Races from the Meeting of the Silesian Association for Horse Breeding and Horse Racing, held on the Breslau-Hartlieb Course, followed by Programme of Talks and Music **8.30,** Variety Concert. **10.0,** Last News Bulletin. **10.30,** Relay of a Dance Music Programme. **12.0 Midnight** (approx.), Close Down.

BRÜNN (441.2 metres) ; 3 kW.—**7.0 a.m.** (approx.), to **11.0 a.m.,** Programme of Talks and Music. **11.0 a.m.,** Orchestral Concert, followed by Programme of Talks and Music. **4.0,** Popular Concert. **6.0,** German Transmission. **7.0,** Orchestral Concert. **10.20,** Musical Selections. **11.0** (approx.), Close Down.

BRUSSELS (508.5 metres) ; 1.5 kW.—**5.0,** Relay of

SUNDAY, AUGUST 5th.

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Dance Music from the **Ostend** Kursaal. **6.0,** Programme for Children by the Clowns Bonzo and Sylvia of the Théâtre des Enfants, Brussels. **6.30,** Instrumental and Soloist Concert. **7.30,** "Le Radio-Chronique — Journal Parlé of Radio-Belgique." **8.15,** Chamber Music Selections. **9.0,** Instrumental Concert, Conducted by Francois Rasse, relayed from the **Ostend** Kursaal, followed by News Bulletin. **10.30** (approx.), Close Down.

BUDAPEST (555.6 metres) ; 35 kW.—**9.0 a.m.,** News Bulletin and Beauty Hints for Women. **10.0 a.m.,** Protestant Divine Service. **12.0 Noon,** Chimes, followed by Time Signal, Weather Forecast and Musical Programme. **3.30,** Agricultural Report. **4.15,** Programme for Children, followed by Weather Forecast, Musical Selections and Dramatic Piece, or Concert ; In the Interval Sports Notes. **10.30,** (approx.), Programme of Tzigane Music, relayed from the Café Spolarits in Budapest. **12.0 Midnight** (approx.), Close Down.

COLOGNE (283 metres) : 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (468.8 metres), and **Münster** (250 metres). **9.0 a.m.,** Sacred Morning Recital, Music and Address followed by Programme of Talks and Music. **1.0,** Orchestral Concert. **3.0,** Sports Relay from the "Rote Erde" Stadium in **Dortmund,** followed by Miscellaneous Programme. **8.0,** Musical Programme, followed by Last News Bulletin and Sports Notes, and Musical Selections. **12.0 Midnight** (approx.), Close Down.

CORK, Call 6CK (400 metres) : 1.5 kW.—**3.30,** Vocal and Instrumental Concert by the Station Orchestra with Songs to Harp Accompaniment by Charles O'Connor ; other Artistes : Aimee R. Gibbings (Contralto), Gennie Gallagher (Mezzo-Soprano), Dr. Staf Gebruers (Carillonneur). **11.0** National Anthem. **11.5** (approx.) Close Down.

CRACOW (563 metres) : 1.5 kW.—**10.15 a.m.,** Divine Service relayed from a Cathedral. **12.0 Noon,** Relay of the Fanfare from Notre Dame, Time Signal and Weather Report. **4.0,** Agricultural Talks. **5.0,** Special Concert on the Occasion of the Departure of the Cracow Legionaries, Programme of Speeches, Recitations, Orchestral and Vocal Sextet Music. **6.30,** Miscellaneous Items. **7.15,** Talk. **8.0,** Fanfare from Notre Dame, followed by Sports Notes. **8.30,** Vocal and Instrumental Concert. **10.0** Programme relayed from **Warsaw. 10.30,** Concert, relayed from a Restaurant. **11.30** (approx.), Close Down.

DUBLIN, Call 2RN (319.1 metres) ; 1.5 kW.—**8.30, to 11.5** (approx.), Programme relayed from the Cork Station, Instrumental and Vocal Concert preceded by a Carillonade by Dr. Staf Gebruers, from St. Colman's Cathedral, Cobh ; at the end of the Programme the National Anthem.

FRANKFURT (428.6 metres), 4 kW.—**8.0 a.m.,** Musical Morning Recital. **11.0 a.m.,** Talk for Parents on the Upbringing of Children. **11.30 a.m. to 6.0** Talk, arranged by the Rhein-Main Association for Popular Education. **8.0** (approx.), Musical Programme. **10.0,** Probable relay of the Mozart Festival from **Salzburg** (see **Leipzig** Programme for details). **11.0** (approx.), Close Down.

HAMBURG, Call HA (in Morse). **(394.7 metres) ;** 4 kW.—Programme relayed by **Bremen** (272.7 metres), **Hanover** (297 metres), and **Kiel** (254.2 metres). **6.30, a.m.,** Orchestral Concert, relayed from **Voxhaus. 8.25 a.m.,** Time Signal, Weather Report and News Bulletin. **11.0 a.m.** (for **Hamburg** only), A trip through the Hamburg Museums, followed by Musical Programme. **12.15** International Time Signal, relayed from **Nauen. 1.0** (for **Hamburg** and **Kiel** only), Orchestral Concert. **2.0,** Programme for Children. **3.0 to 7.40,** Programme of Talks and Music. **7.40,** Sports Notes and Weather Report. **8.0,** Musical Programme, followed by Weather Forecast, News Bulletin and Concert from the Café Wallhof (for **Hamburg** and **Kiel** only). **11.0** (approx.), Close Down.

HANOVER (297 metres) ; 0.7 kW.—**6.30 a.m.,** Orchestral Concert, relayed from **Voxhaus. 8.25 a.m.,** Time Signal, Weather Forecast and News Bulletin from **Hamburg. 11.30 a.m.,** Open air Concert, relayed from the Opera House Square. **12.55, Nauen** Time Signal. **1.0,** Gramophone Records, followed by Programme of Talks and Music. **8.0,** Musical Programme, followed by Weather Report, News Bulletin and Concert, relayed from the Georgspalast. **11.0** (approx.), Close Down.

HILVERSUM (1,071 metres) ; 5 kW.—**12.40,** Concert of Trio Selections. **2.40,** Orchestral and Soloist Concert, relayed from the Scheveningen Kurhaus. **5.40** (approx.), Concert by the Wireless Orchestra, conducted by Nico Treep. **7.40,** Time Signal, Weather Report and News Bulletin. **7.55** (approx.), Concert by the Residence Orchestra from the Scheveningen Kurhaus, conducted by Professor Georg Schneevoigt.

HUIZEN (340.9 metres) : 4 kW.—Programme on 1,950 metres after **5.40.—8.10 a.m.,** Divine Service with Address and Choral Music. **9.30 a.m.** (approx.), Evangelical Morning Service, relayed from a Church. **12.10,** Concert by the Winkels Trio of Amsterdam, followed by Programme of Talks and Music and Programme for Hospitals. **7.25,** Talk. **7.55,** Concert and Miscellaneous Items under the Direction of Mr. M. v.d. Ende. **10.25** Choral Epilogue followed by Close Down.

JUAN-LES-PINS (Radio LL) (344.5 metres) ; 1.5 kW. —**1.0,** Concert by the Izar Orchestra, relayed from the Juan-les-Pins Casino, with Items for Children by "Radiolo" and Selections from Manon Lescaut (Puccini). **2.0 to 9.0,** Interval. **9.0,** News Bulletin and Orchestral Concert. **10.0,** Dance Music Programme by the Casino Orchestras. **10.30** (approx.), Close Down.

KALUNDBORG (1,153 metres) ; 7 kW.—Programme also for **Copenhagen** (337 metres).—**10.0 a.m.,** Divine Service and Address, relayed from a Church. **11.30 a.m.** (for **Kalundborg** only), Weather Report. **2.0,** Divine Service Relay. **6.50** (for **Kalundborg** only), Weather Forecast. **7.0,** News Bulletin. **7.30,** Talk. **8.0,** Relay of Chimes from the Copenhagen Town Hall. **8.5,** Popular Programme of Recitations, Songs and Musical Selections ; in the Interval at **9.0** (approx.), News Bulletin. **9.45,** Programme of Dances by the Viennese Masters, including (a) The Blue Danube, (b) Kriegsabenteuer Gallop (Johann Strauss), followed by Dance Music Programme : in the Interval at **12.0 Midnight,** Relay of Chimes from the Copenhagen Town Hall. **12.30 a.m.** (approx.) (Monday), Close Down.

KATOWITZ (422 metres) ; 10 kW.—**10.15 a.m.,** Divine Service. **12.0 Noon,** News Bulletin. **4.0,** Talk by W. Wlosik : The Silesian Gardener. **4.20,** Two Agricultural Talks. **5.0,** Popular Programme, followed by Miscellaneous Announcements, Programme of Talks and Music. **8.15,** Concert relayed from **Warsaw. 10.0,** News Bulletin. **10.30,** Programme of Dance Music. **11.30** (approx.), Close Down.

KAUNAS (2,000 metres) ; 7 kW.—**12.0 Noon,** Chimes, Weather Report and Recital of Church Music. **5.0,** Report for Farmers. **6.30,** Programme of the Hunting Association. **7.15,** Gramophone Selections, followed by Health Talk. **8.30,** Lowering of the Flag—Ceremony relayed from the Kaunas War Museum. **8.40,** Time Signal, Weather Forecast and Review of Politics. **9.0,** Instrumental Concert. **10.30** (approx.), Close Down.

KIEL (254.2 metres) ; 0.7 kW.—**6.30 a.m.,** Orchestral Concert relayed from **Voxhaus. 8.25 a.m.,** Time Signal, Weather Report, News Bulletin from **Hamburg. 10.55 a.m.,** Divine Service, relayed from the University Church in Kiel. **12.55, Nauen** Time Signal. **1.0,** Concert from **Hamburg. 2.0,** Children's Programme, relayed from **Hamburg,** followed by Programme of Talks and Music. **7.40,** Sports Notes. **7.55,** Weather Forecast. **8.0,** Musical Programme, followed by Weather Forecast, News Bulletin and Concert from the Café Wallhof in **Hamburg. 11.0** (approx.), Close Down.

KÖNIGSBERG (329.7 metres) ; 4 kW.—**9.0 a.m.,** Morning Recital : Sacred Organ Music, Songs and Address. **11.0 a.m.** (for **Königsberg** only), Weather Forecast. **11.15 a.m.,** Orchestral Concert. **12.55, Nauen** International Time Signal, followed by Weather Forecast. **7.0,** Programme of Talks. **8.10,** "Die ledige Ehetrau," Farce, with Songs and Dances in Three Acts (Pordes-Milo and Theo Halton), Music by Joseph Snaga, followed by News Bulletin and Sports Notes, and Programme of Dance Music. **12.0 Midnight** (approx.), Close Down.

LAHTI (1,522.8 metres) ; 35 kW.—Programme also for **Helsingfors** (375 metres).—**8.0 a.m.,** Divine Service in Finnish. **10.50 a.m.,** Orchestral Concert, conducted by Erkki Linko, with Recital of Songs in the Interval. **11.50 a.m.,** Weather Forecast and Time Signal. **12.0 Noon,** Swedish Divine Service. **6.10,** Concert of Orchestral Music. **7.30,** Recital of Songs by Roine R. Ryynänen. **7.50,** Continuation of Orchestral Concert. **8.45,** News Bulletin in Finnish and Swedish. **9.15,** Concert relayed from a Restaurant. **10.0** (approx.), Close Down.

Sunday, August 5th.

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Programmes from Abroad.—

LANGENBERG (**468.8 metres**), 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**9.0 a.m.** Sacred Musical Recital relayed from **Cologne**, followed by Programme of Talks and Music. **1.0,** Orchestral Concert, followed by Programme from **Cologne**. **8.0,** Relay from the Exhibition Hall in **Cologne**, followed by Last News Bulletin and Sports Notes relayed from **Cologne** and Orchestral Concert. **12.0 Midnight** (approx.), Close Down.

LEIPZIG (**365.8 metres**) ; 4 kW.—**8.30 a.m.**, Organ Recital from the University Church. **9 0 a.m.**, Morning Recital of Songs and Instrumental Music. **11.0 a.m.**, Outside Relay of an Orchestral Concert. **12.0.** Hans Bredow School Programme of Talks. **1.0,** Programme of Agricultural Talks. **2.0,** Review of the Foreign Press. **2.30,** Concert by the Dresden Wireless Orchestra, conducted by Gustav Agunte, relayed from the Jahresschau. **Dresden; 3.30,** Literary Programme. **4.30** (approx.), Instrumental Concert, followed by Programme of Talks. **7.30,** Musical and Literary Programme. **10.0,** "Serenade" Relay of the Mozart Festival from **Salzburg** ; The Vienna Symphony Orchestra directed by Dr. Bernhard Paumgartner, Programme from the Works of Mozart, including the Haffner Serenade, composed in July, 1776, on the Occasion of the Marriage of Elisabeth Haffner in Salzburg ; (a) Allegro maestoso ; (b) Andante ; (c) Minuetto ; (d) Rondo ; (e) Minuetto galante ; (f) Andante ; (g) Minuetto ; (h) Adagio—Allegro assai. **11.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**375 metres**) ; 3 kW.—**2.0,** Selections by the Artys Orchestra. **3.30 to 7.0,** No Transmission. **7.0,** Programme for Children. **8.0,** Dance Music Programme. **10.0,** Chimes, Time Signal and Musical Selections by the Municipal Band. **12.30** (approx.) (Monday), Close Down.

MILAN, Call 1MI (**526.3 metres**) ; 7 kW.—**10.30 a.m.,** Vocal and Instrumental Sacred Music. **12 30,** Opening Signal, followed by Quartet Selections. **1.30, to 4.0,** No Transmission. **4.0,** Concert of Quintet Music and Songs. **2.25,** Talk. **8.35,** Time Signal, followed by Talks. **8.50,** "La Cenerentola"—Opera (Rossini). During the intervals Talk and Sports Notes and News. **11.45** (approx.), Close Down.

MOTALA (**1,380 metres**) ; 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), and **Sundsvall** (545.6 metres).—**11.0 a.m.,** Divine Service Relay. **5.55,** Relay of Chimes from the Stockholm Town Hall. **7.50,** An August Programme. **9.45,** Report of the Olympic Games at Amsterdam. **10.0,** Concert including Old-time Dance Music. **11.30** (approx.), Close Down.

MUNICH (**535.7 metres**) ; 4 kW.—Programme relayed by **Augsberg** (566 metres), **Kaiserlautern** (204.1 metres), and **Nuremburg** (241.9 metres).—**11.0 a.m.,** Relay of Chimes from the Town Hall. **11.15 a.m.,** Weather Forecast. **1.0,** Time Signal, Weather Forecast and Programme Announcements, followed by Agricultural Talk. **3.0** (approx.), Programme of Instrumental Music and Talks. **9.30,** News Bulletin. **10.0,** "Serenade"—Special relay of the Mozart Festival from **Salzburg** (See **Leipzig** Programme for details). **11.0** (approx.), Close Down.

NAPLES, Call 1NA (**333.3 metres**), 1.5 kW.—**10.0 a.m.,** Sacred Music Recital, followed by Interval. **4.45,** Programme for Children. **5.0,** Light Orchestral and Vocal Concert. **5.30,** Time Signal and Talks. **8.40,** Time Signal. **8.48,** Report of the Naples Harbour Authorities. **8.50,** Concert of Vocal and Instrumental Italian Music, including "Schiccheri E'Grande"—Comedy in One Act (Sabatino Lopez) : Artistes, Armando Scaturchio, Gino Sampieri, Diana d'Elio and Dina Fabbri. **10.0,** Sports Notes. **10.55,** Calendar and Programme Announcements. **11.0** (approx.), Close Down.

OSLO (**461.5 metres**) ; 1.5 kW.—Programme relayed by **Fredrikasstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), and **Rjukan** (448 metres)—**10.30 a.m.** (approx.), Chimes followed by Divine Service. **7.45,** Weather Forecast and News Bulletin. **8.0,** Time Signal followed by Programme of Talks and Music. **9.30** (approx.), Weather Forecast, News Bulletin and Topical Events Review. **10.30** (approx.), Dance Music relayed from the Hotel Bristol in Oslo. **12.0 Midnight** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (**458 metres**) ; 0.5 kW.—Programme relayed at intervals by the following stations : **Bordeaux** PTT (275 metres), **Eiffel Tower** (2,650 metres), **Grenoble** (416 metres) **Lille** PTT (264 metres), **Limoges** (285 metres), **Lyons** PTT (476 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse** PTT (299 metres).—**8.0 a.m.,** News Bulletin and Time Signal. **10.25 a.m.,** International Time Signal and Weather Forecast. **1.30,** Instrumental Concert. **6.0,** Le Radio-Journal de France. **8.30,** Sports Results. **9.0,** Instrumental Concert, followed by Dance Music relayed from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**2,650 metres**) ; 5 kW.—**8.56 a.m.,** Time Signal on 32.5 metres. **10.26 a.m.,** Time Signal on 2,650 metres. **6.45,** Le Journal Parlé par T.S.F. Talks by Detective Ashelbé, René Casalis, Pierre Descaves, Bertrand Dupeyrat, and other regular contributors. **8.10,** Weather Forecast. **8.30,** Concert by Mario Cazes and his Orchestra. **8.56,** Time Signal on 32.5 metres. **11.26,** Time Signal on 2,650 metres.

PARIS (Petit Parisien) (**340.9 metres**) ; 0.5 kW.—**8.45,** Gramophone Selections, Talk and News Bulletin. **9.0,** Orchestral and Vocal Concert with Songs, M. Rousseau of the Opéra-Comique in Lamento (Duparc). **9.25,** News Bulletin. **9.30,** Symphony Concert. **10.0,** News Bulletin. **10.5** (approx.), Instrumental Selections. **11.0** (approx.), Close Down.

PARIS (Radio LL) (**370 and 60 metres**) ; 1 kW.—**3.0,** Programme of Dance Music Selections, arranged by Les Etablissements Radio LL. **9.0,** Concert of Vocal and Instrumental Music and Solos, including The Fourth Quartet in C Minor (Beethoven), (a) Allegro non tanto, (b) Andante scherzo, (c) Minuetto allegretto, (d) Allegro, played by the Russian String Quartet and Mme. Tosca Marmor (Pianoforte.) **10.30** (approx.), Close Down.

PARIS (Radio-Paris), Call CFR (**1,750 metres**) ; 6 kW.—**8.0 a.m.,** News Bulletin, followed by Review of the Press. **12.0 Noon,** Religious Address by the Rev. Father Pade, followed by Concert of Choral Sacred Music. **12.45,** Selections by the Albert Locatelli Orchestra. **4.30,** Dance Music Programme by the Grand Vatel Dance Orchestra ; News in the Interval. **7.45,** Programme for Children, followed by Agricultural Talk and News Bulletin. **8.30,** Instrumental Concert, News in the Interval.

PITTSBURGH, Call KDKA (**63 and 27 metres**) ; 25 kW.—**3.45,** Telechron Time. **4.0,** Divine Service. The following Programme from WJZ, **New York,** from **7.0 to 11.0. 7.0,** Roxy's Stroll. **9.0,** Time Signal, followed by Dr. Sockman's Question Hour. **10.0,** Twilight Reveries. **11.0,** Telechron Time, Baseball Scores and Concert. **11.30,** KDKA Ensemble Programme, relayed from the William Penn Hotel. **12.0 Midnight,** Telechron Time and Continuation of Ensemble Concert. **1.0 a.m. to 3.15 a.m.** (Monday), Programme relayed from **WJZ. 1.0 a.m.,** Variety, followed by the Whittall Anglo-Persians. **2.15 a.m.,** Concert by the Goldman Band. **3.15 a.m.,** Baseball Scores and Telechron Time. **3.30 a.m.** (approx.), Close Down.

POSEN (**344.8 metres**) ; 1.5 kW.—**10.15 a.m.,** Divine Service. **5.0,** Symphony Concert, relayed from **Warsaw. 6.50,** Talk, relayed from **Warsaw. 8.15,** Concert of Arias and Orchestral Selections from Modern Operettas, Works of Lehár, etc. ; Soloists : Mme. Sophie Fedyczkowska (Soprano), Kajetan Kopczynski (Baritone), accompanied by Professor Fr. Lukasiewicz and a Mandolfne Orchestra. **10.0,** Time Signal, News Bulletin, Weather Report and Sports Notes. **10.20,** Variety Items. **10.40,** Dance Music Programme, relayed from the Palais Royal Restaurant, Posen. **12.0 Midnight** (approx.), Close Down.

PRAGUE (**348.9 metres**) ; 5 kW.—**11.0 a.m.,** Concert of Instrumental Music, followed by Light Music. **12.0 Noon,** Orchestral Concert. **1.5,** Industry and Trade Notes, followed by Concert. **7.15** (approx.), Musical Selections. **10.0,** Time Signal and News Bulletin, followed by Programme relayed from **Brünn. 11.0** (approx.), Close Down.

RIGA (**526.3 metres**) ; 4 kW.—**10.15 a.m.,** Divine Service, relayed from the Mara Church in Riga. **1.0,** Programme for Children. **3.0,** Programme of Talks and Music. **9.0** (approx.), Weather Forecast ; (in the Interval of the Evening Concert) ; after the Concert, News Bulletin.

ROME, Call 1RO (**447.8 metres**) ; 3 kW.—**10.15 a.m.,** Recital of Sacred Vocal and Instrumental Music. **1.15,** Concert of Instrumental Trio Music. **2.15,** News Bulletin. **2.30 to 5.0,** No Transmission. **5.0,** Instrumental Concert. **6.0 to 6.30,** Dance Music Programme, relayed from the Casinetta. **8.0,** Opening Signal, followed by Talks. **8.20,** Forestry Report. **8.30,** News Bulletin. **8.46,** Review of Topical Events. **8.59,** Time Signal. **9.0,** Symphony Concert by the Grande Orchestra, including Pianoforte Solos from the Works of Martucci, by Lidia Trombetti ; in the Interval, Review of Fashions by Madame Pompadour. **11.5,** Last News Bulletin. **11.15** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF (**21.96 and 31.4 metres**) ; 30 kW.—**10.30,** Concert by the Ballad Singers, relayed from **New York. 11.0,** Stetson Parade Programme, American Legion Band, relayed from **Boston, Mass. 12.0 Midnight,** Concert by the National String Quartet, from **New York. 12.25 a.m.** (Monday), Baseball Announcements from **New York. 12.30 a.m.,** Capitol Theatre Programme from **New York. 2.0 a.m.,** Address : Our Government, by David Lawrence, relayed from **Washington D.C. 2.15 a.m.,** Atwater Kent Programme, from **New York. 2.45 a.m.,** Correct Time. **2.47 a.m.,** Biblical Drama from **New York. 3.15 a.m.,** Television Transmission for Experimental Purposes. **3.30 a.m.** (approx.), Close Down.

STAMBOUL (**1,200 metres**) ; 5 kW.—**4.30,** Instrumental Concert. **5.30,** Cereal Market Prices. **6.15,** Concert of Turkish Music. **8.30** (approx.), Weather Forecast and Time Signal. **8.40,** Instrumental Concert. **10.30** (approx.), Close Down.

STETTIN (**236 metres**); 0.75 kW.—Relay of the **Vox-haus** Programme at intervals from **6.30 a.m.**

STUTTGART (**379.7 metres**) ; 4 kW.—**11.0 a.m.** (approx.), Morning Concert. **2.0,** Programme for Children, followed by Programme of Talks and Music. **6.0,** Time Signal and Sports Notes. **7.45,** Time Signal and News Bulletin. **8.0,** Vocal and Instrumental Concert. **10.0,** Probable relay of the Mozart Festival from **Salzburg** (see **Leipzig** Programme for details). **11.0** (approx.), Close Down.

TALLINN (**408 metres**) ; 2.2 kW.—**7.30 a.m. to 9.0** (approx.), Varied Programme of Talks, Music, Weather Reports and News Bulletins.

TOULOUSE (Radiophonie du Midi), (**391 metres**) ; 3 kW.—**12.30,** Instrumental Concert. **1.0,** Time Signal. **1.45,** Press Review. **8.0,** News Bulletin. **8.30,** Instrumental Concert. **9.15,** Verdi Festival Programme offered by the Association des Commercants radio-électriciens du Midi, Toulouse ; Selections from the Operas including "Aida," (a) Vers nous reviens vainqueur, (b) Ces noms sacrés, (c) O céleste Aida, (d) Rhadamès va venir, (e) Jamais, non, non, (f) Introduction et danse mauresque, (g) Grande marche et finale from Act 2, (h) Chorus from Act 4. **10.15,** North African News Bulletin. **10.30** (approx.), Close Down.

VIENNA (**577 and 517.2 metres**) ; 1.5 and 5 kW.—Programme, relayed by **Innsbruck** (294.1 metres), **Klagenfurt** (272.7 metres), and **Linz** (254.2 metres). **11.0 a.m.,** Concert by the Vienna Symphony Orchestra. **4.0,** Concert of Orchestral Music, followed by Chamber Music and Talks, and Musical Programme. **10.0,** Special relay of the Mozart Festival from **Salzburg** (see **Leipzig** Programme for details). **11.0** (approx.), Close Down.

WARSAW (**1,111 metres**), 10 kW.—**10.15 a.m.,** Relay of Divine Service from the Cathedral in **Vilna. 12.0 Noon,** Time Signal, Fanfare from the Tower of Notre Dame in **Cracow,** Aviation Report and Weather Forecast. **12.10 to 3.55,** Interval. **3.55,** Weather Forecast, followed by Programme of Talks for Farmers. **5.0,** Popular Concert by the Philharmonic de Varsovie, Orchestral and Solo Selections. **6.30,** Miscellaneous Items. **6.50,** Talk on Russian History by Professor L. Kulczycki. **7.45,** Talk. **8.15,** Concert of Orchestral Selections by the Philharmonie de Varsovie, relayed from "Dolina Szwajcarska," conducted by T. Mazurkiewicz, Items include Glazounov's Chopiniana Suite. **10.0,** Time Signal, Aviation Report and Weather Forecast. **10.5,** News Bulletin, Police Information and Sports Notes. **10.30,** Dance Music Programme, relayed from the Oaza Restaurant. **11.30** (approx.), Close Down.

ZAGREB (**310 metres**), 0.35 kW.—**11.30 a.m.,** Concert of Military Music. **8.30,** Wireless Propaganda Talk, followed by Instrumental Concert. **9.50,** News Bulletin. **10.0,** Musical Programme, relayed from a Restaurant. **11.0** (approx.), Close Down.

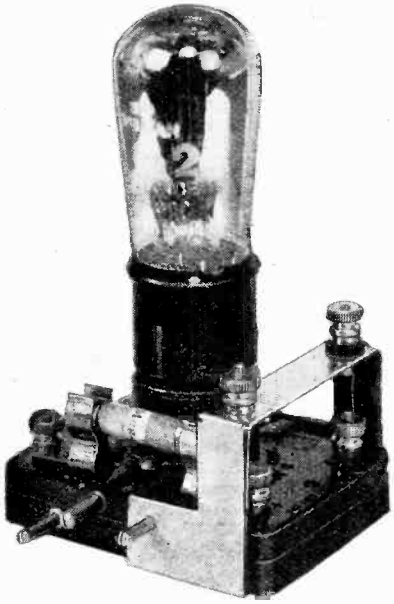
ZURICH (**588 metres**) ; 1 kW.—**11.15 a.m.,** Concert by the Station Orchestra. **12.29,** Weather Forecast. **12.30,** Instrumental Concert. **1.30 to 4.0,** No Transmission. **4.0,** Concert by the Carletti Orchestra, relayed from the Carlton-Elite Hotel in Zurich. **8.0** Concert of Minuets and Waltzes, followed by Request Music by the Station Orchestra. **10.0,** Weather Forecast and News Bulletin. **10.15** (approx.), Close Down.

WIRELESS WORLD LABORATORY TESTS

A Review of Manufacturers' Recent Products.

H.F. UNIT FOR THE NEW "R.C. THREESOME."

Although foreign stations can be well received on the three-valve R.C. Threesome with a good aerial and earth, the makers Messrs. Edison Swan Electric Co., Ltd., 123/125, Queen Victoria Street, London, E.C.4, have decided that a certain degree of H.F. amplification preceding the detector would enable distant transmissions to be received with greater reliability and have produced a H.F. unit known as type "C" for fixing in front of the type "A" unit in the original set. Resistance coupling has been adopted for the H.F. unit to conform with the remainder of the circuit and the aerial circuit comprises a centre-tapped coil for use with a neutralising condenser to stabilise the H.F. valve. Other additional components required include a bridge piece for carrying filament current to the extra valve and an aluminium screen for fitting between the H.F. and detector units.



Ediswan type "C" H.F. unit and filament bridge for addition to the "R.C. Threesome."

Although a high degree of H.F. amplification cannot be expected with resistance coupling, the addition of the H.F. circuit and the high amplification factor of the R.C.2 valve ensures that an increase of signal strength will take place. In any case the addition of a second tuned circuit will improve selectivity and reaction control will be smoother when not applied directly to the aerial circuit.

Full particulars of the complete four-valve receiver, including a full-size blue print, will be sent free of charge on application to the makers.

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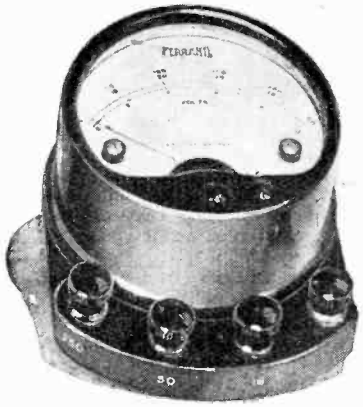
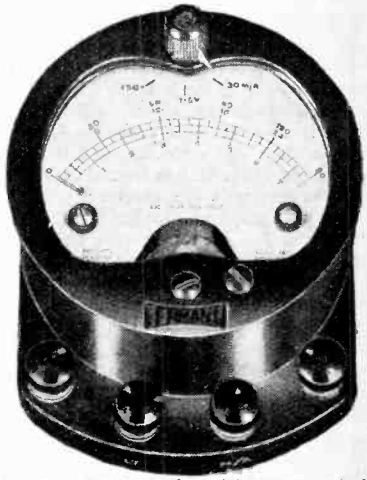
FERRANTI TRIPLE RANGE METERS.

The portable pattern Ferranti meters are made in two types with or without switch. From the point of view of appearance it would be difficult to design a neater instrument than the PR3a model. One model is fitted with terminals for the three ranges and the connections must be altered when changing from one range to another. A triple range voltmeter of this type (10, 50 and 250 volts) having a resistance of 1,000 ohms per volt was submitted for test and on all three ranges the error did not exceed 1 per cent. at any part of the scale. The movement was practically dead-beat and there was no trace of sticking.



Ferranti triple-range voltmeter



Ferranti PR3a model with range switch.

The PR3a model with switch enables rapid changes to be made without the necessity of altering any wiring and is therefore particularly useful in experimental work. The model tested had the following ranges: 7.5 volts, 150 volts and 30 milliamperes; the resistance of the meter was 200 ohms per volt.

Both types are fitted with the Ferranti fuse which was described in page 250 of the March 7th issue.

The movement is of the D'Arsonval type, and is fitted with a light aluminium girder pointer moving over a 110° scale. The pivots are supported on sapphire bearings.

Shrouded terminals and the moulded case are an effective protection against short circuits through external wires accidentally touching the case.

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SIEMENS L.T. BATTERY FOR THE "EVERYMAN PORTABLE."

By a slight modification of the wooden framework of the "Everyman Portable" it is possible to use a Siemens 4½-volt box battery (No. 608Y) for the L.T. supply. This battery is normally used in hand lamps, and supplies are obtainable from most dealers; in fact, it is almost as widely distributed as the pocket lamp type battery originally specified.

The No. 608Y battery costs 1s. 9d.—little more than twice the standard high quality flash lamp battery—yet it gives over ten times the service of the latter type. The battery illustrated was discharged intermittently and at random for periods ranging from ½ to 4½ hours with suitable rest periods for recovery. A fixed resistance of 40 ohms took the place of the two valves in series, and a variable resistance was used to keep the current between 80 and 100 milliamperes. At the end of a fortnight after the battery had been running for a total of 28 hours the current began to fall below 80 milliamperes with the variable resistance all out and only the 40-ohm resistance left in circuit. In practice it has been found that satisfactory signals are received with less than 80 milliamperes passing through the filaments, and it would be safe to put the useful life at 30 to 35 hours—a remarkable performance from the point of view of cost per hour and one which fully justifies the alterations in the framework necessary to take the larger battery. As a matter of fact, a continuous discharge of 24 hours was given through the 40 ohms resistance immediately after the current had passed the 80 mA mark, at the end of which time it was found that 46 mA was still flowing.

The dimensions of the No. 608Y battery are 4in. long × 1⅝in. wide × 3 7/16 in. high over the terminals, and the weight is 14oz.

Siemens No. 608Y battery, suitable for supplying filament current in the "Everyman Portable."

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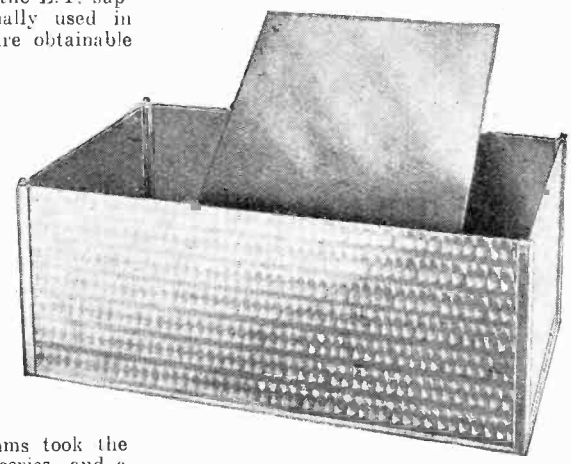
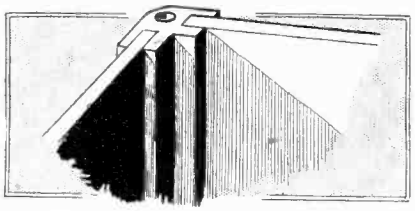
"STELLA" ALUMINIUM CABINETS.

Quite apart from the electrical screening properties of the metal and its attractive appearance, the form of construction adopted in these cabinets gives unusual mechanical strength. Flat aluminium plates of No. 14 gauge are used throughout, and the sides are held together by four channelled corner pieces. The top and bottom plates are secured at each corner by screws fitting into tapped holes in the ends of each channel bar. The side plates may be secured by centre-punching the insides of the channel bars, and, if desired, the front panel may be left free for easy removal. It will be appreciated that the cabinet can be packed into small space for delivery.



"Stella" aluminium cabinet, which is built up of flat plates with channel bar corner pieces.

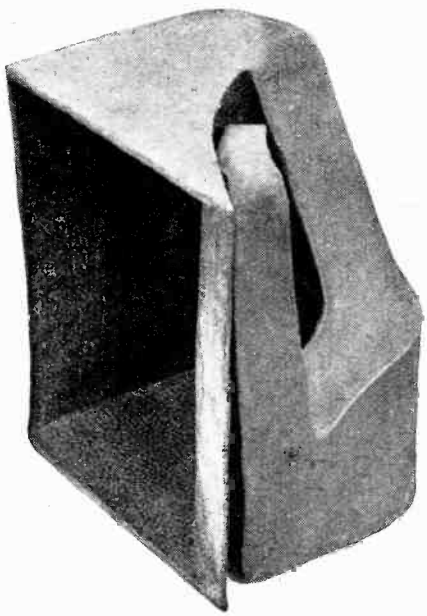


A corner of the "Stella" cabinet showing channelled aluminium bar.

The price of the particular cabinet illustrated with polished interior and mottled exterior finish is £2 14s. 6d., and with a plain polished finish £1 18s. 6d. A wide range of sizes may be obtained from the makers, Messrs. White Bros. and Jacobs, Ltd., 46, Chalk Farm Road, London, N.W.1.

FOLDED EXPONENTIAL HORN.

The Scientific Supply Stores, 80, Newington Causeway, London, S.E.1, have had considerable experience in the manufacture of papier-mâché loud speaker horns and have now produced a folded logarithmic horn of intricate design. Some of the bends are rather acute, and, according to theory, are likely to give rise to a certain amount of internal reflection, but in practice the results obtained are quite pleasing. The total length of the air column is 60in., the initial diameter of the throat is ¾in., and the rectangular flare is 15in. × 18in. The price of this particular horn is 35s. 6d., but a large size having a 70in. air column is available at 49s. 6d.



"Scientific" folded logarithmic loud speaker horn.

CATALOGUES RECEIVED.

H. Clarke and Co. (M/c), Ltd., Atlas Works, Eastnor Street, Old Trafford, Manchester. Wiring chart with instructions for building Clarke's "Atlas" A.B.C. 3-valve receiver for use with the A.B.C. unit for A.C. mains. Copies of this chart will be sent post free on application to the above address.

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The Halcyon Wireless Co., Ltd., 313-319, Regent Street, London, W.1. Illustrated booklet including particulars of the new Halcyon lightweight model "de luxe."

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A.F.A. Accumulators, Ltd., 120, Tottenham Court Road, London, W.1. Catalogue of the new range of "Pertrix" dry batteries including specimen discharge curves.

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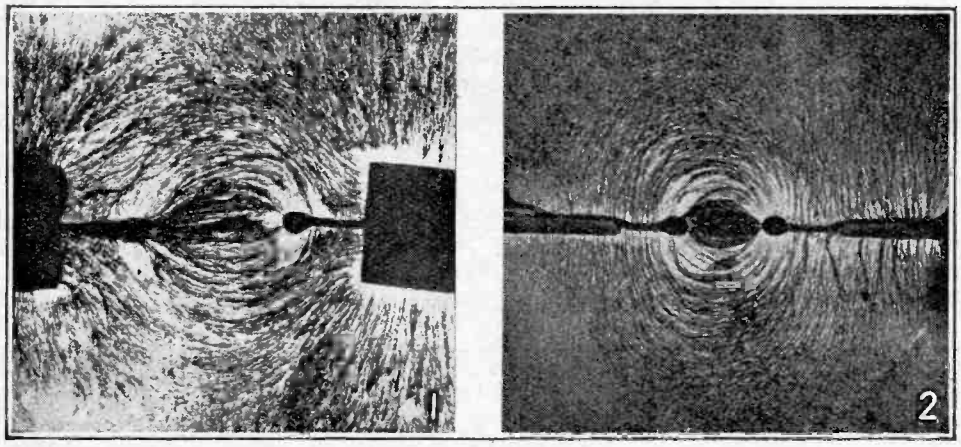
United Kingdom Retail Shopkeepers' Association, 115, Camberwell Road, London, S.E.5. Illustrated leaflet describing tool for drilling square holes in wood.

THE AERIAL AND ITS ELECTRIC FIELD.

Tracing the Field Around a Charged Conductor Immersed in a Liquid Dielectric.

By W. JACKSON, M.Sc.

WHILE the nature of the electrostatic field around charged conductors of simple shape can be determined analytically, it is more impressive and of great instructive value to be able to demonstrate the general character of the field experimentally, as can be done with iron filings in the case of a magnetic field.

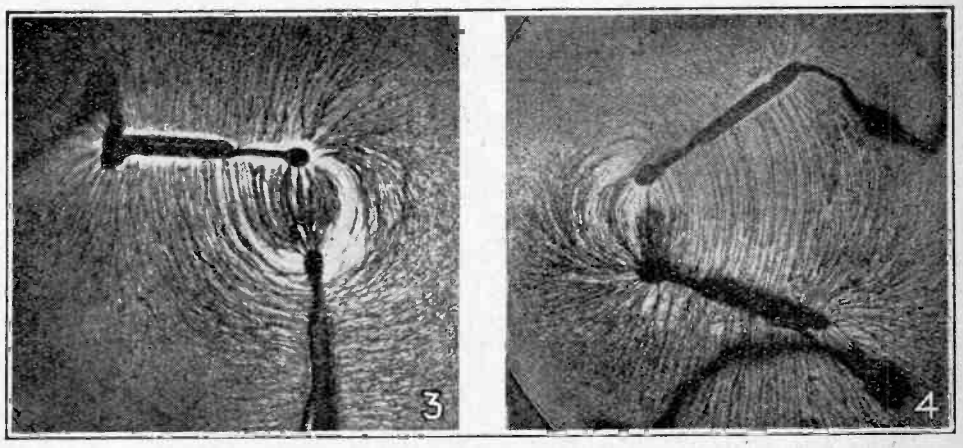


Figs. 1 and 2 show the field in the case of an open oscillator. The simple Hertz radiator employed consists of two rods, each having at one end a spark ball and at the other end a metal plate.]

The delineation of the lines of electric force for several simple physical cases has been demonstrated by Mr. Brookes, late of the Leicester Technical College, and photographs of them communicated to the I.E.E. journal in 1923.[1] It was felt by the writer that much useful information concerning the nature of the electric field of the simple Hertzian oscillator and of several antenna systems might be obtained by use of the method he described.

It is found that if certain of the aniline dyes are suspended in a fine state of division in a dielectric such as paraffin oil or turpentine, and an electric field created by placing charged conductors in the liquid, the dye tends to form extensive deposits along the lines of force. These deposits outline the nature of the electric field in the same way as do the iron filings in the case of a magnetic field. The deposit can be photographed by illuminating the glass dish containing the dielectric and the electrodes from below and arranging a camera vertically above. A Wimshurst machine offers the most convenient source of high potential for applying to the electrodes between which the field is desired. It is important to maintain a constant potential between the electrodes by using a small spark gap on the machine, otherwise convection currents of liquid are set up between the electrodes between successive sparks, rendering the production of a uniform deposit around the electrodes very difficult.

The photographs shown in illustrations (1) to (5) show the nature of the electric field in the case of a simple Hertz radiator consisting of two rods each having at one end a spark ball and at the other end a metal plate. Figs. 1 and 2 represent the case of an open oscillator, while Figs. 3, 4, and 5 show how, on bringing the plates closer together, the lines of force tend to become concentrated between the plates, the result being a reduction in the radiative properties of the oscillator and the production of a closed oscillatory system. Appreciable convection currents in the liquid between the plates rendered the production of a good delineation especially difficult in the case shown in Fig. 5.



Figs. 3 and 4.—Simple Hertz radiators where the electrodes have been brought close together. The lines of force have become more concentrated resulting in a reduction of radiative properties and the production of a closed oscillatory system.

When a satisfactory deposit had been obtained the effect on the lines of force of increasing the potential

[1] *Journal I.E.E.*, page 1141, Vol. 61.

The Aerial and its Electrical Field.—between the spark balls—by increasing the spark gap of the Wimshurst machine—until a spark passed between them was very instructive. As the difference in potential was increased the ends of the lines terminating on the rods and plates showed a tendency to run along the rods towards the spark balls until the spark passed; the field would then reform as before, and the process be repeated. This illustrates the production of the loops of electric strain radiated into space from an actual Hertzian oscillator.

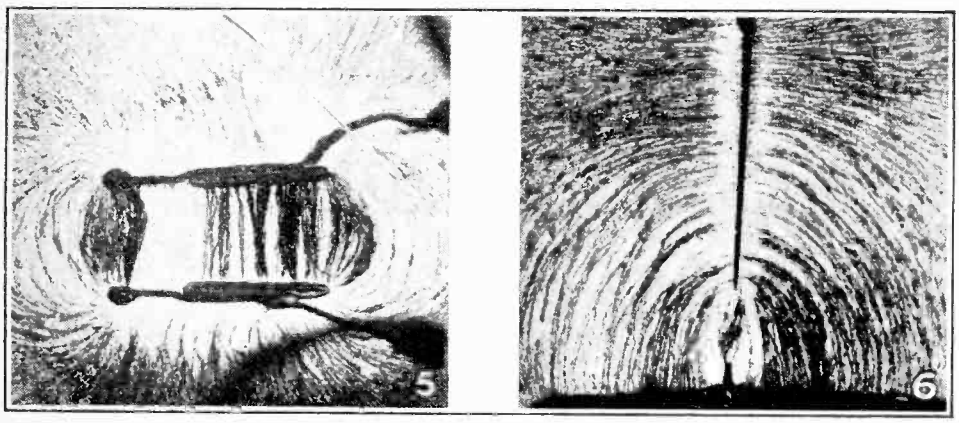
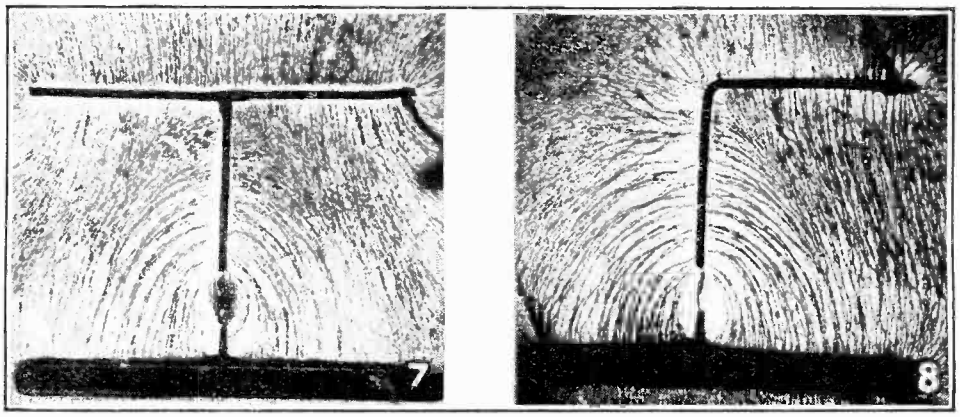


Fig. 5.—Owing to the close disposition of the electrodes convection currents in the liquid have obscured the clean delineation of the lines of force. Fig. 6 represents the field round a simple Marconi vertical antenna.

The electric field of the simple Marconi vertical antenna is shown in Fig. 6. The model vertical wire and earth—consisting of a pin and brass plate respectively—are separated by a short gap and connected to the terminals of the Wimshurst machine. The observed nature of the electric field compares strikingly with that expected, as will be noticed by comparison with the diagrammatic representation put forward by Dr. Fleming some time ago in his extremely interesting publication, "Principles of Electric Wave Telegraphy and Telephony," page 349. Again, the tendency of the lines of electric strain to run down the vertical wire previous to the passage of a spark across the gap was very noticeable.

Figs. 7 and 8 show the character of the field in the case of the T and inverted L aerials, and show the effect of the capacity between the horizontal portion and earth on the distribution of the field.

The photographs illustrate the general nature of the actions taking place in the region of antenna circuits during the propagation of electromagnetic waves into space, and it is hoped will help the wireless amateur to obtain a clearer understanding of the somewhat abstruse phenomena of radiation.

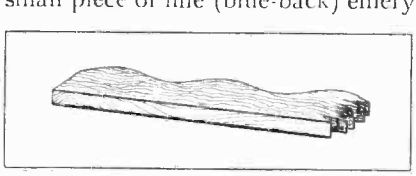


Figs. 7 and 8 show the type of field in the case of a T and inverted L aerial respectively. Note the effect on the distribution of the field due to the capacity between the horizontal portions and earth.

FINISHING COPPER OR ALUMINIUM PANELS.

The amateur often desires to obtain a pleasing wavy finish to his metal panel similar to the machine-modelled panels, etc., which are purchasable commercially. It is quite a simple and inexpensive job for him to accomplish this, and obtain results in no way inferior to machine-finished articles.

A strip of wood about 1in. wide and as long as the longest side of the panel, box, or screen is taken and shaped by means of a spoke-shave or other instrument, in the manner shown in the illustration. The strip is then held firmly on the panel, care being taken to see that it is parallel to the edge of it. A small piece of fine (blue-back) emery cloth about 1in. square is placed under the thumb against the wavy edge of the wooden strip, and drawn along the metal surface under pressure some half a dozen times in one direction. Care should be taken to follow the contour of the strip by firmly pressing the thumb against it. The strip is now moved up the metal surface a distance equal to its own width, and the process repeated until the whole of the metal is covered.



The wood shape required.

R. M. L. E.

News from All Quarters: By Our Special Correspondent.

Those Hospital Sets.—Talks Rumour Denied.—Opening of "The Proms."—B.B.C. Staff at Cricket.—A New Sports Ground.—Announcers' English.

Hospital Sets: A B.B.C. Move.

The Wireless World recently drew attention to the fact that the wireless installations in many hospitals have ceased to function as satisfactorily as when they were new. In some cases, indeed, the reproduction is so atrocious that speech is barely intelligible and the musical broadcasts are hard to endure.

As a consequence of *The Wireless World* investigation, the B.B.C. has decided to send engineers to twenty-two hospitals in the London area. When the tour of inspection is completed they will submit a detailed report. Whether the B.B.C., with its surplus funds, will undertake the work of renewal is a question which I cannot at the moment answer.

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A Talks Rumour.

A rumour gained ground last week to the effect that the B.B.C. contemplated a big extension of the talks policy during the coming winter. I am able to state that alterations in the present policy, if any, will be intensive rather than extensive. The talks may gain in vitality, but they will not be allotted any more programme time than in the past. In fact, no changes will be possible until the regional scheme provides the programme builders with considerably more time than they now have at their disposal.

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Vox Populi?

Here is an extract from a letter received at Savoy Hill last week:—

"I speak for the entire nation. I pronounce the programmes rotten. I do not know precisely what I do want, and I absolutely refuse to make any constructive suggestions, but I do not like what I am getting. If the other fellow likes it he ought not to be pandered to. The licence business, too, is sheer profiteering. It costs something for us to hear a single programme. In America we could receive several programmes simultaneously free, gratis, and for nothing on a cheap set."

Let us thank Heaven that old England never lacks a spokesman.

The Grousing Season.

From my diary:—

August 11th.—B.B.C. opens autumn session with first Promenade Concert.

August 12th.—Grouse shooting begins.

FUTURE FEATURES.

London and Daventry.

AUGUST 6TH.—Excerpts from "So This Is Love," from the Winter Garden Theatre.

AUGUST 7TH.—"The Crossing," a play by Holt Marvell and Cyril Lister.

AUGUST 8TH.—Service from the Menin Gate, conducted by the Rev. Dr. A. C. E. Jarvis. Address by the Most Rev. the Lord Archbishop of York.

AUGUST 9TH.—Sing-song from the Duke of York's Camp.

AUGUST 11TH.—Promenade Concert.

Daventry Experimental (5GB)

AUGUST 6TH.—"Taking Our Pleasures." A Bank Holiday programme.

AUGUST 7TH.—A Coleridge-Taylor Concert.

AUGUST 9TH.—Summer Symphony Concert.

AUGUST 10TH.—"The Songs of Auld Lang Syne," from Birmingham.

AUGUST 11TH.—"A Sharp Attack," a play by Herbert C. Sargent.

Manchester.

AUGUST 7TH.—"On With the Show of 1928."

Newcastle.

AUGUST 6TH.—Opening of Carlisle Pageant by the Duke of York.

Glasgow.

AUGUST 11TH.—The Holiday Fair Concert Party.

Aberdeen.

AUGUST 8TH.—"Sauce for the Goose," a Scottish comedy by Peter Grey.

Belfast.

AUGUST 10TH.—A Programme of Fantasy.

"The Twelfth."

The annual rush north for the opening of the shooting season on the twelfth will be marked in the broadcast programmes by a relay of an all-Scottish concert from the heart of the Highlands to Daventry on August 10th.

The programme comes from the Atholl Palace Hotel, Pitlochry, and will include old reels and strathspeys, with a description of the spectacle of reels danced on the great terrace outside the hotel. The broadcast will conclude with a miniature torchlight tattoo.

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A Play about Eugenics.

The B.B.C. makes the somewhat bold prediction that Cecil Lewis's play, "Good Breeding," to be broadcast this evening (Wednesday) from 2LO, will prove to be "one of the most successful works ever given *via* the microphone." It deals with the problem of eugenics.

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A Musical Feast.

He whose musical appetite needs whetting will find an excellent appetiser in the newly issued Programme for the Thirty-fourth Season of Promenade Concerts to be given by Sir Henry J. Wood and his symphony orchestra at the Queen's Hall from August 11th to October 6th.

About 50 per cent. of the concerts will be broadcast by 2LO, 5XX, and other stations.

As in previous years, Monday nights will be devoted principally to the works of Wagner, while on Fridays the honours will be mostly shared by Beethoven and Mozart. Wednesday programmes will be devoted for the most part to Bach and Brahms alternately. Of the other nights it is sufficient to say that all kinds of music—classical, modern, and even ultra-modern—will be given. There is an imposing "Novelty List" of first performances in England, including works by Kodály, Strauss, Sibelius (Symphonic Poem, "Tapiola"), Eric Fogg, and Dorothy Howell.

The complete programme is obtainable from the B.B.C. at 2, Savoy Hill, W.C.2.

Inaugural "Proms" Concert.

The concert on the opening night of the "Proms," August 11th, will include as soloists Stiles Allen (soprano), Roy Henderson (baritone), Solomon (piano), and G. D. Cunningham (organ), Sir Henry Wood, as usual, conducting the Symphony Orchestra.

The programme opens with a Suite for Organ and Orchestra, by Purcell. Other items to be given are Solemn Melody for Strings and Orchestra (Walford Davies) and Grainger's clog dance, "Handel in the Strand."

Stiles Allen is singing "Lusinche Piu Care" from "Alessandro" (Handel), and Roy Henderson will sing Moussorgsky's "Song of the Flea."

The concert will be broadcast from 2LO and 5XX.

The following Monday (August 13th) will be a Wagner night, and the programme will include "The Mastersinger's Overture," "The Siegfried Idyll," "Klingsor's Magic Garden and the Flower Maiden's Song." Walter Widdop will sing Tannhauser's "Pilgrimage," and Bella Baillie is to sing "Isolde's Liebestod."

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Beyond a Joke?

Station WEE 1, of Boston, has banned all jokes against Scotsmen.

I suppose they would even forbid this one: What is the difference between an accumulator and an Aberdonian? An accumulator can be overcharged.

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All the Winners.

The sporting element is to be well represented in the programmes during the next few weeks.

On Saturday next, August 4th, L. N. Constantine, the now famous West Indies cricketer, will give a talk from 2LO describing some of his adventures on the field.

The big event on the following Saturday will be a running commentary on the athletic meeting between the British Empire and the United States of America at Stamford Bridge. The commentator will be Prof. Noel Baker, the old Cambridge athletic "Blue." On the same evening Col. Philip Trevor will give an eye-witness account of the third Test match at the Oval.

A foretaste of winter will be provided on Saturday, August 18th, by Mr. G. F. Allison, who will talk on football prospects.

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B.B.C at Cricket.

At the opening ceremony of 5XX in 1925 someone remarked jocularly that the Daventry Town Cricket Club should play the B.B.C. staff team in celebration of the event. The challenge was accepted in 1926, and three matches have now been played.

Unhappily for the B.B.C. they have not succeeded in vanquishing their opponents. In last Wednesday's match, played at Daventry, the home team scored 145, the B.B.C. limping home with 73.

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Captain Eckerley's Score.

The B.B.C. captain is G. Alderson, and among his supporters on Wednesday were Captain P. P. Eckersley and Lieut. Walter O'Donnell. There was some sadness in the B.B.C. camp when "P.P." scored a 0, but everybody was satisfied with the explanation, viz., that the Chief Engineer had been concentrating his thoughts on the preparation of a very witty luncheon speech.

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The New Sports Ground.

I hear that next year the Daventry Town team may be guests of the B.B.C. at the Corporation's projected sports ground at Motspur Park, an inviting slice of land near Wimbledon.

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Announcers' English.

Few situations can be more miserable than that of the announcer whose tongue has boggled over a doubtful pronunciation. In Japan, of course, a crime like this means *hari-kari*, and as I read through one of the latest publications of the B.B.C. it seems to me that future offenders on the Savoy Hill announcing staff will be compelled to follow suit.

"Broadcast English" is a brochure for private circulation among announcers. It embodies for their guidance the recommendations of the Pronunciation Advisory Committee, which sat last year to determine what stand the B.B.C. should take when faced with words of doubtful pronunciation. That the committee had a ticklish task is clear to anyone who reads the introduction to this booklet, written by Mr. A. Lloyd James, who was honorary secretary to the committee.

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Tongue Twisters Tabulated.

Mr. Lloyd James writes: "The yard does not vary from Aberdeen to Plymouth, and the pint pot contains as much in Mayfair as in Bethnal Green. Unfortunately, speech is not capable of rigid measurement, and there is no standard of pronunciation. Pronunciation varies from district to district, from class to class, from character to character, in proportion to the local, social, or moral difference that separates them."

Much sage advice follows on how to seek a common denominator of educated speech, and the tentative results of such a search appear at the end of the booklet in the form of a vocabulary of what may be regarded as tongue twisters.

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A Disclaimer.

This is a list that the prudent announcer will study with all his heart and soul. Woe betide him if he calls "caoutchouc" anything else but cówchook, or if he stumbles over "sough" or "houri."

Lest, however, listeners should question the authority of Savoy Hill to regulate the national tongue, the committee states that it is not suggested that the pronunciations given are the only right ones and that any special degree of authority attaches to them.

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Unkindness to "Pirates."

The wireless "pirate" question has recently been receiving attention in South Africa. When a South African resident decides to become a pirate he has to remember, in the first place, that he isn't in England. He will find it very difficult to start pirating. The South African Government pursues the kill-joy course of locking the stable door before the poor horse has a chance to escape and enjoy himself, whereas in this country every ass can generally have a run before he is caught.

In South Africa you can only succeed at the pirate game if you are talented enough to construct every bit of the set yourself, including the telephones or loud speaker. If you seek to purchase components or accessories you must show your receiving licence to the retailer.

What could be more discouraging? It is this sort of legislation that cramps initiative and produces indigestion of the soul.

WHEN HARES MEET HOUNDS. This photograph, taken at the conclusion of a recent transmitter hunt conducted by the North Middlesex Radio Society, shows the mobile transmitter—a loose-coupled Hartley—which was run to earth by several parties equipped with portable sets, also seen in the picture.

Wireless Telephony in The Far South

How Radio Assists the Whaling Fleets.

By H. J. GARLAND.

THE wireless telephone has now penetrated into the snowy regions of the Far South, where, during the past two years, it has proved of enormous value to the whaling industry. Just over twelve months ago the Marconi Company erected a wireless telephone station on the island of South Georgia, where there are a number of whaling stations, and fitted numerous small whaling vessels with telephony apparatus.

South Georgia, a small island, barely 100 miles in length, situated in the far South Atlantic, is well known to the world at large as the burial place of Sir Ernest Shackleton. The seas in this region are the home of the great blue and fin whales, and it is to kill these monsters of the deep that large numbers of whalers go down every year and face the perils and hardships of the frozen South. The principal station in South Georgia is that of the Southern Whaling and Sealing Company at Prince Olaf Harbour, from which four fast steam whale-catchers operate.

Before the whalers arrive at the beginning of the whale hunting season South Georgia presents a scene of the utmost desolation. From the sea the island appears to be nothing but a snow-covered mountainous mass, with peaks towering into the clouds. No signs of life or human habitation are visible or appear possible on such bleak and icy shores. But as the whaling fleet steams slowly through the narrow entrance into the little harbour the tops of the buildings of the whaling station appear. These buildings, which consist of boiler houses and the plant necessary for extracting the oil from whales, together with a few small huts for the staff, are erected on the slope of a mountain close to the water's edge.

Within a few minutes of the whalers dropping anchor half a dozen men who have spent the winter at the station come alongside in a launch to greet the fleet. As soon as the preparations at the station are complete the whale-catchers put to sea.

How Whales are Hunted.

The method of hunting and killing whales has in recent years undergone great changes. Formerly the whale was chased in small rowing boats and killed by means of harpoons and lances thrown by hand, a very dangerous task for the men engaged in the whaling industry, and a very painful and lingering death for the whale. Nowadays, all this is changed. The small rowing boats have been replaced by fast steam whalers, very much like large trawlers, with a speed of 14 knots. The whales are killed by large iron harpoons fired from powerful guns. The harpoon, which measures about five feet in length, has an explosive detonator at the head and a thick rope fastened to the other end. When the harpoon enters the whale the detonator explodes, killing the whale which immediately sinks. It is then heaved

Wireless Telephony in the Far South.—

to the surface by means of the rope which is fastened to the harpoon. As soon as the whale has been brought to the surface a tube is inserted into its body which is inflated with compressed air supplied from a pump in the engine room. When a sufficient quantity of air has been pumped to make the whale buoyant the tube is removed and the hole stopped with cotton waste. The whale will now float, and is lashed alongside the boat and towed to the land base for disposal.

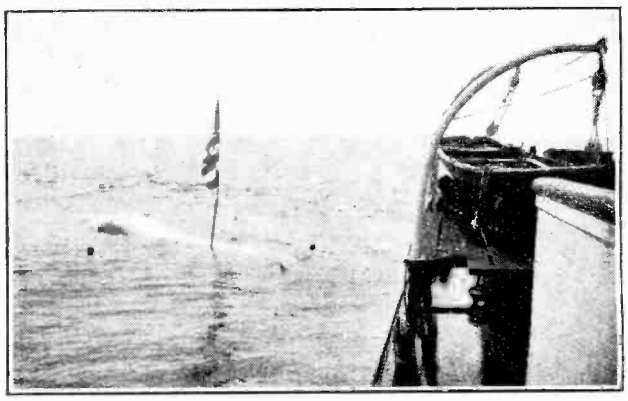
Here the task of extracting the oil from the vast carcases begins. A whale having been drawn from the water on to a special slipway by means of steam winches, its blubber is then cut off and placed into the boiling vats. The blubber is the thick belt of hard fat which lies immediately under the outer skin of the whale, and which yields great quantities of oil. After the blubber has been removed the body is sawn into large pieces by means of steam saws, and these pieces are also boiled until all the oil is extracted. Even the bones of the whale are crushed by means of huge machines, and then boiled so as to obtain the last ounce of oil.

A large blue whale may measure up to 102 feet in length and weigh as much as 120 tons. Its tongue alone may weigh as much as four tons, and it is difficult to believe that these monsters live largely on crustacea, similar in appearance to shrimps.

A modern whaling station in South Georgia. This photograph was taken during the brief period of summer when the snow disappears.

How Wireless Telephony is Used.

Among the modern devices that have contributed to the reorganisation of the whaling industry, the wireless telephone is playing an important part. Prior to the introduction of wireless telephony no communication between the whale-catchers and the whaling station was possible while the catchers were at sea, so that once the boats left harbour no instructions could be given or information received until the vessels returned to the base.



After being harpooned and taken in tow the whales are inflated with air to make them buoyant.

Now the whale-catchers have been fitted with a compact but powerful wireless telephone transmitter and receiver, and the land base has also been fitted with a similar type of apparatus. These telephone sets, which were specially designed by the Marconi Company for use on whalers, trawlers, and other small craft, take up very little room, and are practically "foolproof." Their operation has been reduced to such a simple proposition that they may be worked by any member of the crew. Reception is by loud-speaker, so that it is not necessary to remove head coverings in order to receive.

Speech from these extremely efficient installations has been heard up to 2,000 miles, so that any Antarctic explorer who may in the future endeavour to reach the South Pole could, with the aid of one of these sets, keep in constant telephonic communication with the whalers.

Liaison between Ship and Shore.

The use of wireless telephony by the whaling industry has greatly increased the hunting efficiency of the whaling fleets by enabling them to hunt further afield than ever before without fear of being isolated, and this has had a marked effect on the number of whales caught. It is the practice now for the whalers to leave their base just before dawn and proceed in different directions in search of whales. As soon as a whaler sights a school of whale the gunner telephones to the boats of his own company and informs them of the position. A simple system of code words prevents the message being understood by any boats of another company which may be fitted with wireless. The boats informed converge on the position given, and thereby secure a large number of whales which, but for the use of wireless telephony, might have been lost

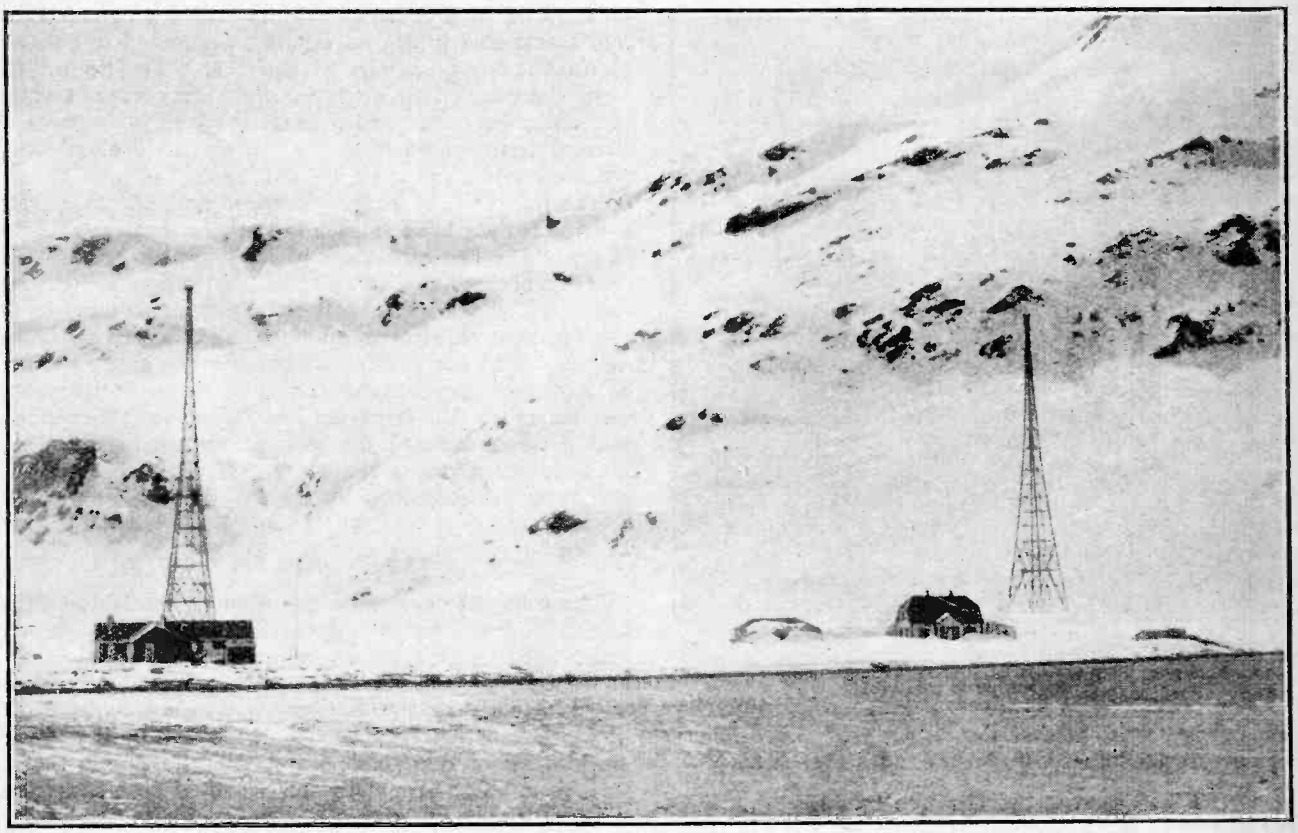
Wireless Telephony in the Far South.—

to them. At intervals of about two hours the gunners make use of the telephones to discuss weather, sea, and whaling conditions, while the whaling manager at the land base can give instructions at any time to his fleet.

Before the advent of this system of inter-communication it frequently occurred that while one boat was in an area abounding with whales the other three boats (each whaling station has from three to five boats) would be searching in the wrong direction, and many thousands of pounds were lost every year through the inability of the gunners to co-operate. It is now possible for the whalers of each company to work together as a team, with the result that the oil production now exceeds all previous records.

On one occasion a whaler broke down when far out at sea. At the time of the mishap the whaler had four whales, the total value of which exceeded £1,500, made fast alongside. The gunner communicated by wireless telephone with another whaler of the same company, which proceeded to his assistance, and towed the disabled whaler and the four whales to the land base. It is certain that had this whaler not been equipped with wireless telephone apparatus the crew would have suffered great hardship, and many thousands of pounds would have been lost to the whaling company on account of the necessity of using all the other boats to search for the missing vessel.

Still further south than South Georgia, in the vicinity of the South Shetlands, are a number of "factory



A typical whaling station. The wireless telephony equipment now employed has revolutionised the industry.

Sometimes boats have been fog-bound while their companion whalers have been in clear weather, and the use of the telephone has enabled the fog-bound vessels to proceed to a clear area.

Increased Safety Due to Wireless.

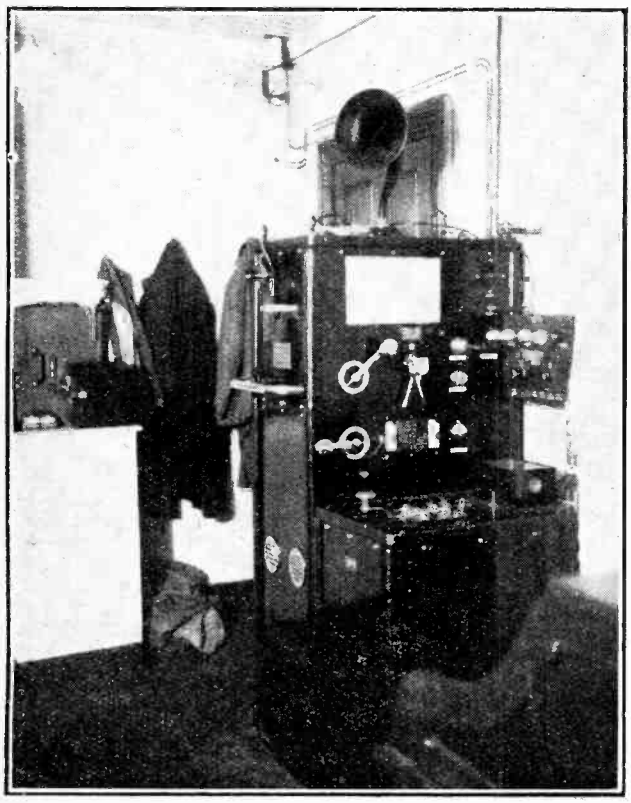
Apart from the commercial value of wireless telephony it is a great safeguard to the lives on board these little boats which day by day face the terrific storms of the Antarctic. Never again shall we hear of missing whale boats whose crews are found months later frozen to death on some snow-covered beach.

ships," equipped with all the necessary boilers and machinery for extracting oil from whales. Three small steam whale-catchers are attached to each "factory ship." A number of these "factory ships" and attendant catchers have been fitted with Marconi wireless telephones which enable the mother ship to keep in constant touch with her whalers. Instructions as to the best fishing areas, the position of the factory ship, weather conditions, chronometer check, and so on, are now given hourly to the whalers, with the result that no time is lost and production is increased.

In addition to the wireless telephones a number of "factory ships" have been fitted with Marconi wireless

Wireless Telephony in the Far South.—direction finders. Blizzards and conditions of low visibility are very prevalent in these icy regions, and the wireless direction finder has proved of great value in guiding the whalers back to their base.

The "factory ships" equipped with Marconi apparatus are also in touch twice daily with the high-power wireless station at Rugby, England, for the reception of messages, so that the isolation of the Antarctic regions, to the Pole itself, has been for ever removed.



The Marconi half-kilowatt telephone-telegraph station at Prince Olaf Harbour, South Georgia. This is the most southerly wireless station in the world.

Description of the Wireless Sets Used.

The Marconi telephone equipment installed on the whalers is a self-contained transmitter and receiver working on a single wavelength. The only controls which are accessible to the operator are the handle for starting and stopping the generator, the handle to change from sending to receiving, and two levers which allow fine adjustments of the receiver to suit varying conditions.

Foolproof Ship's Equipment.

The transmitter—a ½kW. type XMC set—is tuned to the required wavelength when it is installed, and further adjustment by the user of the set (the gunner in the case of the whaler) is neither necessary nor possible as the set is made inaccessible by means of metal panels which are screwed in position. The tuning adjustments are locked in position to prevent any possibility of variation. The transmitting valves are carried in spring suspended holders, and the receiver is supported by elastic cord as a protection against shock and vibration. The transmitter tuning adjustments are locked in position to prevent any possibility of variation. The transmitter is of the coupled circuit type, and incorporates a valve oscillation generator and a modulating valve. Power is derived from a high tension direct current generator run off a suitable supply.

The four-valve receiver is arranged normally to operate a loud-speaker, but provision is made for head telephones if desired. The advantage of loud-speaker reception is that it makes it unnecessary to keep a continuous listening watch. The receiver is left switched on, and the loud-speaker at once attracts attention when a call is made. The valves in the receiver are arranged to give one stage of high-frequency amplification and, after rectification, two stages of low-frequency magnification. The aerial tuning condenser and the reaction coupling control are the only external adjustments provided for the receiver, and these are controlled by the two small levers outside the cabinet.

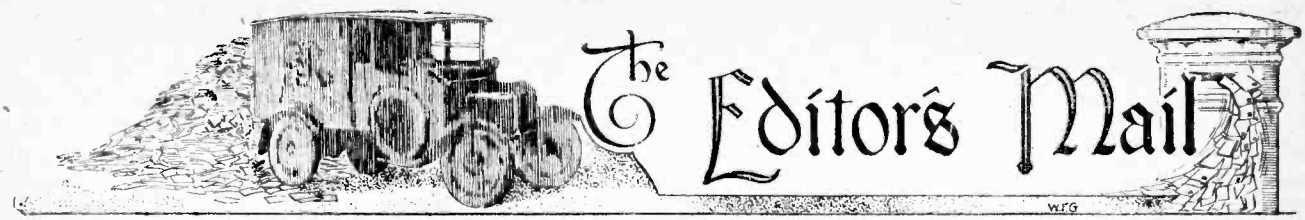
The Direction Finder.

The direction finders on the whalers are of the well-known Marconi marine type, 113, using seven valves, and a fixed frame aerial system. Five of the valves are high-frequency amplifiers, the sixth a rectifier, and the last is a stage of low-frequency magnification, the use of which is optional. The signals received by the aerials are induced in a rotatable search coil and passed thence to the amplifier. An indicator mounted on the axis of the search coil shows the plane of the direction of the transmitting section, and by a comparison with the ship's compass shows the actual direction.

ELIMINATING A.C. INTERFERENCE.

MANY constructors of receivers using the special A.C. mains valves expend a large amount of time and trouble in using lead-sheathed wires for those leads carrying raw A.C. Some, indeed, have even used it for unsmoothed D.C. in those cases where an H.T. eliminator is built into the receiver. The purpose is to shield the wiring and components in the receiver, in particular those associated with the high potential end of grid circuits, from the effect of the strong and constantly varying magnetic field which would, of course, bring about severe interference if not prevented in some manner such as the use of the cable already mentioned.

This wire is, however, very difficult for the amateur to use successfully and still maintain neatness. To mitigate the trouble it is fortunately only necessary to use twin wire for the heater filaments, which is twisted in the manner of ordinary electric lighting "flex." The same effect then occurs as in the case of a fieldless coil, namely, there is no external magnetic field to set up interference.



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,—It is almost superfluous to point out what a blessing "wireless" is to those who live abroad. Hardly an evening passes than I receive news from the dear homeland almost without fault. Morning transmissions are, however, almost invariably mutilated by the arc transmission of our local high-powered, long wave-length station at Croix d'Hins, near Bordeaux. Thanks to its appalling interference, the Memorial Service from the Menin Gate at Ypres last year was a travesty. We would dearly like to hear it this year, but fear the worst. Our attempt to listen to this year's Boat Race broadcast was a misery, and we could only just distinguish that Oxford was a loser from the first.

Would that the powers that be could control the offender.

We are at times troubled greatly by atmospherics, which we have to grin and bear, but there must surely be a remedy for the other evil. E. M. P. BOILEAU.

Libourne,
July 12th, 1928.

OZONISED MUSIC.

Sir,—With regard to the paragraph "Ozonised Music," under heading, "Current Topics," in this week's issue, we should like to say that so far as Bournemouth was concerned the programme for the whole day consisted of "His Master's Voice" gramophone records exclusively, the inference to be drawn from this is that the B.B.C. programme was unsuitable. "Wish the B.B.C. would give us programmes like this" was a remark often heard. L. GASTRELL EADES.

Boscombe,
July 20th, 1928.

[We have been asked to point out that the "Ceto" does not broadcast B.B.C. programmes, permission for which has not been applied for.—ED.]

NATURAL STRENGTH.

Sir,—Looking through some recent numbers of *The Wireless World*, I came across a letter signed by "Flux." As it is on a subject about which I have lately been thinking, it has constrained me to write to you.

It seems to be generally assumed that natural reproduction is not possible unless the output of volume from the loud speaker is at input level. I entirely disagree. If this were indeed the case then wireless is not a practical proposition for the average man in the average home, for on the one hand, who could sit in an ordinary living room with a military band going at full blast, or, on the other hand, if the volume is cut down to reasonable proportions, who, with any musical or artistic sense, can listen to an unfaithful reproduction of the music?

It is for this reason I do not like moving coil loud speakers. Worked from an average set, and at a volume with which it is possible to stay in the room, I have not yet heard one which gives what I consider life-like reproduction. They certainly produce the bass notes well enough, but it is the bass of no instrument that has yet appeared on earth. Not one have I heard gives that rasping throb peculiar to the double bass or the piercing metallic brilliance of the trombone, or the characteristically wooden yet musical thud of the piano. The human voice from one of these instruments sounds to me always as if a giant were bellowing at me. Cut down the volume. The giant is still there behind the baffle, but whispering. This latter effect which I experience may, of course, be due to some psychological peculiarity in myself, and I should be very interested to know whether others have the same feeling. I have come to the conclusion that the moving coil and L.S.5 brigade are on the right track if they wish to transfer the strains of an orchestra from one concert hall to another, but on the wrong track altogether if they wish to produce wireless music for musical people in an ordinary home. I do not even agree with "Flux" that for natural reproduction the intensity of the sound waves entering one's ears need necessarily be the same as when listening to a military band in the open air, or to an orchestra in the concert hall. It is not volume that is wanted, but the *effect* of volume. And this effect can be obtained given two conditions: firstly, that each instrument is being produced with its own peculiar timbre (I believe that is the technical musical term), and secondly, that *the balance of tone* between the instruments is maintained. Provided those two conditions are fulfilled, then the volume can be what we will. I have sat on occasions in my chair and had the impression that I was in the Queen's Hall, with the London Symphony Orchestra going all out, and yet the actual volume was such that the music was inaudible just outside the door. Further, the human voice must be the human voice if it is to be possible to listen to it. I believe one reason why wireless talks are so unpopular is that there is not one receiving installation in a thousand capable of reproducing the voice naturally. If I can sit back, close my eyes, and hear the man himself speaking, then I, for one, can listen to him with as much enjoyment as I can to an actual individual talking to me on a subject in which I am interested. If, on the other hand, the voice is the least bit unnatural, then I cannot take in what is said. The sound merely worries and distracts me.

July 15th, 1928. A. H. B.

P.S.—Since writing the above I have read the letter of Mr. Lionel Cole in your issue of June 27th, who seems to have much the same ideas on this subject as I have.

MOVING COIL LOUD SPEAKER HINTS.

Sir,—"C. H. S.'s" letter in your issue of July 11th *re* moving coil speakers was of great interest to me, and I wish to express myself in complete agreement with his remarks, especially in regard to the use of the D.E. 5A type valves in the output stage.

I have used this valve both as a "straight" amplifier and in "push-pull," and in the latter case several of the possible circuits were tried, including the centre tapped moving coil arrangement. I found in every case that insufficient output was obtainable to give good well defined bass. At this point I, too, began to entertain serious doubts as to the efficiency of my amplifier, and I am still open to conviction on this matter although I am quite certain that with my own apparatus a D.E. 5A type valve is inadequate. My personal opinion is that one good low impedance valve of the L.S. 5A type fed with adequate H.T. and G.B., and, perhaps, slightly underrun *as regards input grid swing*, is capable of greatly superior results when the speaker is used in a medium size room. I do

not understand, however, why "C. H. S." finds it necessary to run L.S. 5A valves in push-pull; surely one L.S. 5A is quite capable of dealing with all the grid swing one is likely to obtain. If greater output is required surely it would be more advantageous to parallel connect two or more of these valves?

I do most heartily agree that the detector can be the cause of a vast amount of trouble. I have found from practical experience that an anode bend type rectifier requires a quite considerable initial voltage swing to operate it satisfactorily, and it would appear that, unless one operates the receiver quite close to the local station, a stage of H.F. is almost essential. The total magnification on this stage need not be large (about five to eight seems to be adequate with a normal aerial), and should most certainly not be of the highly selective, sharply tuned type. I have found that where only a comparatively small grid swing is available to the detector most distressing distortion can occur, causing the milliameters in the anode circuits of a perfectly good amplifier to "kick" violently.

My cone (a 7in. one) and its high resistance coil have always proved quite satisfactory. A. R. THOMAS.

West Ealing, W.5.
July 11th, 1928.

Sir,—I have been interested in the recent correspondence about M.C. speakers and the amount of power required for satisfactory results.

I have only tried the high resistance type of coil and the pot magnet is of the W.W. design, having the $\frac{5}{64}$ in. gap. The magnetising coil consists of 8lb. of 18 S.W.G. wire and consumes $1\frac{1}{2}$ amps. at 8 volts. This gives 2,250 amp. turns. The receiver consists of the H.F. side of the Standard Four and the L.F. side of the Alternative Programme Quality Receiver. I use two D.E. 5A valves in the push-pull stage and 180 volts H.T.

To begin with, I used a 1,500-turn coil, but obtained slightly better results with one of 1,800 turns. When Mr. Branch outlined his system of push-pull I constructed a centre tapped coil of 2,200 turns. This coil, for which there is ample room, gives the most satisfactory results. I should, however, like to point out that it is impossible to notice the slightest change in quality or volume when the earth connecting wire is removed. I am not qualified to enter into a mathematical argument on the subject with Mr. Branch, but I suggest that the reason is as follows:—Mr. Branch discusses the ordinary system of push-pull by considering the unsuitable combination of two 8,000 ohm. valves and a 1,000-turn coil. Suppose we have two 3,500 ohm valves and a 2,000-turn coil. I presume that the impedance of the 2,000-turn coil is about twice that of a 1,000-turn one. Under these conditions there appears to be little difference between the two systems or point about making the earth connection. By leaving it out we can omit the 4 mfd. condensers and save a lot of trouble in making the coil. My point here then is simply this: that just as you normally require to reduce the number of turns when you use valves in parallel, so you need to increase the number of turns when you use them in push-pull when they appear to be in series. I am not clear really about the motional capacity part, but certainly there is *no* change in quality made by the earth connection in practice.

As my valves are not quite matched I find I get better results when their grids are biased to the middle of the straight part of the curve. In any case I gather that the available volume would be the same on Mr. Branch's system using either idea for the grid bias except in so far as it was pointed out by Dr. McLachlan that with matched valves one can make extra use of the curved parts of the characteristics. This advantage holds for the ordinary push-pull system.

Using, then, a 2,200 ohm coil and no centre tap, I can obtain really loud results with little evidence of blasting. At the same time I find that with every increase in volume one becomes more satisfied with the performance. Both bass and upper register are strong. Contrary to Mr. Cole, I find that every one admires the bass most, and this is so strong that the heavy drums in one of the brass bands we hear from 5GB sound almost as if someone had hit the baffle with a coal hammer. The noise is not unpleasant, because the "spongy" effect of the drum is well reproduced.

The faults I notice are: (*a*) A slight tendency to shrillness on some notes, presumably due to diaphragm resonance. This can be largely cured in those transmissions when it is pronounced by using other terminals on the output choke. (*b*) Piano transmissions are seldom satisfactory, though as on rare occasions they come through in a wonderful style, I am still in doubt as to whether the speaker is to blame or the B.B.C. The faults I notice are dullness or heaviness of the bottom notes and sometimes blasting on the top, though the volume may be quite small. (*c*) There is another fault not connected with the music which I only get with 5GB, and that is a sudden violent dithering or vibration of the cone. This does not take place when music is being received, but is most pronounced just before an announcer is going to speak when actually nothing is coming through. Perhaps somebody can explain? It can be a real nuisance.

Retford, Notts. P. B. C. BEASLEY.
July 11th, 1928.

STRAIGHT-LINE INTERVALVE COUPLING.

Sir,—I note in your issue of July 18th a letter from Mr. Hunt, on the subject of quality of reproduction. I am sure that I am not the only one of your readers who would like him to justify some surprising statements he makes. Firstly, what does he mean by grid saturation? The only thing that I can suggest is that he means to define the operating points above which grid current flows, but the meanings are very different if the expression referred to has a meaning in the circumstances with which we are dealing. As regards the rectification side of the matter, I do not propose to comment, except to ask for an explanation of the sentence which remarks on the importance of the diminution of the time constant caused by working the detector valve off its bottom bend. The only meaning of the words "time constant" that seem to fit is the discharge time constant of the grid condenser and leak, which is a function of the values of condenser and leak only. Thus I would ask for an interpretation.

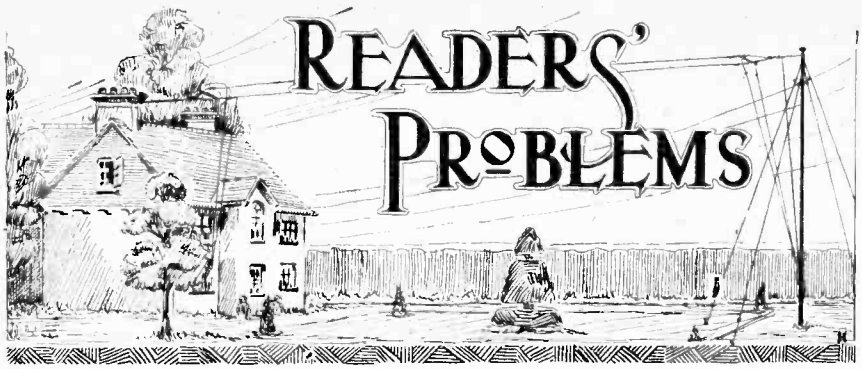
Next comes the question of the time constant in the amplifier. It seems to me that a purely voltage-operated device cannot be effected by a component having a time constant, because the time constant is a measure of the rate of current flow. No amplifier which has the slightest pretensions to quality ever allows any grid current at all, so that there is nothing to prevent the time constant being of any value, provided the other considerations in the design of the condenser and leak are heeded. Any amplifier with grid leaks should be able to run for hours without any grid leak or bias whatever, with perfect results within the other limits of the apparatus. The only snag is that atmospherics, electrical disturbances or over-modulation at the transmitter may bias up the grids, because their strength was such as to overload the amplifier for an instant, causing grid current. If one did not have to allow for these contingencies no one would use grid leaks, because grid biasing would become superfluous.

As regards the chokes substituted for leaks, the question of loss of high or low frequencies is merely a question of design for one stage, but for a number of stages difficulties arise, unless extraordinary precautions are taken. Your correspondent makes some remarks about push-pull which are not very clear to me, because they might mean so many things, so I refrain from comment. His remarks as regards the transformer-resistance combination seem to have only one meaning to me, and that is that it is not desirable, because he uses either unsuitable valves or H.T., etc., for the output he desires. Any amplifier, whatever system it works under, can be overloaded and give grid current and rectification on loud passages, but it is not bad because of this.

In conclusion, I would suggest that your correspondent is overlooking the main points of design to pursue a fallacy, but if he can prove to me that his arguments are true, and that my contentions are wrong, I will be pleased to withdraw them.

My only reason for this long letter is that I think the subject is of interest to a large body of your readers. S. H.

London, N.W.6.
July 18th, 1928.



"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.

Suppressing Lower Frequencies.

I have so far been unsuccessful in completely eliminating "hum" from my eliminator, the circuit of which (as well as the receiver), is shown on the attached diagram. Values are marked. Can you suggest anything? K. W. L.

Your diagram shows a conventional eliminator with smoothing circuits of the kind which may be described as "liberal." We suggest that your trouble is probably due to the value of the coupling components in the two-stage L.F. amplifier included in your receiver. The very large condensers you are using, combined with high resistance grid leaks, will give a "pass on" of the very lowest frequencies—even below audibility—and we think that you could reduce these capacities very considerably without introducing any noticeable alteration in the tone, and at the same time, any slight imperfection in your smoothing circuits would no longer be noticeable.

High Note Loss.

With reference to the article on "High Note Loss" in your issue of March 14th, I notice that a valve with impedance 15,000 ohms and voltage factor 12 is specified for the 1st L.F. stage. Does any commercially obtainable valve (6-volt) satisfy these requirements? P. W.

The characteristics of the Marconi or Osram D.E.L.610 valves are sufficiently close to the specification for all practical purposes. The D.E.L.410 approaches it still more closely; you could, of course, use it with a suitable filament resistor.

An Oversight.

I have been in the habit of keeping a milliammeter permanently connected in series with the loud speaker to act as an indicator of overloading, but since building my new set (the "Regional Receiver") I find that no deflection is given with this method of connection. Can you tell me why this should be? T. W.

You have overlooked the fact that your new receiver includes a choke-filter output arrangement which has the effect of preventing the flow of D.C. current through the loud speaker windings. Your milliammeter should now be connected between the output choke and the H.T.+ terminal.

o o o o

An All-Wave H.F. Unit.

As there have been many advances of late in the design of interchangeable H.F. transformers, I should be glad to know if you recommend me, instead of making separate high-frequency amplifying units for medium and long waves, to construct an instrument on the lines of the "Long-Wave Unit" described in "The Wireless World" for May 18th, 1927, but with plug-in transformers. If this scheme is a good one, can you suggest any further alterations necessary to bring the amplifier up-to-date? T. C. L.

The H.F. unit in question may well be altered in the way you suggest, and, combined with a detector-L.F. set having anode-bend rectification, would provide a sensitive and extremely selective receiver. No important modifications are necessary, but it may be desirable to "tie down" the low potential end of the anode circuit with a large condenser. If you do not object to a slight increase in the length of the panel, it would be possible to use a low-resistance secondary coil of conventional design, in place of an ordinary plug-in coil. In any case, you might add a tapping for an optional auto-transformer coupled aerial, for use when quick searching is desired. We have shown the suggested modifications in Fig. 1.

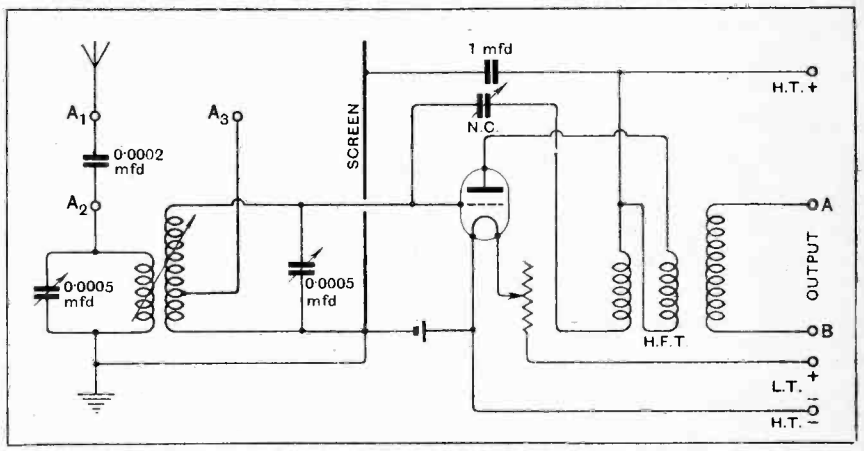


Fig. 1.—An H.F. unit for adding to a detector-L.F. set: the transformer secondary is tuned by the condenser in the receiver.

Directional Aerials.

My aerial is a "T," which I understand receives equally well from any direction. Would it be worth while converting it to an "inverted L" aerial, with a view to reducing interference from my local station? H. R. S.

No, this alteration is unlikely to confer any benefits from the point of view of eliminating local signals. It is only when the length of an "inverted L" aerial is many times greater than its height that its directional properties come into play.

RULES.

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

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

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

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

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

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

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

A Parallel Output System.

Is there any objection to fitting a separate output valve for feeding a second loud speaker installed in another room? My set comprises a push-pull stage, with 200 volts on the plates, supplying a moving coil loud speaker, and I find that the various methods which have been tried of connecting the ordinary horn instrument are not altogether satisfactory. If the addition of the extra valve will not prejudice the operation of the moving coil loud speaker, will you show me how it may be effected? I should perhaps point out that the valve preceding the push-pull stage is of 20,000 ohms impedance; it is therefore impossible to join the horn loud speaker directly in its anode circuit. T. W. G.

Your proposed scheme is not open to any serious objections; indeed, it affords a good solution of your problem. We suggest that you should use the primary of your existing input transformer as part of a choke coupling to the extra valve, which is marked V_4 in the accompanying diagram, Fig. 2; the first stage amplifier and output valves are indicated respectively by V_1 and V_2, V_3.

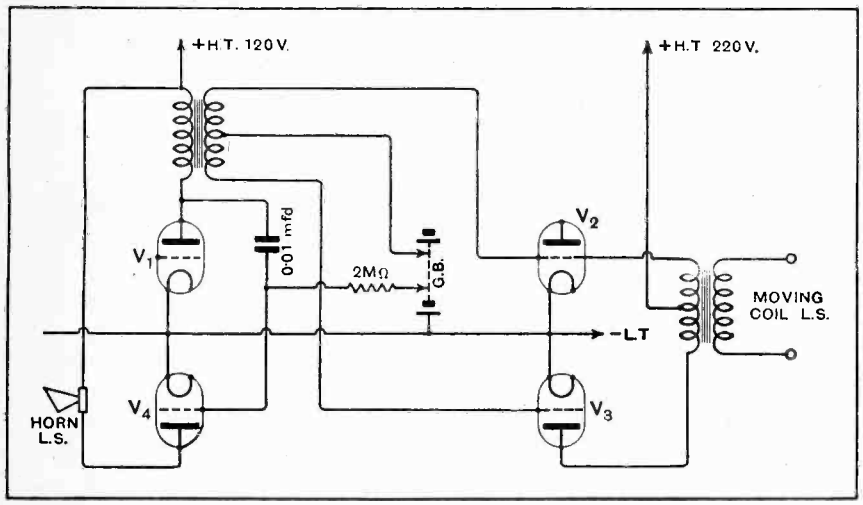


Fig. 2.—Connections of a parallel output valve added to a push-pull amplifier.

The correct setting of H.T. and grid bias voltages for the extra valve depends on several factors, and must be considered. If the push-pull input transformer is of approximately 1 : 1 ratio between primary and each half of the secondary, the signal voltages applied to V_4 will automatically be almost the same as those on the grids of V_2, V_3, so, if it is of the same type, its operating conditions should be similar. If, on the other hand, the transformer gives a considerable voltage step-up, the anode supply of this extra valve may conveniently be the same as that of V_1—presumably about 120 volts, as shown in the diagram. You should attempt to arrange matters so that the added parallel output valve will deal with inputs within the capacity of those handled by the present valves without being itself overloaded.

The Aerial Tuning Condenser.

In the article on "Loose Coupling" in your issue of July 4th, it is stated that the aerial tuning condenser should preferably be larger than that across the secondary coil, "in order to compensate for the effect of aerial capacity which is in parallel with it." Will you please explain this; at first sight it would seem that this fixed capacity in the primary circuit would call for a reduction in the size of its condenser. C. L. R.

As there is a minimum capacity of from 0.0002 to 0.0003 mfd. across the average aerial circuit, the tuning range with a fixed inductance will be excessively restricted unless the tuning capacity is reasonably large; it is mainly for this reason that a large condenser is usually recommended, as it is inconvenient to change the aerial coil more often than the secondary. However, 0.0005 mfd. is generally enough to cover the main part of the medium broadcast band with a single coil; if you are using this capacity, it would be a good plan to obtain an inductance slightly larger than actually required, and then to remove turns until the circuit tunes to the lowest wavelength you will ordinarily require with the condenser at or about its minimum setting.

o o o o

An Eliminating Test.

Will you give me a hint as to how I can decide whether the extremely bad quality I am obtaining is due to a fault in the set or in the loud speaker? The circuit diagram is as shown on the enclosed sheet. E. W. S.

Your receiver seems to be normal, and we should first make the rather obvious suggestion that you should decide whether the loud speaker is at fault by trying it on a friend's set. If this is not possible, we recommend you to connect a pair of phones in series with a high resistance (of roughly 0.5 megohm) across the loud speaker terminals of the choke-filter circuit. The added resistance will reduce signals to a comfortable intensity, and, if quality is still bad, you must blame the receiver.

o o o o

Battery Resistance.

Can you help me to trace the cause of serious distortion and occasional "motor boating" in my receiver, which consists of a reacting detector with resistance and transformer-coupled L.F. stages (in that order)? The symptoms are similar to those usually ascribed to L.F. reaction due to battery resistance, but I can hardly think that this is responsible, as my H.T. supply is derived from an accumulator battery. The set originally worked extremely well. N. M. E.

From the information you give us, it is hardly possible to offer a definite opinion Although L.F. reaction may be produced by the internal resistance of an accumulator battery, particularly when the ampifier is of the high-magnification type, it is most unlikely that this reaction will be sufficient to cause actual oscillation. Apart from the question of internal resistance, however, it is possible that the terminals have become corroded; trouble such as you describe is often traced to this source, as such a connection may have a very high resistance. Moreover, it is quite likely to be intermittent and varying; this would account for the fact that "motor boating" is not continuous.

o o o o

Diminishing Selectivity

The performance of my receiver has fallen off very noticeably of late, and I find it difficult to get any foreign stations. Do you think that this is merely a case of the bad effects of summer time conditions, or does it suggest that something is wrong with the set? It may help you to know that selectivity has also suffered, and the local stations seems to "spread" much more than formerly. S. L.

We think that the trouble lies in your receiver, although, of course, less favourable conditions may be a contributary cause. However, they would not effect the selectivity of its circuits, and we are fairly confident that the fault will be traced to the development of high resistance joints, or more probably to leakages brought about by poor insulation.

o o o o

A Short Wave Crystal Set.

Is there any inherent reason why a crystal set should not be used for the reception of the ultra-short wavelengths (below 40 metres)? L. B. G.

There is no technical reason why a crystal set should not be used for this purpose, but results would be disappointing, and it would only be of value in the area surrounding the station in which the direct ray is received at good strength.

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Editor: HUGH S. POCOCK.

Assistant Editor: F. H. HAYNES

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

Editorial Telephone: City 9472 (5 lines).

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

CONTENTS OF THIS ISSUE.

PATENT DIFFICULTIES.

TWO cases of general wireless interest have recently been heard before the Comptroller-General of the Patent Office in the Patents Court; the first was the case brought by the Brownie Wireless Company of Great Britain, Ltd., against the Marconi Company, in which the Brownie Company are seeking for a compulsory licence under certain of the Marconi patents and further enter a plea for a reduction in royalties and a modification of the present system of assessment of royalties. The second case is an application by the Loewe Radio Company for a licence to manufacture and sell in this country a wireless receiving set employing the Loewe multiple valve, which readers will remember, from references which have been made from time to time in *The Wireless World*, is a multiple valve which comprises the electrodes of the valves and the coupling units between successive valve stages in one bulb.

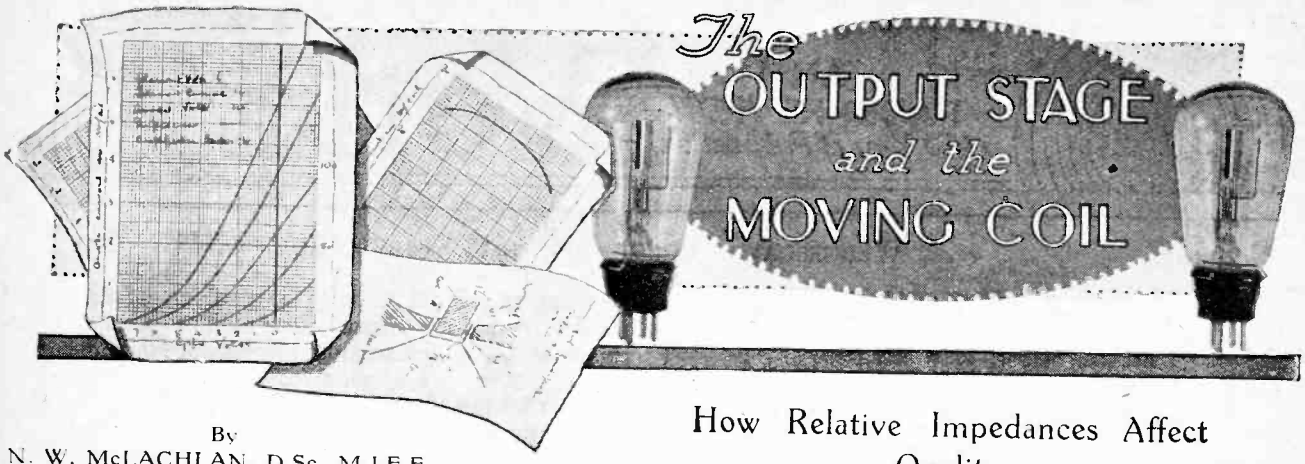
The case put forward by Brownie's is that whereas in the past they have been manufacturing a two-valve amplifier and were informed by the Marconi Company that this did not infringe their patents, and consequently royalties would not have to be paid on it, they more recently decided to manufacture another piece of apparatus which they believe does infringe the Marconi patents and they therefore applied for a licence. The attitude adopted by the Marconi Company was that if they were granted the licence it would have to be on the same terms as the general Marconi licence to manufacturers, a royalty of 12s. 6d. per valve-holder on all apparatus being required. Entering into such an agreement with the Marconi Company would place the Brownie Company in the position of having to pay royalties of 12s. 6d. per valve-holder on amplifiers which were previously exempt, in order that they might participate in the advantages which they would then have in being able to manufacture other apparatus incorporating Marconi patents. This suggestion was considered by the Brownie Company as unreasonable. They petitioned that the extension of royalties in this country to non-patented articles should be stopped, and that a fairer method than that at present in force for assessing the amount of royalty payable would be one where the royalty was a percentage of the selling price of the apparatus.

The Marconi Company expressed the view that the present basis on which agreements were made with manufacturers and royalties assessed was one of convenience both to the Marconi Company and its licencees, and that it had hitherto been accepted by a very large number of manufacturers. That to make their royalty agreements on the basis of individual patents would complicate the machinery to a very large extent.

The Marconi Company also contended that it would not be a practical proposition to attempt to assess the royalty at a percentage on the net selling price of the set, one reason given being that it would then be possible in some instances to put up that part of a receiver which incorporated patents as a distinct unit. As an example, it was suggested that the patented parts might be housed in a box costing 30s. and then linked up with other parts so as to make a complete set selling at £20, the royalty being paid only on the 30s. box of parts.

In the Loewe case the Marconi Company expressed the view that this valve was, to all practical purposes, three valves enclosed in one casing, and that in order to be fair to their other licencees the Marconi Company had to regard a valve of such construction as if it were actually three valves and charge royalties accordingly, instead of, as the Loewe Company suggested, charging a royalty on one valve.

In both cases, after the hearing had been concluded, the Comptroller-General stated that he would reserve judgment for a week, and he expressed the [illegible] in the interval the parties might reach agree[illegible]



The OUTPUT STAGE and the MOVING COIL

How Relative Impedances Affect Quality.

By
N. W. McLACHLAN, D.Sc., M.I.E.E.

IN this journal over twelve months ago[1] I gave formulæ from which the impedance of a moving coil loud speaker can be calculated. Knowing the coil impedance and the internal resistance of the power valve it is possible to ascertain the total impedance of the output circuit. From this impedance the current in the moving coil at different frequencies can be found for a definite voltage change on the grid of the power valve. Now this impedance calculation cannot be done accurately unless we know the inductance and resistance of the moving coil; we must also know the flux density in the air gap of the magnet, the effective mass of the diaphragm, and the number of turns on the coil. For simplicity it is generally assumed that the inductance and resistance are constant at all frequencies. If this is done, then the coil current can be calculated. Even so, there are few experimenters in a position to make all the measurements necessary to secure the requisite data. In this contribution to the subject, I propose to leave theory alone and to show what variations in coil and current are found by experiment over a wide band of frequencies. We shall make no assumptions regarding the current,

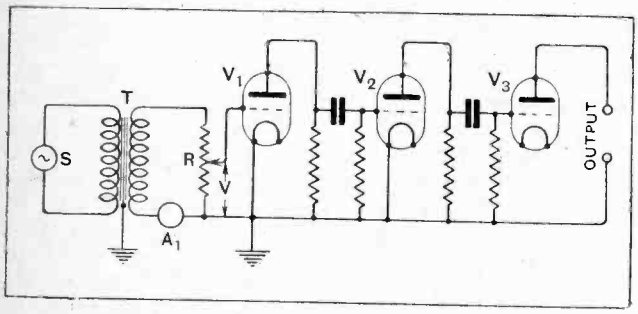


Fig. 1.—Diagram of connections for measuring current in coil of loud speaker. S is the sine wave oscillator, T a screened and balanced transformer, A_1 a sensitive thermoammeter, R an accurate non-reactive resistance. V represents the input volts to the grid of V_1. The valves V_1, V_2, V_3 are resistance-capacity coupled.

but merely present the data as it was taken by direct reading on a thermoammeter of negligible resistance. In the practical loud speaker there are effects which were not introduced in the published theoretical treatment of the subject. The results are of considerable interest, as the reader will discover as he wends his way through these pages.

The circuit used to ascertain the coil current at various frequencies is shown in Figs. 1 and 1a. To the grid of the first valve of a resistance-capacity amplifier is applied a sine-wave voltage of constant value. The voltage was taken from an oscillator unit of pure wave form *via* a screened and balanced transformer. The windings of this transformer are electrically symmetrical, and the primary and secondary are electrostatically shielded from each other by a copper screen. Thus the coupling between the windings is solely electromagnetic. The amplifier is really a historic piece of apparatus, designed in 1922 and employed by the author for experimental work at Marconi House in connection with the inception of broadcasting before the B.B.C. came into existence. It was used to amplify the first land-line transmission from a town on the south coast before applying the signals to the sub-modulator of the old 2LO radio transmitter. To show that we knew how to design R.C. amplifiers even in those early days, the frequency-amplification curve of the instrument is given in Fig. 2.

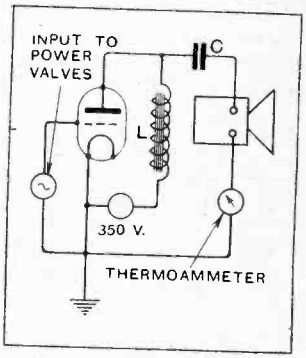


Fig. 1a.—The output stage for the circuit shown in Fig. 1. The valve shown represents LS5A valves in parallel, L is a very large 40-henry choke (with air gap) to carry valve feed current, C has a capacity of 50 mfds. to prevent D.C. from entering loud speaker windings.

Actual Coil Current Measurements.

However, to be quite candid, loud speakers and other associated apparatus at both receiver and transmitter, had such appalling characteristics, that it was quite beyond one's aural powers to distinguish a good amplifier from a bad one. Moreover, this particular amplifier has been asleep for six years, and it was not until quite recently that I appreciated its merits—thanks to

[1] *The Wireless World*, March 30th, 1927.

The Output Stage and the Moving Coil.—the frequency-amplification measurements shown in Fig. 2.

The input voltage to the first valve is amplified about 200 times and applied to the power valve, care being taken to avoid bottom bend rectification and grid current. To get a suitable reading on the thermo-ammeter, the power stage consisted of one or more LS5A valves in parallel, the H.T. voltage being about 350. The loud speaker and the thermoammeter were situated in the usual choke-condenser filter circuit, shown in Fig. 1a, since only the alternating current through the coil was required.

There are two salient conditions under which the coil current—a high-resistance coil was used as specified hereafter—can be measured. First, we can allow the coil and diaphragm to move freely as it would in practice. Second, the coil can be rigidly fixed so that no movement occurs. The former condition was chosen since it complies with practical requirements. In obtaining the results, care must be exercised to get the working conditions constant. For example, the electromagnet warms up with time, and since the resistance of the winding increases, the magnetising current decreases. Thus the magnetic flux in the air gap decreases also. This, however, is not so serious as one might imagine. It is the amplifier working on 350 volts H.T. which requires time for the valves and resistances to settle down. With this value of H.T. the anodes of the LS5A valves work at a dull red heat.

The results of the experiments with the coil in motion in a magnetic field of 9,000 lines per sq.cm. are shown in Fig. 3. The curve is the current through a moving coil having 1,000 turns of 46 S.W.G. enamelled wire, using one LS5A valve. The current attains a maximum value between 128 and 256 cycles. At frequencies above the middle of the pianoforte (256 cycles) it falls away gradually, due to the inductance of the coil, and also to its A.C. resistance, since the latter increases with the frequency due to iron loss (hysteresis and eddy current in pot magnet). Below 128 cycles the current decreases rapidly. It

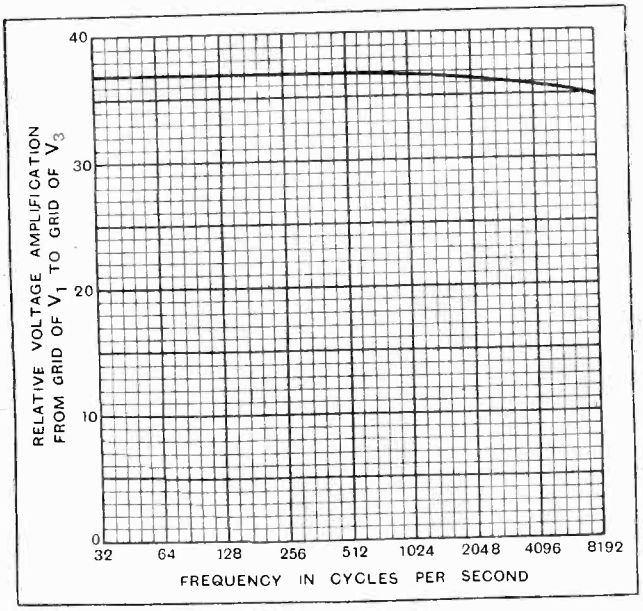


Fig. 2.—Amplification–frequency curve of resistance capacity amplifier used to determine coil current. The actual magnification is approximately 220. The H.T. voltage used is 350. V_1 and V_2 are LS5B valves, while V_3 is a power stage with two LS5A valves in parallel.

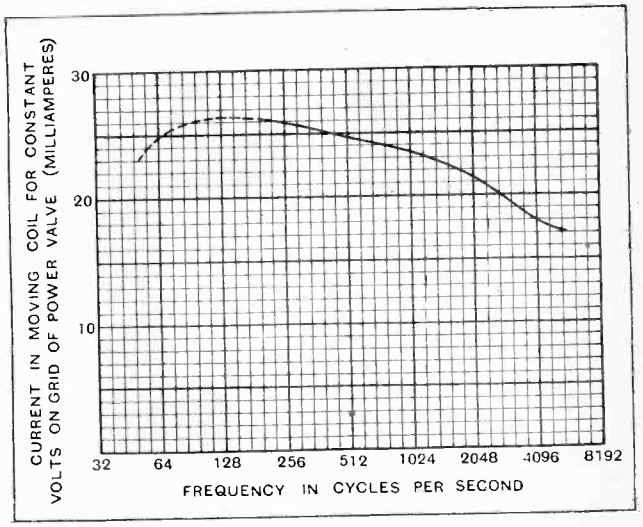


Fig. 3.—Curve showing alternating current in moving coil loud speaker. The moving coil was wound with 1,000 turns of No. 46 gauge enamelled wire. The magnetic field was approximately 9,000 lines per square cm. The power valve was an LS5A with 350 volts H.T.

is this part of the curve which is particularly interesting. The current actually reaches a minimum value at a frequency of 50 cycles, whilst at lower frequencies it increases again. To exhibit this effect more clearly[2] the current was measured. using two LS5A valves in parallel. Owing to the lower output resistance with two valves, the coil reactance was *relatively* enhanced, so that the variations in the current curve became more marked than they were before.

Mysterious Results at Certain Frequencies.

The minimum value of the current is clearly shown in Fig. 4, and occurs at a frequency in the neighbourhood of 50 cycles. The maximum value of current occurs in the neighbourhood of 200 cycles. At the higher frequencies the current decreases more rapidly than with one LS5A, since the inductive reactance of the coil is now a much greater proportion of the impedance of the power valve circuit.[3] There are peculiarities in this curve which do not show up to any visible extent. In order to portray these lesser current fluctuations more clearly, the coil current at the lower frequencies was observed, using five LS5A valves in parallel. This gave an A.C. valve resistance of only 500 ohms or thereabouts. Since the coil resistance is about 1,000 ohms, the total resistance is 1,500 ohms as against 700 with one LS5A. The results are depicted in Fig. 5. The minimum value corresponding to 50 cycles is exhibited in a most striking manner. In fact, we have an absolutely first-class selectivity curve inverted. As the fre-

[2] It is intentionally omitted from Fig. 3.

[3] Owing to the lower resistance of the output circ

The Output Stage and the Moving Coil.—

quency increases up to 175 cycles, nothing of any importance transpires, but beyond this frequency the current rises slightly, suddenly drops at 190 cycles, and then rises again above 200 cycles. Moreover, there are two " mysterious " frequencies, namely, 50 cycles and 200 cycles.

I do not wish to complicate this article by elaborate explanations of these two " mystery " points. This I propose to do in greater detail at another time. For the present, it will be quite sufficient to indicate broadly how these variations in coil current arise.

Shortcomings of the Diaphragm Support.

The reader who has constructed a coil-drive loud speaker knows full well that the conical diaphragm has to be supported at its periphery. Various materials are used for this purpose, all of which are invariably defective both acoustically and mechanically. Personally, I prefer to employ a good grade of flexible rubber, although it has to be renewed every six months. My rubber surround having perished some time ago, I purchased some rubberised silk, this having been recommended by a reader. Now this material, in common with others, is not perfectly elastic, *i.e.*, it does not obey Hooke's law. This law states that a material is perfectly

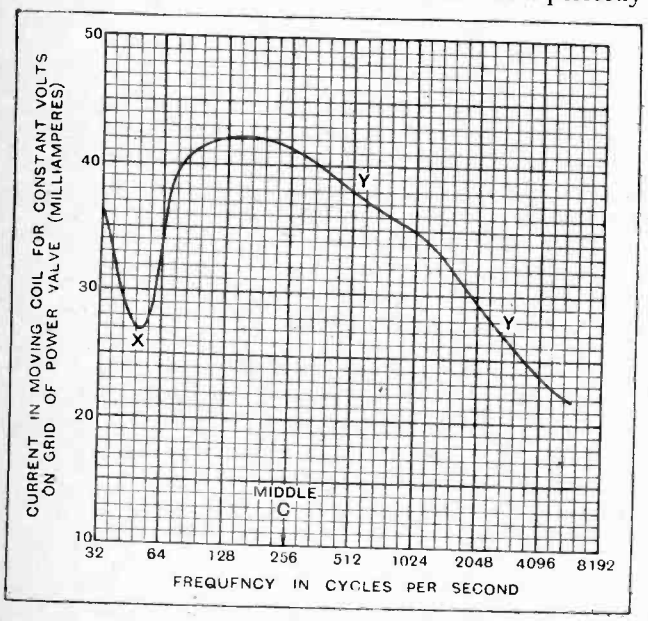


Fig. 4.—Curve showing alternating current in moving coil loud speaker. The moving coil was wound with 1,000 turns, and the flux density in the air gap 9,000 lines per square cm. The power stage was two LS5A valves in parallel. The fall in current at X is due to mechanical resonance of diaphragm, and the fall in current at YY is due to inductance of coil and also increase in A.C. resistance due to iron loss.

elastic when the deflection or stretch is proportional to the stretching force. With rubberised silk—and other materials—one soon reaches a point when there is no perceptible stretch as the applied force increases. Of course, for small amplitudes of motion, the case is probably not quite so bad, since Hooke's law is not violated to the same extent. In these experiments the amplitudes were deliberately made large, so that the various comicalities of the system would raise their heads. With this preamble we are in a position to probe the problem of mystery point number 1—namely, the minimum current at 50 cycles.

At this frequency there is a mechanical resonance of

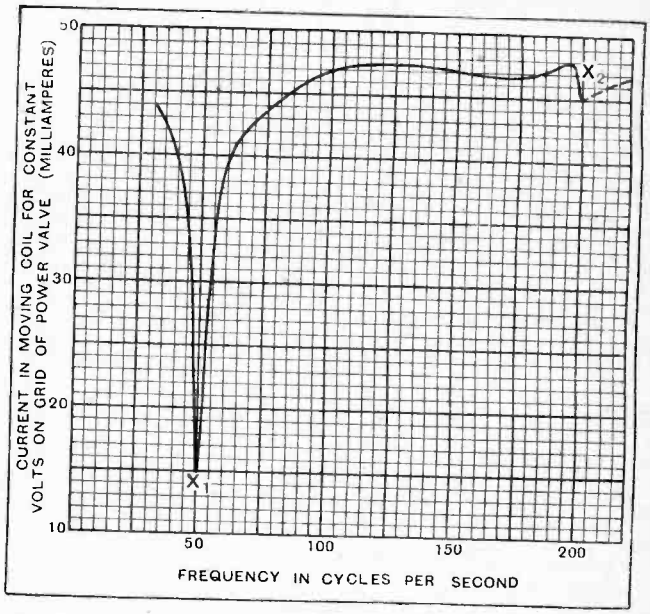


Fig. 5.—Curve showing alternating current in moving coil loud speaker at low frequencies. The moving coil had 1,000 turns, and the flux density in the air gap was 9,000 lines per square cm. Five LS5A valves in parallel were used. The fall in current at X_1 is due to resonance of diaphragm on surround, while the fall at X_2 is due to resonance of diaphragm apart from the surround.

the diaphragm and coil due to the surround (rubberised silk). The amplitude of motion of the diaphragm increases considerably—the total excursion was very visible, being over $\frac{1}{8}$in.—when the resonance frequency is reached. Consequently, in travelling over a greater distance, the coil must move more rapidly than it would under normal circumstances. Thus the velocity of the coil is enhanced by resonance. But when the coil moves in the magnetic field, a back E.M.F. is induced, which reduces the current. Since the coil velocity is much greater than under normal circumstances, so also is the back E.M.F. Thus the current is reduced in a greater degree than it would be in the absence of mechanical resonance of the diaphragm on its surround. I do not want to leave the reader with the impression that rubberised silk is the only material which exhibits this effect. By mounting the diaphragm on a portion of a rubber (not best grade) apron, the resonance frequency was reduced to 25 cycles, where it is comparatively harmless.

Peculiar Resonance at 200 Cycles.

As regards mystery point number two, the reduction in current at 200 cycles is due to a peculiar mode of vibration of the diaphragm. This is doubtless some form of diaphragm resonance. As the reader may be aware, diaphragms do not move as a whole, except at low frequencies. This particular diaphragm, mounted on the rubberised surround, had been tested some time previously. By dusting a light powder on the dia-

The Output Stage and the Moving Coil.—

phragm, a number of radial markings were obtained at 200 cycles, clearly indicating that the diaphragm was executing one of its " modes " of vibration. Obviously, it was not then moving as a whole.

Dangers of Very Low Valve Impedance.

In a previous article I indicated that the internal A.C. resistance of the power valve should not be too low. The reasons for this were: (1) at low frequencies the coil impedance increased, due to the motion of the coil in the magnetic field, whereby a back E.M.F. is induced; (2) at high frequencies the inductance of the coil causes an increase in impedance. Since the coil impedance is augmented in both cases, the current, and therefore the output, is reduced. In the present tests, reason number one has been substantially smothered by the resonance of the diaphragm on the rubberised-silk surround. Although the coil current is reduced at 50 cycles, the electrical conditions associated with the vibration are such that the amplitude, and, therefore, the low-frequency acoustic output, are greatly enhanced. Moreover, so long as the surround causes a resonance at 50 cycles, or even at 25 cycles, the increased impedance of the coil is acoustically offset by the augmented amplitude of motion of the diaphragm. Thus, we are left to juggle with reason number two. This is a really serious matter, and the veracity of statement can readily be seen from Fig. 4, where the output or power stage consisted of two LS5A valves in parallel. From the middle of the pianoforte (taken as 256 cycles, although concert pitch is about 21 cycles higher), the current steadily declines, until at 6,000 cycles its value is half of that at 256 cycles.

Beware of Diaphragm Resonance.

Now the power output depends upon the *square* of the current. Thus, with two LS5A valves, the power at 6,000 cycles is reduced to a quarter the value it would have if the current remained constant.

So far as constancy of current is concerned, the curve of Fig. 3 using one LS5A is definitely better, since at 6,000 cycles the current is reduced to 0.65 instead of 0.5 of its value at 256 cycles. However, to get greater current constancy it would be necessary to use a power valve of 3,500 to 4,000 ohms resistance. An alternative would be to reduce the number of turns on the moving coil. This would immediately reduce the overall output, so that we cannot have our cake and eat it. Hence a compromise between quality and quantity (efficiency) is imperative. From a practical view point there is nothing seriously wrong with one LS5A power valve or any other valve of the same internal resistance. For reduced output, a DE5A answers the purpose quite well. Perhaps I ought to mention that the values of current indicated in the curves are much larger than one would obtain under normal broadcasting conditions with a mains supply of 200 volts H.T. In the above experiments, the grid bias on the power valves was 100 volts, and the applied root mean square signal voltage 45. This latter represents a maximum voltage of 63, which is about twice the voltage to be expected by the reader on his own set. Moreover, if he halves the currents in Fig. 3, the result will be of the same order as that in his own coil-drive loud speaker when worked to capacity using one LS5A and a nominal 200 volts H.T.

So much for the internal resistance of the power valve, but the other moral we have to point is " Beware of the resonance of the diaphragm on its surround." When the diaphragm is small, the surround stiff, and a centring device is added, the resonance is likely to be more pronounced and occur at a higher frequency than that recounted herein. The diaphragm used in the present experiments was just over 9in. in diameter on the conical part. It is shown dimensionally in Fig. 6. The coil weighed about six grams, so that the total effective mass at low frequencies (50 cycles), assuming the diaphragm to move as a whole, amounted to something of the order of 18 to 20 grams.

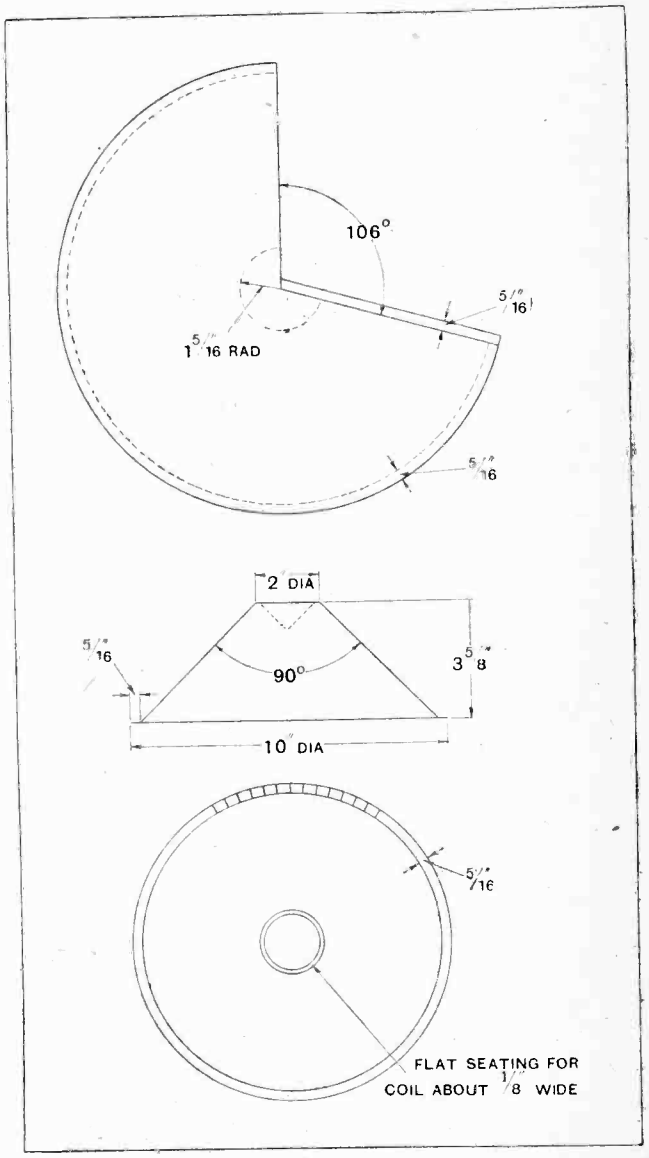


Fig. 6.—Dimensions and constructional details of diaphragm.

USEFUL DATA CHARTS. (No. 5.)

The Reactance of a Coil at Audio Frequencies.

THE reactance of a coil is given by the formula: henrys $\times 2\pi \times$ cycles = ohms, or $L2\pi f = R$. Let us forget about the constant multiplier 2π for the moment and we see that we have two variable quantities which we multiply together to obtain the third variable, that is, we have to draw scales for three quantities, a, b, c, so that $a \cdot b = c$.

In Fig. 1 equal scales are shown for "a" and "b," and we want to know how to draw the "c" scale. The lower dotted line is drawn through the points 10^1 and 10^3, and accordingly must meet the "c" scale at 10^4, since $10^1 \times 10^3 = 10^4$. Another point on the "c" scale

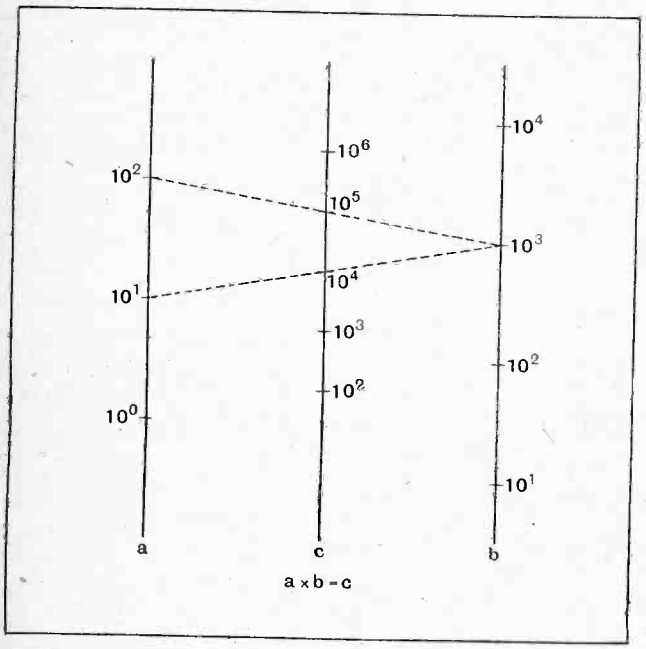


Fig. 1.—An abac in which the scales of a and b are the same while that of c is half either a or b.

can be found by drawing the upper dotted line: since $10^2 \times 10^3 = 10^5$ we get the point 10^5 on the "c" scale. It is evident from these lines that "c" must be plotted on half the scale of "a" or "b."

We can satisfy ourselves that this is correct by pivoting a ruler on the point 10^1 on the "a" scale and sweeping it upwards over the other two scales; every time the value of "b" increases tenfold, "c" will also increase tenfold, but we shall only travel half as quickly up the "c" scale as up the "b" scale.

Measuring the Reactance of Chokes.

Having thus ascertained the relative sizes of the scales, we can proceed to construct the abac: we have to deal with L.F. transformers or chokes in the speech amplifier and in the connections from the power valve to the loud speaker, which is itself a choke; L.F. chokes are also required for filter circuits when sets are worked off the mains supply. None of these items is likely to have an inductance smaller than one henry, while values exceeding 100 henrys are exceptional. Accordingly, the scale of henrys is drawn (Fig. 2) from 1 to 100. Again, we need only consider frequencies between 50 and 5,000 cycles, though for simplicity in lettering these are given in Fig. 2 as between 10 and 10,000. It now only remains to fit in the scale of ohms, which, as we have seen, should be half size. Owing to the factor 2π, this scale will be displaced from its position as shown in Fig. 1. The simplest way is to get one point in the correct position, and then all the others will be correct; we can do this by calculation. Take 10 henrys at 1,000 cycles and join by a dotted line, then $10^1 \cdot 2\pi \cdot 10^3 = R = 2\pi \cdot 10^4 = 62{,}800$, hence the dotted line should meet the R scale at 62,800 ohms.

Useful Loud Speaker Data.

The abac on the next page is drawn on a large scale from the skeleton diagram of Fig. 2. As an example of its use it shows that a transformer with a 100-henry primary working at 50 cycles has a reactance of 31,400 ohms, so that when it is in the plate circuit of a 10,000-ohm valve, the total series impedance is $[31{,}400^2 + 10{,}000^2]^{\frac{1}{2}} = 32{,}900$ ohms, so that the A.C. voltage on the plate is $\frac{314}{329} = .95$ of its value, with a transformer of in-

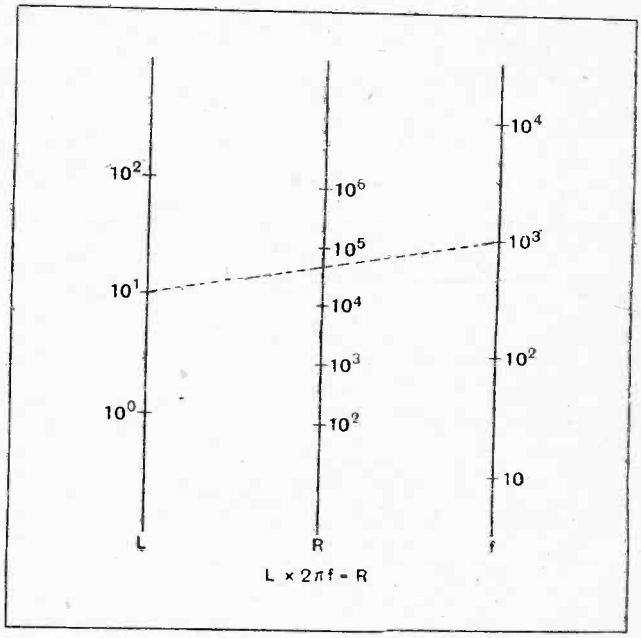
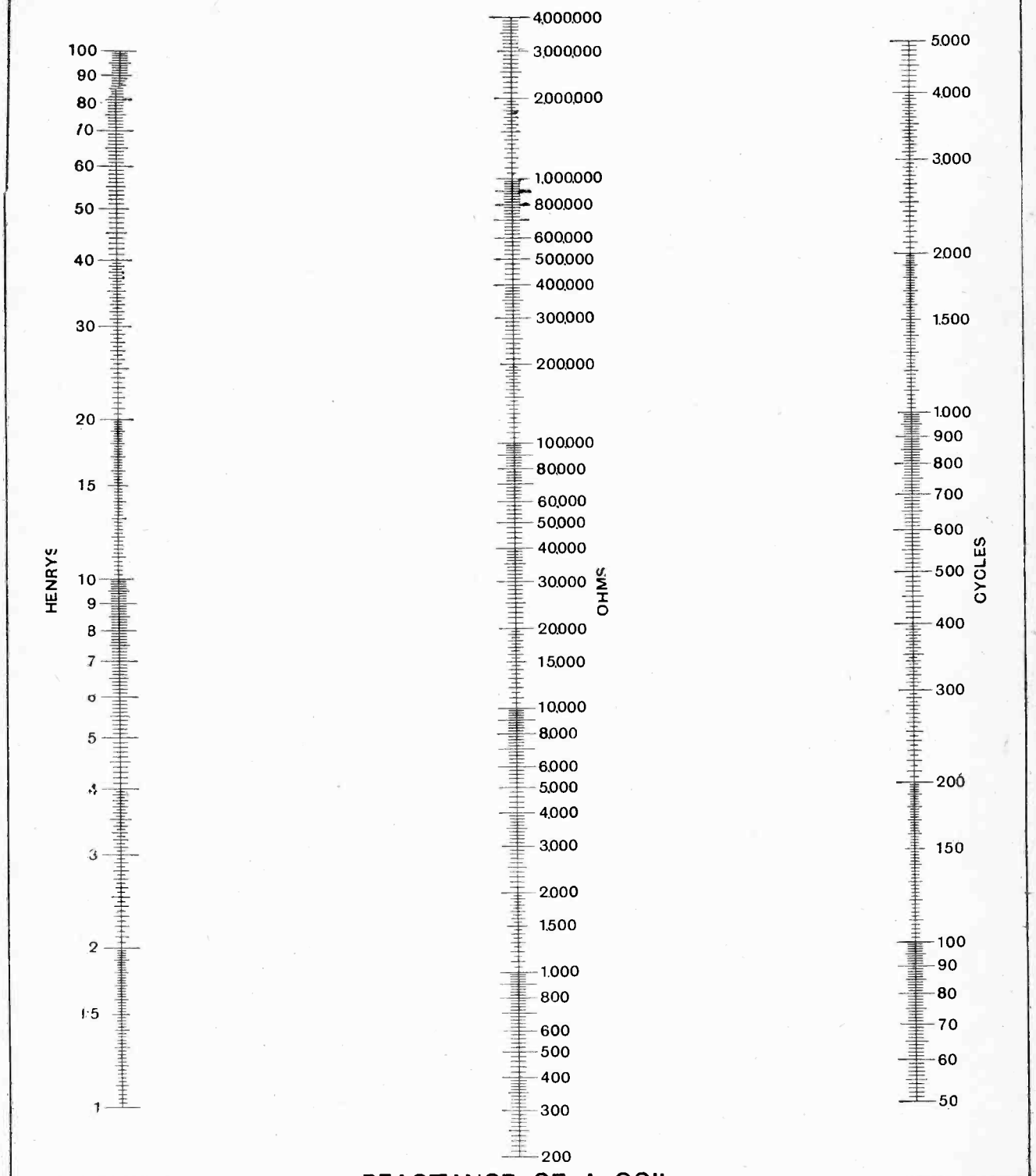


Fig. 2.—To allow for the constant multiplier 2π the scale c of Fig. 1 is displaced.

finitely large impedance. On the other hand, with a 20-henry primary the reactance would be only 6,300 ohms at 50 cycles, and with a 30,000-ohm valve the same



W. W. ABAC

REACTANCE OF A COIL AT AUDIO FREQUENCIES

No. 5

Useful Data Charts (No. 5.).—

calculation shows that only 0·2 of the plate voltage is passed on to the next valve. Hence a good transformer is required in conjunction with a low-resistance valve to bring out the low notes.

As another example, we enquire what current flows when a transformer whose primary has an inductance of 10 henrys, and whose secondary is open circuited, is connected across 50-cycle mains at a pressure of 100 volts (r.m.s.). The reactance is read off from the abac as 3,140 ohms, and the current is therefore 100/3,140 = 0·032 amp. (r.m.s.).

The impedance of a loud speaker at different frequencies can be easily worked out from data supplied by measurements on an A.C. bridge. The following table shows in columns 2 and 3 the figures found for a cone type of instrument, showing increasing resistance and decreasing inductance as the frequency rises. The reactance at each frequency follows from the abac and the impedance in the last column is calculated from the formula, impedance^2 = resistance^2 + reactance^2. It may be noted that the reactance in each case is almost equal to the resistance, a result which is found true for nearly all loud speakers in which resonance has been eliminated by the use of a cone or an exponential horn.

Cycles.	Resistance.	Henrys.	Reactance.	Impedance.
	Ohms.		Ohms.	Ohms.
500	2,000	0.7	2190	2,970
1,000	3,600	0.58	3,640	5,120
2,000	5,100	0.43	5,400	7,430
3,000	7,100	0.33	6,210	9,430

Next week an abac will be given from which the reactance of a coil can be found at radio frequencies. In the units suitable for these frequencies the formula becomes

$$\text{microhenrys} \times 2\pi \times \text{megacycles} = \text{ohms},$$

or if we prefer metres to megacycles, then, since megacycles × metres = 300, we get the alternative formula:

$$\frac{\text{microhenrys} \times 1{,}884}{\text{metres}} = \text{ohms}.$$

R. T. B.

TRANSMITTERS' NOTES AND QUERIES

General Notes.

Mr. G. F. Kitchen (G 5VP) is at present in Yugo-Slavia, where his address is c/o Edison Bell Penhala D.D., Zagreb, and hopes to be able to arrange with the authorities to allow him to conduct tests with home stations, though transmitting licences are somewhat hard to obtain in Yugo-Slavia and, in fact, most of the EJ's are unofficial.

Mr. J. Hum (G 5UM), 17, Eastwood Road, Muswell Hill, N.10, is testing a special type of transmitter and is anxious to obtain reports especially with regard to the character and steadiness of the note. He is transmitting on a fixed wavelength of 167 metres from 2,300 to 2,400 BST on Fridays. He is also co-operating on Sunday mornings and evenings with Mr. F. G. Ingleton (G 6FI), 48, Grassmere Road, N.10, who transmits on 45 and 170 metres and will also welcome reports.

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D.E. Tests on the Norfolk Broads.

Mr. F. J. Singleton (G 5UW) asks us to state that from August 4th to 18th he will be operating a portable set on board the motor cruiser "Alsatian" on the Norfolk Broads. The object of his tests, which have been arranged in conjunction with the Wolverhampton and District Radio Transmitters' Society, is to obtain observations upon the directional properties of small aerials loaded at the fundamental and he hopes that the results will prove of considerable interest. The wavelengths used will be 23, 33, and 44-46 metres, and the power input will be ten watts derived from an M-L anode converter lent for the purpose by the M-L Magneto Syndicate, Ltd., of Coventry.

Short-wave Naval Station.

A correspondent in Gibraltar warns listeners who may attempt to calibrate their receivers by the 35-metre waves which, according to the list of short-wave transmissions in our issue of February 8th, are used by most of the naval coast stations, that these wavelengths are often changed and should not, therefore, be relied on for calibration purposes. We have already given, in our issue of June 27th, the revised wavelengths assigned to BXW, BXY, BYA, and BYZ, but we gather from our correspondent's letter that these are not rigidly adhered to.

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Short-wave Ship Stations.

The same reader sends us the following QRA's of ships transmitting on short waves:—

IAU	Italian s.s. "Conte Grande" on 50 metres C.W.
WSN	U.S.A. s.s. "Leviathan" on 35.5 metres I.C.W. and C.W.
GBZL	s.s. "Arctic Queen" on 35.5 to 36 metres I.C.W.
GLKY	s.s. "Carinthia" on 36 metres approx. I.C.W.
GCTZ	s.s. "Naldera" on 36 metres approx. I.C.W.
BXC	Nore Lightship on 36 metres approx. I.C.W.
SIX	Swedish s.s. "Nuolja" on 37 metres approx. I.C.W.
PIA and **PIC**	Two of the Dutch tugs towing a floating dock to China, working on about 31 metres with PCH (Scheveningen).

Short-wave Work in Iraq.

We understand that Mr. D. MacLaren, while at Ur of the Chaldees last February, worked very successfully with a half-wave aerial stretched on the ground and consisting of a length of rubber-covered wire coupled to the transmitter at its centre. With this arrangement he got into communication with an Australian station about 8,500 miles distant. The transmitter was of the Hartley-Meissner type with an input of 30 watts. The call-sign used was XAQ 1HF, and the wavelength about 32 metres.

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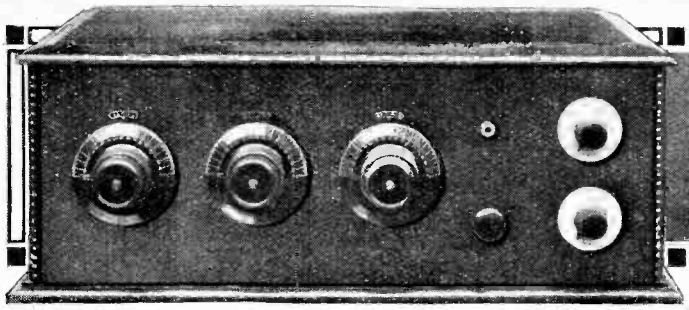
New Call-signs and Stations Identified.

2 MA	(ex 2 BRI), D. D. Marshall, 41, Kelvinside Gdns., Glasgow, N.W., transmits on 23, 45 and 90 metres.
2 QH	C. Hewins, 86, Earl St., Great Grimsby, re-opening his station at new address and transmits on 8, 23 and 45 metres, usually from 2300 B.S.T. onwards, and from 0900 to 1300 and 1800 to 2000 B.S.T. on Sundays. Reports especially from distances over 100 miles will be welcomed.
5 GK	W. Gibb, 301, High St., Kirkcaldy, N.B., transmits on 45 metres and will welcome reports.
5 HP	H. S. Pace, 12a, Kirkdale, Sydenham, S.E.26. (This call-sign was formerly held by Messrs. Cunningham, Ltd.)
5 RM	(ex 2 BVB), R. A. Minter, 60, High St., Bromley, Kent.
6 NG	Norman E. Haigh, 33, Bullroyd Ave., Allerton Rd., Bradford, transmits on 45 metres and will welcome reports. (Change of address.)
2 AJC	D. J. Beattie, 399, Manchester Rd., Burnley, until August 12, after which date his address will be 374, Rossendale Rd., Burnley.
2 BXJ	R. C. Nisbet, Moray Lodge, Curzon Rd., Weybridge.
6 CL	J. Clarricoats, 6, Hartland Road, N.11. (Change of address.)



SUPER-SENSITIVE RECEIVERS

Modern Improvements Ensure Stability of Several H.F. Stages.

By "RADIOPHARE."

MANY experimenters who have undertaken the construction of an H.F. amplifier with more than one stage have met with but partial success, and to achieve stability have found it necessary to content themselves with an overall amplification considerably lower than that which should be obtained. Consequently, performance is often but little better than that to be expected from a good single-stage set, and, compared with it, the gain may be considered insufficient to compensate for the inevitable increase in operating difficulties. The result is that sets with two and three H.F. valves are popular only with those who have the capacity for taking infinite pains to minimise inter-circuit coupling, and until recently it has been the practice of writers in this journal to warn their readers that the construction of such receivers is not to be lightly undertaken.

Nowadays, however, conditions are changed, and it may be asserted with confidence that the almost incredible sensitivity (judged by the standards of a few years ago) and high selectivity attainable with the help of two modern H.F. stages in cascade is open to anyone who cares to exercise no more than reasonable care in the building of his apparatus.

H.F. Amplification for Town Dwellers.

Is the multi-stage amplifier necessary? In the writer's view, the country listener with a good aerial-earth system and complete freedom from interference by a near-by station can seldom avail himself with advantage of more H.F. amplification than that obtainable from a good single stage—but it must be really good. Admittedly, there is at times an almost complete absence of atmospherics, spark interference, and continuous wave telegraphy "mush," when it is possible to take advantage of unlimited sensitivity; it is a matter for the amateur himself to decide whether occasional reception at extreme ranges is sufficiently attractive to warrant the extra cost.

It is an axiom that conditions in large towns are always inferior to those obtaining in the country, and here we have what seems to be the most important field of usefulness of the multi-stage H.F. amplifier, not only because there is always a certain amount of screening, but because the chances are that there will be a broadcasting station in the immediate vicinity. The first difficulty is clearly overcome by the increase in sensitivity brought about by adding an H.F. stage, which, in turn, will automatically provide at least a partial solution to the problem of eliminating unwanted local signals. At the worst, it will considerably reduce interference, due to the filtering effect of the extra tuned circuit.

It would now appear certain that the majority of failures in the past to obtain stability have been due rather

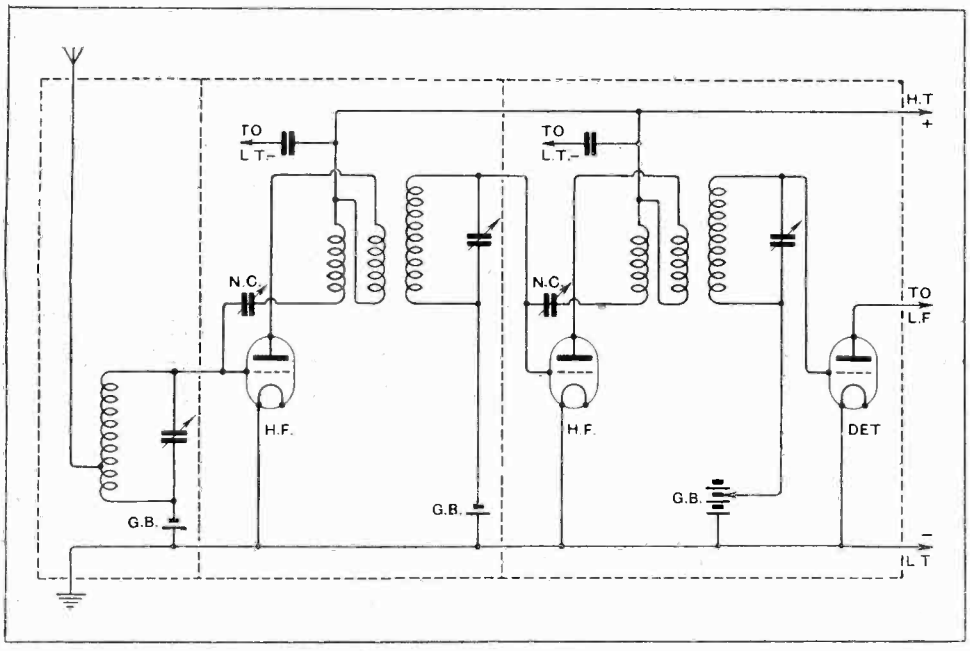


Fig. 1.—A conventional H.F. amplifier, which, in spite of complete screening, may lack stability unless special precautions be taken.

Super-sensitive Receivers.—

to inter-circuit coupling brought about by resistances and impedances common to several valves than to magnetic coupling between the various circuits; this explains the reason for troubles encountered in spite of the adoption of complete screening. A more thorough appreciation of the nature and importance of these unwanted couplings has been followed by the development of methods whereby they may be eliminated; it is now generally recognised that the insertion of decoupling resistances and by-pass condensers, in conjunction with a suitable disposition of the wiring, will prevent L.F. instability, but it is sometimes forgotten that these expedients are at least equally valuable in H.F. amplifiers. The benefits conferred become more obvious as magnification and number of stages are increased. In this article the writer proposes to deal only with ordinary three-electrode valves; the use of screened-grid tetrodes may possibly facilitate the construction of a highly sensitive set, but special problems are involved.

In Fig. 1 is given the circuit of a typical two-stage amplifier with anode bend detector; although theoretical diagrams of this kind are not intended to show the method of making the actual connections, it may be taken that in essentials the wiring of a receiver is practically as shown, and that any resistance in the leads or batteries will be common to several circuits. No special precautions are taken, although the screening (as shown in dotted lines) is assumed to be complete, and the low-potential ends of the H.F. anode circuits are "tied down" with large by-pass condensers. It is quite probable that an amplifier on these lines will not be completely stable if the valves and H.F. transformers are of high efficiency, giving a large magnification.

A modification of this circuit which has been found in practice to be perfectly satisfactory is shown in Fig. 2. The plan adopted is very much on the lines of that suggested in an article entitled "Scientific Wiring" in *The Wireless World* for April 25th, but the departures from conventional practice are less sweeping than those recommended there, and may perhaps present less difficulty to the amateur who has grown accustomed to wiring his receiver in conformity with the old rules, which, incidentally, it would now appear advisable to forget.

Although "decoupling" methods are not carried to the fullest possible extent, it will not be difficult to see that the possibility of interaction is very considerably reduced. Each grid circuit is returned direct to the negative side of the filament; it would be correct to join the positive side of each grid bias cell or battery to the appropriate valve-holder terminal. Similarly, the flow of oscillatory currents in the plate circuits is restricted by inserting feed resistances R and R_1, with by-pass condensers C and C_1. Provided the value of these resistances is much greater than the effective resistance of the battery circuit, we may consider that the H.F. currents "originating" in the valve are confined to the transformer primary and by-pass condenser. It will be observed that the low-potential side of this condenser is joined to negative filament; this connection should be direct, as in the case of the grid return lead.

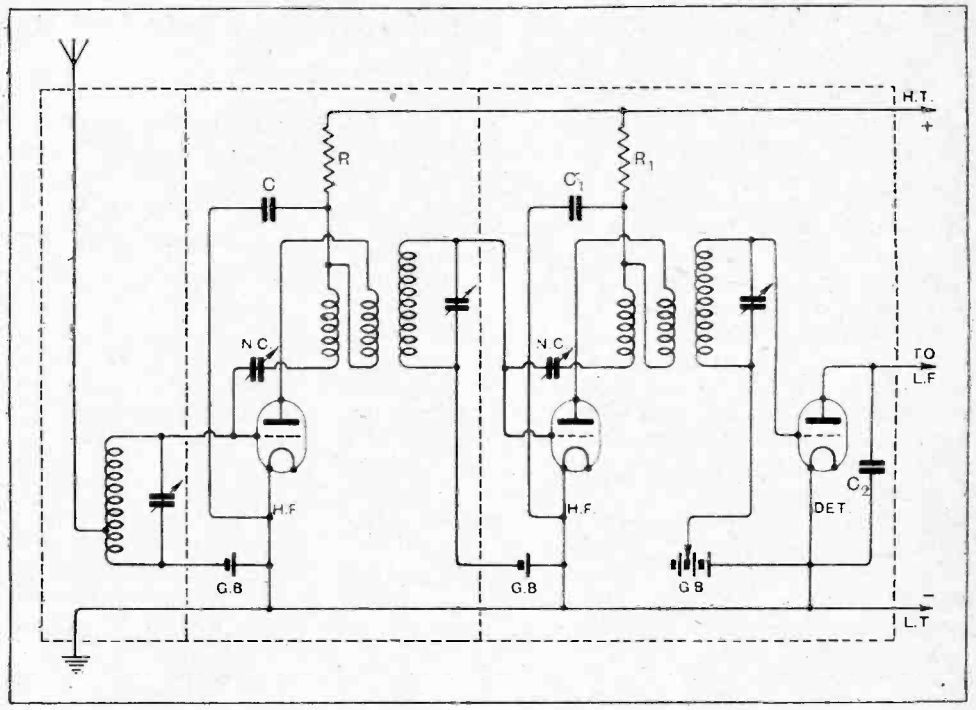


Fig. 2.—High magnification with stability may be obtained by avoiding current paths of appreciable resistance common to several circuits.

As for the detector valve, the usual small by-pass capacity (of from 0.0001 to 0.0005 mfd.) is connected in the same way, in order to limit the H.F. energy in the output circuit; it would be advisable to keep the lead to the L.F. coupling device as short as possible, and also to insert another feed resistance and by-pass condenser between its low-potential end and the H.T. battery connection.

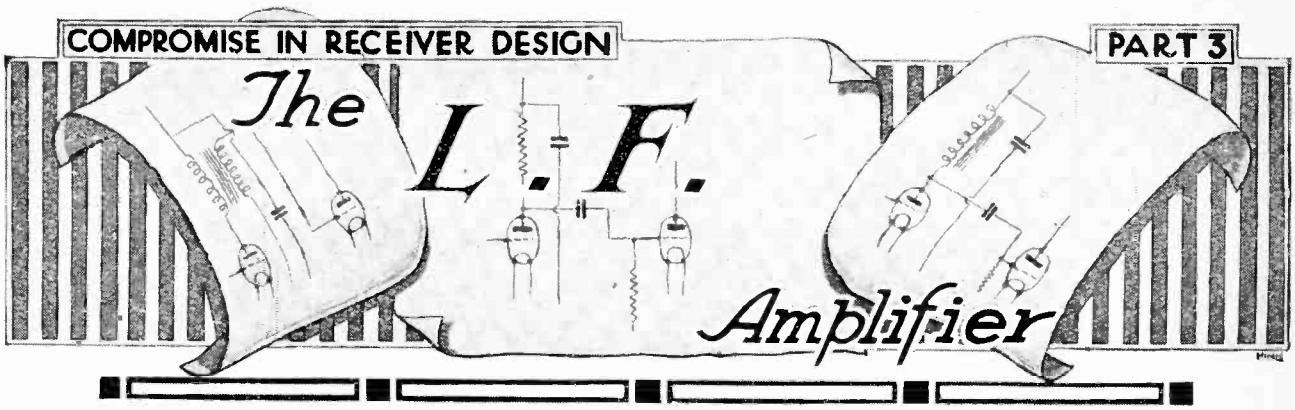
Although practical data on the subject is not available at the moment, it is possible that incomplete screening might be adequate, even for high-magnification stages, but one is inclined to recommend that each valve, with its associated apparatus, should be enclosed in a metal box. Unless this is done, it would be advisable to take precautions against the formation of inductive loops, in the manner described in the above-mentioned article.

When it is not required that any appreciable part of the applied H.T. voltage should be "dropped" in the resistances R and R_1, their value need not exceed 500 or 600 ohms.

COMPROMISE IN RECEIVER DESIGN

PART 3

The L.F. Amplifier



IN the first article of this series we discussed the various types of output stage possible for loud speaker reproduction of received signals, and then, in the second article, we jumped to the detector stage, and considered the pros and cons of the various types available. We have next to deal with the design of a low-frequency amplifier, which is the link between the two parts of the receiver already dealt with.

A Plea for Rational Subdivision of Sets.

Before proceeding further, it may be as well to define what the term "low-frequency amplifier" is meant to include in the present articles, for the term is used by the writer in a manner which is not quite in keeping with general usage. In Fig. 1 is shown a three-valve receiver in which the first valve is the detector. Most people would call this a "detector and two L.F. stages"; the writer very definitely would not. The mode of thought implied by this description, while perfectly suitable for conveying the number of valves and the manner of their use, represents an attitude of mind which is liable to lead to considerable confusion when the task of designing has to be undertaken.

In referring to the valves V_2 and V_3 of Fig. 1 as "two L.F. valves," or, still more, by referring to them as "one resistance- and one transformer-coupled stage," as is so often done, the subdivision of the receiver that is implied is that shown by the dotted lines in the diagram, where the resistance R is made to belong to the valve V_2, and the transformer T to V_3, while the loud speaker, presumably because it is outside the receiver, belongs to the set as a whole rather than to any one valve. Few readers, it is hoped, will need to be reminded that such a mode of regarding the receiver is fundamentally wrong, since the choice of components connected in the grid circuit of a valve is, within reasonable limits, a matter of complete indifference, while the choice of the component for its plate circuit is all-important. So much, indeed, is this the case, that the grid circuit of any valve, even including such items as its stray capacity, is properly regarded as part of the plate circuit of the valve that precedes.

Fig. 2 shows the same circuit re-divided by dotted lines in order to bring out clearly the attitude that it is correct to take up, for design purposes at all events, towards the question of where one stage ends and the next begins. R is now seen to belong to the detector stage, T to the second valve V_2, while the loud speaker is now quite definitely allotted to the sole care of the last valve V_3. Put into words, the receiver is now seen to consist of a detector resistance coupled to an L.F. amplifying valve, which is in turn transformer coupled to the last valve. And what of the last valve? It may, by coining a phrase, be called "loud speaker coupled," but the writer has preferred to call it the output valve, and to include both V_3 and the loud speaker together under the name of "the output stage." In doing so emphasis is laid upon the fact that V_3 must be chosen to suit the loud speaker and the volume of sound that is required from it, and that the choice of V_3 is completely independent of the type, or even of the very existence, of the transformer that in Fig. 2 supplied the signal voltages that it requires. V_3 is, in fact, not put into the set to amplify in the ordinary sense of the word; nor is it strictly true to say that it does amplify. True, it develops across the loud speaker voltages which may be larger than those applied to its grid, but were this all that we required, the design of the output stage as a whole would bear no resemblance whatever to its usual form. The real function of V_3 is to transfer to the loud speaker the maximum amount of *power* (watts) in exchange for the signal *voltage* (which, in the ideal case, is *wattless*) that is applied to its grid.

Where Does the L.F. Amplifier Start?

This last valve is, therefore, sharply distinguished from that of the stage that immediately precedes it, for the task that V_2, with the aid of its transformer, is called upon to fulfil is that of providing a large signal voltage across the transformer secondary in exchange for the much smaller signal voltage applied to its grid by the detector. V_2, then, has to convert a small voltage into a large one; the input and the output being measurable in the same units, the stage can fairly be said to amplify, and, what is more important still, the amplification can readily be expressed as "so many times."

Just as there is no doubt that V_3 stands outside the L.F. amplifier, and must be considered quite apart from it, there is no doubt that V_2 and the transformer must be included under this head. We see then that in the writer's meaning of the phrase, *the L.F. amplifier ends at the grid of the output valve;* where, then, does it begin?

Strictly speaking, the L.F. amplifier must begin at

Compromise in Receivcr Design—The L.F. Amplifier.—

the point where the rectified signals first make their appearance, whether as voltages or as currents of audio frequency. On this basis we must reckon the detector valve itself as part of the L.F. amplifier when a leaky-grid detector is in use, for the rectified signals first appear as audio-frequency voltages upon its grid, inside the grid condenser, and are amplified by the valve in the ordinary way. In the case of the anode-bend rectifier, the first appearance of rectified signals is at the plate of the valve, where they show up as variations of the anode current, so that in this case only the plate circuit of the valve, and not the valve as a whole, belongs properly to the low-frequency amplifier. For convenience, and because the behaviour of the grid circuit of the rectifier is of considerable importance in the design of the high-frequency circuits, we will *in both cases* regard the L.F. amplifier as beginning at the anode of the detector; the components in this anode circuit are, therefore, part of the amplifier. Moreover, the impedance of the detector must be chosen to suit these components in just the same way as in the rest of the amplifier.

The present section may, therefore, be defined to include *everything that lies between the anode of the detector valve and the grid of the output valve,* and to exclude all outside those limits, so that on this basis both Fig. 1 and Fig. 2 may be said to show a receiver with a single stage of low-frequency amplification preceding the output stage.

Having thus defined the scope of our subject, we can proceed to discuss it without fear of ambiguity. Naturally, the first point to consider is the type of coupling that we propose to adopt in our amplifier, which is a question that has provoked considerable controversy in all circles where enthusiasts foregather. There are three methods normally available; each of these has its own particular virtues which the others do not share, and its own special drawbacks from which the others are free. The choice of a mode of coupling, then, must inevitably be made in a spirit of compromise, for we cannot hope with any of the three to attain an amplifier that is perfect from every point of view. It will be as necessary here as elsewhere to sacrifice, in part at least, those advantages we deem of least account in order that we may have in fuller measure those we value more greatly. Let us discuss some of these advantages, keeping the modes of coupling distinct as far as is compatible with the fact that we are really trying to make a comparison between them.

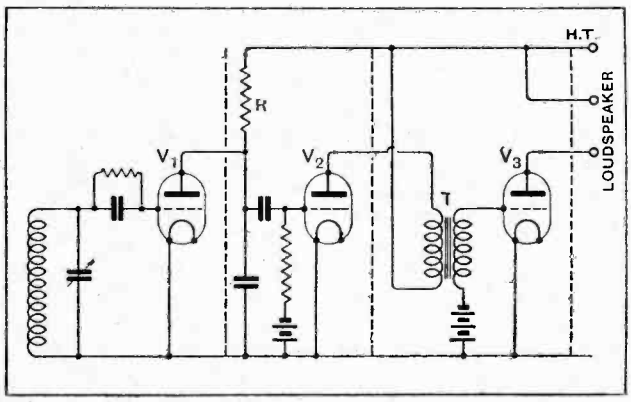


Fig. 1.—The dotted lines show the orthodox sub-divisions of a receiver containing a detector and L.F. amplifier.

Transformer Coupling.

There is one way in which transformer coupling is supreme; it enables us to get the very greatest possible amplification out of each stage. For this reason alone, this mode of coupling is absolutely invaluable in any case where it is desired to keep the number of valves in the receiver down to the irreducible minimum. To set against this, we have the disadvantage that even with the best transformers, used under the best possible conditions, the quality of reproduction is not *quite* up to the standard attainable by other means. Whether this loss of quality will be of importance in any particular case is chiefly dependent upon the loud speaker that is to be used, and it must be admitted that with the vast majority of loud speakers at present available it would be difficult for the most skilled ear to detect any difference between an amplifier using first-class transformers and a practically perfect resistance amplifier. Setting aside the fact that an amplifier using poor transformers will make an audibly nasty noise with any reasonably good modern speaker, and restricting ourselves to the two or three transformers that stand out as the best available, it is fairly safe to say that unless a moving-coil speaker is to be used transformer coupling can be good enough to pass as perfect, when judged by ear. Without direct comparison, indeed, most people would not be able to detect, even with a moving-coil speaker, the difference between a perfect resistance amplifier and an amplifier employing one first-class transformer only.

In the first article of this series, reference was made several times to the possibility of using two output valves, but no details as to the mode of connection were suggested. The fact that the use of one transformer, even in a receiver primarily designed for quality, is not likely to introduce falsity enough to offend even a critical listener, enables us to include as an advantage on the side of the transformer the possibility that it affords of connecting these two output valves in "push-pull." The alternative possibility of connecting the two output valves in parallel, which is, of course, applicable whatever the coupling that precedes them, is in practice found, with the usual "high-resistance" loud speaker at any rate, to afford no appreciable increase in signal strength over that obtainable with a single valve, unless a specially designed output transformer or a special tapped output choke can be used. Moreover, the high-tension voltage required for extracting the maximum power from valves arranged in push-pull is not so high as when they are connected in parallel. It is only fair to mention, however, that there are certain minor difficulties, as yet not quite completely understood, in connection with the push-pull system, so that this scheme should only be embarked upon by those who feel reasonably confident of their ability to track down and eliminate any troubles that may arise.

Another advantage that follows upon the use of transformers is that the amateur designer, so long as he chooses

Compromise in Receiver Design—The L.F. Amplifier.—a make of transformer for which the frequency amplification curve is provided by the makers, is not compelled to embark upon the task of calculating out this curve for himself. The design of the amplifier is, in fact, limited to settling the number of stages necessary to provide the amplification required, and selecting valves having characteristics which the makers of the transformer prescribe as suitable to precede their product.

Of the minor disadvantages that follow upon the use of transformer coupling one may note that, if the transformer is to follow the detector valve, this valve must of necessity be arranged as a leaky-grid rectifier. Except in a few very special cases, the anode rectifier has far too high an impedance under working conditions for the proper reproduction of low notes, however massive the transformer in its plate circuit may be.

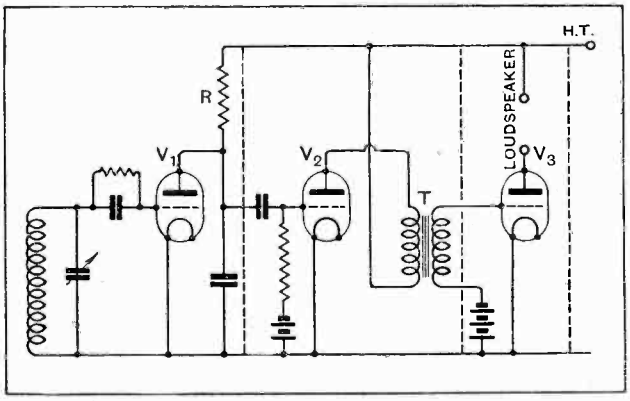


Fig. 2.—The correct sub-divisions of a detector-L.F. receiver. It will be seen that the couplings are closely associated with the anodes of the preceding valves.

Choke Coupling.

In an article dealing with compromise, it is, perhaps, superfluous to remark that choke coupling offers a *via media* between transformers on the one hand and resistances on the other. The writer will, therefore, immediately pass on to place on record his personal opinion that the use of chokes to couple the successive stages of a low-frequency amplifier has been unduly neglected.

It is an undeniable fact, easily demonstrated by a simple calculation, that for the same standard of low-note reproduction, a choke will give greater amplification than a transformer. This must not be taken to mean that by simply replacing a transformer by a choke the amplification will increase; obviously, this would be untrue, on account of the loss of the step-up ratio. But if, in making this change, we simultaneously change the valve that precedes, putting in now a valve of very much higher impedance than before in order to keep the standard of low-note reproduction unchanged, the loss of amplification incurred by sacrificing the step-up of the transformer will be more than made good by the greater amplification factor of the valve we are using with the choke.

Avoiding Low Note Loss.

Alternatively, and perhaps preferably, we can take advantage of the higher efficiency of choke coupling by keeping the overall amplification the same on the middle frequencies, and taking our gains in the form of an increased output of the lower notes. This has the additional advantage that the loss of high notes usually associated with the attempt to obtain a very high degree of amplification per stage will be avoided.

Compared on the other hand with resistance coupling, the choke scores in that there is no serious voltage drop across its windings, so that practically the full voltage of the anode current supply is applied to the plate of the valve itself. This point, while utterly unimportant in the early stages of an amplifier, can sometimes make it not merely advisable, but absolutely necessary, to use a choke rather than a resistance in the plate circuit of the last valve of the amplifier. The need for doing so will generally only arise when the output stage is fed with a high anode voltage, and consists of a valve of very low impedance, so requiring signals of very large amplitude to operate it under the best conditions.

Resistance Coupling.

The overwhelming advantage of resistance coupling, which is the source of its ever-increasing popularity, is that by this means it is possible to design an amplifier which is just as near perfection as we care to make it. Not for one moment is it to be understood that by adopting this type of amplifier all faults instantly disappear, for an amplifier using resistances needs careful design just as much as any other type if the quality is not to be disappointing. But at least in this case the design is reasonably simple and straight-forward, and one is far less dependent upon the makers of components, and far more dependent upon one's own skill in design, than in the case of an amplifier of any other type. If that skill is lacking, or if there is no inclination to undertake the necessary calculations, the writer would suggest the use of transformers instead, choosing valves as directed by the transformer makers. Even if it is not possible to produce in this way an amplifier giving superlative quality, one is at least saved from the mistakes that lie in wait for the unwary user of resistance coupling, and it may well be that the resulting amplifier will give more acceptable quality after all.

But for those who want the very best, who like to feel that the design of the amplifier is really their own work and not that of the makers of components, and, still more, for those who love to know that their amplifier is practically perfect, and can derive an immense æsthetic pleasure from this knowledge in spite of the fact that the ear could hardly detect the difference in quality between their amplifier and another just a little less perfect, the resistance amplifier is the only one possible.

There are difficulties, of course, and perhaps the most important of these lies in the intimate connection between the reproduction of the extreme bass notes and the possibility of "choking." For good bass notes a large coupling condenser and a grid leak of high resistance are essential; and if with this combination the valve is momentarily overloaded so that grid current flows for an instant, the coupling condenser is charged up and, owing to the high resistance of the leak, cannot discharge quickly. While it remains charged the loud speaker will emit very distressing noises totally at variance with the alleged perfection of the amplifier.

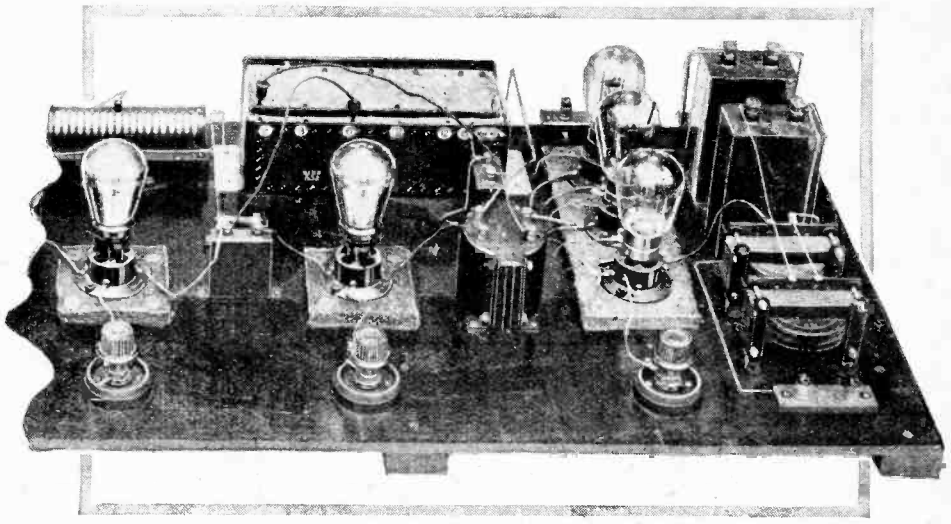
Compromise in Receiver Design—The L.F. Amplifier.

Dodging this difficulty is easy but expensive, for the only way out is to avoid overloading. This can always be done if we so design the amplifier that there is a large margin of safety, the permissible grid swing on each valve being several times that normally needed to deal adequately with the signals being received. If we are willing to go to the expense of equipping ourselves with the high anode voltages that this big margin of safety implies, the low notes can be kept at full strength; if not, we must either remain at the mercy of every passing atmospheric or sacrifice our low notes by decreasing the resistance of the grid-leaks until "choking" no longer occurs.

This suggestion opens the way to a particularly complicated compromise, between three separate factors, for clearly the right thing to do is to allow a reasonable margin of safety, to sacrifice the low notes just a little, and to learn to ignore the very occasional "choking" that an exceptionally heavy atmospheric may produce, even after these precautions have been taken. The exact magnitude of the margin of safety, and the loss of low notes to be accepted, must be decided by every designer for himself.

It will hardly be necessary to remind readers that the difficulty of "choking" is equally prominent when choke coupling is in use, and does not occur with transformers on account of the low D.C. resistance of the secondary.

Keeping the high notes is also something of a problem, for if valves of high amplification factor and of high impedance are employed in a multi-stage amplifier in an attempt to obtain a high degree of amplification per stage, the highest audible notes will inevitably be reduced to a very small fraction of their proper intensity. On no account should any endeavour be made to emulate in one stage the amplification obtainable in a single stage of transformer coupling, for when resistances are in use we are deprived of the "rising characteristic" which makes the transformer immune to a large extent from the baleful effects of inter-electrode and other stray capacities. We must, therefore, accept the fact that with resistance coupling more valves are required than with other types of amplifier, setting against this the cheapness of the coupling and the small demands for anode current that the completed amplifier will make.



A typical L.F. amplifier, with paralleled last stage

It is hoped that this comparison between the possible types of amplifier will help to bring into prominence the sacrifices made and the benefits that accrue, in adopting any one of the three types. In conclusion, it need only be pointed out that the possibilities for compromise are even greater, in an amplifier containing more than one coupling, than appears from this review, for there is nothing whatever to prevent the use of two, or even three, types of intervalve low-frequency coupling in the one receiver.

TRACKING A MOBILE TRANSMITTER.

A NOVEL field-day, involving a hunt for a mobile transmitter, was recently held in the Watford district by several well-known London radio societies. The scheme was organised by Lt.-Col. H. Ashley Scarlett, D.S.O., of the Golders Green and Hendon Radio Society, and the transmitter was operated by the 47th Divisional Signal Company (Territorials). Over forty persons took part, representing the Golders Green, Muswell Hill, North Middlesex and Western Postal District radio societies.

During the operations the transmitter occupied three positions, the first two of which were to be traced on the map only, one hour being allowed for each position. When the transmitter had taken up the third position extra time was allowed to enable the tracking parties to come up and discover the transmitter "in the act." Actually only two groups succeeded in this feat, viz., the North Middlesex group, who arrived first, and the Western Postal District group, who put in an appearance two minutes later. The latter group won the first prize, the judges considering that their map plotting for the first two positions was superior to that of the other group. The prizes, valued at over £6, were the generous gift of Messrs. McMichael, Ltd., and The G.E.C., Ltd.

The general scheme covered a tract of country, approximately twenty miles square, bounded by St. Albans in the north and Stanmore in the south. To prevent premature discovery, the tracking groups were required to keep to the west of a line drawn through St. Albans and Watford, while the transmitter occupied positions I and II at Aldenham and Woodcock Hill (near Elstree) respectively. The ultimate position of the transmitter was at Stanmore.

When the final rendezvous was reached the day's activities were discussed. It was agreed that an hour afforded too little time for each reading, while surprise was expressed that none of the portable sets employed a screened valve.

CURRENT TOPICS

HIND

Events of the Week in Brief Review.

"PORTABLE" FIELD DAY NEAR MANCHESTER.

The Radio Experimental Society of Manchester will hold its annual field day on Saturday, August 25th, in the neighbourhood of Chinley. A mobile transmitter will be used in conjunction with portable receivers.

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THE BORROWED SET.

A Keynsham (Bristol) listener, summoned at the Petty Sessions for operating a wireless set without a licence, pleaded that the set had been lent to him and he understood that he was covered by the owner's licence.

He was fined £1.

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BRADFORD MARKS TIME.

The *Bradford Telegraph and Argus* Radio Exhibition, which was to have been held in the Olympia Hall, Bradford, during October, has been postponed at the suggestion of the Radio Manufacturers' Association. It is pointed out that an exhibition in Manchester to be held at the same time should cover the needs of Bradford, and that the proposed date is also too near the date of the London Exhibition at Olympia.

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WIRELESS IN CADET CAMP.

Two wireless transmitters have been installed in the annual training camp of public secondary schools cadets at Marlborough, which opened on July 29th and continues until Saturday next. Great attention is paid to signal training.

There are approximately 2,000 cadets in the camp besides 150 officers. Between fifty and sixty schools are represented.

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ANXIOUS LISTENERS IN SINGAPORE.

The enthusiasm of amateurs in Singapore over transmissions from the "Old Country" was referred to by Mr. E. Earle, a visitor from Singapore, who addressed members of North London radio societies at the conclusion of a recent field day.

Mr. Earle said that British transmitters might rest assured that there were always two or three amateurs in Singapore anxiously listening every Sunday evening for signals from England. The most suitable wavelength seemed to be 23 metres, as atmospherics were very troublesome on the 45-metre wavelength. Great disappointment was felt that 5SW did not transmit at a more convenient hour. Eindhoven was received very well, but much greater pleasure would be derived from hearing songs and speech from this country. He urged that a continuous transmission should be tried, the cost being borne by the various colonies.

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GUILDFORD WIRELESS SHOW.

The Guildford and District Wireless Society, in collaboration with the local wireless trade, will hold the second radio exhibition in Guildford from October 6th to 10th in the Borough Halls.

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SIMPLE LANGUAGE LESSON.

Question: Do you rejoice at the termination of the dry spell?

Answer: I do.

Q.: Why?

A.: Because the loud speaker is no longer upon the lawn of my neighbour.

LICENCE INCREASE IN FATHERLAND.

The total number of licensed listeners in Germany on July 1st was 2,284,248, making an increase of 49,576 during the second quarter of the year.

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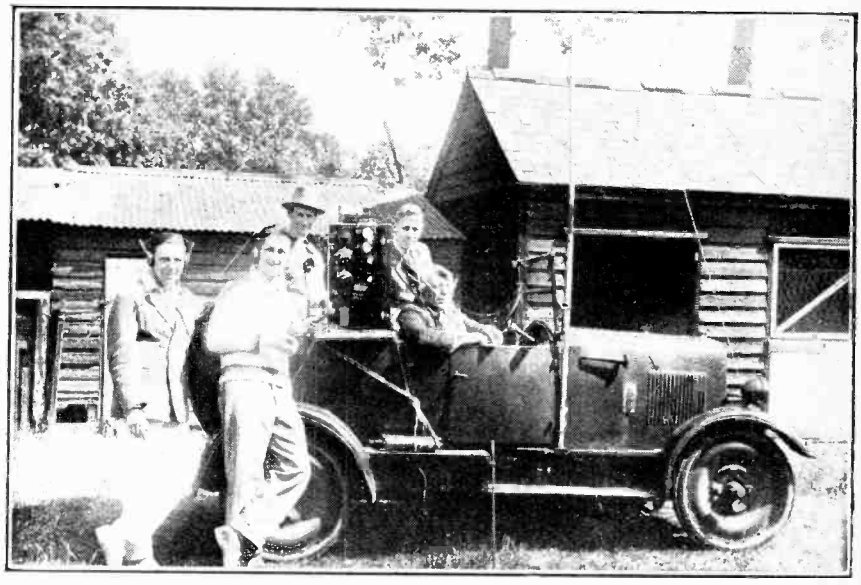
IS AMERICAN ETHER STILL CHAOTIC?

In spite of the labours of the U.S. Federal Radio Commission in allocating new wavelengths to all American broadcasting stations during the past year, alarm is still felt at the prospects of the coming winter when, in the words of the commission, "the summer static has rolled away."

Describing the present state of affairs, Commissioner Caldwell says:—

"WOR, now recognised as one of the great programme sources of the country, nightly has its splendid programmes ruined within 20 to 25 miles of Newark and New York by the heterodyne moans and howls produced from another station on the same wavelength, WOS, in Missouri. Meanwhile, WOR is inflicting similar interference on the good people in Missouri, and to all the rest of the country, of course, the WOR-WOS wavelength is a nightmare of shrieks and



A ROVING TRANSMITTER. 5 QK, an attaché case transmitter specially built for field operations by Mr. R. C. Horsnell (2 ABK) of the Southend and District Radio Society. The photograph was taken on a recent field day when 5 QK toured the countryside while keeping in touch with the Society's fixed station at Rochford

moans. The other popular 5,000-watt Jersey station, WPG, at Atlantic City, is similarly spoiled at any distance by Middle West stations, which, in turn, it similarly injures.

"In New York City, WNYC is continuously ruined by a Chicago station; WHN is blasted by transmitters in Louisiana and Iowa; and WABC is injured by cross-talk from an adjoining channel. In Boston, WNAC has a background of growls which come from Pittsburgh. Massachusetts' big 15,000-watt WBZ station shares a wave with eight other stations, affording the farmer who tries to tune in on its agricultural programmes all the variety of roars incident to feeding time at the Zoo."

In the opinion of the Commission the only way to overcome the trouble is to reduce the number of stations. "We have only 89 wavelengths. For good radio, not over 160 stations of the 500 and 5,000 watt classes can operate simultaneously on 85 wavelengths. On the remaining four wavelengths we can tuck in a couple of hundred little 50- or 100-watt transmitters. There you have the outline of the possibilities of the art in the present state."

It seems unlikely that the Commission will realise its hope that the ether tangle would be finally unravelled by September 1st next!

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A LETTER FROM MAURITIUS.

A happy accident whereby a short-wave enthusiast in Mauritius "tumbled" upon the transmissions of 2NM, Caterham, is narrated in a letter which has been received by Mr. Gerald Marcuse, well known as the owner and operator of Great Britain's first amateur broadcasting station.

The writer, Mr. Lewis Scott, of Beau-Bassin, Mauritius, says: "I have listened to your broadcasts on Sundays for some time past and wish to congratulate you for the results achieved, considering your low input of 1 kW. Reception is rather weak although steady and clear, and your modulation very good indeed and well proportioned to the carrier . . ."

Here follows a report upon a transmission of a Sunday evening service in June last. "It is by accident," continues the writer, "that I tumbled upon one of your transmissions (on 32.5 metres) on a Sunday night while fishing for 3LL, Melbourne, which broadcasts on 32 metres. My receiver is a 3-valve modified Reinartz, home-made, and works off an ordinary broadcast aerial."

The distance covered is roughly 5,000 miles.

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STANDARD TIME CONVERSION CHART.

The Department of Commerce, Bureau of Standards, Washington, D.C., has issued an ingenious and practical chart whereby the standard time at any place on the earth corresponding to that in any other place can be read directly. The chart, which measures 10½in. × 8in., comprises two coils, the outer one being marked in degrees east and west of Greenwich with the principal countries indicated opposite their respective longitudes. The inner circle is a movable dial marked with the 24 hours of the day, midnight to noon being white and the other half black. Thus, by setting the known time as marked on the movable dial opposite any desired longitude, the corresponding times in all other countries of the world can be read at a glance, remembering, of course, that the time between the 180° mark and midnight in a counter-clockwise direction belongs to a different date from the remainder of the time-circle. The price is 10 cents.

DIRECTION FINDING IN FOG.

Although the artificial dissipation of fog has not yet been achieved by science, the next best thing is being accomplished almost daily by means of the wireless direction finder. A remarkable instance of its usefulness is described in a report which the Marconi Company has received from the master of Messrs. P. and A. Campbell's (Bristol) passenger steamer *Waverley*, which had to cross the Channel during a recent foggy period.

The master says that during the trip from Hastings to Boulogne the results given by the Marconi wireless direction finder were "absolutely accurate." The ship ran into dense fog in mid-Channel. Wireless bearings were immediately taken and the course of the ship altered as required.

The first thing sighted after the ship entered the fog was Boulogne Buoy which, when first seen, was only a few yards on the starboard bow. The ship entered the harbour dead slow with the piles on either side barely visible.

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WIRELESS AT WESTMINSTER.

(From Our Parliamentary Correspondent.)

Revenue from the Beam Services.

In the House of Commons last week Sir Wm. Mitchell-Thomson, Postmaster-General, informed Mr. Ammon that the first Imperial beam wireless service, namely, that to Canada, was opened in October, 1926; the Australian service in April, 1927; the South African in July, 1927; and the Indian in September, 1927. There had thus not been one full year's working of the combined services. On the basis of current earnings the gross receipts of the Post Office from the four services might be put at about £470,000 a year, and the profit, before charging depreciation or interest on the capital, was at the rate of about £212,000 a year.

WIRELESS AND CABLES.

Report of the Imperial Conference.

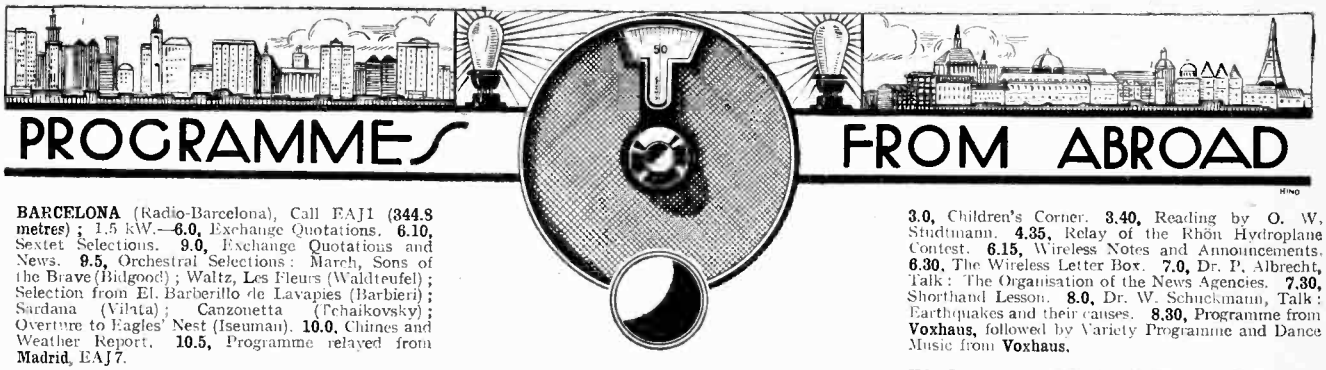
THE report of the Imperial Wireless and Cable Conference has been issued as a White Paper by H.M. Stationery Office. The conference was called to examine the situation which has arisen as a result of competition between the beam and cable services, and was composed of Sir John Gilmour (Secretary for Scotland) and Mr. A. M. Samuel (Financial Secretary to the Treasury), with representatives and advisers of Great Britain, Canada, Australia, New Zealand, South Africa, the Irish Free State, India, and the Colonies.

The principal recommendation is that a merger company be formed to acquire, as from April 1st, 1928, all the ordinary shares of the Eastern, Eastern Extension, and Western Telegraph Companies, and all the ordinary and preference shares and debentures (if any) of Marconi's Wireless Telegraph Company. It is also recommended that a Communications Company be formed, to which the Cable and Marconi companies will sell, as at April 1st, 1928, all their communication assets in exchange for shares. By the formation of the Communications Company an arrangement is made to segregate in one company what may be termed the purely "communications" aspect of the undertaking, leaving in the hands of the merger company the investments of the cable companies and the Marconi interests in non-traffic undertakings such as the manufacture of radio apparatus and the exercise of wireless patent rights.

The board of directors of the companies will be identical. It is explained that if the boards of the various companies were not identical, there would be a risk of separate and conflicting policies being pursued. In regard to questions of policy, including any alteration of rates, the Communications Company is to consult an advisory committee, which the conference suggest should include representatives of the government's participating in the conference. It is to be agreed (*a*) that British control of all the companies must be guaranteed; (*b*) that the Governments may assume control of the cable and wireless systems in time of war or other national emergency; (*c*) that the fighting services are entitled to build and work cable or wireless stations for their own purposes, but not for commercial purposes.

The Conference is convinced that the scheme propounded provides the best solution of the problem. "The telegraph service," says the report, "is not only a matter of common interest, but possibly the link on which, more than any other, the several parts of the Empire depend for mutual intercourse and understanding."

The report is obtainable from H.M. Stationery Office, price 6d.



SATURDAY, AUGUST 11th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

BARCELONA (Radio-Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**6.0,** Exchange Quotations. **6.10,** Sextet Selections. **9.0,** Exchange Quotations and News. **9.5,** Orchestral Selections: March, Sons of the Brave (Bidgood); Waltz, Les Fleurs (Waldteufel); Selection from El. Barberillo de Lavapies (Barbieri); Sardana (Vilata); Canzonetta (Tchaikovsky); Overture to Eagles' Nest (Iseuman). **10.0,** Chimes and Weather Report. **10.5,** Programme relayed from **Madrid,** EAJ7.

BERGEN (**370.4 metres**); 1.5 kW.—**8.0,** Concert: Goldregen Waltz (Waldteufel); Selection from The Grand Duchess of Gerolstein (Offenbach); Harlequinade (Ganne); Serenata lamentosa (Humphries); Selection from La Danse des Libellules (Lehár); March, Curro cuchares (Metallo). **9.0,** Miss Martens, Talk: Japan—the land of the rising sun. **9.30,** Sketch (Adolph Berg). **10.0,** Weather Report, News and Time Signal. **10.15,** Concertina Concert. **10.45,** Dance Music relayed from the Hotel Norge. **12.0 Midnight** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,250 metres**); 40 kW.—**12.0 Noon,** Relay of the Parliamentary Festival from the Reichstag, **Berlin.** **4.30,** Talk by Dr. F. W. Eismann. **5.0,** Programme from **Hamburg.** **6.0,** Classe, Talk: The Life of a Lighthouse Keeper. **6.30,** R. Grossmann, Talk: Coué. **6.55,** Prof. C. Grabau, Talk: The Duet. **7.20,** Ernst Schrumpf, Talk: Goethe and Carl August. **8.30,** Programme relayed from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**); 4 kW.—**6.0 a.m.,** Morning Gymnastics. **10.10 a.m.,** Market Prices. **10.15 a.m.,** Weather Report, News and Time Signal. **11.0 a.m.,** Programme of Gramophone Records. **11.30 a.m.,** Exchange Quotations. **12.0 Noon,** Relay of the Parliamentary Festival from the Reichstag: Recitations; Address by Dr. Radbruch, An Deutschland—Poem by Max Kalbeck; Address by Chancellor Müller; Massed Rendering of the First and Last Stanzas of the Deutschlandlied. **4.30,** K. W. Goldschmidt, Talk: Balkan Travels. **5.0,** Talk. **5.30,** Concert: March, Amerikanischer Zapfenstreich (Coy); Waltz, Die Chorsänger (Phelps); Karpathen-Tanz (Fehervaru); Eichenblätter (Morena); Overture to Il Seraglio (Mozart); Im sonnigen Süden (Lampe); Intermezzo, Blumenmädchen (Wenrich), followed by Programme Announcements. **7.0,** Dr. Arno Schirokauer, Talk: What Poets say and write—and what men believe. **8.0,** Dr. Neuendorff, Talk: Friedrich Ludwig Jahn—His Life and his Importance to German Athletics. **8.30,** Parliamentary Festival relayed from the State Opera House; Concerto Grosso for String Orchestra (Handel); Psalm 150 for Choir, Soloists and Orchestra (Bruckner); Address by Lord Mayor Böss; Hymnus zur Verfassungsfeier (Baussnern), followed by Concert relayed from the Hotel Esplanade, Weather Report, News, Sports Notes and Olympic Games Report. **10.30,** Dance Music. **12.30 a.m.** (Sunday), Close Down.

BERN (**411 metres**); 1.5 kW.—**8.0,** Time Signal and Weather Report. **8.5,** Dr. Troesch, Talk: Reminiscences of Scandinavia. **8.30.** The Bern Orchestra. **8.45,** Selections of Yodel Songs and Tales in Dialect. **9.45,** News and Weather Report. **10.0,** The Bern Orchestra. **10.35,** Dance Music. **12.0 Midnight** (approx.), Close Down.

BRATISLAVA (**300 metres**); 1 kW.—**5.10,** Children's Corner. **5.25,** Agricultural Report. **5.30,** A Puppet Play. **6.30,** Concert: Overture to Gri-Gri (Lincke); Waltz, Eve (Lehár); La Belle Hélène (Offenbach); Herzen und Blümen (Czibulka); Chanson sans Paroles (Tchaikovsky); Russian Songs (Leuschner). **7.30,** Orchestral Selections. **8.0,** Programme from **Prague.** **10.25,** Exhibition Programme.

BRESLAU (**322.6 metres**); 4 kW.—**4.0,** Book Review. **4.30,** Concert: Overture to Oberon (Weber); Waltz, Nordseebilder (Joh. Strauss); Andante Sostenuto (Mozart); Menuetto Grazioso (Kreutzer); Violin Solo, Sonata in D Major (Händel); Fantasia from Hänsel and Gretel (Humperdinck); German Dance (Schubert); Vom Deutschen Walde (Heinze-Gandert); Adlerflug-Marsch (Blankenburg). **6.15,** Esperanto Talk by Margarete Polier. **6.30,** Recitations from the Works of Friedrich Ludwig Jahn. **7.10,** Dr. Grumbkow, Talk: The State of Weimar. **8.15,** Olympic Games Report. **8.30,** Programme relayed from **Berlin.**

10.0, Olympic Games Report. **10.30,** Programme relayed from **Berlin.**

BRÜNN (**441.2 metres**); 3 kW.—**6.0,** Time Signal, News and German Transmission; La Tosca (Puccini); Selection from The Flying Dutchman (Wagner). **6.25,** Programme of Talks. **7.30,** Slovakian Orchestra. **8.30,** Selection of Songs. **9.5,** News from **Amsterdam.** **9.10,** Exhibition Programme. **10.0.** News from **Prague.** **10.25,** Exhibition Programme.

BRUSSELS (**508.5 metres**): 1.5 kW.—**5.0,** Dance Music from the St. Sauveur Palais de Danse. **6.0,** M. Bouckaert, Talk: Victor Hugo's Visits to Belgium. **6.15.** M. Carl Goebel, Talk: Some Great European Cities. **6.30,** Concert: Globe Trotter (Leopold); Des Millions d'étoiles (Katcher); Selection from The Desert Song (Romberg); Crazy Words (Ager); Selection (Gauwin); Ballet Scene for Flute (Glück); Selection from A Waltz Dream (Strauss); Souvenir d'Amérique, for Clarinet (Hazénier); Pudding (Morena). **7.30,** "Radio-Chronique." **8.15,** Gramophone Selections. **8.30,** Pianoforte Interlude. **9.0,** Symphony Concert from the Kursaal, **Ostend,** followed by News.

BUDAPEST (**555.6 metres**); 35 kW.—**5.45,** Orchestral Concert. **7.0,** Reading by Dr. B. Horst. **7.45,** Comedy (Sardou). **10.0,** Time Signal, News and Olympic Games Report, followed by Tzigane Music relayed from the Café Spolarits.

COLOGNE (**283 metres**); 4 kW.—**12.0 Noon,** Relay of the Ceremony from the Reichstag, **Berlin.** **1.5,** See **Langenberg.** **2.30,** Household Notes. **4.30,** Programme from **Königswusterhausen.** **5.0,** Talk for Women: The Uses of Gas in the Household. **6.0,** See **Langenberg.** **7.15,** Olympic Games Report. **7.20,** Talk for Workers. **7.45,** See **Langenberg.** **8.30,** Programme from the Berlin Opera House. **9.30,** Orchestral Concert from the Works of Beethoven, (a) Overture to Weihe des Hauses, (b) Concerto for Pianoforte in G Major, (c) The Fifth Symphony in C Minor, followed by News, Sports Notes, Orchestral Selections and Dance Music. **1.0 a.m.** (approx.) (Sunday), Close Down.

CRACOW (**566 metres**); 1.5 kW.—**7.0,** Miscellaneous Items. **7.30,** Review of Foreign Affairs for the Past Week. **7.55,** Agricultural Report. **8.5,** News and Announcements. **8.15,** Programme from **Warsaw.** **10.30,** Concert from a Restaurant. **11.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**1.30,** Weather Report and Gramophone Selections. **7.20,** News. **7.30,** Monologue Recital by Joseph O'Dea. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Germany, France and Italy in Music by the Station Orchestra. **8.40,** Tenor Solos by E. Williams. **8.50,** Violin Solos by L. McCann. **9.5,** "The Constant Lover," Sketch by Gertrude Quinn and Co. **9.35,** Tenor Solos by E. Williams. **9.45,** P. J. Duffy, Illustrated Talk: Schubert. **10.15,** The Station Orchestra. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**428.6 metres**); 4 kW.—**12.0 Noon,** Programme from **Voxhaus.** **1.0,** Gramophone Records. **3.0,** Children's Corner. **3.40,** Reading by O. W. Studtmann. **4.35,** Relay of the Rhön Hydroplane Contest. **6.15,** Wireless Notes and Announcements. **6.30,** The Wireless Letter Box. **7.0,** Dr. P. Albrecht, Talk: The Organisation of the News Agencies. **7.30,** Shorthand Lesson. **8.0,** Dr. W. Schuckmann, Talk: Earthquakes and their causes. **8.30,** Programme from **Voxhaus,** followed by Variety Programme and Dance Music from **Voxhaus.**

HAMBURG, Call HA (in Morse), (**394.7 metres**); 4 kW.—**12.0 Noon,** Relay of the Ceremony from the Reichstag, **Berlin.** **3.30,** Review of Books. **4.0,** Labour Exchange Report. **4.15,** Peter Tchaikovsky Programme, relayed from **Kiel** (254.2 metres). **5.0,** Concert by the Rostock Teachers' Choral Society, relayed from **Schwerin:** Freedom and Fatherland (Göpfert), Volk (Heinrichs), Kamerad, komm (Klughardt), Eine Wiese voll reiner Margueriten (Heuser), Feldeinsamkeit (Wendel), Ach du klarblauer Himmel (Silcher), Lütt Matten de Has (Groth), Ei, du lütte Flasskopp (Grimm); Flemish Folk Song, Suse, leiwe Suse. **6.0,** Request Concert Programme. **7.0,** Prof. Meyer, Talk: The Birthday Anniversary of Friedrich Ludwig Jahn. **7.25,** Talk by Dr. Stratil-Sauer. **7.50,** Olympic Report and Weather. **8.0,** "Protect our native reptiles," Sketch by J. Holst. 8.25, Programme from **Voxhaus,** followed by Weather Report and News.

HILVERSUM (**1.071 metres**); 5 kW.—**11.40 a.m.,** Police News. **12.10,** Concert of Trio Music. **1.40,** Concert, relayed from the Tuschinski Theatre, **Amsterdam.** **3.40.** Thé Dansant, relayed from the **Kurhaus, Scheveningen.** **5.40,** Time Signal. **5.42,** Concert: Heil den Siegern (Blankenburg), Künstlerleben (Joh. Strauss), Orpheus in the Underworld (Offenbach), Romance (Tchaikovsky); Songs, Selection from Mignon (Thomas), Serenade, Moonshine (Moret), Close to your heart (Heagny); Selection from Der Bettelstudent (Millöcker); March, Erzherzog Eugen (Krafft). **7.25,** Police News. **7.40,** Programme arranged by the Workers' Radio Society.

HUIZEN (**340.9 metres**); 4 kW.—Transmits from **5.40 p.m.** on 1.950 metres. **12.10,** Concert of Trio Music. **5.10,** Gramophone Selections. **7.25,** Talk by Prof. P. v. Grinsv. **7.55,** Concert of Vocal and Orchestral Selections.

JUAN-LES-PINS (Radio L.L.) (**244.5 metres**); 1.5 kW.—**9.0.** News and Weather Report, followed by Fashion Talk. **9.15** (approx.) Concert. **10.0,** Dance Music. **10.30** (approx.), Close Down.

KALUNDBORG (**1 153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**7.30 a.m.,** Morning Gymnastics. **11.0 a.m.,** Weather Report. **3.0,** Trio Concert: The Liberty Bell March (Sousa); Waltz, Loreley Rheinklänge (Joh. Strauss); Selection from Oberon (Weber); Fox-Trot, Baby, My Baby (Morris); 'Cello Solo, Berceuse de Jocelyn (Godard); Entr'acte from Mignon (Thomas); Fox-Trot, Teblade (Nicholls); Recitations; Waltz, Le Retour du Printemps (Waldteufel); Selection from Il Troyatore (Verdi); Fox-Trot, Constantinople (Carlton); Selection from Napoli (Gade); Serenade, Spanish Waltz (Métra); Tango, Hollywood (Ellison); Fox-Trot, Ice-cream (Johnson, Moll and King). **6.20,** Talk. **6.50,** Weather Report. **7.0,** News and Exchange Quotations. **7.15,** Time Signal. **7.30,** Talk by E. Mellerup. **8.0,** Chimes from the Town Hall. **8.2,** Old Time Dance Music, followed by News. **9.15,** Modern Dance Music. **12.0 Midnight,** Chimes from the Copenhagen Town Hall. **12.15 a.m.** (Sunday), Dance Music. **1.0 a.m.** (approx.), Close Down.

KATOWITZ (**422 metres**); 10 kW.—**6.0,** Programme for Children. **7.0,** Miscellaneous News. **7.30,** Talk by Dr. Farnik. **7.55,** Agricultural Report. **8.15,** Concert relayed from **Warsaw.** **10.0,** Time Signal, Weather Report and News. **10.30,** Dance Music.

KAUNAS (**2.000 metres**); 7 kW.—**7.0,** Gramophone Selections. **9.0,** Concert by an Ex-Service Men's Orchestra. **10.0,** Dance Music.

KÖNIGSBERG (**329.7 metres**); 4 kW.—**12.0 Noon,** Programme relayed from the Stadthalle, Königsberg. **3.30,** Orchestral Concert, relayed from the Wireless Exhibition. **6.15,** Market Prices Report. **6.30,** Dr. Eppich, Talk: Five Years of German Broadcasting,

Programmes from Abroad.—

relayed from **Danzig** (272.7 metres). **7.0**, Programme Announcements in Esperanto. **7.5**, Talk: Memoirs of the Gymnast, Ludwig Jahn, in Commemoration of the 150th Anniversary of his Death, relayed from **Danzig**. **8.30**, Programme from **Voxhaus**, followed by Weather Report, News and Sports Notes; Dance Music, relayed from **Voxhaus**.

LAHTI (1,522.8 metres); 35 kW.—**5.0**, Orchestral Selections: Kronoborgsregementets Marsch (Latann); Selection from The Gipsy Baron (Strauss). **5.30**, Talk by Arvo Alanne. **5.50**, Orchestral Selections: Valse (Lanner); Romance (Beccé); Selection from Mademoiselle Nitouche (Hervé); Melodies (Offenbach). **7.30**, Finnish Songs. **7.50**, Orchestral Concert. **8.45**, News in Finnish and Swedish. **9.15**, Restaurant Relay. **10.0**, Close Down.

LANGENBERG (468.8 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**12.0 Noon**, Relay of the Ceremony from the Reichstag. **Berlin. 1.5**, Concert from **Elberfeld**: Carnival March (Fink); Overture to Athalie (Mendelssohn); Waltz, Dorfschwalben aus Osterreich (Strauss); Selection from Rigoletto (Verdi); Dramatic Legend (Beccé); Radetzky-Marsch (Strauss); Potpourri from The Merry Widow (Lehár); The Lost Chord (Sullivan); Gelübde (Fatuo). **2.30**, Programme from **Cologne. 4.30**, Programme from **Königswusterhausen. 5.0**, Programme from **Cologne. 6.0**, Concert from **Düsseldorf**: Reitermarsch (Schubert); Overture to The Force of Destiny (Verdi); Selections from Der Evangelimann (Kienzl); Waltz, Seid Umschlungen Millionen (Joh. Strauss); Selection from Paganini (Lehár); Prelude and March from Der Bergische Löwe (Ebert). **7.15**, Programme from **Cologne. 7.45**, Westphalian Programme from **Dortmund. 8.30**, Programme from the Berlin Opera House. **9.30 to 1.0 a.m.** (Sunday), Programme from **Cologne.**

LEIPZIG (365.8 metres); 4 kW.—**12.0 Noon**, Relay from the Reichstag, Berlin. **1.15**, News and Exchange Quotations. **3.0**, Orchestral Concert from the Jahresschau, Dresden. **4.30**, Orchestral Concert. **6.30**, The Letter Box. **6.45**, Weather Report and Time Signal. **7.0**, Dr. Rudolphi, Talk: Conditions of Life at the Pole. **7.30**, F. Schille, Talk: Practical Hints for the Week-ender. **8.0**, Talk: Friedrich Ludwig Jahn. **8.30**, Programme from **Voxhaus. 10.0**, News and Sports Notes. **10.30**, Programme from **Voxhaus.**

MADRID (Union Radio), Call EAJ7 (375 metres); 3 kW.—**7.0**, Sextet Selections: Selection from Le Roi Malgré Lui (Chabrier); Selection from Las Corsarias (Alonso); Selection from Macbeth (Verdi); Interlude by Luis Medina. **8.0**, Dance Music. **9.45**, Agricultural Report. **10.0**, Chimes. **10.2**, Symphony Concert: Overture to Carnaval Romain (Berlioz); Chorale from the 140th Cantata (Bach); Symphonic Illustrations (Bacarisse); Fourth Symphony (Brahms); Petite Suite (Debussy); Scherzo from L'Apprenti Sorcier (Dukas); News. **12.0 Midnight**, Dance Music. **12.30 a.m.** (approx.) (Sunday), Close Down.

MILAN, Call 1MI (526.3 metres); 7 kW.—**8.35**, Time Signal and Talk. **8.45**, News. **8.50** (approx.), Variety Concert: Fingal's Cave (Mendelssohn); Undine's Dance from Lorelei (Catalani); Baritone Solos, (a) Die Linden (Schubert); (b) April (Tosti). Soprano Solos (Scontrino and Tosti); Sonata in B Flat Major for Pianoforte (Clementi); Tenor Solos, (a) Celeste Aïda, from Aïda (Verdi), (b) The Death of Othello, from Othello (Verdi); Baritone Solo from Hérodiade (Massenet); Soprano Solo from Il Trovatore (Verdi); Pianoforte Solos, (a) Tango (Godovsky), (b) Spinning Chorus from The Flying Dutchman (Wagner); Tenor Solo from Cavalleria Rusticana (Mascagni); Tarantelle (Cui). **10.55**, News, followed by Dance Music. **11.45** (approx.), Close Down.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (290.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres).—**12.35**, Weather Report. **12.45**, Exchange Quotations. **12.55**, Time Signal. **5.30**, Children's Programme. **6.15**, Roli Cabaret Programme. **7.30**, Reading of Dialect Poetry. **7.45**, Talk: Professions and occupations, followed by Talk on Topicalities. **8.15**, Concert from **Göteborg. 9.15**, News and Weather Report. **9.45**, Olympic Games Report. **10.9**, Dance Music from **Göteborg. 11.30**, Rolf Dance Orchestra. **1.0 a.m.** (approx.) (Sunday), Close Down.

MUNICH (535.7 metres); 4 kW.—**6.0**, Talk on Wireless. **7.0**, The Letter Box. **7.30**, Zither Duet Recital: Rêverie, Traumesnacht (Haustein); Variations on an old German Song (Richter); Die Spieldose (Obermeier); Humoresque (Obermeier); Waltz Intermezzo; Im Banne der Liebe (Benzinger). **8.0**, Programme to be announced. **10.0**, Talk and News. **10.45**, Dance Music relayed from the Galerie Arcadia, Munich.

Saturday, August 11th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

NAPLES, Call 1NA (333.3 metres); 1.5 kW.—**8.20**, Wireless Notes. **8.40**, Time Signal and News, followed by Harbour Notes. **8.50**, Light Music: Overture to The Betrothal by Lantern Light (Offenbach); La secchia rapita (Burgmein): Ballo amor (Marenco). **9.30**, Relay from a Naples Theatre; Dance Music in the Intervals. **10.0**, Topical Review. **10.50**, News. **10.55**, Calendar, Programme Announcements and Close Down.

OSLO (461.5 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), and **Rjukan** (448 metres). **7.45**, Weather Report, News, Agricultural Report and Time Signal. **8.2**, Recitations (G. Scott). **8.30**, Orchestral Concert: Overture to Zampa (Hérold); Andante from the Fifth Symphony (Tchaikovsky); Tränme (Wagner). **9.30**, Weather Report and News, followed by Topical Talk. **10.0**, Orchestral Concert: Spring Song (Mendelssohn); Trois Chansons (Kjerulf); Canzonetta (Godard); Suite from Wolgageister (Leuschner). **10.30**, Dance Music from the Grand Hotel. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (2,650 metres); 5 kW.—**6.45**, "Le Journal Parlé," Talk: "Safeguarding Patrimony." **8.10**, Weather Report. **8.30**, Concert: Chœur des fileuses from Karmaria (Erlanger); Prelude to Karmaria (Erlanger); Le mariage des roses (Franck); Violin Solo, Lied (Franck); The First Spanish Dance (de Falla); Villanelle (Ganne); Selections (Levadé), (a) Feuillets d'Album; (b) Rose de Mai; (c) Fritz de Suzel; (d), En Rêvant; (e) Colombine; (f) Chanson des pâtres; (g) Petite Marche; Piece for Flute, Vers l'Eglise dans le soir (Ladmirault); Ballet Music from Isoline (Messager); Scènes Foraines (Mignan).

PARIS (Petit Parisien) (340.9 metres); 0.5 kW.—**8.45**, Gramophone Selections. Talk on Radio Programmes, and News. **9.0**, Concert: Overture to Madame Favart (Offenbach); Greek Dance from Les Erinnyes (Massenet); Ein Sonntag (Brahms); Le Songe d'une nuit d'été (Thomas); L'apprenti sorcier (Dukas); Air from Rozenn (Lalo); Minuet from the Septet (Saint-Saëns); L'Attente (Saint-Saëns); Russian Ballet (Luigini); Berceuse (Glazounov); Mélodie-caprice (Squire); Sérénade-valse (Staub); El Capitan (Sousa).

PARIS (Radio-Paris), Call CFR (1,750 metres); 6 kW.—**12.30**, Gramophone Selections, News in the Intervals. **1.50**, Market Prices and Religious Announcements. **3.45**, Dance Music, News in the Intervals. **8.0**, Agricultural Report. **8.15**, Medical Talk, followed by Market Prices and News. **8.30**, Concert: Serenades (Tchaikovsky, Grétry, Schubert and Massenet); Imitation Musicale; Concerto for Flute and Orchestra (Mozart); News in the Intervals.

PITTSBURGH, Call KDKA (63 and 27 metres); 25 kW.—**11.0 p.m., to 4.15 a.m.** (Sunday), Time Signal and Baseball Scores, followed by Variety Concert; Orchestral Selections, Literary Talk, Band Music, Time Signal, Weather Report and Baseball Scores.

POSEN (344.8 metres); 1.5 kW.—**6.3**, Children's Programme, from **Warsaw. 7.0**, Miscellaneous Items. **7.35**, Talk by M. Herniczek. **8.0**, Financial Report. **8.15**, Programme from **Warsaw. 10.0**, Time Signal, News, Weather Report and Miscellaneous Items. **10.40**, Dance Music from the Carlton Restaurant. **12.0 Midnight**, Orchestral Concert arranged by Maison Philips. **2.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (348.9 metres); 5 kW.—**6.0**, German Transmission. **6.25**, Agricultural Report. **6.35**, Talk for Workers. **7.30**, Slovakian Orchestra. **8.30**, Programme of Songs. **9.5**, Sports Notes from Amsterdam. **9.10**, Programme from **Brünn. 10.0**, Time Signal and News. **10.25**, Programme from **Brünn.**

RIGA (526.3 metres); 4 kW.—**6.0**, Programme of Talks. **7.0**, Concert: Overture to Semiramide (Rossini); Valse triste (Sibelius); The Rustle of Spring (Sinding); Scènes pittoresques (Massenet); Songs; Violin Solo; Songs; Spanish Rhapsody (Chabrier); The Second and Third Movements from the Symphonie pathétique (Tchaikovsky). **9.0** (approx.) Weather Report and News. **9.10** (approx.), Dance Music. **11.0** (approx.), Close Down.

ROME, Call 1RO (447.8 metres); 3 kW.—**1.0**, Concert of Trio Music. **2.0**, News. **4.40**, Opening Signal and News. **4.50**, Children's Corner. **5.15**, Agricultural Report. **5.29**, Time Signal. **5.30**, Concert: 'Cello Solos, (a) Andantino (Martini), (b) Czardas (Fischer); Bass Solos (a) Air from Sonnambula (Bellini), (b) Air from Ernani (Verdi); Soprano Solo, Minuetto allegro(Gaffii); 'Cello Solo, Variations (Boellmann); Bass Solos, (a) Occhi di fata (Denza), (b) The Last Song (Tosti); Soprano Solos, (a) On Wings of Song (Mendelssohn), (b) In sandolo (Bianchini). **8.10**, Time Signal and Government Report. **8.30**, Sports Notes, News and Weather Report. **8.47**, Topical Talk. **8.59**, Time Signal. **9.0**, "I Pagliacci" Opera (Leoncavallo); in the First Interval: Review of Art and Literature. **11.5**, News. **11.15**, Close Down.

SCHENECTADY, Call 2XAD and 2XAF (21.96 and 31.4 metres); 30 kW.—**11.55**, Baseball Scores. **12.0, Midnight**, Concert by Statler's Pennsylvanians, directed by Johnny Johnson, from **New York. 12.30, a.m.** (Sunday), Concert from the Hotel Sagamore, **Rochester. 1.0 a.m.**, Keystone Duo with Balladeers, from **New York. 1.30 a.m.**, Time Signal. **1.32 a.m.**, Concert by the New York Philharmonic Orchestra, conducted by Willem Van Hoogstraten, from the Lewissohn Stadium. **3.20 a.m.**, Organ Recital by Robert Berentsen, from **Rochester. 4.0 a.m.**, Dance Music from **Buffalo. 5.0 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**4.30**, Orchestral Concert. **5.30**, Cereal Market Prices. **6.15**, Concert of Turkish Music. **8.30**, Weather Report and Time Signal. **8.40**, Orchestral Concert: Suite Internationale (Tchaikovsky); Soprano Solos; Waltz from Mireille (Gounod), Romances (Gounod), Cavalleria Rusticana (Mascagni); Suite Napolitaine (Mascagni). **10.0**, News, and Close Down.

STUTTGART (379.7 metres); 4 kW.—**12 Noon**, Relay of the Ceremony from the Reichstag, **Berlin. 1.0**, Weather Report and Gramophone Selections. **2.15**, News. **2.30**, Children's Programme. **3.30**, Concert of Italian Opera Music. **6.0**, Time Signal and Weather Report. **6.15**, Legal Talk, relayed from **Freiburg** (577 metres). **6.45**, Talk for Motorists by L. Leibfried. **7.15**, Richard Tschorn, Talk: The 150th Birthday Anniversary of the gymnast Jahn. **7.45**, Report of the South-west German Labour Exchange, Time Signal, Weather Report, and Sports Notes. **8.30**, Programme from **Voxhaus**, followed by News, Sports Notes and Concert: Josma Selim and Dr. Ralph Benatzky.

VIENNA (577 and 517.2 metres); 1.5 and 5 kW.—**4.0**, Orchestral Concert. **5.50**, Concert: Air from Der Zarewitsch (Lehár), Da fällt der Himmel (Engel-Berger), In der Lobau (Strecker); Violin Solos, (a) Tambourin Chinois (Kreisler), (b) Gitarre (Moszkovsky), (c) Variations (Tartini-Kreisler); Neapolitan Folksongs; Air from St. Paul (Mendelssohn). Air from Iphigenia in Tauris (Glück); Pianoforte Solo, Soirée de Vienne (Liszt). **6.50**, Humorous Sports Anecdotes by Paul Askonas. **7.45**, "Susi," Operetta (Martos), followed by Programme of Dance Music.

VILNA (435 metres); 1.5 kW.—**7.0**, Programme for Women. **7.25**, Historical Talk: The Declaration of Rights; History of the French Revolution. **7.50**, Miscellaneous News. **8.15**, Programme from **Warsaw. 11.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**7.0**, Miscellaneous Items. **7.30**, Talk: Health and Medicine. **7.55**, Agricultural Report. **8.5**, News and Announcements. **8.15**, Popular Concert: Overture to William Tell (Rossini), Potpourri from A Masked Ball (Verdi), Intermezzo from Ratcliff (Mascagni), Marche solennelle (Meyerbeer), Potpourri from Die geschiedene Frau (Fall); Gold and Silver Waltz (Lehár); Soloist, Potpourri from Bocaccio, Barcarolle from Tales of Hoffman (Offenbach), Potpourri from A Waltz Dream (Strauss); Gavotte, Sylphides (Lehár); Recitations: The Starspangled Banner (Sousa); In the Interval, News in French. **10.0**, Time Signal, Aviation Notes, Weather Report, Announcements, and Sports Notes. **10.30**, Dance Music from the Oaza Restaurant. **11.30** (approx.), Close Down.

ZURICH (588 metres); 1 kW.—**4.0**, Orchestral Concert from the Carlton-Elite Hotel. **5.20**, Orchestral Concert. **5.55**, Weather Report and Market Prices. **7.0**, Zurich Church Chimes. **7.45**, Time Signal, Weather Report and Talk. **8.15**, Popular Programme. **10.0**, Weather Report and News, followed by Close Down.

Programmes from Abroad.—

BARCELONA (Radio-Barcelona), Call EAJ1 (**344.8 metres**) ; 1.5 kW.—**12.0 Noon,** Chimes relayed from Barcelona Cathedral, followed by Regional and General Weather Report. **1.30,** Light Selections by the Iberia Instrumental Trio, with Gramophone Record Selections in the intervals. **2.45 to 9.0,** No Transmission. **9.0,** Sports Notes and Agricultural Report. **9.15,** Selections by the Station Orchestra. **10.0,** Relay of Chimes from the Cathedral followed by a Recital of Tenor Arias from Italian Operas by Miguel Artelli. **10.25,** Selections by the Station Orchestra. **11.0** (approx.), Close Down.

BERGEN (370.4 **metres**) ; 1.5 kW.—**10.30 a.m.,** Divine Service relayed from a Church. **12.30,** Weather Forecast and News Bulletin. **8.0,** Selections by the Station Orchestra. **9.0,** Travel Talk. **9.30,** Recital of Violin and Pianoforte Music by Mr. Lars Fermæus and Mrs. Gyllenkreutz Fermæus. **10.0,** Weather Forecast, News Bulletin and Time Signal. **10.15,** Selections of Music. **12.0 Midnight** (approx.), Close Down.

BERLIN (Königswusterhausen) **1,250 metres**) ; 40 kW.—**6.30 a.m.,** Orchestral Concert relayed from **Voxhaus.** In the Interval about **7.0 a.m.,** Gymnastic Exercises. **8.55 a.m.,** Chimes from the Potsdam Garrison Church. **9.0 a.m.,** Vocal and Organ Concert and Address, from **Voxhaus,** and Chimes from the Berlin Cathedral. **11.30 a.m.,** Concert relayed from **Voxhaus. 3.0,** Talk on Photography. **3.30,** Agricultural Programme, followed by Music, relayed from **Voxhaus. 6.30,** Literary Talk. **7.10,** Talk by Professor von Hauff, followed by Probable Relay from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**) ; 4 kW.—**6.30 to 8.0 a.m.,** Orchestral Concert, In the Interval, about **7.0 a.m.,** Gymnastic Exercises. **8.55 a.m.,** Chimes from the Potsdam Garrison Church. **9.0 a.m.,** Vocal and Organ Concert, with Religious Address in the Interval followed by Chimes from the Berlin Cathedral. **11.30 a.m.,** Orchestral Concert. **2.0,** Children's Programme : Fairy Stories for Children, told by Hans Bodenstedt. **3.30,** Agricultural Programme, Talks, and Review of Market and Weather Conditions for the past week, followed by Musical Programme and Station Notes. **7.0,** Programme of Talks. **8.30,** Musical Programme. **10.15,** News, Weather Report, Time Signal and Sports Notes. **10.30,** Dance Music by Gerhard Hoffmann's Orchestra. **12.30 a.m.** (approx.) (Monday), Close Down.

BERN (**411 metres**) ; 1.5 kW.—**10.30 a.m.,** Divine Service Relay. **1.0,** Time Signal and Weather Forecast. **1.5,** Orchestral Concert. **3.30 to 5.35,** Concert by the Bern Municipal Orchestra. **8.0,** Time Signal and Weather Forecast. **8.15** (approx.), Musical or Dramatic Programme. **9.45,** Sports, News Bulletin and Weather Report. **10.0,** Selections by the Bern Municipal Orchestra. **10.35** (approx.), Close Down.

BEZIERS (**158 metres**) ; 0.6 kW.—**8.15,** News Bulletin and Sports Notes. **8.30,** Concert of Instrumental Music. **9.0,** Dance Music Programme.

BREMEN (**272.7 metres**) ; 0.7 kW.—**6.30 a.m.,** Orchestral Concert relayed from **Voxhaus. 8.25 a.m.,** Time Signal, Weather Forecast, and News Bulletin, from **Hamburg. 11.0 a.m.,** Talk relayed from **Hamburg. 12.55,** Nauen Time Signal. **1.0,** Instrumental Concert. **2.0,** Children's Programme from **Hamburg,** followed by Talks and Musical Programme. **8.0,** Concert or Opera followed by Weather Forecast, News Bulletin, and Concert relayed from a Restaurant. **11.0** (approx.), Close Down.

BRESLAU (**322.6 metres**), 4 kW.—**8.45 a.m.,** Chimes relayed from Christchurch, Breslau. **11.0 a.m.,** Catholic Morning Recital. **12.0 Noon,** Selections of Music. **2.0,** Competitions. **2.35,** Lesson in Chess by Adolf Kramer. **3.0,** Reading of Fairy Tales. **3.30,** Talk on Agriculture, followed by Programme of Talks and Music. **8.15,** Special Report on the Olympic Games in Amsterdam (Part 1). **8.30,** Instrumental and Vocal Concert. **10.0,** News Bulletin followed by Report on the Olympic Games (Part 2). **10.30,** Programme of Dance Music. **12.0 Midnight** (approx.), Close Down.

BRÜNN (**441.2 metres**) ; 3 kW.—**9.15 a.m.** (approx.), Agricultural Report. **11.0 a.m.,** Concert of Classical Music. **3.0,** Instrumental Concert. **4.0,** Popular Programme. **6.0,** Programme for German Listeners. **7.0,** Orchestral Concert of Popular Music. **10.15** (approx.), Musical Programme. **11.0** (approx.), Close Down.

BRUSSELS (**508.5 metres**) ; 1.5 kW.—**5.0,** An Hour's Entertainment by the Dance Orchestra at the Ostend Kursaal. **6.0,** A Half-Hour for the Children. **6.30,** Instrumental Concert. **7.30,** Le Radio-Chronique—Journal Parlé of Radio-Belgique. **8.15,** Musical Interlude. **9.0,** Symphony Concert, under the direction of François Rasse, relayed from the Kursaal, Ostend. **10.15** (approx.), News Bulletin. **10.30** (approx.), Close Down.

SUNDAY, AUGUST 12th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

BUDAPEST (**555.6 metres**) ; 35 kW.—**9.0 a.m.,** News Bulletin and Beauty Culture Talk. **10.0 a.m.,** Catholic Divine Service. **12.0 Noon,** Chimes Relay, followed by Weather Forecast and Time Signal and Programme of Instrumental Music. **3.30,** Programme of Agricultural Talks. **4.15,** Programme for Children, followed by Weather Forecast, Musical and Dramatic Programme, Sports Notes in the interval. **10.30** (approx.), Tzigane Music, relayed from the Café Spolarits. **12.0 Midnight** (approx.), Close Down.

CHATELINEAU (**220 metres**) ; 1.5 kW.—**8.0,** Orchestral Concert ; during the Programme Selections from the Works of Wagner, and Talk. **10.0** (approx.), Brabançonne and Marseillaise, followed by Close Down.

COLOGNE (**283 metres**) ; 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (468.8 metres) and **Münster** (250 metres).—**9.0 a.m.,** Catholic Morning Recital of Sacred Music, with Address and Bible Reading, followed by Talk on the Worth and Honour of the German Tongue by Fritz Würm, relayed from **Düsseldorf. 1.0,** Concert of Orchestral Music, followed by Programme of Talks, Literary Selections and Music, with Chess Lesson. **8.0,** "Die Czardasfürstin," Operetta (Kalman), followed by Last News Bulletin, Sports Notes, Orchestral Selections and Dance Music Programme. **12.0 Midnight** (approx.), Close Down.

CORK, Call 6CK (**400 metres**) ; 1.5 kW.—**8.30,** Instrumental and Vocal Concert, with Edgar Williams (Tenor), Raymonde Amy (Soprano), David Clancy (Baritone), Laurence McCann (Violinist), Harry Whitehouse (Tenor), and the Station Quintet. **11.0,** National Anthem. **11.5** (approx.), Close Down.

CRACOW (**566 metres**) ; 1.5 kW.—**12.0,** Fanfare, relayed from the Church of Notre Dame in Cracow, Time Signal and Weather Forecast. **4.0,** Programme of Talks for Farmers. **4.40,** Weekly Agricultural Review by Dr. St. Wasniewski. **5.0,** Programme from **Warsaw. 8.0,** Sports Notes. **8.30,** Vocal and Instrumental Concert, featuring Mr. Wolf ('Cello), Mme. R. Freundlich (Pianoforte), Mme. Lachman-Milewska and Mr. St. Siwik (Vocalists) and Mr. Casimir Peteeki (Accompanist), including St. Niewiadomski's Les Pavots ; Veni Creator, and Sur le Chalumeau, sung by Mme. Milewska. **10.0,** Programme, relayed from **Warsaw. 10.30,** Relay of a Concert from a Restaurant. **11.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**) ; 1.5 kW.—**8.30,** Programme, relayed from the Cork Station ; Instrumental and Vocal Concert, with Selections by the Station Quintet. **11.0,** National Anthem. **11.5** (approx.), Close Down.

FRANKFURT (**428.6 metres**) : 4 kW.—**8.0 a.m.,** Morning Recital. **11.0 a.m. to 11.30 a.m.,** Talk for Parents under the direction of Herr Dr. Flesch and Herr K. Wehran, Director of Education. **3.0,** The Children's Hour, conducted by Herr K. Wehran. **4.0,** The Südwestdeutscher Rundfunk Orchestra, followed by Programme of the Rhein-Main Association for Popular Education. **7.30** (approx.), Musical Programme, followed by Concert or Dance Music.

HAMBURG, Call HA (in Morse), (**394.7 metres**) ; 4 kW.—Programme, relayed by **Bremen** (272.7 metres), **Hanover** (297 metres), and **Kiel** (254.2 metres).—**6.30 a.m.,** Orchestral Concert, relayed from **Voxhaus. 8.25 a.m.,** Time Signal, Weather Report and News Bulletin. **11.0 a.m.** (**Hamburg, Hanover,** and **Bremen**), Talk on a Technical Subject, by Dr. Funk, followed by Commercial Talk and Musical Programme. **12.55,** International Time Signal, relayed from **Nauen. 1.0** (for **Hamburg** and **Kiel** only), Orchestral Concert. **2.0,** Funkheinzelmann's Programme for Children. **3.0 to 7.40,** Programme of Talks and Music. **7.40,** Sports Notes and Weather Report. **8.0,** Musical Evening, followed by Weather Forecast, News Bulletin and Concert from the Café Wallhof (for **Hamburg** and **Kiel** only). **11.0** (approx.), Close Down.

HANOVER (**297 metres**) ; 0.7 kW.—**6.30 a.m.,** Orchestral Concert, relayed from **Voxhaus. 8.25 a.m.,** Time Signal, Weather Forecast and News Bulletin, from **Hamburg. 11.0 a.m.,** Programme, relayed from **Hamburg. 12.55,** Time Signal from **Nauen. 1.0,** Programme of Gramophone Record Music, followed by Talks and Musical Programme. **8.0,** Concert or Opera, followed by Weather Report, News Bulletin, and Concert, relayed from a Restaurant. **11.0** (approx.) Close Down.

HILVERSUM (**1,071 metres**) ; 5 kW.—**12.40 to 2.10,** Lunch-time Music by the Station Trio. **5.40** (approx.), Concert by the Wireless Orchestra, conducted by Nico Treep. **7.40,** News Bulletin. **7.55** (approx.), Concert by the Residence Orchestra, directed by Prof. Georg Schneevoigt, including items by a Soloist, relayed from the Kurhaus, **Scheveningen.**

HUIZEN (**340.9 metres**) ; 4 kW.—Programme on 1,950 metres after **5.40.**—**8.10 to 9.10 a.m.,** Divine Service and Vocal Music. **12.10,** Concert by the Winkels Trio, of Amsterdam. **1.10,** Talk, followed by Concert and Programme for Hospitals. **5.0** (approx.), Divine Service Relay. **7.25,** Talk. **7.55,** Concert by the Orchestra of the Catholic Broadcasting Association, conducted by Mr. M. v.d. Ende ; Popular Items. **10.25,** Epilogue by the Choir and Close Down.

JUAN-LES-PINS (Radio LL) (**244.5 metres**) ; 1.5 kW.—**1.0 to 2.0,** Concert of Orchestral Selections by the Izar Orchestra, relayed from the Casino of Juan-les-Pins ; in the Interval, Children's Corner, by Radiolo. **9.0 to 10.0,** News Bulletin, Weather Forecast and Orchestral Selections. **10.0,** Programme of Dance Music by the Casino Dance Orchestras. **10.30** (approx.), Close Down.

KALUNDBORG (**1,153 metres**) ; 7 kW.—Programme also for **Copenhagen** (337 metres).—**10.0 a.m.,** Divine Service, relayed from a Church. **11.30 a.m.** (for **Kalundborg** only), Weather Forecast. **2.0,** Divine Service, followed by Programme of Music. **6.50** (for **Kalundborg** only), Weather Forecast. **7.0,** News Bulletin. **7.15,** Time Signal. **7.30,** Talk. **8.0,** Chimes, relayed from the Copenhagen Town Hall. **8.5,** Vocal and Instrumental Concert, followed by News Bulletin **10.0,** Orchestral Concert, including Handel's Concerto Grosso, No. 5, (a) Andante Allegro, (b) Adagio, (c) Allegro ma non troppo, (d) Allegro ; followed by Dance Music Programme : in the Interval and **12.0 Midnight,** Relay of Chimes from the Copenhagen Town Hall. **12.30 a.m.** (approx.) (Monday), Close Down.

KAUNAS (**2,000 metres**) ; 7 kW.—**12.0 Noon,** Chimes Relay, Weather Report and Sacred Music Recital. **6.30,** Wireless Bulletin for Housewives. **7.30,** Talk on Health. **8.30,** Ceremony of the Lowering of the Flag, relayed from the War Museum. **8.40,** Time Signal, Weather Forecast and Political Events Review. **9.0,** Instrumental Concert. **10.30** (approx.), Close Down.

KIEL (**254.2 metres**) ; 0.7 kW.—**6.30 a.m.,** Orchestral Concert, relayed from **Voxhaus. 8.25 a.m.,** Time Signal, Weather Report, News Bulletin from **Hamburg. 10.55 a.m.,** Divine Service, relayed from the University Church in Kiel. **12.55,** Nauen Time Signal. **1.0,** Concert from **Hamburg. 2.0,** Funkheinzelmann's Programme for Children, relayed from **Hamburg,** followed by Musical Programme and Talks. **7.40,** Sports Notes. **7.55,** Weather Forecast. **8.0,** Musical Programme, followed by Weather Forecast, News Bulletin and Concert from the Café Wallhof, **Hamburg. 11.0** (approx.), Close Down.

KÖNIGSBERG (**329.7 metres**) ; 4 kW.—Programme relayed by **Danzig** (272.7 metres).—**9.0 a.m.,** Sacred Morning Recital of Vocal and Organ Music, with Address. **11.0 a.m.,** Weather Forecast, followed by Instrumental Music. **12.55,** International Time Signal from **Nauen,** followed by Weather Forecast. **3.0 to 8.0,** Programme of Talks and Music. **8.0,** Popular Concert of Opera Selections, relayed from the Zoppot Kurgarten : Soloist, Ilonka v. Ferenczy, and the Danzig Municipal Theatre Orchestra ; in the Programme : Andante con moto from the Symphony in C Major (Schubert). **10.0,** News Bulletin and Sports Notes, followed by Dance Music Programme. **12.0 Midnight** (approx.), Close Down.

LAHTI (**1,522.8 metres**) ; 35 kW.—Programme also for **Helsingfors** (375 metres).—**9.0 a.m.,** Divine Service in the Finnish Language. **11.0 a.m.** (approx.), Concert of Orchestral and Vocal Selections. **11.50 a.m.,** Weather Forecast and Time Signal. **12.0 Noon,** Divine Service in the Finnish Language, followed by Afternoon Programme of Music and Recitations. **5.57,** Time Signal and Weather Forecast. **6.10,** Orchestral and Vocal Concert, including Melodies from Faust (Gounod). **8.45,** Last News Bulletin in Finnish and Swedish. **9.15,** Relay of a Concert from a Restaurant. **10.0** (approx.), Close Down.

LANGENBERG (**468.8 metres**) ; 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**9.0 a.m.,** Sacred Catholic Morning Recital, relayed from **Cologne,** followed by Talk on the Worth and Honour of the German Tongue, by Fritz Würm, relayed from **Düsseldorf. 1.0,** Concert of Orchestral Music, followed by Programme of Talks, Literary Selections and

Programmes from Abroad.—

Sunday, August 12th.

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Music and Chess Lesson. **6.0,** Talk on "Animals in Word and Song," by Dr. Leonhard Blass, followed by Programme from **Cologne.** **12.0 Midnight** (approx.), Close Down.

LEIPZIG (**365.8 metres**); 4 kW.—**11.0 a.m.,** Instrumental Concert. **12.0 Noon,** Two Talks, arranged by the Hans Bredow Foundation. **1.0,** Two Agricultural Talks. **2.0,** Review of the Foreign Press. **2.15.** Programme of the Deutscher Sprachverein. **2.30,** Orchestral Concert, relayed from the Jahresschau in **Dresden.** **4.30,** Instrumental Concert, followed by Programme of Talks. **7.30,** Programme of Music: Songs by well-known Wireless Artistes from Leipzig and Dresden; Listeners are requested to guess the names of the singers, and Prizes will be awarded by the Wireless Journal, "Die Mirag": in the Intervals, Gramophone Records, followed by Orchestral Music. **12.0 Midnight** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**375 metres**); 3 kW.—Programme relayed by **Salamanca,** EAJ22 (405 metres).—**2.0,** Selections by the Artys Orchestra. **3.30 to 7.0,** No Transmission. **7.0,** Kiki and his Friends, with Luis Medina in a Programme for Children. **8.0,** Sextet Selections of Dance Music. **8.30 to 10.0.** No Transmission. **10.0,** Relay of Chimes, Time Signal and Selections by the Station Orchestra. **10.45,** Concert by the Municipal Band, under the Direction of Señor Villa. **12.0 Midnight.** Dance Music Programme by the Palermo en Rosales Orchestra. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, Call 1MI (**526.3 metres**); 7 kW.—**10.30 a.m.,** Vocal and Instrumental Concert of Sacred Music. **12.30,** Time Signal and Concert by the Wireless Quartet. **4.0,** Opening Signal followed by Concert of Quintet and Vocal Selections. **8.25,** Opening Signal, Wireless Notes and Report. **8.35,** Time Signal followed by Talk. **8.45,** Sports Notes. **8.50,** "Rigoletto" Opera (Verdi); After the Second Act, News Bulletin and Sports Notes. **11.45** (approx.), Close Down.

MOTALA (**1,380 metres**); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), and **Sundsvall** (545.6 metres). **11.0 a.m.,** Divine Service. **5.0,** Programme for Children. **6.0,** Divine Service. **7.15,** "Chitra," Dramatic Prose Poem (Rabindranath Tagore), followed by Programme of Music. **9.45,** Special Report on the Olympic Games in Amsterdam, followed by Programme of Old-time Dance Music. **11.0** (approx.), Close Down.

MUNICH (**535.7 metres**); 4 kW.—Programme relayed by **Augsberg** (566 metres), **Kaiserlautern** (204.1 metres) and **Nuremburg** (241.9 metres).—**11.0 a.m.,** Chimes relayed from the Munich Town Hall. **11.15 a.m.,** Weather Forecast. **1.5,** Time Signal, Weather Report and Programme Announcements. **1.15,** Agricultural Report followed by Programme of Musical and Literary Selections. **4.0,** Special Relay from the Prince Regent Theatre in Munich of the Second Day of the Dramatic Festival, "Der Ring des Nibelungen," "Siegfried" (Wagner). **9.30** (approx.), News Bulletin. **10.0,** Musical Programme. **12.0 Midnight** (approx.), Close Down.

NAPLES, Call 1NA (**333.3 metres**); 1.5 kW.—**10.0 a.m.,** Concert of Sacred Music. **4.45,** Programme for Children. **5.0,** Vocal and Instrumental Concert. **5.30,** Time Signal. **8.20,** Wireless News. **8.40,** Time Signal. **8.48,** Report of the Authorities of the Harbour of Naples. **8.50,** Concert of Italian and Foreign Music, including "La Figlia di Jefte," Comedy in One Act (F. Cavalotti). **10.0,** Sports Notes. **10.55,** Calendar and Programme Announcements for the Following Day. **11.0** (approx.), Close Down.

OSLO (**461.5 metres**); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), and **Rjukan** (448 metres). **10.20 a.m.** (approx.), Chimes, followed by Divine Service. **7.45,** Weather Forecast and News Bulletin. **8.0,** Time Signal, followed by Musical Programme. **9.30** (approx.), Weather Forecast and News Bulletin. **9.45,** Talk on Topical Events. **10.0,** Dance Music relayed from the Hotel Bristol. **12.0 Midnight** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (**458 metres**); 0.5 kW.—Programme relayed at intervals by the following stations: **Bordeaux PTT** (275 metres), **Eiffel Tower** (2,650 metres), **Grenoble** (416 metres), **Lille PTT** (264 metres), **Limoges** (285 metres), **Lyons PTT** (476 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse PTT** (260 metres). **8.0 a.m.,** News Bulletin and Time Signal. **10.25 a.m.,** Time Signal and Weather Forecast. **1.30,** Orchestral Concert. **6.0,** Le Radio-Journal de France. **8.30,** Sports Talk. **9.0,** Concert of Instrumental Music, followed by Dance Music, Programme relayed from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**2,650 metres**); 5 kW.—**8.56 a.m.,** Time Signal on 32.5 metres. **10.26 a.m.,** Time Signal on 2,650 metres. **6.45,** Le Journal Parlé par T.S.F., Programme of Talks. **8.10,** Weather Forecast. **8.30,** Concert by Mario Cazes and his Orchestra. **8.56,** Time Signal on 32.5 metres. **11.26,** Time Signal on 2,650 metres.

PARIS (Petit Parisien) (**340.9 metres**); 0.5 kW.—**8.45,** Gramophone Records, Talk and News Bulletin. **9.0,** Orchestral Concert with Vocal Solos by M. Rousseau of the Opera-Comique. **9.25,** News Bulletin. **9.30,** Half-an-Hour of Symphony Music, under the Direction of M. Francis Casadesus. In the Programme, Life is a Journey from "The Magic Flute" (Mozart). **10.0,** News Bulletin, followed by Instrumental Concert. **11.0** (approx.), Close Down.

PARIS (Radio L.L.) (**370 and 60 metres**); 1 kW.—**12.30 to 1.0,** Radio-Liberté Programme—News Bulletin and Review of Events by "La Liberté," followed by Musical Programme. **3.0,** Concert of Dance Music (No Evening Transmission).

PARIS (Radio-Paris), Call CFR (**1,750 metres**); 6 kW.—**8.0 a.m.,** News Bulletin. **12.0 Noon,** Sermon by the Rev. Father Padé, followed by Recital of Sacred Music, Choral Selections. **12.30,** News Bulletin. **12.45,** Albert Locatelli Orchestral Concert. **4.30,** Dance Music Programme, in the Intervals, News. **8.0,** Agricultural Report. **8.15,** News Bulletin. **8.30,** Concert of Symphony Music Conducted by M. Eugène Bigot. In the Intervals, News.

PITTSBURGH, Call KDKA (**63 and 27 metres**); 25 kW.—**3.45,** Telechron Time Signal. **4.0,** Divine Service relayed from a Church. **7.0,** Roxy's Stroll Programme, relayed from Station WJZ, **New York.** **9.0,** Telechron Time Signal. **9.2,** Dr. Sockman's Question Box, from WJZ. **10.0,** Twilight Reveries, from WJZ. **11.0,** Telechron Time Signal, Baseball Scores and Instrumental Music. **11.30,** Atlantic City—KDKA Ensemble Concert, Conducted by Victor Saudek, relayed from the Palm Room of the William Penn Hotel, Pittsburgh. **12.0 Midnight,** Telechron Time, Baseball Scores, and Continuation of Ensemble Concert. **1.0 a.m.** (Monday), Miscellaneous. **1.45 a.m.,** Whittall Anglo-Persians from WJZ. **2.15 a.m.,** Concert by the Goldman Band, from WJZ, Longine Time. **3.15 a.m.,** Baseball Scores, Telechron Time Signal, Atlantic City. **10.30 a.m.** (approx.), Close Down.

POSEN (**344.8 metres**); 1.5 kW.—**5.0,** Concert, relayed from **Warsaw.** **6.30,** Bulletin of the Polish League of Youth. **6.50,** Talk; Programme relayed from **Warsaw.** **7.15,** Talk by M. Busiakiewicz: Silva Rerum. **7.45,** Talk: Programme from **Warsaw.** **8.30,** Concert by the Orchestra of the Railway Employees, conducted by A. Zdun; Artistes, Mlle. Jeanne Wojciechowska (Soprano, Mr. Kajetan Kopczynski (Baritone), and Mr. W. Yrlej Jurkiewicz (Pianoforte); in the Programme, Pianoforte Solos from the Works of Debussy and Chopin. **10.0,** Time Signal, Weather Forecast and News Bulletin. **10.20,** Miscellaneous Items. **10.40** Dance Music, relayed from the Palais Royal Restaurant in Posen. **12.0 Midnight** (approx.), Close Down.

PRAGUE (**348.9 metres**); 5 kW.—**7.0 a.m.,** Open Air Concert, relayed from **Carlsbad,** followed by Musical Selections and Agricultural Report. **7.0** (approx.), Popular Concert, followed by Exhibition Relay and News Bulletin.

RIGA (**526.3 metres**); 4 kW.—**10.15 a.m.,** Relay of Divine Service in the Latvian Language from the Mara Church in Riga. **1.0,** Programme of Songs, Tales and Music for Children, followed by Agricultural Talks. **4.0,** Musical Programme. **9.0,** Weather Forecast, followed by Dance Music Programme. **11.0** (approx.), Close Down.

ROME, Call 1RO (**447.8 metres**); 3 kW.—**10.15 a.m.,** Recital of Vocal and Instrumental Sacred Music. **1.0** (approx.), Concert of Instrumental Trio Selections. **2.0 to 5.0,** No Transmission. **5.0,** Opening Signal, followed by Concert from the Studio. **6.0,** Dance Music Programme, relayed from the Casinetta in Rome. **8.0,** Various Announcements. **8.30,** Sports Notes and News Bulletin. **8.46,** Review of Current Events. **8.59,** Time Signal. **9.0,** Symphony Concert with Pianoforte and Vocal Solos; In the Programme, The Eighth Symphony in F Major (Beethoven): (a) Allegro vivace e con brio, (b) Allegretto scherzando, (c) Tempo di Minuetto, (d) Finale—Allegro vivace; during the interval, Reading of Sea Stories by Guido Milanesi. **11.5,** Last News Bulletin. **11.15** (approx.), Close Down.

SAN SEBASTIAN (Union Radio), Call EAJ8 (**335 metres**); 0.5 kW.—**10.0 to 12.0 Midnight,** Relay of the Orchestral Programme from the Grand Casino in San Sebastian; Selections of Dance Music.

SCHENECTADY, Call 2XAD and 2XAF (**21.96 and 31.4 metres**); 30 kW.—**3.30,** Divine Service, relayed from the First Methodist Episcopal Church in Schenectady. **10.30,** Ballad Singers in their Repertoire, relayed from **New York.** **11.0,** Stetson Parade, American Legion Band, from **Boston.** **12.0 Midnight,** Musical Programme. **12.25 a.m.** (Monday), Baseball Scores from **New York.** **12.30 a.m.,** Capitol Theatre Programme from **New York.** **2.0 a.m.,** Talk on the Government of the United States, relayed from **Washington, D.C.** **2.15 a.m.,** Atwater Kent Programme from **New York.** **2.45 a.m.,** Correct Time. **2.47 a.m.,** Biblical Drama, relayed from **New York.** **3.15 a.m.,** Television Experimental Transmission. **3.30 a.m.** (approx.), Close Down.

STAMBOUL (**1,200 metres**); 5 kW.—**4.30,** Instrumental Concert. **5.30,** Market Prices of Cereals. **6.15,** Concert of Turkish Music. **8.30** (approx.), Weather Report and Time Signal. **8.40,** Orchestral Concert. **10.30** (approx.), Close Down.

STUTTGART (**379.7 metres**); 4 kW.—**11.0 a.m.,** Instrumental Concert. **2.0,** Children's Corner, followed by Talks and Light Vocal and Instrumental Selections. **8.0** (approx.), Variety Concert, Vocal and Instrumental Music, Recitations and Sketches, followed by Sports Notes and News.

TALLINN (**408 metres**); 2.2 kW.—**7.30 am.,** Early Morning Orchestral Concert. **8.30 a.m.,** Divine Service, relayed from a Church. **6.0,** Instrumental and Solo Concert. **8.0,** Agricultural Talk. **8.30,** News Bulletin. **8.45** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (**391 metres**); 3 kW.—**12.30,** Orchestral and Solo Concert of Light Music. **1.0,** Carillon, Time Signal. **1.45,** News Bulletin, contributed by the Newspapers "Le Télégramme," "L'Express" and "Le Midi Socialiste"; Interval. **8.0,** Exchange Quotations and News Bulletin by the "Agence Fournier," followed by Press Review of "La Dépêche" and "Le Petit Parisien." **8.30,** Orchestral Concert, and Song Recital. **10.15,** North African News. **10.30** (approx.), Close Down.

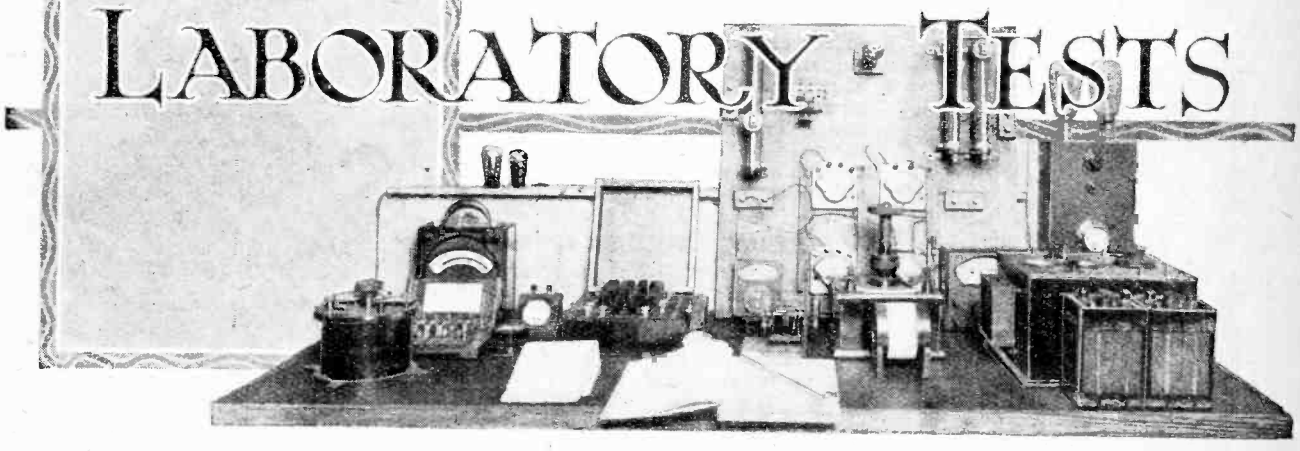
VIENNA (**577 and 517.2 metres**); 1.5 and 5 kW.—Programme relayed by **Graz** (357.1 metres), **Innsbruck** (294.1 metres), **Klagenfurt** (272.7 metres) and **Linz** (254.2 metres).—**11.0 a.m.,** Concert by the Vienna Symphony Orchestra. **4.0,** Vocal and Instrumental Concert, followed by Programme of Chamber Music. **8.0,** "Cosi Fan Tutte," Opera (Mozart), relayed from **Salzburg.**

VILNA (**435 metres**); 1.5 kW.—**9.30 to 11.15 a.m.,** Transmission of the Polish Legionaries' Ceremony, relayed by **Cracow, Kattowitz, Posen** and **Warsaw;** Mass, relayed from the Vilna Cathedral, followed by Relay of the Cathedral Chimes, Consecration of the Standard of the Polish Legionaries of the Vilna District, and Address pronounced by Monseigneur Bishop Wladyslas Bandurski, followed by Programme of Talks and Music.

WARSAW (**1,111 metres**); 10 kW.—**12.0 Noon,** Time Signal. **4.0,** Agricultural Talks. **5.0,** Popular Concert by the Philharmonie de Varsovie. **6.0,** Talk by Marshal Pilsudski from the Vilna fortress. **7.45,** Talk. **8.15,** Vocal and Instrumental Concert by the Philharmonie de Varsovie and Soloists. **10.0,** Time Signal, Aviation Report and Weather Forecast. **10.5,** P.A.T. Bulletin. **10.20,** Police Information and Sports Notes. **10.30,** Dance Music Programme, relayed from the Oaza Restaurant in Warsaw, Orchestra conducted by W. Roszkowski and L. Karbowick. **11.30** (approx.), Close Down.

ZURICH (**588 metres**); 1 kW.—**11.15 a.m.,** Concert by the Station Orchestra. **12.29,** Weather Forecast. **12.30 to 1.30,** Instrumental Music. **4.0,** Selections by the Carletti Orchestra, relayed from the Carlton-Elite Hotel, Zurich. **8.0,** Vocal and Instrumental Concert, with Song and Aria Recital by Wilhelm Bockholt (Bass) of the Zurich Municipal Theatre, followed by Request Programme of the Station Orchestra. **10.0,** Weather, followed by News Bulletin. **10.15** (approx.), Close Down.

WIRELESS WORLD LABORATORY TESTS



A Review of Manufacturers' Recent Products.

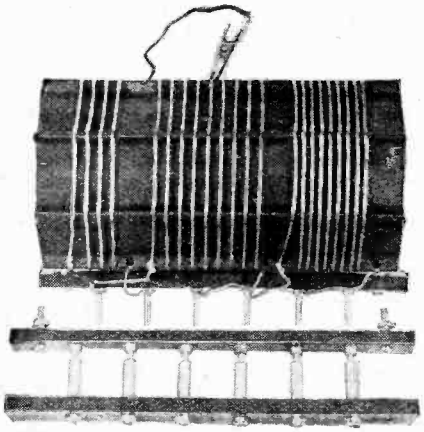
S.R.S. SHORT-WAVE ADAPTOR.

The Cossor Melody Maker is well suited for short-wave reception, both as regards circuit and components—the Ormond dials, for instance, are effective in preventing hand capacity effects. The Stonehouse Radio Supplies, 54, Union Street, Plymouth, have produced a tuner unit which converts the Melody Maker into a short-wave set. The alteration is effected by mounting the Cossor broadcast coil on a special six-pin base supplied with the short-wave unit. All that is then necessary is to change over the tuning unit when short waves are required.

The coils in the S/W unit are wound on a ribbed ebonite former 4in. in diameter, the aerial grid and reaction coils comprising 4, 9, and 9 turns respectively. The wavelength range can be varied by a tapping clip which short-circuits one or more turns of the grid coil.

Stranded wire is used, but as the strands are bare it is doubtful if any advantage is gained over solid wire of equivalent diameter. For Litz to be effective, the strands must be insulated, and each wire must appear at the core and at surface an equal number of times.

The price, complete with explanatory chart, is 17s. 9d., post free.



S.R.S. short-wave adaptor for the Cossor Melody Maker.

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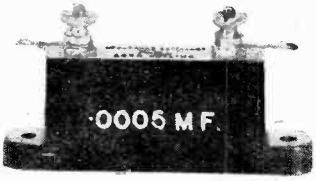
TRIX FIXED CONDENSERS.

Trix fixed condensers are made in capacities from 0.0001 to 0.001 mfd. at 1s., 0.002 to 0.006 mfd. at 1s. 6d., and 0.01 mfd. at 1s. 9d. The 0.0003 mfd. size, which is commonly used for leaky grid rectification, is supplied free of charge with a pair of grid leak clips for connecting the leak in parallel with the condenser. A special series-parallel clip is supplied at the extra cost of 3d.

The condensers are constructed with best ruby mica and copper foil, and are sealed into vertical moulded cases fitted with terminals and soldering tags.



Trix fixed condenser with terminals and soldering tags.

A few representative capacities were measured, the results being as follows :—

Nominal capacity (mfd.).	Measured capacity (mfd.).	Difference (per cent.).
0.0003	0.000292	3.5
0.0005	0.000490	2
0.001	0.000887	11
0.002	0.001876	6

These values are within the limits allowed by the B.E.S.A. specification for normal grade condensers.

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LISSEN ANODE RESISTANCES.

Special wire having a resistance of approximately 100,000 ohms per foot is used in the construction of these resistances, which are mounted in the conventional Paxolin cartridges with metal end caps. The addition of terminals is a distinct improvement over the ordinary

Lissen wire-wound anode resistances and holders.

pointed end cap, which introduces a bad contact unless the spring holder is properly adjusted.

The Lissen holder is of the vertical type, and is fitted with slotted contact springs spaced to fit the terminals of the wire wound resistances. The moulded body is exceptionally strong, and is provided with screw holes for vertical or horizontal mounting.

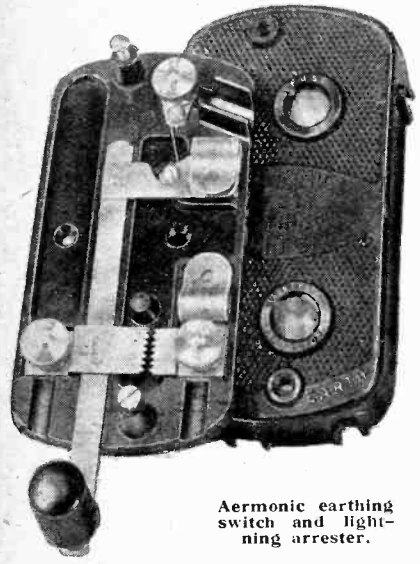
Resistances are available in values between 10,000 and 250,000 ohms, the current carrying capacity being 10 milliamps. Specimen resistances were measured and gave the following values :—

Nominal resistance (ohms).	Measured resistance (ohms).	Difference (per cent.).
50,000	52,100	4.2
80,000	82,400	3.3
100,000	105,600	5.6
150,000	154,000	2.7
250,000	259,000	3.6

The accuracy of most anode resistances is guaranteed only to ten per cent., so that the above figures are exceptionally good. Prices are as follows :—50,000 ohms, 3s. 6d.; 80,000 ohms, 4s.; 100,000 ohms, 4s. 6d.; 250,000 ohms, 6s. 6d. The holder costs 1s. extra.

AERMONIC EARTHING SWITCH.

The working parts of the switch are enclosed in a moulded case which should be mounted on the outside of the window frame. It is not hermetically sealed, but



Aermonic earthing switch and lightning arrester.

should prove sufficiently waterproof if fixed in a sheltered position. The switch tongue is mounted on a sliding bar which, when pulled down, isolates the aerial from the set and joins it to earth. While the set is working a serrated spark gap protects it from minor discharges, and a fuse is provided with the idea of automatically isolating the set in the event of a heavy discharge. Both the fuse and spark gap may be inspected through small glass windows in the moulded cover.

This component costs only 4s. 6d., and is made by Messrs. James Christie & Sons, Ltd., 246, West Street, Sheffield.

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MARCONIPHONE VARIABLE CONDENSERS.

The design and construction of this condenser follow American practice. Instead of using spacing washers, both the fixed and moving vanes are forced into slots milled in the solid metal. The ends of the vanes are bent over and soldered together to give increased rigidity and accurate spacing. There is only one end plate, which carries the single bearing for the quartering spindle, and the fixed vanes are mounted on a single block of ebonite attached to the end plate. Two point fixing to the panel has been adopted and countersunk screws provided for this purpose. The 0.00025 mfd. condenser examined had a minimum capacity of 11 micro-mfd. and a maximum of 0.000275 mfd. Two other capacities are available, namely, 0.00013 and 0.0005 mfd., and the price in each case is 8s. 3d. without knob and dial. The latter cost 1s. 3d. extra.

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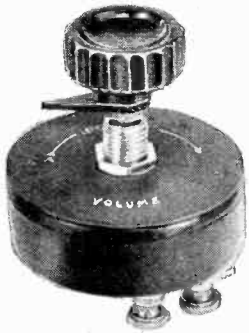
"IMPERIAL" VOLUME CONTROL.

This volume control is provided with three terminals in order that it can be connected as a potentiometer. The resistance element consists of a circular graphite line on ebonite, to which contact is made through a radial contact spring. The nominal resistance is 500,000 ohms, and the specimen submitted had a resistance of 300,000 ohms. The resistance is totally enclosed in a polished ebonite box and is supplied complete with knob, turner, and indicating dial. The



Imperial potentiometer volume control.

makers are the Wireless Apparatus Co., 256, Marlborough Road, Leicester, and the price is 4s.

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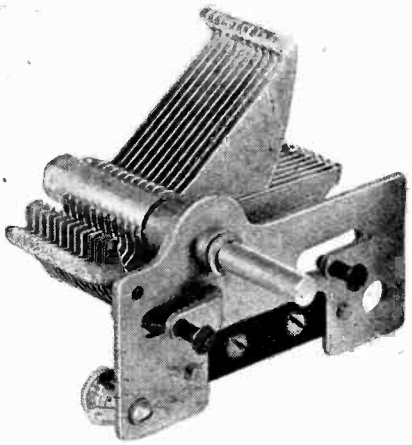
PETO-SCOTT MINIATURE CONDENSERS.

The small dimensions and special earthing shield at once qualify the first two of these condensers for use in portable sets where space is limited and hand capacity effects are prevalent.

Peto-Scott miniature condensers. (Left to right) "Minator" square law tuning condenser, "Midget" reaction condenser and baseboard neutralising condenser.

"Minator" Condenser (0.00025 *mfd*).—The end plates of this condenser consist of two high-quality ebonite discs 2¼in. in diameter and spaced 2½in. apart on brass distance pieces. Both sets of vanes are



New Marconiphone medium priced variable condenser.

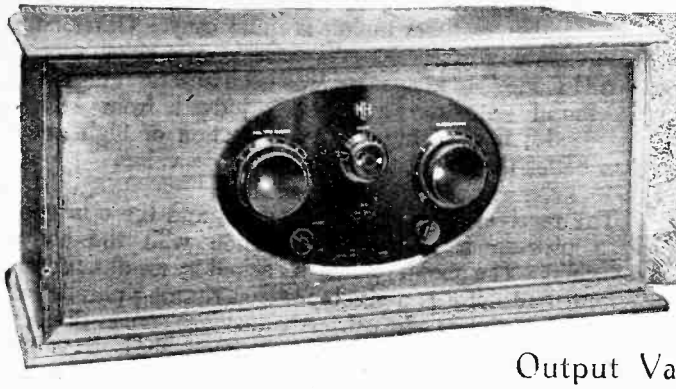
insulated from the circular metal earth screen covering the top end plate, and the condenser is suitable for tuning anode circuits or biased grid circuits where both sides of the condenser are "live." An ebonite washer is supplied for use with metal front panels.

The moving vanes are semi-circular and the fixed vanes are cut away to give a square law variation of capacity. Connection is made with the moving vanes through a hard-drawn brass wire pigtail. A single ball thrust bearing in the bottom plate holds the spindle against a plain cone bearing in the top plate. No tensioning spring is provided, and reliance is placed on the slight "give" in the end plates. The measured maximum and minimum capacities were 0.000258 mfd. and 9 micro-mfds. respectively. The price of this model is 10s. 6d.

"Midget" Condenser (0.0001 *mfd*.).—This condenser is mounted on a single end plate and earth screen of the same type as the "Minator" condenser; the vanes are also of similar size and shape. As in the larger condenser, the single bearing is of the cone type, but in this case the cone is inverted and tension is provided by a spring washer inserted between the underside of the bearing and the fixed vanes. The price is 5s. 6d., and the specimen tested had a minimum of 8 micro-mfds and a maximum of 0.000123 mfd.

Neutralising Condenser.—Designed for baseboard mounting, this model is characterised by exceptionally solid construction. The moving vanes are crescent-shaped and are mounted on an ebonite bridge, the fixed vanes being attached to the base. A cone bearing is again used, and a locking ring is provided which forces the cone against its seating. The minimum capacity is only 3 micro-mfds and the maximum 23 micro-mfds. The overall height is 4in., and the base measured 2½in. × 2in. The price is 5s.

All the above models are made by Messrs Peto-Scott Co., Ltd., 77, City Road, London, E.C.1.



BROADCAST RECEIVERS

THE SCREENED DIMIC THREE

Screened Grid H.F. Valve—Pentode Output Valve—Wave Range 15 to 2,000 Metres.

ALL the latest innovations in valve design have been exploited in the production of this receiver which gives results, with only three valves, quite equal to the best commercial four-valve sets and the majority of five-valve sets using three electrode valves.

The screened grid valve offers three important advantages over its predecessors:

(1) Considerable H.F. amplification without elaborately designed coupling circuits.

(2) Easy switching from one wave range to another.

(3) Reaction may be used *ad lib.* in the detector stage without fear of energising the aerial.

The combined effect of the intrinsic H.F. amplification and low damping of the screened valve together with reaction gives a performance equivalent to two ordinary H.F. stages, both as regards sensitivity and selectivity. It was thought that on ultra-short wavelengths the oscillations generated by the detector would be able to penetrate the small residual capacity of the screened valve, but tests proved this fear to be groundless; reaction can be used with impunity on all wavelengths.

Coils for the long waves are wound in slotted ebonite formers and built permanently into the receiver. These are brought into operation by a pair of plunger-type change-over switches, one in each compartment, connected by a system of links to a single knob on the front panel. The normal broadcast waveband is covered by a pair of special coils fitting into standard Dimic bases. These coils are changed for the reception of ultra-short waves.

A Single Stage Pentode Amplifier.

The set will accommodate screened valves of the double-ended variety as well as the Mullard type actually used in the receiver tested.

An Osram H.L.210 three-electrode was used as detector, followed by a Ferranti AF4 transformer. An H.F. choke between the anode and the transformer primary diverts the H.F. component of the rectified current through the reaction coil and reaction feed condenser. Sockets are provided for a gramophone pick-up and the detector then functions as an amplifier; it is for this reason that a L.F. valve is specified for the detector stage. One socket is joined direct to the grid and the other to the single grid bias cell in the H.F. screen compartment, thus the detector is biased to 1½ volts negative. With this arrangement the amplification is in excess of requirements for the average pick-up and an external volume control is necessary to prevent overloading.

The pentode deals single-handed with the L.F. output from the detector. Its high amplification factor enables the usual intermediate L.F. stage to be omitted, yet it passes to the loud speaker an undistorted output equal to that of a DE5A or LS5A—this with a grid bias of only 4½ volts. In the Screened Dimic Three the loud speaker is connected directly in the anode circuit of the pentode and the windings must therefore be suitably designed to carry the 13.5 mA steady anode current which flows with 120 volts H.T. and 4½ volts grid bias.

Excellent Long-wave Performance.

The total anode current for the set is 19.5 mA of which 4 mA is accounted for by the screened grid valve and 2 mA by the detector. The filaments require 0.52 amp. at 2 volts. From this it will be seen that, although the pentode effects a saving in first cost to the extent of a L.F. valve and its coupling components, the running costs are still the same as for a four- or five-valve set. In other words, the results, although obtained by a new method with fewer valves, require the same expenditure of primary battery power. Judging from the space allowed inside the cabinet for H.T. batteries, it would appear that the makers have in mind cells of "intermediate" capacity. The discharge will therefore be the maximum permissible for this size of cell, and the service should be approximately 400 working hours, equivalent to about 4 months' use.

The receiver was tested during the recent spell of hot weather when the Heaviside layer refused to collaborate in long distance work and atmospherics were troublesome. Nevertheless, some excellent results were obtained, particularly on the very long and very short wavelengths, and the weather conditions were, of course, no impediment to the estimation of selectivity or quality of reproduction from the local station.

At 1¾ miles from 2LO it was found possible, making full use of reaction, to approach within 30 metres of that station without incurring serious interference. An additional aerial coil (No. 176) giving increased selectivity is supplied for the 200-500 metre band, and this coil was used in making the selectivity test.

On long waves no difficulty was experienced in separating 5XX and Radio Paris in spite of the enormous volume from both stations. High efficiency on

Broadcast Receivers.—The Screened Dimic Three.—

the long waves seems to be a characteristic of McMichael sets, and the latest product is no exception. Warsaw (1111.1 metres, to 10 kW) easily overloads even the pentode and the half-dozen more important long-wave transmissions come in at full loud speaker strength. Croydon and the channel air route telephony stations are an interesting feature of the long waveband, which extends from 800 to 2,000 metres.

The performance on the 200-500 metre band, although satisfactory, is not exceptional—an adjective which can be applied without exaggeration to the long and ultra-short waves. The aerial coils for this band appear to be wound astatically and therefore have a considerable H.F. resistance as compared, say, with "Everyman Four" coils. The set seems sensitive to any increase of resistance due to the aerial, and it is advisable to experiment with different lengths of aerial and also with different values for the series aerial condenser. As the latter is of the convenient McMichael clip-in type the right value is soon found. With everything in this respect adjusted to the best advantage on a 50ft. aerial with a rather long earth lead, 5GB gave full loud speaker strength with reaction adjusted to the maximum and was comfortably loud with reaction at zero. The only other distant stations received on the 200-500 band during the period of the test were Huizen (340.9 metres, 4 kW), Prague (348.9 metres, 5 kW), Langenberg (468.8 metres, 20 kW) and Munich (535.7 metres, 4 kW)—all these just comfortably audible with full reaction.

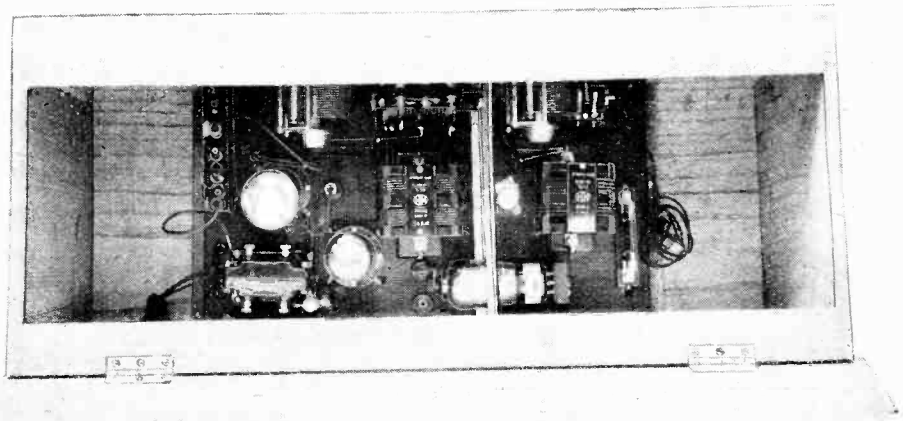
Short-wave coils are supplied as an extra. The SW2 and SW3 Dimic coils were used for test purposes and covered a wavelength of approximately 35 to 100 metres. A prearranged test on the 45 metre amateur wavelength gave results at least 100 per cent. better than the conventional detector and 2 L.F. set, showing that the screen grid valve contributes some H.F. amplification even on this wavelength. Telephony at full loud speaker strength was received from an unidentified German station, and over the whole waveband the set showed extraordinary liveliness. Reaction is a little critical on the short waves, but in other respects tuning is quite easy. Other coils are available for wavelengths down to 15 metres.

A "Kone" loud speaker was used and no fault could be found with the quality as judged from DE5A standards; if anything, the reproduction of high notes was better than with the three-electrode valve.

Effective Screening.

The receiver is effectively screened and there is very little pick-up from the local station with the aerial detached. The ebonite panel is backed by an aluminium screen, and there is a similar screen running parallel at the back of the baseboard. A transverse screen divides the set into two compartments and effectively isolates the aerial tuning coil from the reacting detector. So complete is the isolation that it has its effect on the tuning, which is quite different from the ordinary H.F. set. There is practically no "pulling" between the two circuits, and this point should be remembered when tuning in for the first time.

The layout of the parts is excellent, many of the fixed condensers and most of the wiring being carried beneath the baseboard. The detector and pentode are mounted in Sterling sponge rubber valve holders, and microphonic noise and howling are non-existent.



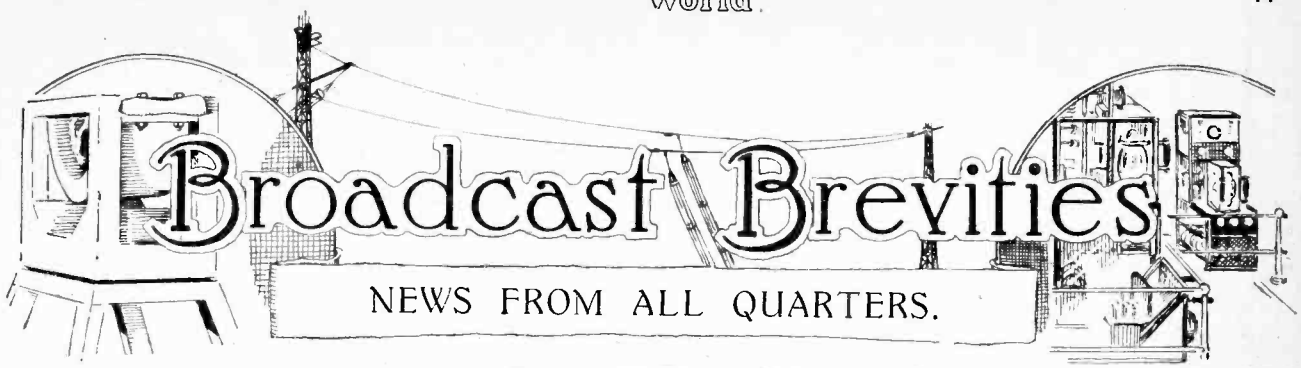
Space has been allowed inside the cabinet for two 60-volt H.T. batteries on either side of the receiver unit.

The price of the Screened Dimic Three is £21 16s., complete with valves and coils for long and normal broadcast wavelengths. To this must be added the royalty of 37s. 6d. and the cost of batteries, loud speaker, and ultra-short-wave coils. The makers are L. McMichael, Ltd., Wexham Road, Slough, Bucks. London showroom: 179, Strand, London, W.C.2.

A PUSH-PULL PITFALL.

VARIOUS causes of distortion experienced with the push-pull system have already been published.[1] A possible cause which has been overlooked, however, is that, owing to the large permissible grid swing rendered possible by this system, it is very easy to overload the preceding valve. This fault will not be revealed by connecting a milliammeter in the plate circuit of the output valves, nor by any of the usual tests in the output stage, owing to the fact that it exists entirely outside the push-pull system itself. The obvious remedy is to increase the H.T. voltage on the penultimate valve, with, of course, a corresponding increase in grid bias. If this does not suffice it will become necessary to use a valve of larger permissible grid swing in this position.

[1] *The Wireless World*, June 6th, 1928, page 614.



By Our Special Correspondent.

Morning Programmes for Provincial Stations.—Sir Thomas Beecham and the B.B.C.—Keston's American Relay Triumph.—5XX Heard in U.S.—News from Dublin.

Dangers of Perpetual Grousing.

Grousing is such a general accomplishment nowadays that it often fails to attract notice for that very reason. Only when people stop grousing do we begin to fancy that something must really be wrong.

No doubt the B.B.C. thinks on these lines, and we can sympathise with such an attitude up to a point. There is, however, the danger that a genuine grouse may go undetected.

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A Genuine Grouse?

A grouse with a genuine ring about it comes from the Midlands and the regions farther north. Put briefly, it is this: Why should London and the area served by Daventry (5XX) have the benefit of more programme time than the many important towns and cities in the provinces?

Is this a genuine grouse? To find out we have only to take a glance at the B.B.C.'s official organ.

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Silent Mornings.

We turn the pages at random, lighting upon "Programmes for Tuesday, July 31st."

London and Daventry begin transmission at 10.15 a.m. and, after a break from 10.30 to 11, provide a steady programme from 11 o'clock until 2. During that entire period the provincial stations, main and relay, are silent without exception. They are not heard till 4 o'clock, by which time London and Daventry listeners have been able to listen for three hours and a quarter.

On the next day the provincial stations actually have a lunch hour transmission, but when 4 o'clock comes round they are still two hours and a quarter behind the London and Daventry figure. Yet this is a comparatively full day for the provinces. They never do better than this. Why?

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The Licence Question.

So far as I know, the pang of parting with a ten-shilling note is every whit as painful in Leeds as it is in London, and the pain does not diminish as one travels farther north. What answer can be given, then, to the licence-holder in the north who complains that, having paid the same licence fee as a Londoner, he receives inferior service?

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A Chance for Local Talent.

The only retort that Savoy Hill can make is that morning relays to the provincial stations are generally impossible because the Post Office lines are not available until the afternoon. But what is to prevent the broadcasting of local talent in the mornings? Many listeners would like an answer. What about it, Savoy Hill?

FUTURE FEATURES.

London and Daventry.

AUGUST 12TH.—Service from St. Martin-in-the-Fields.
AUGUST 13TH.—Promenade Concert.
AUGUST 14TH.—Classical Request Programme by The Wireless Symphony Orchestra and soloist.
AUGUST 17TH.—"Mayor of Casterbridge," a play by Hardy-Drinkwater.

Daventry Experimental (5GB).

AUGUST 12TH.—A Bantock Programme, from Birmingham.
AUGUST 14TH.—"Husbands Unlimited," a farcical duologue by Stuart Ready.
AUGUST 16TH.—Promenade Concert.

Cardiff.

AUGUST 14TH.—Scenes from Shakespeare.

Manchester.

AUGUST 14TH.—"The White Blackbirds," Feldman's Concert Party.
AUGUST 17TH.—Promenade Concert.

Glasgow.

AUGUST 15TH.—Music of the Highlands and Hebrides.
AUGUST 18TH.—The Golden Cameos Concert Party.

Aberdeen.

AUGUST 15TH.—International Variety Programme.

Belfast.

AUGUST 18TH.—Running Commentary on the Royal Automobile Club International Tourist Trophy Motor Race.

Sir Thomas Beecham.

Some rather premature rejoicings were indulged in among musical circles last week over a reported alliance between Sir Thomas Beecham and the B.B.C. In the past year or two Sir Thomas has expressed his views on broadcasting with a candour which leaves very little to the imagination. He does not, or did not, like broadcasting or anything connected with it.

Now, however, Sir Thomas contemplates the formation of a new permanent orchestra, holding daily rehearsals, with the idea of providing a weekly symphony concert in the Queen's Hall. It was in connection with this enterprise that the name of the B.B.C. was linked.

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B.B.C. Co-operation.

On enquiry at Savoy Hill I was informed that no definite scheme had yet been evolved, though it is quite true that the formation of such an orchestra has been discussed tentatively with Sir Thomas Beecham during the past few months. The hope is expressed by the corporation that Sir Thomas will succeed in his project; if so, it is highly probable that some form of co-operation would follow. But this would be dependent upon the conditions, financial and otherwise, which Sir Thomas Beecham might be able to arrange.

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Another Triumph for Keston.

The Keston short-wave receiving station more than justified its existence on the morning of the Tunney-Heeney fight. Never has an American relay come through with such startling clarity.

Mr. J. A. Partridge (2KF), who controls the fortunes of the little outpost of the B.B.C., told me that there was nothing surprising in the quality of the transmission; he almost went as far as to say that Keston can now guarantee a good relay at any time the programme department likes to ask for it between 7 p.m. and 4 a.m.

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The "Broomstick" Aerial.

The big fight was picked up from 2XAF on a seven-valve superhet and a "broomstick" aerial. This arrange-

ment seems to be quite as effective as the elaborate spaced-aerial system at Chelmsford, of which we hear so little.

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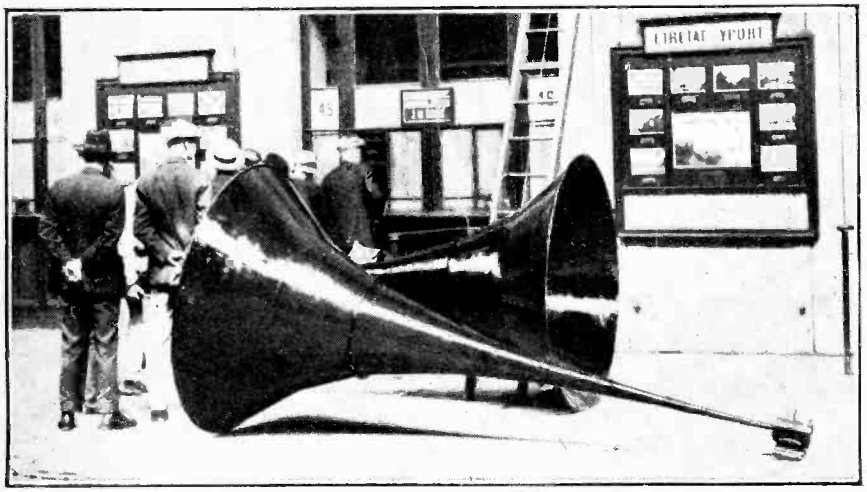
A Daventry Surprise.

Meanwhile, the short-waves are not having things all their own way. A few days ago a letter was received at Savoy Hill from a listener in Chicago reporting reception of Daventry 5XX! The writer gave details of the programme—a performance of the National Orchestra of Wales broadcast from 5WA and 5XX only—which removed any doubts as to the authenticity of the report.

This is believed to be the first occasion on which the 1,600-metre signals have been reported from the other side of the Atlantic.



LOUD SPEAKERS ON THE RAILWAY. A picture taken in the St. Lazare Station, Paris, a few days ago by a "Wireless World" photographer, showing two giant loud speakers which are to be used for the guidance of intending passengers.

2RN Expands.

I hear that the Dublin broadcasting station (2RN) is suffering from growing pains and that a move will shortly be made to more commodious quarters in the General Post Office Buildings.

Larger studios are to be constructed and—quite as important—bigger administrative offices are to be provided to give the staff more elbow room. I gather that at present they are nearly as badly cramped as the B.B.C. staff were in the old days at Kingsway, where the managing director had his private office in a glorified cupboard!

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Scotland As Others Saw Her.

A semi-historical, semi-imaginative attempt to show what "distinguished strangers" have thought of Scotland in the past is to take the form of a broadcast programme which Glasgow is providing for all stations of the B.B.C. on August 24th.

Through four short sketches in dramatic form it will show something of what such great figures as Dr. Johnson, Mendelssohn and Wordsworth discovered in the Scotland of their time. This distinctly original programme will be in no sense a "heavy" one, and a humorous note is promised in one of the sketches, which depicts a typical American tourist's visit to Burns' Cottage.

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A Masefield "Thriller."

A dramatic thriller by John Masefield, entitled "The Locked Chest," is in 2LO's programme for August 21st.

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Bare-faced Interference.

The residents of Terre Hill, Pa., U.S.A., are, I fear, in for a hot time. One of their number, Earl W. Davidson, has invented a radio receiver through which, he declares, he "can talk to other radio set users using the wave-length on which the sets are in tune. The messages are received by persons who have tuned in on the same station but are audible only when the station is on the air but not radiocasting."

This sounds more like old-fashioned re-radiation than anything else, and I expect that Earl Davidson will soon be qualified to understudy Tommy Handley's "General Nuisance."

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Duke and Duchess of York in Scotland.

The Duke and Duchess of York are to visit Stirling on August 10th, when a broadcast will take place from Edinburgh of the ceremony of admitting the Duke and Duchess as Guild-Brethren of the Stirling Merchant Guildry.

T.R.H. will receive the Freedom of the Royal Burgh of Stirling, and the speech of the Duke, after he and the Duchess have taken the oath and signed the Guildry roll, will be broadcast at 11.45 a.m.

At 2.30 p.m. the Duke and Duchess will open the new Stirling Royal Infirmary and Maternity Home. The Duke's address will be broadcast, as well as a running commentary on the visit.

Another Seyler Revue.

"Djinn—and Bitters," to be broadcast from 2LO on August 25th, is the second revue to be written for wireless by Clifford Seyler, the author of "Something in the Air," which was broadcast the other day. The music for the new revue is by Billy Milton and Harry Pepper, who have done a good deal of work for the B.B.C.

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Persons in the "Proms."

There are some famous names in the long list of artists who will figure as soloists during the Queen's Hall Promenade Concerts. Among the pianoforte soloists are Solomon (August 11th), Harold Samuel (August 24th), Maurice Cole (September 4th), and Myra Hess (September 19th), while the prominent violinists include Isolde Menges (August 15th), Adila Fachiri (September 5th), and Albert Sammons (September 20th). The vocalists present an imposing array with such names as Stiles-Allen, Dorothy Silk, Flora Woodman, Megan Thomas, Joseph Farrington, Harold Williams, Dennis Noble, and Walter Widdop, to mention only a few.

The season opens on Saturday, August 11th, and will continue until October 6th. Approximately three concerts will be broadcast each week.

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Tragedies of To-morrow.

On August 20th, 5GB listeners are to hear a tragedy entitled "All the To-morrows," written by Mr. Aubrey Millward, who will himself play the part of Harry Sinclair, and other members of the cast are Trevor Cash, Gladys Ward, Gladys Joiner, and Ethel Malpas.

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Two English Musicians.

Alec Rowley, the young English composer and organist, will give a recital of his own compositions from 2LO on August 17th, while on the following evening London listeners are to hear Albert Sammons, who is considered by many to be our finest English violinist.

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Preserved Talks.

It is an ever-growing paradox to me that the B.B.C. who know so much about distortionless transmission, pays so little attention to the elimination of distortion in the cover designs of their publications.

Before me lies a copy of one of the latest Savoy Hill booklets—"Home, Health and Garden"—with a cover design which seems to depict a goitred lady holding up a little victim of infantile paralysis. Yet the unpleasant flavour pervading this design finds no place inside the covers. "Home, Health and Garden" is an excellent réchauffé of the many household and health talks given in 1927—well illustrated, brief, and admirably adapted for reference.

The subjects treated range from cookery, spring cleaning and kitchen planning, to landscape gardening and bee-keeping. It contains that rare commodity—a really good index.

Some Recent Patents

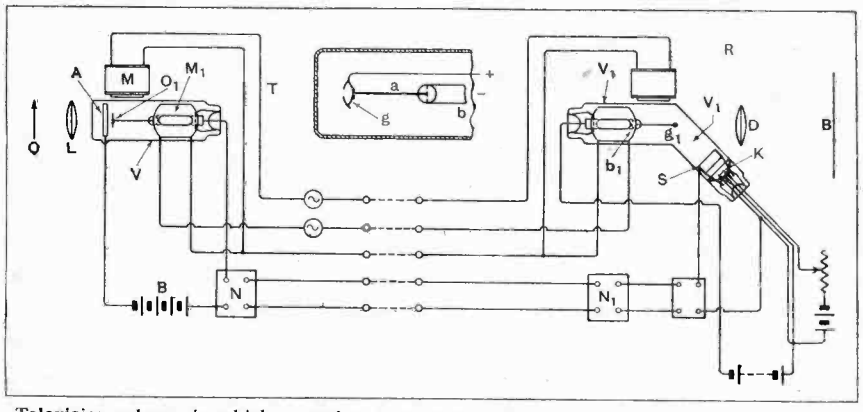
The following abstracts are prepared, with the permission of the Comptroller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

Television.
(No. 287,643.)

Application date: December 24th, 1926.

Relates to a system of television in which an image of the object to be transmitted is focused inside a vacuum tube, which functions partly as a light-sensitive cell and partly as a thermionic amplifier. As shown in the figure, an image O_1 of the external object O is projected by a lens L into the interior of the tube V, the light rays passing through a meshed or perforated anode A.

Here the image is scanned by a light-sensitive point g mounted at the end of a vibrating system comprising two flat springs a, b joined together end to end, as shown separately. The external magnets M supplied by currents of suitable frequency, vibrate each of the springs a, b independently, one moving at the rate of 1000 and the other at 10 cycles per second. The same currents synchronize a similar vibrating-spring system at the receiving end R.



Television scheme in which reception depends upon fluorescence by electron bombardment. (No. 287,643.)

The sensitised point g is connected to the negative, and the anode A to the positive pole of a high-tension battery B. The resulting variations of photo-electric current, after amplification N, are transmitted to the distant receiving station R either by wire or through the ether. There the incoming currents are first amplified at N_1, and are then applied to the grid S of a tube V_1, so as to control the electron emission from a heated cathode K. In reception the vibrating compound spring b_1 is fitted with a point g_1 which fluoresces under the influence of the electron bombardment from the cathode K, and so reproduces the original object, which is finally projected by a lens D on to a viewing screen B. Patent issued to B. Rtcheouloff.

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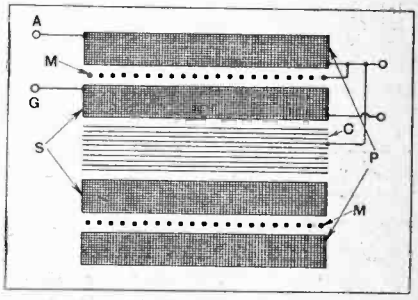
Intervalve Transformers.
(No. 287,191.)

Application date: October 18th, 1926.

Transformer breakdown is usually attributed either to excessive current or to mechanical shock or vibration. The present invention is, however, based upon the theory that the trouble is frequently due to electrolytic action from layer to layer through the insulating material, especially where the full potential of the high tension source of supply exists between the primary and secondary windings.

It is not practicable to exclude moisture altogether from the insulating material during the course of manufacture. Moreover, it is equally impossible to avoid the presence of minute pinholes in the insulation layer protecting the finished wire. In these circumstances, electrolytic action sets in and tends to destroy the wire at the point of origin of the electrolytic current.

To prevent damage from this cause, any electrolytic "leakage" currents leaving the higher-potential windings are made to pass through a metallic shield sufficiently substantial to withstand corrosive action. As shown in the figure, the primary winding P is separated from



Safeguarding transformer windings from electrolytic action. (No. 287,191.)

the secondary winding S by a layer M of stouter wire, or by a metal sheet conductively connected to H.T. positive and to the laminated core C.

Any electrolytic leakage current that may set in will now leave the higher-potential level from the metal screen M, where it can do no harm. The connections to the H.T. supply are shown at the right hand, and those to the anode A and grid G of the valve at the left hand of the figure. Patent issued to Burndept Wireless, Ltd.

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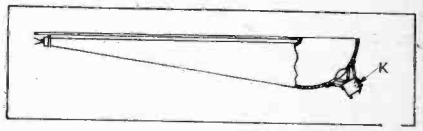
Loud Speakers.
(No. 281,634.)

Convention date (U.S.A.): December 1st, 1926.

A compound loud speaker, specially though not exclusively suitable for use in large auditoriums, comprises a logarithmic horn resonator and a cone reproducer



Loud speaker combining the cone and logarithmic horn systems. (No. 281,634.)

K, preferably of the moving-coil type, mounted in alignment with the aperture of the horn. The combination is stated to give a richer and better balance out

put than can be obtained from either a large horn with a small diaphragm at its lower end, or from the standard type of cone reproducer operating alone. Patent issued to De Forest Phonofilms, Ltd.

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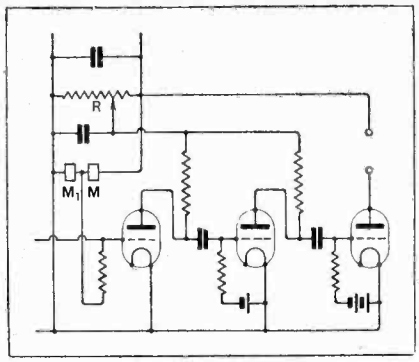
Stabilised Amplifiers.
(No. 285,229.)

Application date: January 20th, 1927.

It is well known that any impedance existing in the source of high-tension supply to a multi-stage amplifier is liable to set up undesirable reaction effects or energy transfer between the output and input circuits. In order to counterbalance this tendency, additional impedances are provided in order to set up



Neutralising L.F. oscillation. (No. 285,229.)

an energy transfer between the input and output circuits in opposition to that first mentioned.

As shown in the figure, in the case where the H.T. supply is derived from a mains eliminator, two impedances M and M_1 are inserted in shunt across the bridge resistance R, M taking the form of a 1 microfarad condenser, whilst M_1 is an adjustable resistance up to 1 megohm. The mid-point connection is taken to the grid of one of the valves, preferably the first. In this way a fraction of the total H.T. voltage is applied to the grid of that valve, and is adjusted in phase so as to eliminate any tendency to instability.

Patent issued to Igranic Electric Co.

INDEPENDENT VOLUME-CONTROL FOR SEVERAL LOUD SPEAKERS.

IN houses where several loud speakers are installed in different rooms, the problem of volume-control cannot be solved completely by any of the means that are usually adopted. If the control is in the receiver itself, then the volume can only be adjusted by someone in the same room as the set, and the adjustment so made affects all the loud speakers in circuit. If independent control is required, it is clearly necessary to have a separate device for this purpose by each speaker, and to allow the set at all times to deliver its maximum output in case full signal-strength is required at any of the listening points.

If the loud speakers are all wired in parallel, this can be achieved by placing a variable resistance in series with each, as shown in Fig. 1. As this resistance is increased, less and less of the output from the set passes through the particular speaker to which the volume-control is attached, until when the circuit is broken entirely, signals at that listening point cease altogether. This will be accompanied by a slight increase in loudness at the other points.

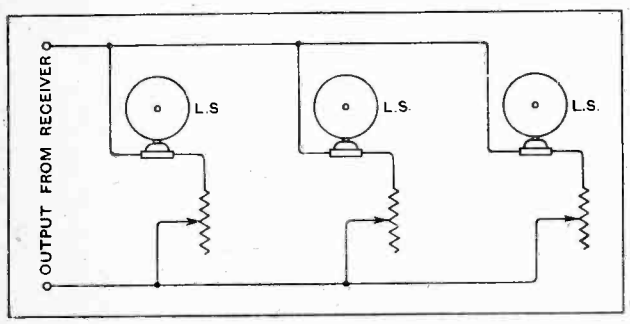


Fig. 1.—Independent volume control in series with each loud speaker. Here the loud speakers are in parallel.

This method has the drawback that the total resistance necessary runs into not less than 50,000 ohms if a wide range of control is required, and to make up such a resistance entails a good deal of work and a not inconsiderable expenditure upon resistance wire. Moreover, it is difficult to make such a resistance without introducing considerable capacity, so that when the volume is brought down to a small value the feed to the speaker takes place largely through the capacity of the resistance windings. The result of this is two-fold; a higher value of resistance is required for adequate control of volume, and the rise in pitch which is invariably associated with reproduction at low intensities is considerably accentuated.

Volume-Control by Shunt Resistances.

The alternative method, which consists in putting the loud speakers in series and connecting a variable resistance in shunt across each, as suggested in Fig. 2, is free from both these disadvantages. In this case the resistance employed need have a total value of no more

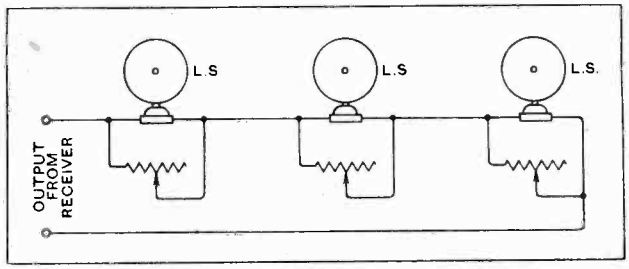
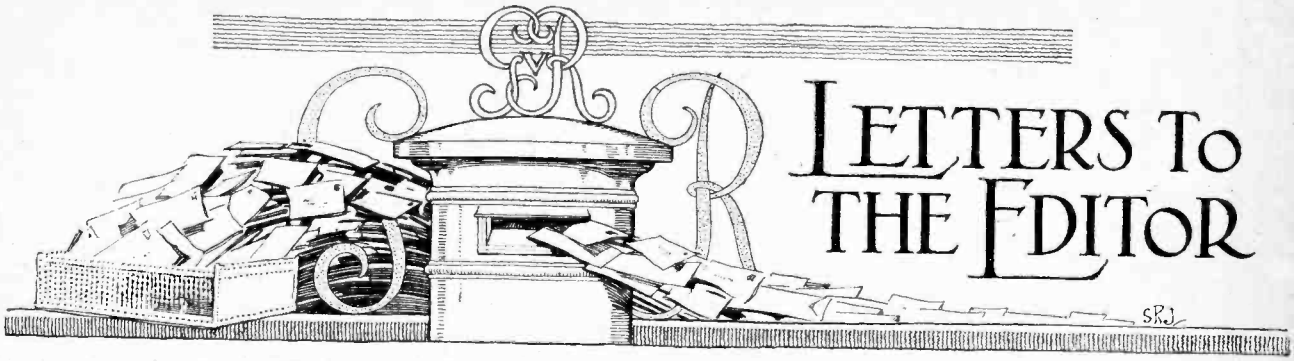


Fig. 2.—Variable shunt resistances across each loud speaker provide a satisfactory independent volume-control when the loud speakers themselves are in series.

than 10,000 ohms at most, which simplifies construction, while the effect of rising pitch as volume is lowered is much less marked, being to some extent counterbalanced, instead of enhanced, by the capacity of the windings. Complete silence can be obtained, just as before, this time by short-circuiting the loud speaker entirely, while by suitably choosing the tapping points on the resistance the control may be made as smooth as could be desired.

For winding the resistances, Eureka wire of 42 or 44 gauge may be employed; the former has a resistance of about 50 ohms per yard, and the latter about 80 ohms per yard. A close enough approximation to even control may be achieved by arranging to halve or double the shunt resistance for each step of the stud-switch that controls it.

A. L. M. S.



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

WIRELESS AND ELECTRICITY SUPPLY.

Sir,—Your recent leading article on the subject of New Regulations and Restrictions in Connection with Battery Eliminators is doubtlessly influenced by a commendable desire to safeguard the interests of the experimenter and the public interested in radio reception. I feel sure, however, that the eminent reputation which *The Wireless World* enjoys will ensure me an opportunity of pointing out that there is another side to this important question.

Firstly, as regards the regulations issued by the Institution of Electrical Engineers. You will have observed that these are in the nature of recommendations only and no penalties are incurred by non-fulfilment.

All sections of the electrical industry are in agreement that their ultimate interests depend upon electrical power being used with safety to the public, and therefore the Institution, as the central technical organisation, is justified in making regulations from time to time which tend to secure that most important object, for there is no doubt that danger does exist, and, indeed, lives have been lost through the inadvertent contact of wireless receiving circuits with public supply mains. It is beyond dispute that these dangers may be largely or entirely overcome by compliance with the regulations now available.

The second aspect of the question is the attitude taken by supply authorities to the use of battery eliminators, and in this connection the following circumstances must not be overlooked :—

Recently the Government initiated certain new schemes with a view to increasing and developing the availability of electric power in all parts of the kingdom. The magnitude of this scheme is such that the details are not yet complete, and several of the existing supply authorities are not yet sure that they may not be superseded or merged into larger units in the future.

In any case, it seems fairly clear that alternating current distribution will take the place of direct current, but when and where still remains unknown, and for that reason some supply authorities are obliged to impose some restriction on the kind of apparatus which their consumers may wish to install. This applies more particularly to battery eliminators, because the energy which they consume is negligible in relation to their prime cost.

At the moment of writing I have before me the catalogue of a well-known manufacturer which indicates the price of an A.C. type at £8 5s., inclusive of valve and royalty, and further states that the consumption from the mains is between 5 and 10 watts. It is a simple matter to compute that the energy taken from the mains would be one Board of Trade unit per hundred hours, and, assuming the set to be used for three hours per day per annum, the total consumption would be ten units only, representing revenue to the supply authorities of 1s. 8d., on the assumption that the energy is taken from a radiator power plug at, say, 2d. per unit.

It will be clear that the profit on such a sum would not be more than 5d. per annum, and therefore it is unreasonable to expect a supply authority to undertake to replace battery eliminators in any event which rendered that course necessary; in fact, the insignificant energy consumption prevents the authorities from regarding them as revenue producers, and it is a concession on their part to allow them to be connected to the mains.

From the users' point of view these appliances are a great convenience and very economical, and as these benefits are enjoyed, not by the supply companies, but by the users, it is only fair that the responsibility for replacement or renewal should rest with them.

L. F. FOGARTY.

Ruislip.
July 23rd, 1928.

Sir,—I have read with interest your Editorial in the issue of July 11th, and am in entire agreement with your remarks generally, but there is one point I think might be made clearer for the benefit of readers possessing, or intending to install, mains units. I refer to your concluding paragraph, in which you say: ". . . in our belief that it is not a question of choice, but of obligation, for electricity supply corporations to replace or make what alterations are necessary to electrical apparatus used by the consumer if the corporation decides to change over from direct to alternating current, provided, of course, that prompt notice is given to the corporation by the consumer as to what apparatus he has in use *as soon as notice that a change is likely to come about is given him by the supply company.*"

It is usual for supply authorities to insert a clause in their "conditions of supply," demanding that notice be given the authorities before any new piece of apparatus be connected to the installation. In the event of a change of supply, therefore, the supply authorities should be aware of the existence of any apparatus, the working of which would be affected by the change. If they find that any apparatus, such as, for instance, mains units, battery chargers, or vacuum cleaners, etc., has been installed without such notice having been given, they are, in my opinion, quite entitled to refuse to replace such apparatus when the change in supply is made. I have known of several cases, in different towns, where this penalty has been enforced.

Whether upon proper notification the supply authority could refuse to allow the apparatus to be used on their supply is another matter. I, personally, do not see that they could, provided the consumer were able to satisfy the authorities that his apparatus conformed to the usual regulations to ensure safety in use to both persons in the house and the authorities' mains and plant.

G. BOURNE.

Blackpool.
July 11th, 1928.

REBROADCASTING AMERICA.

Sir,—No doubt many enthusiastic listeners, like myself, will wish to thank the B.B.C. for their initiative in rebroadcasting, so very successfully, the running commentary on the big fight this morning, which they picked up at Keston and put out through 2LO and 5XX.

One point, however, which I consider was an outstanding

feature and worthy of investigation by the B.B.C. was the fact that although the narrator in the Stadium appeared to be holding the "mike," and had no special cabinet to broadcast from, the noise from the excited crowd of 40,000 odd spectators did not prevent him from "getting his stuff over" successfully. This is in marked contrast to our own running commentaries on football matches, etc., narrated from special silence cabinets, but which do not prevent the noises of the crowd without completely obliterating quite half the narrator's comments on the game, etc., in progress.

Bury St. Edmunds. C. A. JAMBLIN (G6BT).
July 27th, 1928.

MORSE INTERFERENCE.

Sir,—With reference to Mr. W. R. Younger's letter in your issue for June 13th on Morse interference, may I point out that in my opinion he is taking an entirely wrong point of view in the matter?

As an operator I fully understand the importance of wireless communication; but at the same time when I was in England I was a very keen listener, and had to put up with a little interference from Morse at times.

In all parts of the world there are innumerable wireless stations representing the public service, and these stations are allotted a wave or group of waves on which to work. In the majority of cases these consist of C.W. transmitters, and do not cause interference unless the receiver is oscillating or very near to the transmitter.

It is regrettable, however, that nearly all of the ships and ship stations are equipped with the old type of spark sets which radiate damped trains of waves and, like atmospherics, cannot be sharply tuned. The reason for this is that to obtain maximum efficiency with a spark transmitter, tight coupling must be used between the aerial circuit and main oscillatory circuit, thus giving rise to a range of "peak" values.

Until these spark sets are replaced by more modern C.W. installations we cannot hope to have faultless reception. Owing to the enormous expense of these sets and to the waste resulting in scrapping existing ones, this cannot be done in a day.

Meanwhile, let Mr. Younger remember that communication between ship and shore, and, indeed, between any W/T stations, is absolutely necessary, and ranks far ahead of broadcasting in its importance. C. EDMUNDSON.

Quetta, India.
July 8th, 1928.

MOVING COIL REPRODUCTION.

Sir,—Mr. Oliver, whose letter you publish in your issue of the 11th inst., says that he has used a gap as small as 0.025in.

I think it would be of very considerable interest if Mr. Oliver would be kind enough to give details of the former and winding which he was able to work in such a small gap. As Mr. Oliver says, the iron circuit is likely to be saturated when a good number of ampere turns are available, but the construction would be of great interest to those users who have to limit the magnetising current to the lowest possible figure. C. H. S.

July 23rd, 1928.

Sir,—Will you allow me to reply to A. F. B., Blackheath, who has apparently mistaken the whole object of my letter?

He says that I have not drawn the right conclusions from my experiments, and that No. 1 was a really good instrument, but No. 2 hopelessly inefficient. Both were good speakers, No. 2 being one of the acknowledged finest speakers at present on the market.

Again, he says that the *fault* of the experiment No. 1 was that the speaker was delivering too much volume, and results would have been improved by judicious "toning down." If he will again refer to my letter he will see that this is precisely what I set out to prove.

With regard to the point he raises, that, when the volume from the speaker is reduced, the bass fades much more rapidly than the treble, if he will try my method of control by means of the field in the magnet pot, he will find, as I did, that the volume can be reduced to almost inaudibility whilst still retaining the bass drum notes.

I would like to point out that my experiments were not concerned with the merits or demerits of the H.R. or L.R. moving coil speakers, but merely to show that any set capable of giving a pure undistorted output from an ordinary, say, cone speaker, would give very good results on a coil drive speaker, and that the use of valves of the L.S.5a type with the attendent high anode and grid volts was neither necessary nor desirable from the home user's point of view.

Clapton, E.5. LIONEL COLE.
July 12th, 1928.

MOVING COIL LOUD SPEAKER HINTS.

Sir,—The correspondence which has lately been appearing in your journal concerning M.C. speakers has interested me immensely, especially the letter by "C. H. S." in your issue of July 11th.

I have tried a number of M.C. speakers and fully agree with "C. H. S." when he says that the amplifier design is the key to the whole matter.

I have often seen it recommended that the amplifier should consist of one resistance-coupled stage followed by one stage of push-pull, but I personally have never obtained really first-class results from any push-pull amplifier and very poor results indeed from some. My best results have been obtained when using a three-stage amplifier, in which all the stages are resistance-coupled. The valves used in it are as follows:—First stage, L.S. 5B with a resistance of 75,000 ohms in its anode circuit; second stage, L.S.5 with anode resistance of 20,000 ohms; while the output stage consists of two L.S. 5A's connected in parallel and feeding the loud speaker through a special heavy duty *30 henry choke*, and *not a 1 : 1 transformer*. Each valve is fed through a separate filter circuit, consisting of a choke and 4 mfd. condenser to prevent any possible L.F. feed back and subsequent distortion.

"C. H. S." states that he has never obtained good results using D.E. 5A's in the output stage, but good results can be obtained if you use a speaker whose coil consists of 1,800-2,000 turns of 47 S.W.G., and work this in a dense field.

Dudley, Worc. P. D. SIMPSON.
July 13th, 1928.

B.B.C. FAILINGS.

Sir,—Recently I noticed many complaints in your paper concerning the unpopularity of the B.B.C. programmes, and I should be grateful if you would open further your columns for the views of your readers upon this question.

I am convinced that the programmes contain matter that could be put forward more satisfactorily for all, and suggest that full evenings programmes should be allocated to various sections, say, Monday symphony, Tuesday plays, Wednesday variety, and so on.

One does not wish to listen always for 10s. per year, but could enjoy an evening now and then under these conditions.

Summer and portables go together, but it puts a damper on the possibilities of pleasure to find the afternoon's programme commencing at 4 p.m., and even then the programmes are far from suitable.

I am sure these matters concern your readers generally, and many would be grateful if light was permitted to be thrown on this question.

The "Radio Times" is offering guineas per week for criticism of their programme, but, unfortunately, they appear to favour giving awards to those who are satisfied with their programmes under the Pro's, and the awards under the Con's are those who are dissatisfied with the programmes because they are not entirely highbrow.

You will appreciate that it is necessary for an independent authority to convince the B.B.C. that the greater percentage of those from whom they draw their income are normal brow listeners, and they cannot be satisfied to-day with the everlasting talks that take place, and the over-abundance of highbrow matter that is provided. H. S. TAYLOR.

Huddersfield.
July 6th, 1928.

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.

Detection and Signal Strength.

Will you give me a word of advice as to the choice of a detector? I have decided, for local station reception, to limit myself to two valves, but require loud signals (up to 200 volts H.T. is available from a D.C. eliminator). On the one hand, I am told that anode bend detection is best for great volume, while on the other I read that the leaky grid condenser method is undoubtedly more sensitive. These statements seem to be contradictory, so perhaps you will tell me which you recommend to suit my requirements, at a distance of slightly over three miles from the station?

D. K. R.

There can be no doubt that, with conventional circuit arrangements, the anode bend detector will give much louder signals on the input you should receive under normal conditions, at your distance. The other form of detection is more sensitive only when dealing with small signal amplitudes.

○○○○

A Stiff Circuit.

I have recently come across the expression "a stiff circuit." This is new to me; will you explain it?

E. W. T.

This expression is applied to a circuit with a high degree of selectivity, it being implied that this quality is due to the use of large capacity and small inductance, rather than to the "low loss" properties of its components.

○○○○

Learning Morse.

With the help of a friend I am trying to learn the Morse code, and have connected up a buzzer, battery and key. How is it possible to join a pair of phones to the buzzer in such a way that signals will not be excessively loud? The various methods tried have not proved satisfactory, and the intensity is almost deafening if the leads are joined across the buzzer coils or across its vibrating contacts.

W. E. P.

There are a number of methods open to you whereby signals of comfortable strength can be obtained. You might try the effect of winding some dozen turns of fine wire over one of the magnet bobbins and joining the phones across this coil. Perhaps, however, the method shown in Fig. 1 will be most convenient; as you will see, the phones in series with a variable resistance are connected across the buzzer windings. The resistance should preferably have a maximum value of something approaching 250,000 ohms, so that you can adjust intensity to a value comparable with that of incoming signals.

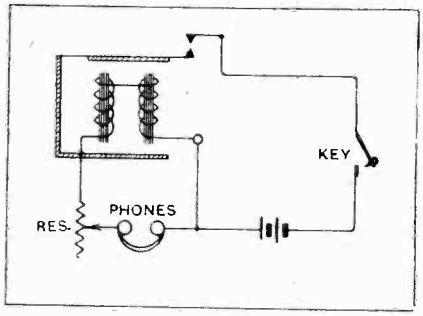


Fig. 1.—For Morse practice: Phones connected to a buzzer through a volume-reducing resistance.

As an alternative, you might connect the resistance in parallel with the phones instead of in series with them; in this case a maximum value of some few hundred ohms would be ample.

○○○○

Bright Emitters as Rectifiers.

Is there any objection to using bright emitter valves as rectifiers in an eliminator which is to supply a simple two-valve "local station" set? I ask this because I have a number of these valves, and would like to use them if possible. My transformer is capable of supplying their filaments with current.

S. H. S.

These valves are capable of giving quite good service in an eliminator when requirements as to output are not extravagant; their use was discussed in the article describing "The Universal Battery Eliminator" in the issues of *The Wireless World* for February 22nd and 29th.

○○○○

The Need for Caution.

Can you refer me to one of your published designs which would fulfil the following requirements?

Reception of 2LO, the two Daventrys, and about half-a-dozen Continental stations, at full loud speaker volume. Not more than two controls, possibly with reaction.

Preferably a maximum of three valves, although I am willing to use four if you consider it necessary.

W. St. J. E.

Without a good knowledge of your local receiving conditions, we would certainly hesitate to assume the responsibility of saying that *any* three- or four-valve set would give the results you desire in daylight, although if your aerial-earth system is reasonably efficient, there is no doubt that any good set would do so at night. We suggest, subject to the above, that the "New All-Wave Four" (*The Wireless World*, June 13th and July 4th) is likely to be suitable for your needs, and in any case we think it would be well to concentrate on a set giving good amplification on the long waves; unless local conditions are really good, stations on this band are likely to provide the most consistent reception.

RULES.

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

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

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

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

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

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

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

A Helpful Formula.

Some time ago you published a simple rule for determining the correct negative bias for an amplifying valve. Unfortunately I have forgotten it, and cannot trace it in my back numbers. Will you repeat the information? W. J. M.

A good idea of the correct grid bias for any valve may be obtained by dividing the H.T. voltage by twice the amplification factor of the valve. As an example, a power valve with an amplification factor of 7, fed from a 120-volt battery, would be biased to $\frac{120}{7\times 2}=8.5$ volts. In practice one would choose the nearest tapping on the battery, which would be 9 volts. This rule is not absolutely accurate, but it gives a very useful indication of the correct operating conditions.

○○○○

Modifying the "Switch-over Three."

To avoid the possible necessity of adjusting the number of turns on the H.F. transformer after the set is built, I propose to use separate neutralising condensers for the long- and short-wave circuits of the "Switch-over Three." This modification is mentioned by the designer, but I am not quite clear as to how it should be carried out. Will you give me a circuit diagram? J. C. T.

A diagram showing the neutralising condenser connections affected by the modification you require is given in Fig. 3, from which you will observe that the grid of the H.F. valve is joined direct to the switch contact which was originally connected to the single neutralising condenser.

A Tantalum Rectifier.

Will you give me the circuit diagram of a full-wave tantalum rectifier for L.T. accumulator charging? I understand that it is possible to use a single cell with three electrodes, and would prefer this arrangement. L. S. T.

The circuit diagram you require is given in Fig. 2. The transformer should

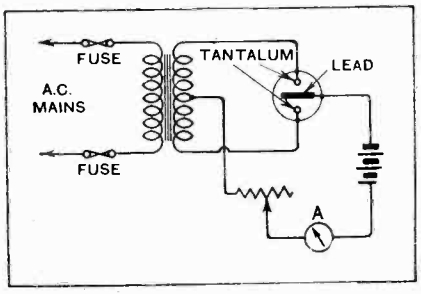


Fig. 2.—An L.T. accumulator charger with full-wave Tantalum rectifier.

be designed to give about 15 volts across each half of the secondary, and, if you are making your own, we would refer you to the design given in our issue for October 5th, 1927. A reduction of about 40 turns in each section of the secondary would be desirable.

○○○○

How Many Henrys?

Will you tell me how to measure the inductance of an L.F. choke coil when under the effect of a steady D.C. current? F. W. B.

We fear that this matter is quite beyond the scope of the Information Department, and under the circumstances we cannot do better than refer you to articles on this subject which appeared in our issue of January 18th last, and also in *Experimental Wireless* for October, 1927, and February, 1928.

○○○○

A Distant Loud Speaker.

I wish to fit an extension lead for a loud speaker in a building other than that in which the receiver is installed, at a distance of over 100 yards. Can this be done satisfactorily, and, if so, how should the leads be arranged? E. D. L.

It is quite possible to work a loud speaker even at a greater distance than 100 yards from the set. We recommend you to use a choke filter output circuit, with a single lead extension and an earth return. The wire to the distant point should be reasonably clear of earthed objects, and we suggest that it should be carried on porcelain insulators in the same way as a telephone line.

○○○○

Too Much "Negative."

A milliammeter is connected in the anode circuit of my output valve, and I find that its needle always kicks in an upward direction on loud passages. Does this indicate that grid bias is insufficient or excessive? P. H. L.

When a momentary increase of anode current coincides with a loud signal, it can generally be assumed that the valve is over-biased, or, in other words, that it is acting as an anode bend rectifier and not as an amplifier. On the other hand, a downward deflection shows that the valve is operating as a grid circuit rectifier: from the point of view of quality, this is even more objectionable than the other form of rectification.

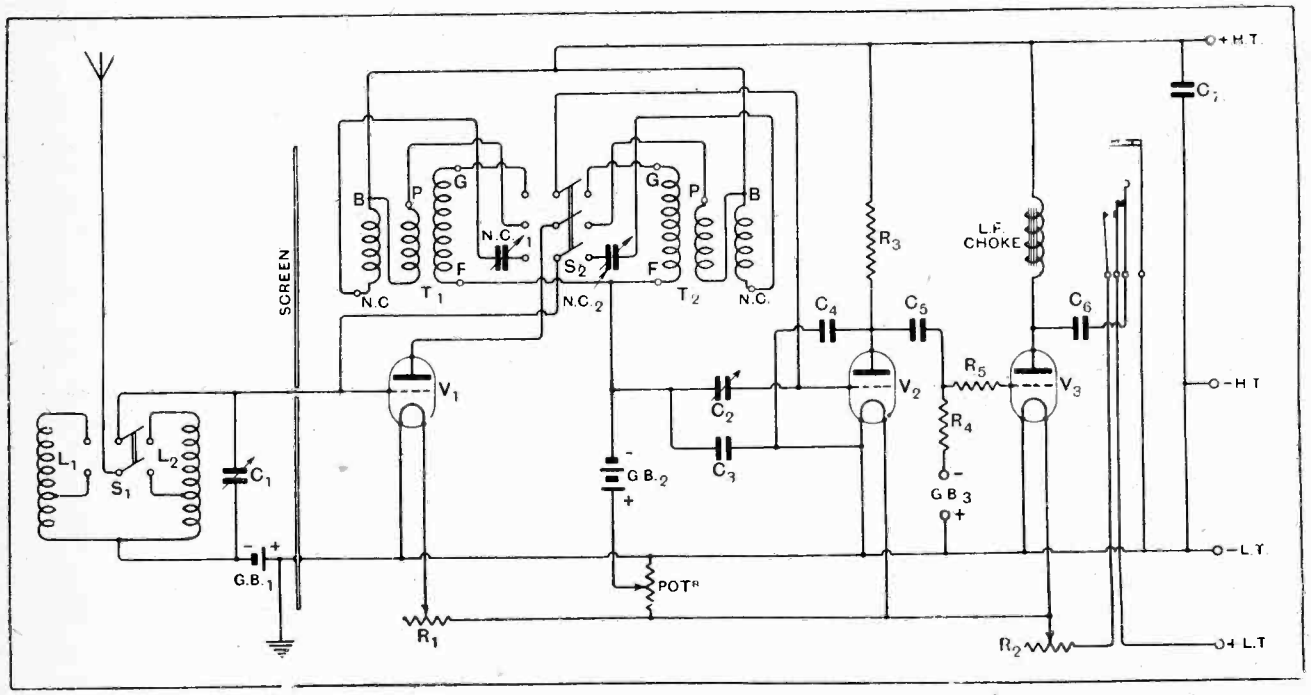


Fig. 3.—Modification of the "Switch-over Three" in which a separate neutralising condenser is used for each waveband.

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(16th Year of Publication)

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Assistant Editor: F. H. HAYNES.

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CONTENTS OF THIS ISSUE.

THE BROADCASTING MONOPOLY.

THE Wireless Telegraphy Act, 1904, which gives to the Postmaster-General the monopoly of the ether and the authority to grant licences at his discretion for the exploitation of the ether in wireless transmissions, has stood the test of years, and when broadcasting came along, after very careful deliberation the decision was arrived at that the Postmaster-General should grant a monopoly licence for broadcasting to one organisation—at that time the British Broadcasting Company, which, as we know, has since become a Corporation.

As we understand it, the Postmaster-General is also required to grant licences to amateurs, experimenters, and research workers, to conduct experimental transmissions, provided that such transmissions do not interfere with the monopoly of the B.B.C.—these, of course, in addition to the licences which they grant for working commercial telegraph stations.

The Television Position.

In view of these facts, it is not clear to us what is the position of the Baird Television Development Company in making an announcement of broadcast television transmissions for the autumn, and indicating that the head and shoulders of a person broadcasting will be seen with movements synchronising exactly with the voice. The B.B.C. has stated that it does not contemplate transmissions of television at present, so that we can dismiss the idea that these television transmissions which have been announced will emanate from the stations of the B.B.C. If the experimental licence which has been granted to the Baird Television Development Company has been extended by the Postmaster-General to permit them to broadcast a regular service of television transmissions, it looks, on the face of it, as if this might be regarded as an encroachment on the B.B.C. monopoly, and it seems almost certain that it would be so regarded if music or speech accompanied the transmissions so as to synchronise with the movements as promised.

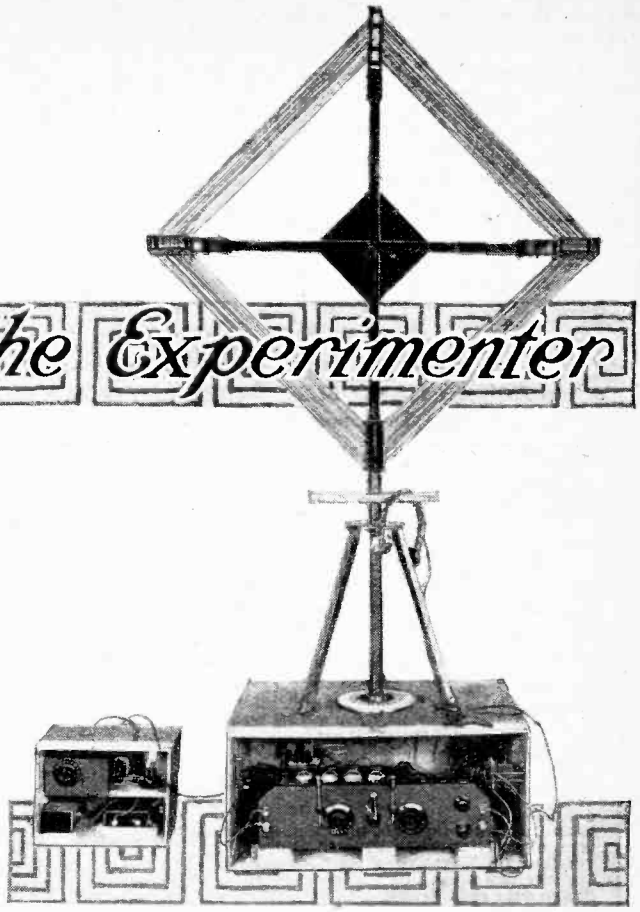
Is a Licence Necessary?

It has been suggested that a transmission without speech or music is outside the monopoly of the Postmaster-General, and that for such transmissions a licence would not strictly be necessary. This interpretation of the position does not, however, seem to us to be a correct one because now that still life picture transmission has reached a stage when it is commercially applicable to the transmission of photographs, or even facsimiles of written messages, such an interpretation of the Act would undoubtedly (to put it bluntly) knock the bottom out of the Post Office monopoly and reduce the basis of the Wireless Telegraphy Act to an absurdity. However, such situations have before now arisen on legal points, and we await with interest possible developments in the situation.

Accepting Responsibility.

A dispute with the Postmaster-General along these lines might have one beneficial effect if it is definitely established that the Postmaster-General is responsible for the control of all ether radiations (other, of course, than those due to atmospherics), for it would then perhaps follow that the Postmaster-General would be required to busy himself with the question of man-made static and interference with broadcast reception from electrical machinery, which in some districts has for so long been regarded as one of the nuisances against which there is no appeal unless those responsible for the interference of their own free will undertake to effect a remedy. If the Postmaster-General controls all ether radiation then he must expect to be held responsible for controlling the traffic and taking action against those who cause unnecessary obstruction to the users of the ether in just the same way as the police are responsible for maintaining order on the highways.

RADIO DIRECTION FINDER for the Experimenter



Part. I.—The Theory of the Frame Aerial. Avoiding Electrostatic Pick-up.

By R. L. SMITH ROSE, D.Sc., Ph.D., A.M.I.E.E.

THE radio direction finder is now well known as an instrument which can be used to determine the direction of arrival of wireless waves, and which has an application to both the science and practice of wireless communication. Although there are several commercial types of direction finder now in use, they all employ the same fundamental principle of the single-frame coil system, the operation of which may be briefly described as follows:—

The single-frame coil direction finder consists essentially of a vertical loop aerial rotating about a vertical axis, and connected to a suitable wireless receiver. Fig. 1 represents such a loop placed in the path of arriving wireless waves travelling horizontally along the earth's surface. The electric force in such waves is nearly vertical, and an electromotive force is accordingly induced in each of the vertical sides of the loop. It will be seen from the diagram that these two electromotive forces are usually tending to cause a current round the loop in opposite directions. Since, at any instant, the magnitude of the vertical electric force of the waves varies along the direction of propagation, the electromotive forces in opposite sides of the loop are not quite equal, and it is the resultant E.M.F. which gives rise to an oscillatory current round the loop, and hence permits its use as a receiving aerial. A little consideration will make it evident that the current will be greatest when the plane of the coil lies in the direction of the transmitter, for in this case the difference between the E.M.F.s induced in the two sides of the coil is a maximum.

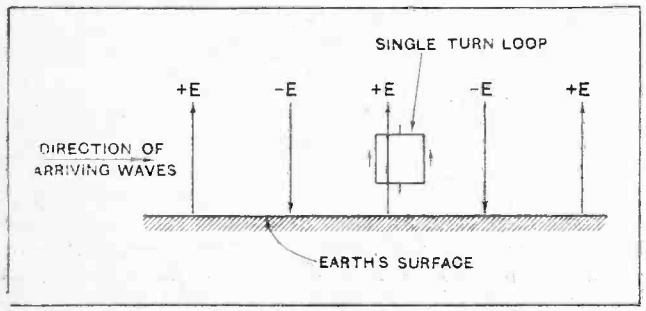


Fig. 1.—Single-turn frame aerial placed in the path of wireless waves travelling along the earth's surface. The electric force is vertical.

The Cosine Law.

As the coil is rotated about a vertical axis the resultant E.M.F. decreases according to a cosine law, until it reaches zero, when the plane of the coil is at right angles to the direction of the arriving waves. It is this position of zero, or, at least, minimum signal intensity which is used in the employment of the rotating frame coil as a direction finder.

An alternative method of viewing these principles may be understood by considering the effect of the magnetic field of the waves upon the loop. In Fig. 2(a), for example, L represents the loop rotating about a vertical axis in the field of an arriving wave, whose component electric and magnetic forces are as shown. The intersection of the magnetic lines of force in the passage of the wave across the loop induces an electromotive force therein. From the plan view in Fig. 2(b) it is evident that the induced E.M.F. is proportional to the cosine of the angle α between the direction of the magnetic

Radio Direction Finder for the Experimenter.—

field and the axis of the loop, or, which is the same thing, between the direction of the arriving waves and the plane of the loop. Thus, as the coil is rotated in the field of the arriving waves, the E.M.F. induced therein passes through successive maxima and minima. The accuracy with which any definite position of the coil may be located depends upon the rate of change of E.M.F. with orientation; *i.e.*, the accuracy is proportional to sin α. Thus the determination of the direction of arrival of the waves is most accurate when the signal E.M.F. induced by the waves is zero. All the present-day types of radio direction finder operate upon this fundamental principle of locating the position of a coil at which the induced E.M.F. passes through a zero or minimum value.

The most important feature which requires attention in the design of a practical direction finder is the avoidance of spurious E.M.F.s introduced into the system from one or both of the phenomena commonly known as "antenna effect" and "direct pick-up." The term "antenna effect" is applied to the property possessed by a frame-coil receiver of acting as an untuned vertical aerial as well as a coil for reception purposes. As a result of this, the receiving system may have induced in it an E.M.F. whose phase and magnitude are independent of the orientation of the coil. The signal heard in the telephones will be the sum of that produced by the rotating coil acting as such, and that due to the equivalent aerial effect of the whole receiver. As the coil is rotated it is found that the signal zeros become blurred into broad minima only, and, moreover, they may be displaced from their correct position. The existence of this antenna effect in the system, therefore, makes the observed directions incorrect, and also makes the determination of these directions much more difficult.

Somewhat similar results may be produced by the second of the two causes mentioned above, *viz.*, "direct pick-up." This last term implies that portions of the receiving system, such as the tuning circuits and the amplifier, are getting E.M.F.s induced in them directly by the incoming waves. These E.M.F.s will obviously be independent of the orientation of the main receiving frame, and they will be effective in adding to or subtracting from the signal strength finally heard in the telephones. It must be appreciated that while these stray E.M.F.s may be small compared with the main E.M.F. picked up by the rotating frame coil in its maximum position, they become of very great importance when the coil is turned into its minimum position.

The methods adopted for overcoming the effects of these spurious E.M.F.s are based on the use of somewhat elaborate screening arrangements which are described in some detail below.

Elimination of Antenna Effect.

While there are several circuit arrangements by means of which the antenna effect of a frame coil receiver may be compensated for, it has been found convenient for many purposes to overcome the difficulty by adopting an open-wire screen of the type described by Barfield.[1] In this arrangement a whole hut containing the D-F receiver may be placed within a screen consisting of plane vertical, unclosed loops. These loops are well insulated from each other, from the ground, and from the receiver, and care must be taken to ensure that no loop or combination of loops has any resonance action at the frequency of the incoming waves. The effect of such a screen is that the oscillatory currents produced in the wires by the incoming waves give rise to a secondary electric field within the screen which is sensibly equal and opposite in phase to the electric field of the waves. (This screening action of open wire aerials has been explained in a previous article recently published.[2]) The difference in phase of the wave field on the two sides of the coil is the quantity which determines the received E.M.F., and this remains unaltered. Thus the signal E.M.F. induced in a vertical frame coil is unimpaired by the presence of the screen, whereas practically no E.M.F. is received on an open wire aerial placed within the screen. These facts are easily demonstrated by experiments.

Advantages of a Wire Screen.

A typical hut screened in the above manner, and containing a complete direction finder, is shown in the photograph in Fig. 3. Among the advantages of such a screen is the fact that when once it is installed no adjustments or alterations whatever are required for any direction of the waves or their wavelength. For portable work the above arrangements will obviously require some modifications, and in the design to be described below it will be seen that the wire screen is built on to the coil frame, and the whole rotated in one unit.

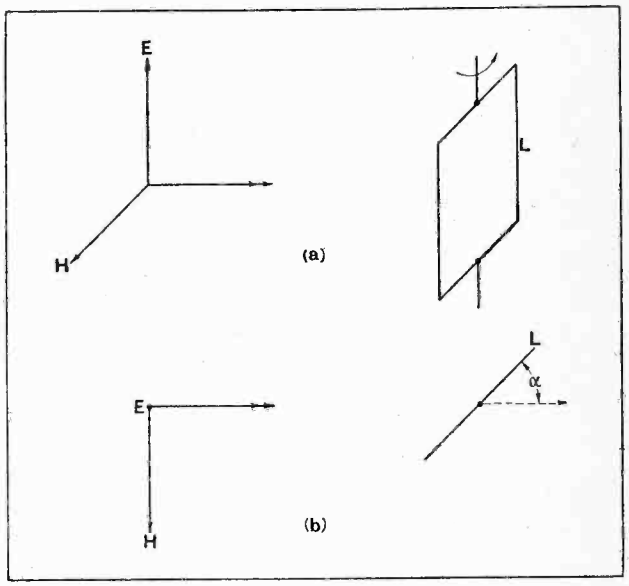


Fig. 2.—(a) L represents the frame aerial rotating about a vertical axis. E and H show the electric and magnetic components of the field of an arriving wave. (b) A plan view from which it can be deduced that the E.M.F. in the frame is proportional to the cosine of the angle between the arriving waves and the plane of the frame.

[1] Journal Inst. Elec. Eng., 1924, Vol. 62, p. 257.

[2] "Wireless Masts and Screening," *The Wireless World*, May 2nd, 1928

Radio Direction Finder for the Experimenter.—

A consideration of the theory of antenna effect on frame-coil receivers shows that the difficulties due to this cause increase with the frequency of the waves employed, so that for medium- and short-wave direction finding it is well to consider another method of eliminating antenna effect, which may be used as an alternative or preferably in addition to the one described above.

Unequal Capacities to Earth.

This method may be understood with the aid of Fig. 4, which shows a simple one-turn loop, the tuning condenser of which is connected to the grid and filament terminals of the first valve of a receiver. It will be appreciated that the capacity to earth of the coil connected to the filament will be higher than the capacity between the grid terminal and earth, since in the former case the comparatively large capacity of the low- and high-tension batteries is present. On account of these unequal capacities [C_F and C_G in Fig. 4(b)] the currents flowing to earth on the two sides of the coil will be unequal even when the plane of the loop is at right angles to the direction of the arriving waves. There will result, therefore, a potential difference across the terminals F G of the tuning condenser which will cause an audible

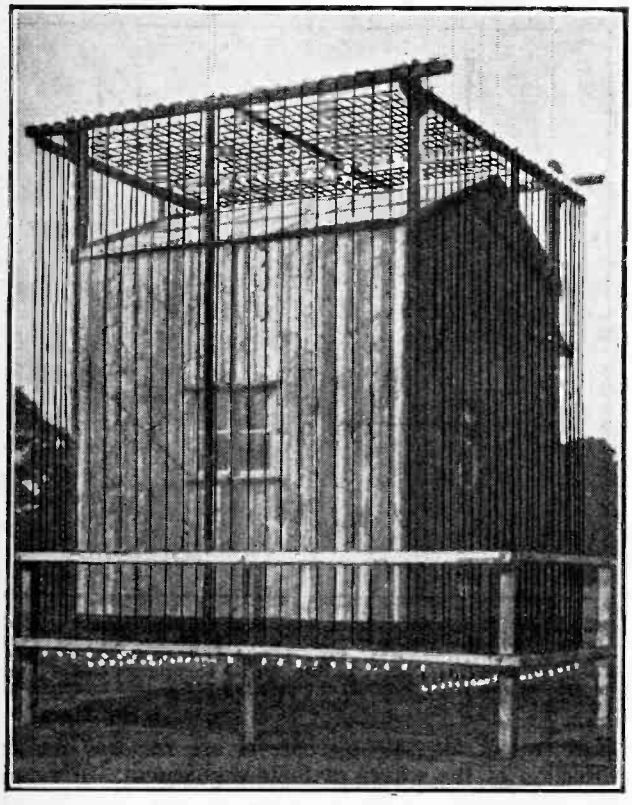


Fig. 3.—Open-loop wire screen arranged around a hut to reduce antenna effect.

signal in the telephones when the coil is in the zero signal position.

The elimination of such unwanted signals is, however, easily effected by connecting a balancing condenser C_B in parallel with C_G, and adjusting this until $C_G + C_B = C_F$. While this method has certain disadvantages when used without a screen, it may be useful as a final adjustment to obtain sharper signal zeros when screening arrangements are employed as well.

Screening the Receiver.

The elimination of the "direct pick-up" effect already described may be accomplished within practical limits by enclosing the whole of the receiving apparatus, apart from the frame coil itself in a metallic screening

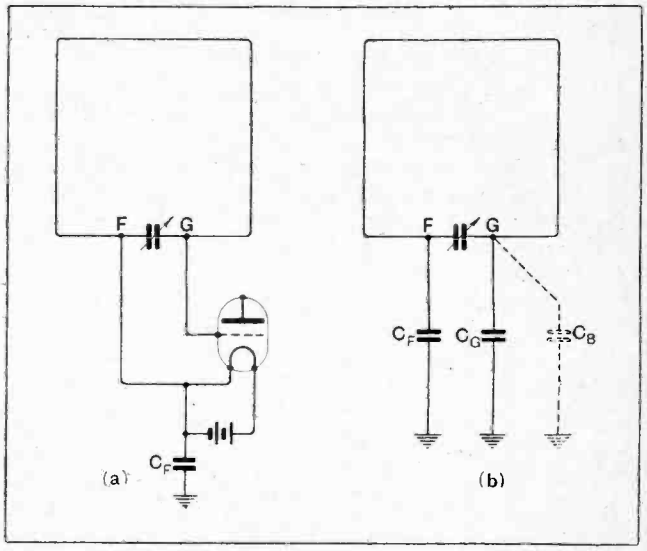


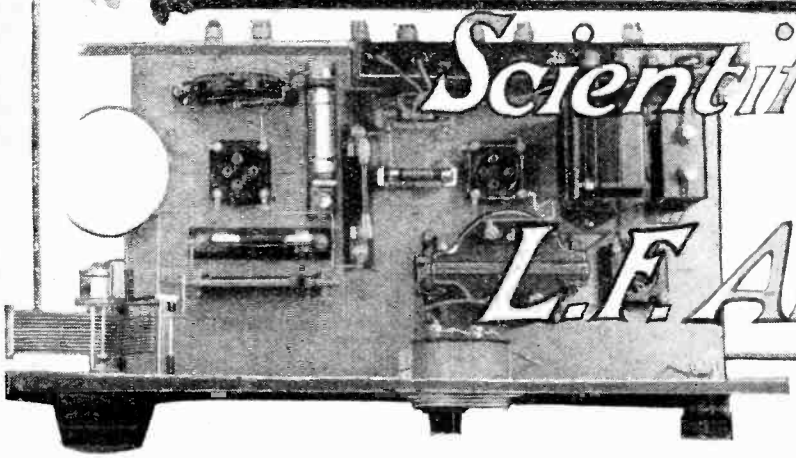
Fig. 4.—(a) Illustrating the unequal capacities to earth produced when a frame coil is connected to a valve. In (b) is shown the manner of equalising such capacities by the addition of C_B which is a balancing condenser.

box. In the ideal case there would be no holes or cracks in such a box, but it is obvious that a compromise must be drawn for any practical instrument. For laboratory use, it is a moderately simple matter to arrange the box with a mercury-sealed lid, but such an arrangement is hardly suitable for portable work. It may be said that the screening box should be covered as completely as possible with either copper sheet or preferably tinned-iron plate, all joints being well lapped and soldered, and the lid being made a good fit to ensure good metallic contact with the box throughout the whole of its periphery. In designing the receiver, advantage may be taken of the fact that within the limits of ordinary direction finding the magnetic field of the arriving waves is practically horizontal, and that, therefore, no signal E.M.F. is induced in horizontal loops or wires. It is thus desirable that the coils and wiring of all tuned circuits be kept in a horizontal plane, as far as is possible. In addition, it is evident that by fitting the lid of the box at one side, the importance of the contact between lid and box is materially reduced.

With this explanation of the principles involved in a wireless direction finder, we may proceed to the description of the design of a portable D-F set, suitable for the average experimenter.

The concluding instalment (Part 2) of this article, giving design data for a practical direction-finder, will appear in the issue of "The Wireless World" dated August 29th.

COMPROMISE IN RECEIVER DESIGN: PART 4



Scientific Design of the L.F. Amplifier

Numerical Treatment of the Growth of Grid Swings from Stage to Stage.

WHEN the magnitude of the output stage has been decided upon, the type of detector chosen, and the mode of coupling for the low-frequency amplifier selected, a point has been reached at which the real business of numerical design can no longer be postponed. It becomes necessary, therefore, to consider what conditions must be fulfilled by the low-frequency amplifier, and then to see how best we can meet them in a practical design.

The purpose of the L.F. amplifier is to magnify up the output of rectified signals from the detector to a sufficient extent to operate satisfactorily the output stage that has been chosen, and to do this without introducing any distortion. It should be done, too, with the smallest number of valves, or, alternatively, with the smallest expenditure compatible with the degree of amplification and the standard of quality that the particular circumstances of each case demand.

Peak Volts and Grid Bias.

The design will be determined chiefly by the conditions obtaining at the two ends of the amplifier; that is, upon the output expected from the detector, and the quality, as well as the volume of sound, required from the loud speaker. Since grid and anode detectors give outputs of very different magnitudes, it will make for greater coherence in arrangement if we treat the two types of detector entirely separately, even though this means covering some of the same ground twice over. But whichever detector is to be used, the volume and quality demanded will probably be the same, and will depend only upon the size of the output stage and the excellence of the loud speaker chosen. As a basis for concrete numerical suggestions, it will be assumed throughout that the output stage to be used will consist of one or two "super-power" valves with an anode voltage of the order of 160, which is the output stage upon which greatest stress was laid in the first article of this series. The valves suggested, with the plate voltage mentioned, will require a grid potential of the order of 20 volts, and as a consequence it will be necessary so to build our amplifier that it will supply the output stage with signals whose maximum or peak voltage has this value. If a smaller or larger output stage is to be used, the necessary variations from the figures to be given for overall amplification can easily be made if it is borne in mind that the peak signal voltage required from the amplifier is the same as the grid bias applied to the output valve. The only exception to this simple rule is where the push-pull system is employed, in which case, since the signals are divided between the two output valves, the signal voltage available must necessarily be increased to double the grid bias in use.

Although the magnitude of the signals required from our amplifier is thus easily determined, the quality that we shall want is much more difficult to specify in exact numerical terms. Clearly, it is not worth our while to attempt to retain the lowest bass notes throughout the amplifier, possibly making heavy sacrifices in overall amplification to do so, if when these notes are finally shepherded carefully down the flex to the loud speaker that instrument completely fails to reproduce them. Nor, on the other hand, is it particularly profitable to go to the trouble and expense of a loud speaker that responds fully to the lowest bass, if we so design our amplifier that it cuts off at fifty cycles.

Build the Amplifier to Suit the Loud Speaker.

While all this is obvious enough, it is a matter of some difficulty to decide, for any given loud speaker, upon any definite frequency below which we can permit the amplifier to cut off. It is not sound, unfortunately, to take the line of least resistance and knowingly to make the amplifier pass on at full strength bass notes far below the lowest that the speaker can reproduce, because overloading on low notes, and with it audible distortion *on all notes*, will then begin at a lower signal strength than if the amplifier were only delivering notes that the loud speaker could reproduce. With such an

Compromise in Receiver Design—The L.F. Amplifier.—amplifier, therefore, a greater margin of safety must be allowed, and this implies higher plate voltages and a more expensive installation. To make the most economical use of the apparatus available, it is in consequence desirable to arrange that the amplifier passes on the lowest notes that the speaker can reproduce, and cuts off all notes below this limit.

Official figures for the lowest notes that can adequately be dealt with by loud speakers of various makes are not available; the writer can therefore only offer suggestions based largely upon guesswork (or judgment by ear, which is much the same thing) as to the lowest frequencies that it is worth while to retain for loud speakers of different types.

Frequency Response of Loud Speakers.

For the average horn speaker it does not seem necessary, in practice, to bother about frequencies lower than about 200 cycles or so; in consequence an amplifier designed to feed such a loud speaker can be made to give comparatively high amplification per stage by using transformers of good quality with valves of fairly high amplification factor. A cone-type instrument, driven by a balanced armature, seems capable, at least in the best models, of reproducing down to about 70 cycles, and notes of all frequencies above this should be scrupulously retained. For speakers of the moving-coil type, it is suggested that the lowest limit in the amplifier should not be above 20 cycles or so, though in this case limitations of anode

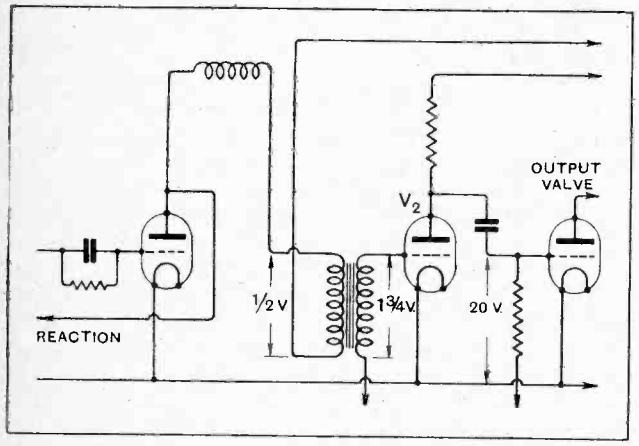


Fig. 1.—A low-frequency amplifier preceded by a grid rectifier. Assuming that 1/2-volt (peak) is developed across the anode impedance of the first valve, in order to obtain 20 volts (peak) across the input of the last valve, a stage of 3 1/2 followed by a second stage of approx. 12 magnification is required.

voltage may sometimes make it more profitable to set the limit appreciably higher.

These suggestions, it must be amphasised, are expressions of opinion rather than of scientific fact; all that is claimed for them is that their adoption leads to reproduction of very acceptable quality. It is quite possible that higher limits might be set without appreciable deterioration in this respect.

We have now fixed exactly in point of magnitude, the voltage that our amplifier has to provide to operate the output valve. We have also come to a reasonable compromise on the debatable question of the frequency-range with which it must be expected to deal, so that we can now turn our attention to the signals provided by the detector, which are the raw material upon which the amplifier has to work. It is at this point that the division of amplifiers into two types that has already been mentioned must begin.

The Amplifier Following a Leaky-grid Detector.

In discussing the grid detector in a previous article, we have already come to the conclusion that it will not

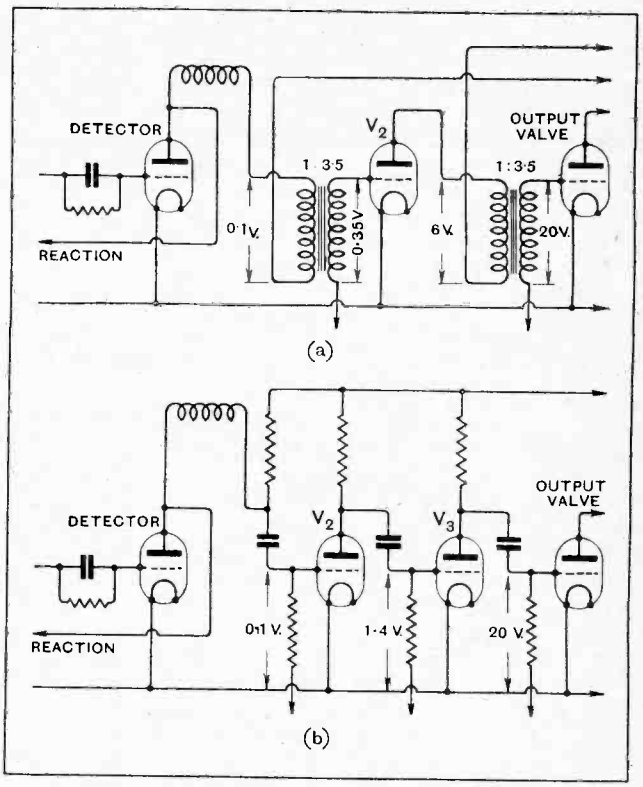


Fig. 2.—Assuming a rectified output from the grid detector of only 1/10th volt (peak), in order to obtain 20 volts (peak) on the grid of the output valve, either two transformers (a) or three resistance couplings (b) are required. The growth of the signal potential as it passes from stage to stage is shown numerically.

pay us to use too great a measure of amplification at high frequency. For this reason, and because it is necessary to take care that there shall be no possibility of overloading the rectifier, we shall need a considerable amount of low-frequency amplification. It is suggested that after this type of rectifier a voltage amplification of thirty times, measured from the anode of the detector to the grid of the output valve, should be regarded as the absolute minimum compatible with safety, even when a very modest output stage, calling for only a small signal voltage to operate it to the limit of its capacity, is in use.

As a rough guide we may take it that the maximum signal output that can reasonably be expected from a grid rectifier, worked at a safe distance from the point at which overloading begins, is about half a volt. This

Compromise in Receiver Design—The L.F. Amplifier.—

figure represents the voltage developed across the impedance, of whatever type it may be, that is connected in the anode circuit of the rectifier. If we accept this figure for design purposes it means that an overall amplification of 40 times will be required to feed an output stage using 20 volts grid bias. A skeleton diagram of an amplifier to this specification, employing a transformer after the detector and a resistance-coupled stage before the output valve, is given in Fig. 1, in which the signal voltages at various stages are shown as an indication of the way in which the design was put together.

Transformer with Rising Characteristic.

But although such an amplifier will be perfectly satisfactory whenever we can feed the detector with a great enough high-frequency voltage to produce our hypothetical half-volt of rectified signals, it will not give sufficiently loud signals on distant stations unless plenty of high-frequency amplification is available to keep the input to the detector up to its necessary value. Unless the need for selectivity makes it advisable to employ high-frequency amplification to this amount, we shall obtain a more efficient receiver (in the sense of " more noise per valve ") if we design for a greater low-frequency amplification, and make the detector operate on a smaller input. It is suggested, as more generally suitable for the type of receiver in which a grid rectifier is normally employed, that the L.F. amplifier should be based on an assumed detector output of not more than one-tenth of a volt. This will lead us to an amplifier giving an overall amplification of 200 times, which may be achieved by employing designs such as those shown at (a) and (b) in Fig. 2.

It will be appreciated that if still greater amplification is required one or two of the resistances in (b) might be replaced by a transformer, or, for a smaller increase, some or all of them might be replaced by chokes of suitable inductance value, leaving the valves unchanged in either case. Alternatively, valves of higher amplification factor might be used with the resistances, but it should be remembered that if this is done there will be some loss of high notes, which can, however, be made up to some extent by replacing one of the resistances by a transformer chosen for the possession of a rising characteristic.

Avoid Loss of High Notes.

The only remaining matter which is dependent upon the type of detector in use is the choice of a component for the plate circuit of the detector valve itself. As has already been pointed out, in the case of the leaky-grid detector rectification actually takes place on the grid of the valve, so that in this case the components in the plate circuit have no direct bearing on rectification. In considering them we can therefore restrict our attention to the purely L.F. aspect of the case.

A grid detector has a working impedance which in the average case is about the same as that given for the valve in the maker's catalogue, for the lowering of impedance brought about by the application of a positive potential to the grid of the valve is roughly offset by the increase involved in the use of comparatively low anode voltage, which is essential in most cases for efficient rectification. Any component that would be satisfactory in the plate circuit of the same valve used as a plain L.F. amplifier may therefore be used to couple the detector to the succeeding valve. It will be wise, however, to take whatever precautions may be deemed necessary in order to keep the high-frequency component of the detector output out of the L.F. amplifier.

These precautions, whatever may be their exact form, all tend to cut down the high notes a little, so that it will be safer to refrain from using as detector, or for the valve immediately following it, valves of very high impedance or very high amplification factor, unless the achievement of high amplification per stage is counted as a greater merit than the retention of the high notes at their full strength. Any condenser that may be connected in the plate circuit, whether as part of a filter designed to keep high-frequency voltages from the grid of the next valve, or to ensure proper reaction effects when such are required, should in the interests of the high notes be cut down to a minimum.

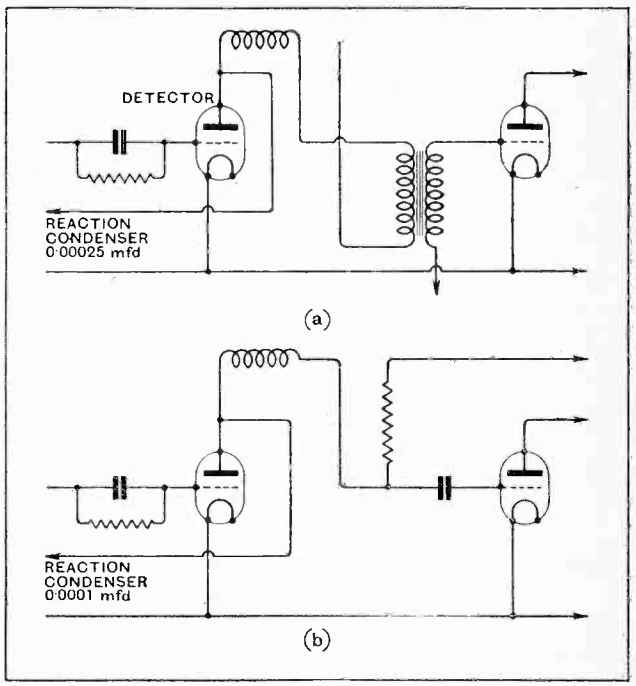


Fig. 3.—Filter circuits for eliminating undesired high-frequency components in an amplifier preceded by leaky-grid detection.

Fig. 3 shows suggested filter circuits for eliminating the undesired high-frequency component, and the values given have been chosen with the aim of effecting the necessary compromise between inefficient filtering and undue loss of high notes.

Either a resistance, a transformer, or a choke may be used to couple the detector to the next valve, for components of all three types are available in values suitable for the purpose. As a convenience it may be suggested that if a resistance be chosen its value should be such that the " H.T. + " end of it can be connected

Compromise in Receiver Design—The L.F. Amplifier.—

to the same battery tapping as that used for some other valve in the receiver, relying upon the voltage drop in the resistance itself to bring down the voltage actually reaching the plate of the valve to a value that is suitable for efficient detection with the valve chosen.

The Amplifier Following an Anode-bend Detector.

The case of the anode-bend rectifier is very different in many respects from that which we have just been discussing. Here the anode voltage available plays a very big part in determining the output that the detector will give without overloading. Given a really high plate voltage, and an adequate high-frequency input, an anode rectifier can deliver a surprisingly large signal voltage without overloading, so that, if we are content with the local station only, or if plenty of high-frequency amplification is used on more distant stations, the amplification at low frequency can be cut down to a very low figure, and may even, with many of the modern output valves, be omitted altogether.

But if the high-tension voltage is limited, or if, in the interest of simplicity in handling, the high-frequency amplification is not to be great, it will be necessary to follow an anode rectifier with an amplifier magnifying the signals even as much as fifty times before they are applied to the grid of the output valve. In such a case, of course, we are relying upon low-frequency amplification to do the work that the high-frequency amplifier has left undone, and are sacrificing efficiency to convenience and, perhaps, to quality as well.

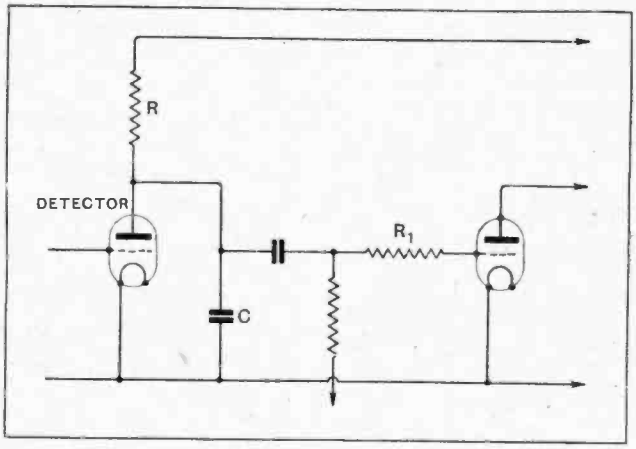


Fig. 4.—Skeleton circuit with anode bend detector and resistance coupling. The detector valve has a mag. factor of 35 and an impedance of 55,000 ohms. R is 250,000 ohms; C, 0·0001 mfd.; R_1, 70,000 ohms; 1st L.F. valve has a mag. factor of 15 to 20.

As a rough guide, we may take it that the maximum signal output that can reasonably be expected from an anode rectifier, with an anode-current supply of 120 volts, is about 5 volts (peak value). This figure is, in a way, a very conservative estimate, since in favourable conditions, and with a generous high-frequency input, it can be exceeded very considerably before overloading commences, but it is suggested as a maximum because in most receivers with which long-range reception is attempfed the amplification at high-frequency is not sufficient to provide a bigger output than this. Indeed, in the majority of cases this figure can only be achieved on the local station and perhaps on 5GB.

To operate our standard output stage, which requires 20 volts grid bias, from an anode rectifier delivering 5 volts of signals, we shall require an amplification of four times. If we wish to make up on the L.F. side for inadequacies in the high-frequency amplifier, we may postulate a lower detector output down to, say, 1 volt, which increases the L.F. amplification required to 20 times. Higher than this it is not advisable to go, unless for some special reason, for the small H.F. input to the detector that this would imply leads to very inefficient detection.

It is hardly necessary to illustrate amplifiers to give these results; all that is wanted between the detector and the output stage is a single valve followed by a resistance or a choke, the amplification factor of the valve being so chosen that it is some ten to twenty per cent. greater than the magnification required.

When an anode detector is in use the working impedance of the valve is so high, owing to the negative grid bias applied, that it is not practicable, except under special conditions, to use in its plate circuit any coupling other than a resistance. If an inductive coupling is tried, either in the form of a transformer or a choke, it will normally be found that the reproduction of the low notes suffers; the only exception to this rule is when the received signal is very strong indeed.

The value of the resistance to be chosen is a matter of compromise between the conflicting claims of efficiency and sensitiveness in detection on the one hand, which demand a very high value of resistance, and of high notes on the other, which are inclined to vanish if the plate resistance is increased unduly. The amplification factor of the first L.F. valve enters into the question too, for the higher its value the greater the tendency for the loss of high notes. In practice, a reasonable compromise may be reached by avoiding the very high impedance valves in both detector and first L.F. positions, and choosing a resistance about five times greater than the nominal impedance of the valve. A combination that has given satisfaction in the writer's hands is as follows: Detector: $\mu=35$, $R_0=55{,}000$ ohms; $R=250{,}000$ ohms, $C=0.0001$ mfd., $R_1=70{,}000$ ohms. 1st L.F.: $\mu=15$ to 20. (See Fig. 4.) These valve figures, which are suitable for the broadcast band, may be varied in either direction as the preferences of each individual may dictate, bearing in mind that greater signal strength can only be purchased at the cost of some loss of high notes, and that more perfect reproduction of high notes involves a loss of sensitivity.

Use Small Anode Shunt Capacity.

The position is complicated to quite a considerable extent, however, by the appearance of two more factors in the problem. One of these, the filter-circuit used to keep high-frequency voltages from the grid of the first L.F. valve, has already been mentioned in connection with the grid rectifier, and the remarks there made hold good here also. The anode-shunt condenser by-

Compromise in Receiver Design—The L.F. Amplifier.—

passing the load in the plate circuit of the detector (C in Fig. 4) has, however, an additional influence in the case of an anode rectifier, for its presence is essential to efficient rectification. On the broadcast band, it will be found that signal strength increases, rapidly at first and then more slowly, as the value of this capacity is increased from zero up to about 0.0005 mfd., while on the wavelength of 5XX a value as high as 0.002 mfd. is required to bring the detector to maximum sensitivity.

The Impedance of the Detector Valve.

Such a value of capacity, at so critical a point in the circuit, would cut high notes to an intolerable extent unless the impedance of the detector valve, and the resistance in its plate circuit, were decreased to a very low value indeed. To do this would result in decreasing the sensitivity to an extent which would much more than counterbalance the increase due to the large capacity, so that some sort of compromise is essential. We must therefore sacrifice some detector efficiency by using a valve of moderate impedance only, with a not-too-high value of anode resistance, and use for our shunt condenser a capacity that is not large enough to sacrifice more high notes than we can afford to lose, nor small enough to render the detector very inefficient or to render the filter-circuit incapable of fulfilling its function.

The exact combination that will be most suitable for any particular case depends on more factors still; if, for example, a multi-stage H.F. amplifier is in use we may be compelled to use a low-impedance detector for the sake of being able to increase the anode-shunt capacity until the filtering action of the circuit is high enough to ensure stability of the H.F. stages, without undue loss of the high notes which produces that muffled effect in reproduction.

The extreme difficulty of combining a sensitive detector, and an efficient H.F. filter with good amplification of the high notes, is perhaps the greatest obstacle in the way of designing a receiver incorporating an anode rectifier. In all cases where this type of rectifier is employed the very greatest care and attention must be devoted to its anode circuit, for this point is the most critical in the entire set. On the compromise finally made between the many factors which must here be considered will depend very largely the final success or failure of the receiver as a whole.

The Rest of the Amplifier.

The design of the amplifier, after the plate circuit of the detector has been settled, is in comparison simple and straightforward. The principles that govern the design have already been discussed many times in the pages of this journal, and it only remains to offer some suggestions as to the liberties that can be taken when designing for imperfect loud speakers, and some remarks bearing upon the choice of valves.

In a resistance amplifier, a middle path between high amplification per stage and high-note loss must be taken, though when using a loud speaker from which the bass is missing a greater loss in this direction can usually be tolerated than when a moving-coil speaker is employed. For the latter case, the writer would suggest that the valves should have amplification factors not greater than 15 and 25 for the two-volt and six-volt series respectively, but others may prefer to compromise on quite different figures.

Where transformers or chokes are to be used definite figures can be given for the amplification of the low notes. The choice of a transformer should never be made without a knowledge of the inductance, *under working conditions*, of the primary. Similarly, the inductance of a choke should be known, and in either case the relationship of inductance to valve impedance should be such as to provide for a reproduction of low notes that is sufficient to supply the loud speaker properly with the lowest notes that it can reproduce faithfully.

Some idea of this relationship can be gathered from the following table, in which suitable inductance values to follow valves of various impedances are given. The columns refer to three different standards of reproduction, suitable for receivers working horn, armature-driven cone, and moving-coil speakers respectively. The combinations suggested permit in each case a falling-off of amplification at the lower limit of frequency to 75 per cent. of that obtained on middle notes; the lower limit in question is taken for horn speakers as 200 cycles, for armature-driven cones as 70 cycles, and for moving-coil instruments 20 cycles.

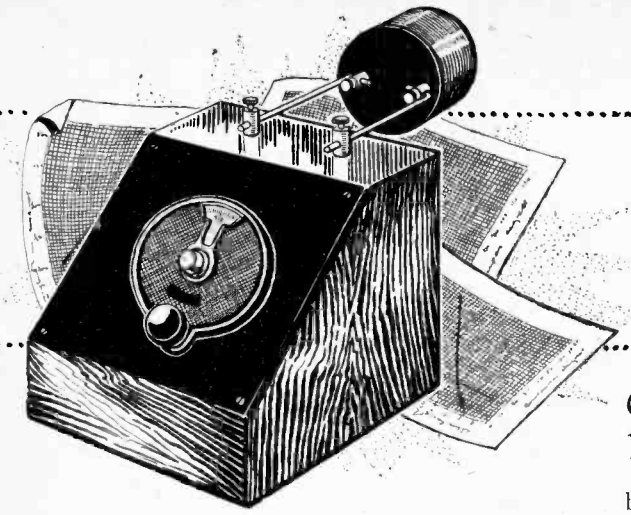
Valve Impedance. (ohms)	A. (Horn)	B. (Cone)	C. (Coil)
8,000	8 hys.	27 hys.	80 hys.
10,000	10 ,,	33 ,,	100 ,,
15,000	15 ,,	50 ,,	150 ,,
20,000	20 ,,	70 ,,	200 ,,
30,000	30 ,,	100 ,,	300 ,,
50,000	50 ,,	160 ,,	500 ,,
80,000	80 ,,	270 ,,	800 ,,

Many readers may think the compromise that has here been made between perfection of quality on the one hand, and cost and bulk on the other, is very ill done, but if the figures given are used as a basis upon which to build a fresh compromise more to the taste of each individual, they will have served their purpose.

It should be noticed that the figures suggested are applicable to any stage of the amplifier, including the plate circuit of the grid detector, but are not valid as a guide to the choice of coupling following an anode detector. For this purpose, as already stated, only a resistance will prove satisfactory.

Either a diode rectifier or a crystal of the galena type may be regarded, for coupling purpose as a valve of about 10,000 ohms impedance, without serious error; for perikon 15,000 ohms may be assumed, and for carborundum not less than 20,000 ohms.

Having dealt *in extenso* with the problems involved in choosing an output stage, a detector, and the intermediate low-frequency amplifier, we shall proceed in Part 5 of this series to discuss the high-frequency amplifier, including the vexed question of screened grid versus neutrodyne.



THE SIMPLEST WAVEMETER

Calibrating a Receiver by the Absorption Method.

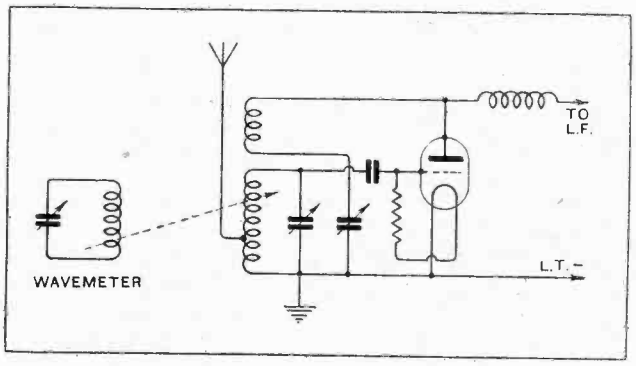
By "RADIOPHARE."

IS a wavemeter of much use to the ordinary listener? If his main interest lies in the reception of the local station and not in experimental work or distant reception, clearly it will be almost valueless to him. Even if he has succumbed to the fascination of searching for elusive foreign stations, his needs can be adequately met by calibrating his receiver, but this procedure will not be very helpful if its circuit, layout, and components are being constantly changed in an effort to keep abreast of progress. Until a state of affairs approaching finality has been reached, it can be said with confidence that every amateur or home constructor—if given to altering his set—will benefit by the use of a measuring instrument which will enable him to check the settings of his condenser dials and facilitate the tuning-in of a station for which the adjustments are unknown.

There seems to be a general impression that the absorption wavemeter is suitable only for use with transmitters or receivers in an oscillating condition. This is wide of the truth; a measurement sufficiently accurate for all practical purposes can be made provided signals of any kind are being received. It is an admitted fact that a meter of the buzzer or heterodyne type, which actually generates oscillations of any desired frequency within its range, is more convenient for the average user's requirements; however, these instruments are more elaborate and costly. The simpler appliance performs its functions in a perfectly adequate manner, and can be constructed with a minimum of trouble and expense, consisting as it does of nothing more than a coil and variable condenser connected as shown in the figure.

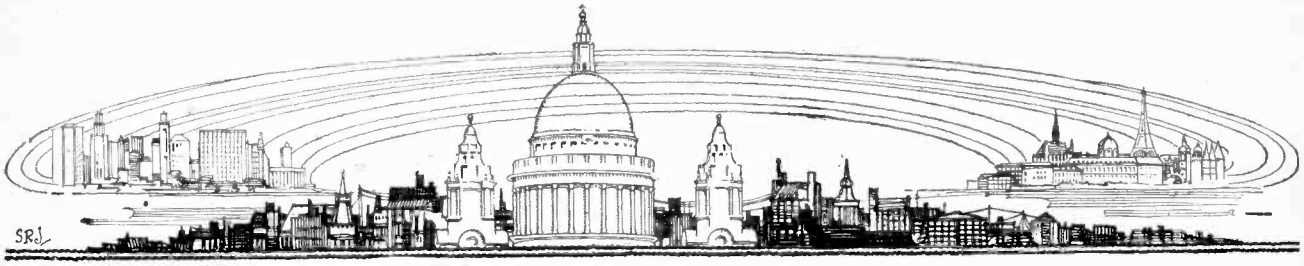
In the matter of mounting these components, the reader may safely follow his own inclinations if he bears in mind the need for rigidity; any considerable change in the relative positions will alter the natural frequency of the circuit. It is also desirable that the operator's hand should not come into proximity with the coil. An instrument which fulfils these requirements, and which has been found convenient, is shown in the title illustration; as will be seen, the cylindrical coil former is fitted with terminals for attachment to rigid metal rods which act both as supports and electrical connections to the condenser. Inductances may be quickly changed when required. By adopting this method of mounting, the coil can easily be manœuvred into any desired position relative to the windings in the receiver; its axis may be horizontal or vertical.

The instrument may be calibrated on signals from known stations by plotting condenser readings against wavelength in the usual manner. To obtain a reading, the coil should be placed in inductive relation with one of the tuned inductances in the receiver, the condenser dial then being rotated until signals as heard in the telephones or loud speaker are of minimum strength, indicating that the meter circuit is tuned to the same wavelength. If the reading is not well defined another coil position should be tried, bearing in mind the desirability of working with a loose coupling.



An absorption wavemeter coupled to the aerial–grid coil of a detector–L.F. receiver.

The procedure for using the meter as an indicator of the wavelength of received signals is similar to that followed in calibrating it, with the difference that condenser readings are converted into metres with the help of the chart. Even if no actual signals are available at any particular setting of the receiver dials, there is generally a slight background of Morse or atmospherics, which will be audibly reduced in intensity when the wavemeter is brought into tune. A circuit which is in a state of self-oscillation is measured very easily, as absorption at resonance will stop oscillation.



CURRENT TOPICS

Events of the Week in Brief Review.

SET BUILDING AT DUBLIN SHOW.

A work-bench at which wireless receivers will be constructed in full view of visitors will be one of the attractions of the Dublin Wireless Exhibition, to be held in the Mansion House early in October. There will be a special day for schools and a number of prizes will be offered for the best essay descriptive of the exhibition.

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TELEVISION TRIERS.

Six stations have been specially licensed by the U.S. Federal Radio Commission for experiments in television. The wavelengths granted for this purpose are 140.1, 70.05, and between 63.79 and 61.19 metres.

The television call sign of the Radio Corporation of America is 2XBS, and that of the Westinghouse Company, 8XAV.

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WORLD'S BIGGEST "S.B."?

What is regarded as the biggest "S.B." ever attempted took place on Saturday last, August 11th, when a speech of Herbert Hoover, the Republican candidate for the U.S. Presidency, was broadcast from eighty-five stations in the United States and from several short-wave transmitters for reception abroad.

The previous record for national "hook-ups," as they are called in America, was eighty-five stations for the broadcast of the Radio Industries banquet from the Hotel Astor in New York in September last year.

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LOUD SPEAKER CAR ON TOUR.

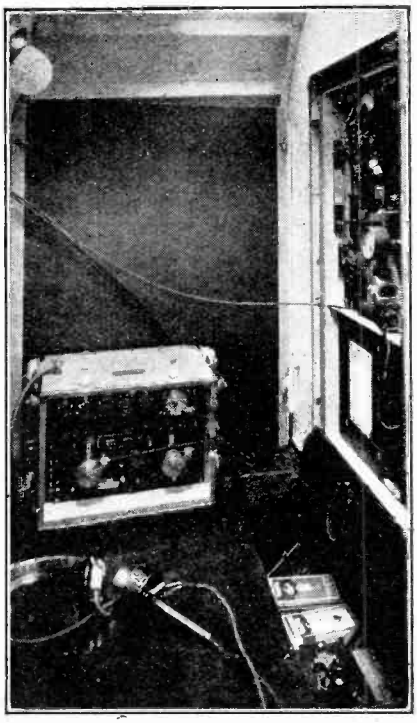
A van of imposing appearance, and still more imposing sound, is paying a round of calls on the south coast. It is the *Evening News* super loud speaker car, equipped with apparatus which includes an electric gramophone, and a multi-valve amplifier. At each place of call holiday-makers are entertained with programmes of songs, jazz tunes, opera melodies, and other selections designed to appeal to all tastes.

There are nine valves and the maximum plate voltage is 1,500 volts. The equipment can be put into operation within two minutes of the car's arrival.

A miniature "studio" containing a microphone is included.

COMMUNAL WIRELESS.

Community broadcast programmes are now being enjoyed by the residents of Barrowford, near Burnley, through the enterprise of Mr. N. Plunkett. A 10-valve receiver has been installed at the distributing station, which is connected to subscribers' houses by lead-covered wires.



WORLD'S MOST POWERFUL AIR-CRAFT TRANSMITTER. The wireless compartment of the Short "Calcutta" flying boat of Imperial Airways showing, on the right, the Marconi AD8 500-watt CW and tonic train transmitter. On the left is the 5-valve receiver. Both are controlled from the pilot's cockpit by Bowden cables.

RADIOFARE.

A Washington taxi-driver has fitted his vehicle with a broadcast receiver. No doubt the loud speaker, which is placed in the passenger's compartment, helps to distract attention from the irritating figures on the taxi-meter.

RUSSO-AMERICAN PATENT EXCHANGE?

The Soviet Government is reported to have concluded preliminary arrangements with the Radio Corporation of America for the exchange of patents.

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WHERE DO THE OTHERS GO?

An official of the U.S. Federal Radio Commission computes that only one watt in every 50,000 transmitted by the broadcasting stations is utilised by receiving sets.

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CAR RADIO RALLY.

The first automobile "radio rally" in the Principality of Monaco is to be held on Sunday, October 7th, when wireless enthusiasts from the surrounding districts will forgather in Monaco to exchange news and opinions. Special messages will be transmitted from the broadcasting station at Nice (Juan-les-Pins). The arrangements are in the hands of the Federation des Radio-Clubs du Sud-Ouest et de la Côte-d'Azur.

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AMERICA'S "OLYMPIA."

The big event in the American wireless year—the Radio World's Fair—will again be held in the Madison Square Garden, New York, between September 17th and 22nd next. The special features will include entertainments by the "world's leading radio laboratories," television displays, and daily broadcasts from a studio with transparent walls. Stands will be occupied by 300 radio manufacturers, many of international repute.

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INVENTIONS OF STATE EMPLOYEES

Inventors in the employ of the U.S. Federal Government are to retain the title rights to their patents by virtue of recent patent legislation by Congress. In future the State-employed inventor merely grants a licence for the use of the apparatus by the Government.

This decision is believed to be the outcome of the famous controversy between Maj.-Gen. G. O. Squier, former chief signal officer of the U.S. Army, and the American Telephone and Telegraph Co., regarding wired wireless, the latter contending that free use could be made of Gen. Squier's invention, as the General was a public servant!

AN EASY FIRST.

A display of all the radio journals of the world will appear on the stand of "Internationale Radiotechnik" at the Berlin Wireless Exhibition next month.

Of the two hundred journals on view *The Wireless World* will be the oldest established, having first seen the light of day in April, 1913!

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IS THE SOUND-PROOF STUDIO POSSIBLE?

How recent theories of sound absorption are affecting the design of broadcasting studios is shown in the description, given in the monthly *Record* of the Bell Telephone Laboratories in New York, of the new sound-proof rooms erected for research purposes.

The rooms are first made with brick walls 4in. thick, covered on both sides with hard cement plaster. This structure has a minimum tendency to resonate and a maximum tendency to reflect sound. The doors are built of two thicknesses of ¼in. steel plate, separated by an air space, and are fastened by clamps similar to those used on watertight bulkhead doors. Inside the masonry wall, and separated from it by an air space, is an inner room built of wood and covered with celotex, separated from the wood by a sheet of metal ⅛in. thick, inside which are four successive layers of celotex. The room is supported on as few wooden blocks as possible. In practice it is found that the smallest opening permits the passage of sound. Outer and inner doors, therefore, are arranged so that they are clamped against cushions of rubber foam. So far as sounds of fairly high frequency are concerned, the rooms are sound absorbent, but sounds of low frequency are transmitted through the entire structure. The more nearly sound proof the room is the more sensitive do listeners become to slight sounds. An absolutely sound-proof room seems at present to be impracticable.

FORTHCOMING EVENTS.

WEDNESDAY, AUGUST 15th.

North Middlesex Radio Society.—At 8 p.m. At St. Paul's Institute, Winchmore Hill, N.21. Questions and Answers Night.

THURSDAY, AUGUST 16th.

Slade Radio (Birmingham).—At 8.15 p.m. At 8, Victoria Road, Erdington. Talk on "Coils and Coil Winding," by Mr. N. B. Simmonds.

SATURDAY, AUGUST 25th.

Radio Experimental Society of Manchester.—Annual Field Day at Chinley.

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WIRELESS AT THE B.I.F.

The National Association of Radio Manufacturers has been asked by Mr. Douglas Hacking, M.P., Parliamentary Secretary to the Department of Overseas Trade, to co-operate in connection with the British Industries Fair, which is to be held simultaneously in London and Birmingham next year from February 18th and March 1st.

"Thanks largely to the help which we received from trade associations and from other representative bodies, the Fair held last February," writes Mr. Hacking, "achieved a decisive success, the number of exhibitors, the exhibiting area occupied, and the attendance of buyers from overseas and home, surpassing all previous figures."

As in previous years, it is expected that the British wireless industry will be well represented at the 1929 Fair.

NEWS FROM THE CLUBS.

D.F. Tests at Cuffley.

Cuffley was chosen as the scene of operations for the North Middlesex Radio Society's field-day on July 21st. A transmitter was erected during the morning, and began transmission, according to schedule, at 3 p.m. Three parties equipped with portable direction finders started from their allotted positions, proceeding in turn to each of four selected spots. Thus, after four transmissions, each party had four bearings from the same four points, and this formed a useful basis for comparing the accuracy obtained by the various groups.

All groups then proceeded to locate the transmitter, Mr. Gartland's party being the first to succeed. The groups led by Mr. Holton and Mr. Laister arrived almost simultaneously a little while later.

During tea the afternoon's operations were discussed, and it was found that extremely accurate bearings had been taken. These results, together with the success obtained by the Society at the Golders Green field-day on Sunday, July 15th, when the second prize was secured in competition with twelve groups from other societies, proved that the North Middlesex Radio Society is quite able to hold its own in direction-finding tests.

It is hoped to organise a further field-day on Sunday, September 9th, when other societies will be invited to co-operate.

Hon. Secretary: Mr. E. H. Laister, "Endcliffe," Station Road, N.21.

A Screened-grid Three.

The new McMichael Dinic screened-grid three receiver was demonstrated by Mr. A. Freeman at a recent meeting of the Slade Radio Society, Birmingham. Very impressive results were obtained, and the lecturer described how, in a private test extending over three weeks, he had received 2XAD, Schenectady, nightly, at consistently good strength and quality.

At the previous meeting Mr. Derek Shannon interested his audience with an account of experiments conducted to determine the effect of the moon on wireless reception. He put forward the theory that variation in signal strength is caused by the gravitational effect of the moon and sun acting on ether waves and deflecting them from their course.

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

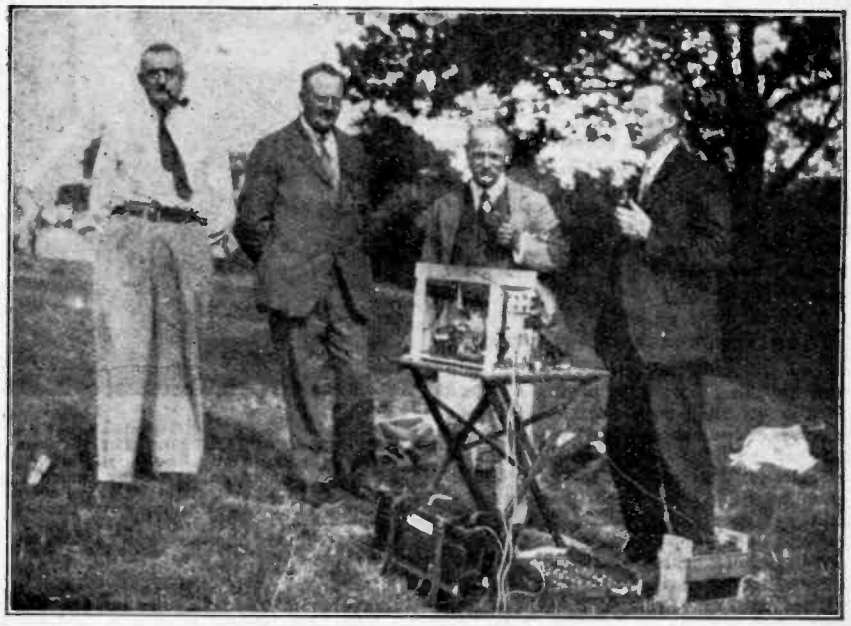
Mobile Transmitter Triumph.

Two transmitters, one stationary and one which roved round the countryside, took part in the Southend and District Radio Society's second field-day of the season on July 27th, in the neighbourhood of Rochford. A photograph of the mobile transmitter, mounted on a car, appeared in last week's issue of *The Wireless World*.

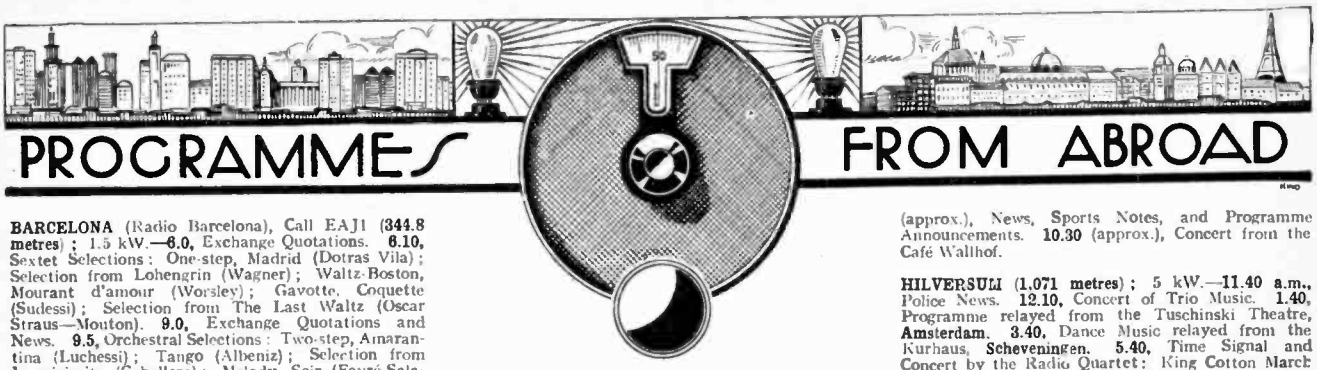
In addition to inter-communication between the parties, the fixed station worked with Crayford and Wickford on telephony, and with 2KT Wanstead on C.W.

The mobile transmitter excelled by exchanging 'phone signals with 2MI Broadstairs, using a small aerial about 9ft. high. The distance covered was forty miles.

The fixed station received speech from the moving station on a loud speaker, and when the car was over two miles away speech was heard on the loud speaker at a distance of 100 yards. Power at both stations was supplied by 200-volt dry batteries.



"HAVE THEY SPOTTED US"? Members of the North Middlesex Radio Society photographed during a lull in transmission from the Society's field station at Cuffley on a recent field day. Three parties with portable direction finders were successful in locating the transmitter.



SATURDAY, AUGUST 18th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ1 (**344.8 metres**) ; 1.5 kW.—**6.0,** Exchange Quotations. **6.10,** Sextet Selections : One-step, Madrid (Dotras Vila) ; Selection from Lohengrin (Wagner) ; Waltz-Boston, Mourant d'amour (Worsley) ; Gavotte, Coquette (Sudessi) ; Selection from The Last Waltz (Oscar Straus—Mouton). **9.0,** Exchange Quotations and News. **9.5,** Orchestral Selections : Two-step, Amarantina (Luchessi) ; Tango (Albeniz) ; Selection from La viejecita (Caballero) ; Melody, Soir (Fauré-Salabert) ; Waltz-Boston (Worsley) ; March, Statfortiter (Monestés). **10.0,** Chimes, Weather Report, and Closing Market Prices. **10.5,** Programme from **Madrid,** EAJ7.

BERLIN (Königswusterhausen), (**1,250 metres**) ; 40 kW.—**5.0,** Programme from **Hamburg.** **6.0,** Dr. Herbert Witt, Talk : The Chemical Industry. **6.30,** Spanish Lesson. **6.55,** Talk : The Duet. **7.20,** Talk : Eckermann—the Man. **8.30,** Programme from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**) ; 4 kW.—**6.0 a.m.,** Morning Gymnastics. **10.10 a.m.,** Market Prices **10.15 a.m.,** Weather Report, News and Time Signal. **11.0 a.m.,** Programme of Gramophone Records. **11.30 a.m.,** Exchange Quotations. **12.55,** Time Signal. **1.30,** Weather Report and News. **3.19,** Agricultural Prices and Time Signal. **3.30,** Programme of Gramophone Records. **4.30,** Dr. Paul Frank, Talk : Medical Hygiene. **5.0,** Recitations. **5.30,** Orchestral Concert : Selection from Carmen (Bizet) ; Lichtertanz der Bräute von Kaschmir (Rubinstein) ; Selection from Eugen Onegin (Tchaikovsky) ; Entr'acte and Barcarolle from The Tales of Hoffmann (Offenbach) ; Romance in F Major (Grünfeld) ; Overture mignonne (Becce) ; Einzug der Gaukler (Becce) ; Air (Brogi) ; Spanish Dance. (Moszkovsky) ; Caprice Italien (Tchaikovsky) ; Programme Announcements. **7.0,** Hermann Rössler, Talk : The Norwegian Landscape and the Norwegian People. **7.30,** Talk by Albert Benary. **8.0,** Otto Specht, Talk : Hunting, State, and Economics. **8.30,** Ingeborg : Comedy in three Acts (Kurt Götz). **10.15** (approx.), Weather Report, News, Time Signal and Sports Notes. **10.30,** Dance Music. **12.30 a.m.** (Sunday), Close Down.

BERN (**411 metres**) ; 1.5 kW.—**8.0,** News and Weather Report. **8.5,** Talk : Should the husband help with the housework ? **8.20,** Songs and Accordion Selections. **9.30,** Orchestral Selections. **9.45,** News and Weather Report. **10.0,** Orchestral Concert. **10.35,** Dance Music. **12.0, Midnight** (approx.), Close Down.

BRESLAU (**322.6 metres**) ; 4 kW.—**6.15,** Esperanto Talk. **6.30,** Talk : Detlev von Liliencron and his Friends. **7.25,** Karl Schück, Talk : A Walk Round New York. **8.39,** Pianoforte Recital : Sonatine (Ravel) ; Egypt (Scott) ; Suggestions Diaboliques (Prokofieff). **9.0,** Concert : Overture to Der Bettelstudent (Millöcker) ; Czardas from Die Fledermaus (Strauss) ; Mein Weiberl (Manas) ; Blues, Just One Night ; Waltz, Dorfschwalben aus Österreich (Joh. Strauss) ; Tamara (Robitschek) ; Tango, Alma Mia ; Reiterlied (Robitschek) ; Der Verflixte Wein (Gilbert) ; Du Bist Kein Kavalier (Petersen) ; One-Step, Sag Mir Oui. **10.30,** Dance Music. **12.0 Midnight** (approx.), Close Down.

BRÜNN (**441.2 metres**) ; 3 kW.—**6.0,** Time Signal and German Transmission. **6.25,** Programme of Talks. **7.15,** "The Soldier and the Dancer," Comedy (Martinu), relayed from the National Theatre. **10.0,** News from **Prague,** followed by Exhibition Programme.

BRUSSELS (**508.5 metres**) ; 1.5 kW.—**5.0,** Dance Music relayed from the St. Sauveur Palais de Danse. **6.0,** M. Carl Goebel, Talk : Some Great European Cities. **6.15,** M. Julien Flamant, Talk : The Birth of a Language. **6.30,** Concert : Gavotte and Musette (de Taye) ; Dancing Tambourine (Polla) ; The Butterfly and the Rose (Yvain) ; Characteristic Piece (Translateur) ; Petit Promenade (Bosch) ; Nocturne for Pianoforte (Chopin) ; Selection from The Fair Maid of Perth (Bizet) ; Clarionet Fantasia (Reuschel) ; In the Camp of the Ancient Britons (Ketelbey) ; Woodland Sketches (Fletcher). **7.30,** "Radio-Chronique." **8.15,** Gramophone Selections. **8.30** Selections by the Station Trio. **9.0,** Symphony Concert, relayed from the Kursaal in **Ostend** ; News.

BUDAPEST (**555.6 metres**) ; 35 kW.—**6.0,** Concert by a Military Band. **7.20,** Julius Varga, Talk : French Lyrics of the 19th Century. **8.0,** Concert of Tzigane Music from the Zoological Gardens ; Time Signal, News and Sports Notes in the Interval. **11.0,** Concert of Operetta Music.

COLOGNE (**283 metres**) ; 4 kW.—**11.15 a.m. to 2.30,** Programme from **Langenberg.** **2.30 to 4.0,** Programme from **Langenberg.** **4.30,** Programme from **Königswusterhausen.** **5.0,** Talk for Women. **5.30 to 8.5,** Programme from **Langenberg.** **8.15,** Variety Programme, followed by News, Sports Notes, Exchange Quotations, Orchestral Selections and Dance Music. **1.0 a.m.** (approx.) (Sunday), Close Down.

CRACOW (**566 metres**) ; 1.5 kW.—**7.0,** Miscellaneous Items. **7.30,** Talk : A Survey of Foreign Politics during the recent week. **7.55,** Agricultural Report, News and Communications. **8.15,** Programme from **Warsaw.** **10.30,** Concert from a Restaurant.

DUBLIN, Call 2RN (**319.1 metres**) ; 1.5 kW.—**1.30,** Weather Report and Gramophone Selections. **7.20,** News. **7.30,** Recitations by May Pitchford. **7.45,** Irish Lesson by Seamus O. Duirinne. **8.0,** Italian Operatic Selections by Aileen Doyle's Trio. **8.15,** Operatic Duets by Ceinwen Rowlands and Philip Bertram. **8.30,** Musical Chat by H. R. White. **8.45,** Baritone Solos by Philip Bertram. **9.0,** Aileen Doyle's Trio. **9.20,** A Pierrot Entertainment by Dorothy Day and Company. **10.0,** Aileen Doyle's Trio—Songs (Molloy). **10.15,** Old Ballads by Ceinwen Rowlands. **10.25,** Aileen Doyle's Trio. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**428.6 metres**) ; 4 kW.—**4.35,** Orchestral Concert. **6.15,** Announcements. **6.30,** Wireless Letter Box. **6.45,** Dr. Neumann, Talk : The German Popular Ballad. **7.15,** Lesson in Stenography. **7.45,** Dr. Majer-Leonhard, Talk : A Journey to England by the Students under the Auspices of the Society for Popular Education. **8.15,** Recital of American Negro Spirituals, by Mary Brown (Soprano), Frederic Bittke (Baritone), and R. Merten (Pianoforte), followed by (a) The Old Folks at Home, (b) Poor Old Joe, (c) Dixie, (d) Water Boy, (e) Modern American Songs. **9.15,** Variety Programme, followed by Dance Music relayed from **Voxhaus.** **12.30 a.m.** (Sunday), Close Down.

HAMBURG, Call HA (in Morse) (**394.7 metres**) ; 4 kW.—**10.0 a.m.,** Dr. A. Esau, Talk : Short Electric Waves, relayed from the Museum, **Bremen** (272.7 metres).—**10.15 a.m.,** News. **11.0 a.m.,** Programme of Gramophone Records. **12.10,** Weather Report **12.15,** Exchange Quotations. **12.20,** English Lesson—Shakespeare's Stratford-on-Avon. **12.20,** Music Talk, by Dr. Wodick. **12.30,** Concert relayed from **Hanover** (297 metres). **12.45,** Shipping Forecast. **12.55,** Time Signal from **Nauen.** **1.5,** Tidal Report. **1.10,** News. **2.0,** Concert from the Overseas Home of the Hamburg-American Line. **2.40,** Exchange Quotations. **3.30,** Review of Books. **4.0,** Labour Exchange Report. **4.15,** Talk by Dr. Bernhard Engelke. **5.0,** Jugglers, Indians, and Dancing Negroes. **6.0,** Request Programme. **7.0,** F. Hendrick, Talk : Art in Advertisements. **7.30,** Ernst Held, Talk : Dramaturgic Experiences. **7.55,** Weather Report. **8.0,** Festival Concert, relayed from the Casino, **Bremen.** **10.15** (approx.), News, Sports Notes, and Programme Announcements. **10.30** (approx.), Concert from the Café Wallhof.

HILVERSUM (**1,071 metres**) ; 5 kW.—**11.40 a.m.,** Police News. **12.10,** Concert of Trio Music. **1.40,** Programme relayed from the Tuschinski Theatre, **Amsterdam.** **3.40,** Dance Music relayed from the Kurhaus, **Scheveningen.** **5.40,** Time Signal and Concert by the Radio Quartet : King Cotton March (Sousa), Valse des Blondes (Ganne), Overture to Alessandro Stradella (Flotow) ; Selected Items by G. H. Gossens ; Brise de Mer (Leoncavallo) ; Selection from Samson and Delilah (Saint-Saëns) ; Narcissus (Nevin) ; Together We Two (Berlin) ; Items by G. H. Gossens ; Medley, Aspiration (Witte) ; Aubade d'amour (Monti) ; Friendship March (Sousa). **7.25,** Police News. **7.40,** Time Signal and Programme arranged by the Workers' Radio Society ; Concert and Talk. **11.15** (approx.), Close Down.

HUIZEN (**340.9 metres**) ; 5 kW.—Transmits from 5.40 p.m. on 1,950 metres. **12.10,** Concert of Trio Music. **5.10,** Gramophone Selections. **7.25,** Talk by Dr. Hoffman. **7.55,** Talk. **8.0,** "Kalkoen Bros.," Comedy.

JUAN-LES-PINS (Radio L.L.) (**244.5 metres**) ; 0.5 kW.—**1.0,** Orchestral Concert : Joyeux Montmartre (Paradis) ; Waltz from La Dolores (Waldteufel) ; Habanera (Odéro) ; Coppelia (Delibes) ; Cœur de Poupée (Picquet) ; La Chasse (Mendelssohn) ; Vesuviana (Marchetti) ; Pas sur la Bouche (Yvain). **9.0,** News, Weather Report and Talk for Women by Mme. La Comtesse de Tremeuge. **10.0,** Dance Music. **10.30** (approx.), Close Down.

KALUNDBORG (**1,153 metres**) ; 7 kW.—Programme also **Copenhagen** (337 metres).—**7.30 a.m.,** Morning Gymnastics. **11.0 a.m.,** Weather Report. **3.0,** Trio Concert : King Cotton March (Sousa) ; Liebeswalzer (Moszkowski) ; Selection from Thrymskviden (Hartmann) ; Fox-Trot, Husker Du Endnu (Schroder) ; Avec Toi (Gillet) ; 'Cello Solo, Romance Without Words (Davidoff) ; Fox-Trot, Brisson (Harrison) ; Recitation ; Waltz, Neu Wien (Joh. Strauss) ; Selection from La Bohème (Puccini) ; Fox-Trot, Men en Somand (Holden and Frankl) ; Two Selections from Peer Gynt (Grieg) ; Elegy (Massenet) ; One-Step, Helan Gaar (Normann). **6.20,** Oscar Jensen, Talk : A Mutiny in the South Seas. **6.50,** Weather Report. **7.0,** News and Exchange Quotations. **7.15,** Time Signal. **7.30,** Holger Ibsen, Talk : Esthonia. **8.0,** Chimes from the Town Hall. **8.2,** Concert of Old Dance Music : Grand Duke Albrecht's March (Komzak) ; Waltz, Laura (Millöcker) ; Swedish Rustic Mazurka (Translateur) ; Polka, Pepita (Lumbye) ; Old North Jutland Dances ; Quadrille from The Gipsy Baron (Joh. Strauss) ; Mazurka Susanne (Möller) ; Polka, Annen (Joh. Strauss) ; Gallop, Bacchus (Lumbye) ; News. **9.15,** Readings, followed by Light Musical Selections. **10.45,** Dance Music. **12.0 Midnight,** Chimes from the Town Hall. **12.15 a.m.** (approx.) (Sunday), Close Down.

KATOWITZ (**422 metres**) ; 10 kW.—**7.0,** Miscellaneous Items. **7.30,** Talk on Literature. **7.55,** Agricultural Report : **8.15,** Popular Concert. **10.0,** Time Signal, Weather Report and News. **10.30,** Dance Music.

KAUNAS (**2,000 metres**) ; 7 kW.—**7.0,** Gramophone Selections. **9.0,** Orchestral Concert : In Sunny Spain (Elliot) ; Italian Suite (Becce) ; Japanese Suite (Jeschytomo) ; Souvenir de Caire (Armandola) ; Slavonic Idylle (Ackermann) ; Ballet (Popy).

LAHTI (**1,522.8 metres**) ; 35 kW.—**5.0,** Concert. **6.10,** Orchestral Concert : Finnish Military March (Lincke) ; Finnish Melodies (Kauppi) ; Finnish Melodies (Merikanto) ; Prelude (Järnefelt) ; Finnish Songs (Kuula) ; Waltz, Tuhkomo (Palmgren) ; Autrefois (Sibelius) ; Valse Chevaleresque (Sibelius). **7.30,** Recital of Songs. **7.50,** Orchestral Concert : Selection from La Traviata (Verdi) ; Un Peu Rococo (Malmström) ; Valse Münchner Kindl (Komzak) ; Wiegenlied (Strauss) ; Selection (Bull) ; Selection (Ekman) ; War March (Kajanus). **8.45,** News and Announcements in Finnish and Swedish. **9.15,** Relay from a Restaurant. **10.0** (approx.), Close Down.

LANGENBERG (**468.8 metres**) ; 20 kW.—Programme also for Aix-la-Chapelle (400 metres) ; **Cologne** (283

Programmes from Abroad.—

metres) and **Münster** (250 metres).—**11.15 a.m.**, Programme for Schools. **12.10**, Gramophone Selections. **12.50**, Weather Report. **12.55**, Time Signal from **Nauen**. **1.5**, Concert from the Café **Corso, Dortmund**: Overture to Martha (Flotow); Aquarellen-Walzer (Strauss); Rusticanella (Cortipassi); Marquisette (Thĕimer); Souvenirs de Delibes (Urbach); Pianoforte Solo, Polonaise in A Flat Major (Chopin); Humoresque (Dvorák); Potpourri on Lilac Time (Schubert-Berté); Heil Torero (Morena). **2.30**, See **Cologne**. **4.0**, Anecdotes, by Jos. Lodenstein, from **Düsseldorf**. **4.30**, Programme from **Königswusterhausen**. **5.0**, See **Cologne**. **5.30**, Arnold Höllriegel, Talk: Travelling Experiences—In the Bush, from **Dortmund**. **6.0**, Concert from **Elberfeld**. **7.20**, Talk for Workers, by Walter Volmer, from **Dortmund**. **7.45**, Talk, by Max Kochskämper, from **Münster**. **8.15**, Programme from **Cologne**. **1.0 a.m.** (approx.) (Sunday), Close Down.

LEIPZIG (**365.8 metres**); 4 kW.—**7.0**, Talk: The Week-end from a Health Point of View. **7.30**, Dr. Rammner, Talk: Animal Life on the Mountain Ranges. **8.0**, Weather Report, Time Signal and Wireless Notes. **8.15**, Zither Concert: Concerto Overture (Swoboda); Romance in D Major (Haustein); Romance (Schiffel); Episode (Schiffel); Andalusian Intermezzo (Kollmaneck); Spring Fantasia (Kollmaneck); Melodies from Zeller's Der Obersteiger (arr. Schiffel). **9.15**, Vocal Quartet Concert: Starlit Night (Kaschewaroff); The Little House (Klimowsky); Elégie (Glinka); Wanderer's Night Song (Rubinstein); Song (Glazounov); There Sleeps a Little Cloud (Dargomyrsky); Two Songs (Schulgin), Volga Song (arr. Schulgin), The Breeze (Schulgin). **10.15**, News and Sports Notes. **10.30**, Dance Music. **12.0 Midnight** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**375 metres**); 3 kW.—**7.0**, Sextet Selections: Fantasia on Música, Luz y Alegria (Alonso); Fantasia on Sapho (Massenet); Fantasia on La Leyenda del Monje (Chapi); in the Interval, Items by Luis Medina. **8.0**, Dance Music. **9.45**, Market Prices and Exchange Quotations. **10.0**, Time Signal. **10.2**, Vocal and Orchestral Concert, followed by El Casus Belli, Sketch (Ruiv de las Arcas); News. **12.0 Midnight**, Dance Music. **12.30 a.m.** (Sunday), Close Down.

MILAN, Call 1MI (**526.3 metres**); 7 kW.—**8.35**, Time Signal and Talk. **8.50**, Concert: Overture to Joseph (Mehul); Selections from Faust (Gounod); Tenor Solo from Werther (Massenet); Soprano Solo from Le Villi (Puccini); Sonata in Fantasia form (Mortari); Mezzo-Soprano Solo from Carmen (Bizet); Air from La Nave Rossa (Seppilli); Air from Fedora (Giordano); Soprano Solos, (a) Air from Hérodiade (Massenet), (b) Piangete Aure (Carissimi): Mezzo-Soprano Solo from Don Carlos (Verdi). **10.55**, News and Dance Music, relayed from the Hotel Diana. **11.45** (approx.), Close Down.

MOTALA (**1,380 metres**); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres).—**5.30**, Concert of Light Music, relayed from **Göteborg**. **6.30**, Programme for Children. **7.0**, Concert of Popular Music. **7.30**, Folk Song Selections. **7.45**, Cabaret Show Programme. **9.0**, Topical Events Talk. **9.45**, Dance Music. **12.0 Midnight** (approx.), Close Down.

MUNICH (**535.7 metres**); 4 kW.—**5.30**, Pianofor e Recital by Mischa Rubasch; Two Studies Op. 23 (Schumann); Two Arabesques (Debussy); Selection from Hommage to Schumann, Op. 5 (Moszkovsky). **6.0**, Talk, by H. Schwan, relayed from **Nuremberg**. **6.30**, Labour Market Report. **7.0**, The Letter Box. **7.30**, Zither Recital by Johann Konz, Rondo in C Major (Pugh); Selection from Künstler-Traum (Konz); Hungarian Dance (Smetack); Waltz, Estudiantina (Waldteufel). **8.0**, Topical Talk. **8.15**, Concert and Song Recital by Robert Koppel: March (Eilenberg); Comedy Overture (Kélér-Béla); Songs, (a) Ich Weiss ein kleines Städtchen (Waldau), (b) Franz Schubert, in dich ist die Welt geliebt, (c) Eine Schöne weisse Chrysantheme (Rosen), (d) Bei einer Flasche Mosel (May); Waltz, Polenlut (Nedbal); Blues, Sag du mir (Stolz); Songs, (a) Trinklied (Kistenmacher), (b) Du mein Nürnberg (May), (c) Johann Strauss, geh schau mal runter (Schwarz), (d) Es liegt in der Luft (Spoliansky); Selection from Der Zarewitsch (Lehár); Songs, (a) Des Freiherrn von Münchhausen erstes See-Abenteuer (Bürgher), (b) Schultzer beim Eskimo (Glasbrenner), (c) Der Kragen Knopf (Petsch-Krapp); Waltzes (Lincke); Songs, (a) Was sagt mein Mädel dazu (Benatzky), (b) Spinn, Spinn (Ruch), (c) Schnuteken, det darfst de nich (Thiele), (d) Wenn ein Fräulein keinen Herrn hat (Tobias and Sherman). **10.0**, News and Announcements. **10.30**, Dance Music Programme by Heinrich Frick's Orchestra. **1.0 a.m.** (approx.) (Sunday), Close Down.

NAPLES, Call 1NA (**333.3 metres**); 1.5 kW.—**8.45**, News and Announcements. **8.50**, Programme of

Saturday, August 18th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

Light Music: La Serva Padrona (Suppé); Dance, Wiener Boheme (Uhl); Ballet Suite from Sylvia (Delibes). **9.30**, Relay from a Theatre, in the Interval, Dance Music from the Trocadero. **10.50**, News, Calendar, Announcements, and Close Down.

OSLO (**461.5 metres**); 1.5 kW.—Programme, relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), and **Rjukan** (448 metres). **7.45**, Weather Report, News and Agricultural Prices. **8.0**, Time and Reading, relayed from **Porsgrund**. **8.30**, Orchestral Concert: Invitation to the Dance (Weber); Waltz, Du und Du (Joh. Strauss); Selection from Robert le Diable (Meyerbeer-Schreiner). **9.0**, Song Recital from the Works of Schubert: Ihr Bild, Der Neugierige, Liebesbotschaft, Der Leiermann, Ständchen, Die liebe Farbe, Der Jüngling an der Quelle, Danksagung an den Bach, Lied des Schiffers. **9.30**, Weather Report, News and Talk on Topical Events. **10.0**, Concert (continued): Intermezzo from Si (Mascagni); Two Viennese Dances (Fuchs); Selection from The Merry Widow (Lehár). **10.30**, Dance Music from the Grand Hotel. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**2,650 metres**); 5 kW.—**6.45**, "Le Journal Parlé." **8.10**, Weather Report. **8.30**, Concert: Selections (Chaminade), (a) Spanish Serenade, (b) Reste, (c) Passepied, (d) Courante, (e) Pavane, (f) Portrait; Le vieux chapeau de mon grandpère; La naissance des roses (Missa); Les fraises (Missa); Song, Petit Suite florentine (Delmas); American-Indian Songs, (a) By the Waters of Minnetonka (Lawrence), (b) The Moon drops low (Cadman); The Night Wind; Selection from Mamzelle Vendémiaire (Gillet); Arab Dances (Grunbach); Je vous quitte (Royan); La Boudoir (Missa); Selections (Pesse), (a) Dans les bois odorants, (b) Scherzo flueri, (c) Comme les papillons, (d) Chant de crépuscule; La petite Bohême (Hirschmann).

PARIS (Petit Parisien) (**340.9 metres**); 0.5 kW.—**8.45**, Gramophone Selections. Talk, News and Announcements. **9.0**, Concert: Overture to The Count of Luxembourg (Lehár); Mandoline (Debussy); Russian Dance from Boris Godunov (Moussorgsky); Selection from Le Cid (Massenet); Symphony Orchestra, (a) The Preludes (Liszt), (b) Selection from Louise (Charpentier), (c) Premiers rythmes espagnols (Laparra), (d) Premier gazon (Schumann); Ballet from Faust (Gounod); Le Bachelier de Salamanque (Roussel); Humoresque (Dvorák); Marche nuptiale d'une poupée (Lecocq); Scherzo, Gaiement (Staub); News in the Intervals.

PARIS (Radio-Paris), Call CFR (**1,750 metres**); 6 kW.—**12.30**, Gramophone Concert: Slavonic Dances (Dvorák); Selection from Manon (Massenet); Sonata Appasionata (Beethoven); Guitar Duet, Fado Armandintro; Blues Blue River, Is she my girl friend; Fox-Trot, Constantinople; Fox-Trot, Get out and get under the moon: Fox-Trot, When. **1.50**, Market Prices and Exchange Quotations. **3.45**, Dance Music and News. **8.0**, Agricultural Report. **8.15**, Talk, followed by Exchange Quotations and News. **8.30**, Radio Concert, Melodies, Dance Music, News in the Intervals.

PITTSBURGH, Call KDKA (**63 and 27 metres**); 25 kW.—**10.0**, Telechron Time, Baseball Scores. **11.30**, Concert by the Westinghouse Band, Conducted by Victor Saudek, relayed from the William Penn Hotel. **11.55**, Baseball Scores. **12.0 Midnight**, Telechron Time, followed by continuation of Concert. **12.15 a.m.** (Sunday), Isaak Walton League Programme. **12.30 a.m.**, Home Radio Club Meeting. **12.45 a.m.**, Gems of American Literature. **1.0 a.m.**, Lew White Organ Recital. **1.15 a.m.**, A Week of the World's Business, by Dr. Julius Klein, from WJZ. **1.30 a.m.**, Goldman Band Concert from WJZ. **3.15 a.m.**, Longine Time and Baseball Scores. **4.0 a.m.**, Weather Forecast. **4.15 a.m.** (approx.), Close Down.

POSEN (**344.8 metres**); 1.5 kW.—**6.0**, Children's Corner, from **Warsaw** (1,111 metres). **7.0**, Talk: Topical Events. **8.0**, Report on Finance. **8.15**, Popular Concert from **Warsaw**. **10.0**, Time Signal, News, Weather Report, Sports Notes and Miscellaneous Items. **10.40**, Dance Music, relayed from the Carlton Restaurant. **12.0 Midnight**, Concert arranged by Maison Philips. **2.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (**348.9 metres**); 5 kW.—**6.0**, German Transmission. **6.25**, Agricultural Report. **6.35**, Talk for Workers. **7.15**, "The Soldier and the Dancer": Play (Martinu). **10.0**, Time and News, followed by Programme from **Brünn**.

RIGA (**526.3 metres**); 4 kW.—**9.30 a.m.**, Gramophone Selections. **11.0 a.m.**, News, Announcements, Market Prices, Exchange Quotations and Weather Report. **6.0**, Programme of Talks. **7.0**, Symphony Concert: Overture to Der Freischütz (Weber); Symphony in G Minor, No. 40 (Mozart); Songs, Violin Solo, Songs, Danse macabre (Saint-Saëns); Prelude in A Major (Chopin), The Ride of the Valkyrie, from The Valkyrie (Wagner); News and Dance Music. **11.0** (approx.), Close Down.

ROME, Call 1RO (**447.8 metres**); 3 kW.—**8.30**, Sports Notes, News and Weather Report. **8.47**, Talk and Time Signal. **9.0**, "Fedora," Opera (Giordano); Talks in the Intervals. **11.5**, News and Close Down.

SCHENECTADY, Call 2XAD and 2XAF (**21.96 and 31.4 metres**); 30 kW.—**11.55**, Baseball Scores. **12.0 Midnight**, Statler's Pennsylvanians, directed by Johnny Johnson, from **New York**. **12.30 a.m.** (Sunday), Musical Selections from the Hotel Sagamore, **Rochester**. **1.0 a.m.**, Keystone Duo with Balladeers, from **New York**. **1.30 a.m.**, The New York Philharmonic Orchestra, conducted by Willem Van Hoogstraten, from the Lewissohn Stadium. **3.20 a.m.**, Organ Recital by Robert Berentsen, from **Rochester**. **4.0 a.m.**, Dance Music from the Hotel Ten Eyck, **Albany**. **5.0 a.m.** (approx.), Close Down.

STAMBOUL (**1,200 metres**); 5 kW.—**4.30**, Orchestral Selections. **5.30**, Cereal Market Prices. **6.15**, Concert of Turkish Music. **8.30**, Weather Report and Time Signal. **8.40**, Orchestral Concert: Overture to The Marriage of Figaro (Mozart), Andante from the Ninth Symphony (Beethoven); Songs, (a) Air from Thaïs (Massenet); (b) Air from Carmeu (Bizet); Trio Selections, Romances.

STUTTGART (**379.7 metres**); 4 kW.—**6.0**, Time Signal and Weather Report. **6.15**, Talk: Travelling in Italy in Goethe's times and in the present day, relayed from **Freiburg** (577 metres). **6.45**, Legal Talk. **7.15**, Max Schilling, Talk: From Oslo to Bergen. **7.45**, South-west German Labour Exchange Report, Time Signal, Weather Report and Sports Notes. **8.15**, Chamber Music: String Trio in B Flat Major (Schubert); 'Cello Sonata in E Minor (Brahms); followed by Variety Concert: Overture to Nabucco (Verdi); Santuzza's Song from Cavalleria Rusticana (Mascagni); Die Weinsberger Hatz (Czoker); Cobbler's Song from The Mastersingers (Wagner); Fautasia on Wagneriana (Eberle); Two Chorales; Two Songs (R. Strauss); 'Cello and Accordion Selections, (a) Cophtisches Lied (Wolf), (b) Erschaffen und Beleben (Wolf); Rhapsody No. 14 (Liszt); Rudolfskänge (Herzer); Lacrimæ Christi (Bohm); Drinking Song (Bellmann); Nachdenkliches; Accordion Solo; Light Songs; Waltz, Wine, Women and Song (Strauss); Songs; Accordion Solos; Swablan Item; Swabian Rhapsody (Kämpfert). News.

TOULOUSE (Radiophonie du Midi) (**391 metres**); 3 kW.—**12.30**, Dance Music, followed by Choral and Orchestral Concert. **8.0**, Exchange Quotations and News. **8.30**, Concert, by a Balalaika Orchestra: Toréador et Andalouse; Chant sans Paroles (Tchaikovsky); Clair de lune; Pizzicati de Concert; Song of the Volga Boatmen; Kazbeck; Popunée Is (Ukrainskich). **9.0**, Concert arranged by La Chanterelle. In the Interval—Dance Music. **11.0**, North African News.

VIENNA (**577 and 517.2 metres**); 1.5 and 5 kW.—**4.0**, Instrumental Concert. **6.0**, Concert: Songs, (a) Air from Il Seraglio (Mozart), (b) Villanelle (del'Acqua), (c) Träumerei (Mayer-Aichhorn), (d) Heimweh (Wolf), (e) Sechs, sieben, acht (Brull); Pianoforte Solos, (a) Sonata Fantasia, Andante and Minuet (Schubert), (b) Turkish March (Mozart); Selections (Beethoven), (a) Andenken, (b) Laute Klage, (c) Resignation. **6.50**, Talk: Town and Suburb. **7.50**, "The Geisha" Operetta (Jones), followed by Dance Music.

WARSAW (**1,111 metres**); 10 kW.—**6.0**, Children's Corner. **7.0**, Miscellaneous Items. **7.30**, Radio-Chronique. **7.55**, Agricultural Report and News. **8.15**, Orchestral Concert: Marche Joyeuse (Chabrier); Waltz, Mefisto (Liszt); Selections from Raymonde (Glazounov); Rhapsody No. 2 (Svendsen); Solo, La Marche des Bovards (Halvorsen); Nachtfalter (Oscar Straus); Intermezzo from Naila (Delibes); Selection from Carmen (Bizet). News in French in the Interval. **10.0**, Time Signal, Aviation Notes, Weather Report, News and Sports Notes. **10.30**, Dance Music from the Oaza Restaurant. **11.30** (approx.), Close Down.

ZURICH (**588 metres**); 1 kW.—**7.45**, Time Signal and Weather Report. **7.47**, Dr. G. A. Farner—Recital. **8.15**, Popular Programme. **10.0**, Weather Report and News. **10.10**, Gramophone Selections of Dance Music.

Programmes from Abroad.—

BARCELONA (Radio-Barcelona), Call EAJ1 (**344.8 metres**) ; 1.5 kW.—**12.0 Noon**, Relay of Chimes from the Barcelona Cathedral, Regional and General Weather Report. **1.30**, Concert by the Iberia Instrumental Trio ; Gramophone Selections in the Intervals. **2.45** to **9.0**, No Transmission. **9.0**, Opening Signal, Sports Notes, Agricultural Market Prices. **9.15**, Concert by the Station Orchestra. **10.0**, Chimes from the Barcelona Cathedral, followed by Recital of Songs by Carmen Gombau. **10.25**, Orchestral Concert. **11.0** (approx.), Close Down.

BERGEN (**270.4 metres**) ; 1.5 kW.—**10.30 a.m.**, Divine Service Relay. **12.30**, Weather Forecast and News Bulletin. **8.0**, The Station Orchestra. **9.0**, Talk, followed by Musical Programme. **10.0**, Weather Forecast and Time Signal. **10.15**, Relay of Musical Selections. **12.0 Midnight** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,250 metres**) ; 40 kW.—**6.30 a.m.**, Morning Recital relayed from **Voxhaus**. In the Interval about **7.0 a.m.**, Gymnastic Exercises. **8.55 a.m.**, Potsdam Garrison Church Chimes. **9.0 a.m.**, Concert of Vocal and Instrumental Music and Address from **Voxhaus**, Chimes from the Berlin Cathedral. **11.30 a.m.**, Orchestral Concert relayed from **Voxhaus**. **3.0**, Talk for Amateur Photographers. **3.30**, Agricultural Talks followed by Music, relayed from **Voxhaus**. **6.30**, Talk on Wives and Mothers of Great Men. **7.10**, Health Talk followed by Outside Relay.

BERLIN (Voxhaus) (**484 metres**) ; 4 kW.—**6.30 a.m.**, Morning Recital. In the Interval about **7.0 a.m.**, Gymnastic Exercises. **8.55 a.m.**, Potsdam Garrison Church, Chimes. **9.0 a.m.**, Concert of Vocal and Instrumental Music, Address in the Interval, followed by Chimes from the Berlin Cathedral. **11.30 a.m.**, Orchestral Concert. **2.0**, Children's Programme arranged by Hans Bödenstedt and Fritz Jöde. **3.30**, Agricultural Talks and Report on Market and Weather conditions for the past week, followed by Musical Programme. **7.0**, Programme of Talks. **8.30**, Musical Programme. **10.15**, News, Weather Report, Time Signal and Sports Notes. **10.30**, Dance Music Programme—Gerhard Hoffmann's Orchestra. **12.30 a.m.** (approx.) (Monday), Close Down.

BERN (**411 metres**) ; 1.5 kW.—**10.30 a.m.**, Divine Service Relay. **1.0**, Time Signal and Weather Forecast. **1.0 to 2.30**, Concert of Orchestral Music. **2.30**, Running Commentary on the Horse Races in Bern, Musical Selections in the intervals. **5.35** to **8.0**.—No Transmission. **8.0**, Time Signal and Weather Forecast. **8.5**, Talk. **8.30**, Concert of Instrumental and Solo Music. **9.45**, Sports Notes, News Bulletin and Weather Report. **10.0**, Selections by the Bern Municipal Orchestra. **10.35** (approx.), Close Down.

BRATISLAVA (**300 metres**) ; 1 kW.—**7.0 a.m.**, Promenade Concert, relayed from **Carlsbad**. **11.0 a.m.** (approx.), Concert. **12.0 Noon** (approx.) to **6.20**, Programme of Talks and Music. **6.20** (approx.), Talk. **6.40** (approx.), Programme of Talks and Music, including Items from **Prague**. **10.20**, Programme relayed from the Exhibition, Brünn.

BREMEN (**272.7 metres**) ; 0.7 kW.—**6.30 a.m.**, Orchestral Concert relayed from **Voxhaus**. **8.25 a.m.**, Time Signal, Weather Forecast and News Bulletin, from **Hamburg**. **11.30 a.m.**, Talk from **Hamburg**. **12.55**, Nauen Time Signal. **1.0**, Instrumental Concert. **2.0**, Children's Programme from **Hamburg**, followed by Talks and Musical Programme. **8.0**, Musical Programme followed by Weather Forecast, News Bulletin, and Concert relayed from a Restaurant. **11.0** (approx.), Close Down.

BRESLAU (**322.6 metres**) ; 4 kW.—**8.45 a.m.**, Chimes relayed from Christ Church. **11.0 a.m.**, Sacred Morning Recital with Address. **12.0 Noon**, Instrumental Concert. **2.0**, Talk for Amateur Gardeners. **2.35**, Chess Problems Talk. **3.0**, Programme for Children. **3.30**, Agricultural Talks, followed by Sports Relay and Programme of Music and Talks. **8.30**, Evening Programme of Musical Items. **10.0**, News Bulletin. **10.30**, Probable relay of Dance Music. **12.0 Midnight** (approx.), Close Down.

BRÜNN (**441.2 metres**) ; 3 kW.—**7.0 a.m.**, Promenade Concert relayed from **Carlsbad**, followed by Talks and Music. **11.0 a.m.**, Instrumental Concert. **3.0**, Musical Programme. **4.0**, Popular Concert. **6.0**, German Transmission. **7.0**, Orchestral Concert of Popular Music. **10.15** (approx.), Musical Programme. **11.0** (approx.), Close Down.

BRUSSELS (**508.5 metres**) ; 1.5 kW.—**5.0**, Dance Music Relay. **7.30**, La Radio-Chronique—Journal Parlé of Radio-Belgique. **8.15**, Concert of Orchestral and Vocal Selections. Solos and Duets from the Works of Wagner and Greig by M. Rubeau (Tenor) and M. de Lil (Bass). **10.15** (approx.), News Bulletin. **10.30** (approx.), Close Down

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SUNDAY, AUGUST 19th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

BUDAPEST (**555.6 metres**) ; 35 kW.—**9.0 a.m.**, News Bulletin. **10.0 a.m.**, Divine Service Relay. **12.0 Noon**, Chimes from the University Church, followed by Weather Forecast, and Programme of Instrumental Music. **4.15**, Fairy Tales for Children, followed by Weather Forecast, Musical and Dramatic Selections, Sports Notes in the interval. **10.30** (approx.), Tzigane Music Selections. **12.0 Midnight** (approx.), Close Down.

COLOGNE (**283 Metres**) ; 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (468.8 metres), and **Münster** (250 metres).—**9.0 a.m.**, Relay of the Evangelical Morning Recital, given in the Bartningkirche, Cologne. **1.5**, Instrumental Concert, followed by Programme of Talks and Music. **8.0**, Musical Programme, followed by Last News Bulletin, Sports Notes, Orchestral Selections, and Dance Music. **12.0 Midnight** (approx.), Close Down.

CORK, Call 6CK (**400 metres**) ; 1.5 kW.—**8.30**, Concert of Instrumental and Vocal Music, with Duets by Raymonde Amy (Soprano), and Herbert Cameron (Bass-Baritone). **11.0**, National Anthem. **11.5** (approx.), Close Down.

CRACOW (**566 metres**) ; 1.5 kW.—**10.15 to 11.45 a.m.**, Divine Service, relayed from a Polish Cathedral. **12.0 Noon**, Fanfare from Notre Dame Church, Time Signal, and Weather Forecast. **4.0**, Talks for Farmers. **4.40**, Agricultural Chronicle. **5.0**, Concert, relayed from **Warsaw**, followed by Miscellaneous Programme and Talks. **8.30**, Concert of Vocal and Instrumental Music : Accompanist, Mr. Casimir Petecki, Paraphrase on Wagner's "Parsifal" and Grail scene, played by Mr. Schwarzenberg-Czerny (Violin) and Mme. R. Freundlich (Pianoforte). **10.0**, Programme from **Warsaw**. **10.30**, Concert, relayed from a Restaurant. **11.30** (approx.), Close Down.

DUBLIN, Call 2KN (**319.1 metres**) ; 1.5 kW.—**8.30 to 11.5** (approx.), Programme, relayed from **Cork** : Concert of Vocal and Instrumental Music by the Station Quintet, with Seamus MacAonghusa (Uilleann Pipes), Robert Dalton (Tenor), Gertrude Persse (Pianoforte), and others. **11.0**, National Anthem and Close Down.

FRANKFURT (**428.6 metres**) ; 4 kW.—**8.0 a.m.**, Morning Recital, followed by Talk for Parents and Literary Programme. **1.0**, Report of the Wiesbaden Chamber of Agriculture. **3.0**, Children's Corner. **4.0** (approx.), Orchestral Concert, followed by Programme of the Rhein-Main Association for Popular Education, and Musical Programme.

HAMBURG, Call HA (in Morse) (**394.7 metres**) ; 4 kW.—Programme, relayed by **Bremen** (272.7 metres), **Hanover** (297 metres) and **Kiel** (254.2 metres).—**6.30 a.m.**, Orchestral Concert, relayed from **Voxhaus**. **8.25 a.m.**, Time Signal, Weather Report and News Bulletin. **11.0 a.m.** (**Hamburg, Hanover, and Bremen**), Talk on a Visit to the Hamburg Museums. **11.30 a.m.**, Commercial Talk and Musical Programme. **12.55**, International Time Signal, relayed from **Nauen**. **1.0** (for **Hamburg** and **Kiel** only), Orchestral Concert. **2.0**, Programme for Children. **3.0 to 7.40**, Programme of Talks and Music. **7.40**, Sports Notes and Weather Report. **8.0**, Musical Programme, followed by Weather Forecast, News Bulletin and Concert from the Café Wallhof (for **Hamburg** and **Kiel** only). **11.0** (approx.), Close Down.

HANOVER (**297 metres**) ; 0.7 kW.—**6.30 a.m.**, Orchestral Concert, relayed from **Voxhaus**. **8.25 a.m.**, Time Signal, Weather Forecast and News Bulletin from **Hamburg**. **11.30 a.m.**, Talk from **Hamburg**. **12.55**, Time Signal from **Nauen**. **1.0**, Gramophone Selections, followed by Talks and Musical Programme. **8.0**, Musical Programme, followed by Weather Report, News Bulletin and Concert, relayed from a Restaurant. **11.0** (approx.), Close Down.

HILVERSUM (**1,071 metres**) ; 5 kW.—**12.40 to 2.10**, Concert by the Wireless Trio. **5.40**, Concert by the Wireless Quartet and Jacques Kinsbergen (Violinist). **7.40**, Weather Forecast, News Bulletin and Sports Notes. **7.55**, Concert, relayed from the Kurhaus, Scheveningen, conducted by Professor Georg Schneevoigt. **10.15** (approx.). Close Down.

HUIZEN (**340.9 metres**) ; 4 kW.—Programme on 1,950 metres after **5.40**.—**8.10 to 9.10 a.m.**, Divine Service : Address, "There is Nothing New Under the Sun," and Vocal Music. **12.10**, Concert by the Winkels Trio, of Amsterdam, followed by Concert and Programme for Hospitals. **7.25**, Talk. **7.55**, Concert by the Orchestra of the Catholic Broadcasting Association, conducted by Mr. M. v.d. Ende ; Popular Items. Epilogue by the Choir, and Close Down.

JUAN-LES-PINS (Radio LL) (**244.5 metres**) ; 1.5 kW.—**1.0**, Instfumental Concert with Items for Children by Marcel Laporte. **2.0 to 9.0**, No Transmission. **9.0**, News Bulletin, Weather Forecast and Musical Selections. **10.0**, Dance Music Programme from the Juan-les-Pins Casino. **10.30** (approx.), Close Down.

KALUNDBORG (**1,153 metres**) ; 7 kW.—Programme also for **Copenhagen** (337 metres).—**10.0 a.m.**, Divine Service. **11.30 a.m.** (for **Kalundborg** only), Weather Forecast. **2.0**, Divine Service Relay, followed by Instrumental Concert. **6.50** (**Kalundborg** only), Weather Forecast. **7.0**, News Bulletin. **7.15**, Time Signal. **7.30**, Talk. **8.0**, Chimes, relayed from the Copenhagen Town Hall. **8.5**, Instrumental and Vocal Concert. **9.0** (approx.), News Bulletin. **9.15**, Solo Recital. **9.45**, Concert of Orchestral and Solo Selections with Henry Munck (Oboe), Louis Preil (Violin), and Ole Frosig (Clarionet) ; Orchestral Selections from The Bartered Bride (Smetana), followed by Programme of Dance Music ; in the Interval at **12.0 Midnight**, Chimes from the Town Hall. **12.30 a.m.** (approx.) (Monday), Close Down.

KATOWITZ (**422 metres**) ; 10 kW.—**10.15 a.m.**, Divine Service Relay. **12.0 Noon**, News Bulletin. **4.0** (approx.), Talk by W. Wlosik : The Silesian Gardener, followed by Two Agricultural Talks. **5.0**, Popular Concert, followed by Miscellaneous Announcements, Programme of Talks and Music. **8.15**, Instrumental Concert, relayed from **Warsaw**. **10.0**, Time Signal, Weather Forecast and News Bulletin. **10.30**, Programme of Dance Music. **11.30** (approx.), Close Down.

KAUNAS (**2,000 metres**) ; 7 kW.—**12.0 Noon**, Chimes and Weather Forecast. **12.10**, Recital of Sacred Music. **12.30**, Programme of Stories, Songs and Music for Children. **5.0**, Report for Farmers. **6.0**, Programme for Young People. **6.30**, Hunting Association Programme. **7.30**, Health Talk. **8.0**, Lowering of the Flag, Ceremony relayed from the Kaunas War Museum. **8.0** (approx.), Talk. **8.30**, Time Signal, Weather Forecast and Political Review. **9.0**, Instrumental Concert. **10.30** (approx.), Close Down.

KIEL (**254.2 metres**) ; 0.7 kW.—**6.30 a.m.**, Orchestral Concert, relayed from **Voxhaus**. **8.25 a.m.**, Time Signal, Weather Report, News Bulletin from **Hamburg**. **10.55 a.m.**, Divine Service, relayed from the University Church in Kiel. **12.55**, Nauen Time Signal. **1.0**, Concert from **Hamburg**. **2.0**, Programme for Children, relayed from **Hamburg**, followed by Musical Programme and Talks. **7.40**, Sports Notes. **7.55**, Weather Forecast. **8.0**, Musical Programme, followed by Weather Forecast News Bulletin and Concert from the Café Wallhof, **Hamburg**. **11.0** (approx.), Close Down.

KÖNIGSBERG (**329.7 metres**) ; 4 kW.—Programme relayed by **Danzig** (272.7 metres).—**9.0 a.m. to 12.55**, Programme of Talks, Music and Weather Forecasts. **12.55**, International Time Signal from **Nauen**, followed by Weather Forecast. **3.0**, Chess Lesson, by P. S. Leonhardt, followed by Music and Talks. **8.10**, Variety Concert, with Käte Mann, of the Südfunk, Stuttgart ; Selections from Light Cavalry (Suppé). **10.0** (approx.), News Bulletin and Sports Notes, followed by Dance Music Programme. **12.0 Midnight** (approx.), Close Down.

LAHTI (**1,522.8 metres**) ; 35 kW.—Programme also for **Helsingfors** (375 metres).—**8.0 a.m.**, Divine Service in Finnish. **10.50 a.m.**, Review of the Press. **11.0 a.m.**, Concert. **11.50 a.m.**, Weather Forecast and Time Signal. **12.0 Noon**, Swedish Divine Service. **5.0**, Orchestral Concert, conducted by Erkki Linko : Melodies from Madame Butterfly (Puccini). **7.30**, Recital of Songs. **7.50**, Concert of Orchestral Music. **8.45**, News Bulletin in Finnish and Swedish. **9.15**, Relay of a Concert from a Restaurant. **10.0** (approx.), Close Down.

LANGENBERG (**468.8 metres**) ; 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**9.0 a.m.**, Morning Recital, relayed from **Cologne**, followed by Programme of Talks and Music. **1.5**, Concert by the Vienna "Schwalben-Schrammeln," relayed from **Düsseldorf**, followed by Programme of Talks and Music. **8.0**, Programme from **Cologne** ; Concert, Last News Bulletin, Sports Notes, Popular Music and Dances. **12.0 Midnight** (approx.), Close Down.

LAUSANNE (**680 metres**).—**3.30**, Programme relayed from **Bern**. **8.30**, Concert or Religious Address.

Sunday, August 19th.

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Programmes from Abroad.—

LEIPZIG (365.8 metres) ; 4 kW.—**9.0 a.m.**, Morning Recital of Instrumental and Vocal Music. **11.0 a.m.**, Outside Relay of a Concert. **12.0 Noon**, Two Talks. **1.0**, Agricultural Programme. **2.0**, Review of the Foreign Press. **2.15**, Deutscher Sprachverein Programme. **2.30**, The Dresden Wireless Orchestra, conducted by Gustav Agunte, relayed from the Jahresschau, **Dresden**. **3.30**, Literary Reading. **4.30**, Concert of Instrumental Music. **6.30 to 7.30** (approx.), Programme of Talks. **7.30**, Programme of Musical Puzzles—Listeners have to guess the names of the well-known artistes who will perform during the programme ; during the Intervals : Gramophone Records ; after the Competition, Concert. **10.0**, Sports Notes, followed by Music. **12.30 a.m.** (approx.) Monday), Close Down.

LYONS (Radio-Lyon) (291 metres) ; 0.5 kW.—**11.0 a.m.**, Concert of Sacred Music. **12.0 Noon to 7.30**, No Transmission. **7.30**, Le Journal Parlé—Weather Forecast, News Bulletin and Review of Current Events followed by Sports Talk by M. Paul Garcin. **8.15**, Orchestral Concert with Violin Solos by M. Camard. **9.15**, Programme of Ancient and Modern Dance Music. **10.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (375 metres) ; 3 kW.—Programme relayed by **Salamanca**, EAJ22 (405 metres).—**2.0**, Concert of Orchestral Music. **3.30 to 7.0**, No Transmission. **7.0**, Programme for Children—Variety Items and Sextet Selections. **8.0**, Dance Music Programme. **8.30 to 10.0**, No Transmission. **10.0**, Chimes, Time Signal, followed by Orchestral Concert : Selections from "The New World Symphony" (Dvorák), and Music from the Paseo de Rosales. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, Call 1MI (526.3 metres) ; 7 kW.—**10.30 to 11.15 a.m.**, Vocal and Instrumental Concert of Sacred Music. **12.30 to 1.30**, Quartet Selections. **4.0**, Opening Signal followed by Quintet and Vocal Concert. **8.25**, Programme of Reports, Time Signal and Sports Notes. **8.50**, "Manon Lescaut" Opera (Puccini). After the Second Act, News Bulletin and Sports Notes. **11.45** (approx.), Close Down.

MOTALA (1,380 metres) ; 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), and **Sundsvall** (545.6 metres). **11.0 a.m.**, Divine Service relayed from a Church. **5.0**, Children's Corner. **5.55**, Chimes relayed from the Stockholm Town Hall. **6.0**, Divine Service Relay. **7.15**, "Dunungers."—A Comedy in Four Acts, by Selma Lagerlöf, relayed from the **Göteborg** Station. Followed by a Programme of Old-time Dance Music. **11.0** (approx.), Close Down.

MUNICH (535.7 metres) ; 4 kW.—Programme relayed by **Augsberg** (566 metres), **Kaiserlautern** (204.1 metres), and **Nuremburg** (241.9 metres).—**11.0 a.m.**, Chimes from the Munich Town Hall. **11.15 a.m.**, Weather Forecast. **12.0 Noon**, Instrumental Music. **1.5**, Weather Forecast and Programme Announcements. **1.15**, Agricultural Talks Programme, followed by Talks and Music. **8.0**, Orchestral Concert Conducted by Kurt Pastor, The Bonn "Liederblüte" Double Quartet, followed by News Bulletin, and Evening Concert. **12.0 Midnight** (approx.), Close Down.

NAPLES, Call 1NA (333.3 metres) ; 1.5 kW.—**10.0 a.m.**, Recital of Sacred Music. **4.45**, Programme for Children. **5.0**, Concert of Light Instrumental Music with Soprano Solos. **5.30**, Time Signal, followed by Reports. **8.40**, Time Signal. **8.48**, Report of the Harbour Authorities. **8.50**, Concert of Vocal and Instrumental Music. In the Interval, "O Bere O Affogare"—Comedy in One Act (Leo Castelnuovo). **10.0**, Sports Notes. **10.55**, Calendar and Forthcoming Programme Announcements. **11.0** (approx.), Close Down.

OSLO (461.5 metres) ; 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), **Rjukan** (448 metres).—**10.20 a.m.** (approx.), Chimes followed by Divine Service Relay. **7.45**, Weather Forecast and News Bulletin. **8.0**, Time Signal. **8.5**, Concert of Vocal and Orchestral Music. **9.30** (approx.), Weather Forecast and News Bulletin. **9.45**, Review of Topical Events. **10.0**, Dance Music relayed from the Hotel Bristoi. **12.0 Midnight** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (458 metres) ; 0.5 kW.—Programme relayed at intervals by the following stations : **Bordeaux PTT** (275 metres) ; **Eiffel Tower** (2,650 metres) ; **Grenoble** (416 metres) ; **Lille PTT** (264 metres) ; **Limoges** (285 metres) ; **Lyons PTT** (476 metres) ; **Marseilles** (303 metres) ; **Rennes** (280 metres) ; **Toulouse PTT** (260 metres).—**8.0 a.m.**, News Bulletin and Time Signal. **10.25 a.m.**, Time Signal and Weather Forecast. **1.30**, Concert of Orchestral Music. **6.0**, Le Radio-Journal de France. **8.30**, Talk on Sports. **9.0**, Concert of Instrumental Music, followed by Dance Music Programme relayed from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (2,650 metres) ; 5 kW.—**8.56 a..m.**, Time Signal on 32.5 metres. **10.26 a.m.**, Time Signal on 2,650 metres. **6.45**, Le Journal Parlé par T.S.F.—Programme of Talks, by M. Bertrand Dupeyrat, Dr. Pierre Vachet, M. André Delacour and other regular contributors. **8.10**, Weather Forecast. **8.30**, Mario Cazes and his Orchestra. **8.56**, Time Signal on 32.5 metres. **11.26**, Time Signal on 2,650 metres.

PARIS (Petit Parisien) (340.9 metres) ; 0.5 kW.—**8.45**, Gramophone Selections, Programme of Talks and News Bulletin. **9.0**, Vocal and Instrumental Concert : Soloist M. L. Guenot of the Opéra-Comique, Vision fugitive from Hérodiade (Massenet). **9.25**, News Bulletin. **9.30**, Short Symphony Concert. **10.0**, News Bulletin. **10.5** (approx.), Instrumental Selections. **11.0** (approx.), Close Down.

PARIS (Radio L.L.) (370 and 60 metres) ; 1 kW.—**12.30**, Radio-Liberté Transmission, News Bulletin. **3.0**, Concert of Dance Music, organised by the Compagnie Nationale de Radiodiffusion. **9.0**, Gala Concert of Russian Chamber Music, conducted by General de Gorlenko. **10.30** (approx.), Close Down.

PARIS (Radio-Paris), Call CFR (1,750 metres) ; 6 kW.—**8.0 a.m.**, News Bulletin. **12.0 Noon**, Sacred Music Recital and Address, News Bulletin. **12.45**, Concert of Light Music by the Albert Locatelli Orchestra. **4.30**, Dance Music Programme, News in the Interval. **7.45**, Children's Programme. **8.15**, Agricultural Report and News Bulletin. **8.30**, Symphony Concert by the Station Orchestra, conducted by M. Eugène Bigot, News in the Interval.

PITTSBURGH, Call KDKA (63 and 27 metres) ; 25 kW.—**3.45**, Telechron Time. **4.0**, Divine Service. **7.0**, Roxy's Stroll Programme, relayed from WJZ, **New York**. **9.2**, Dr. Sockman's Question Box, from WJZ. **10.0**, Twilight Reveries, from WJZ. **11.0**, Telechron Time, Baseball Scores and Instrumental Music. **11.30**, KDKA Ensemble Concert, relayed from the Palm Room of the William Penn Hotel, Pittsburgh. **12.0 Midnight**, Telechron Time, Baseball Scores and Continuation of Ensemble Concert. **1.0 a.m.** (Monday), Miscellaneous. **1.45 a.m.**, Whittall Anglo-Persians from WJZ. **2.15 a.m.**, Concert by the Goldman Band, from WJZ Longine Time. **3.15 a.m.**, Baseball Scores, Telechron Time Signal, Atlantic City. **10.30 a.m.** (approx.), Close Down.

POSEN (344.8 metres) ; 1.5 kW.—**10.15 a.m.**, Divine Service. **12.0 Noon**, Time Signal. **5.0**, Programme, relayed from **Warsaw**. **6.50**, Talk, Programme from **Warsaw**. **7.15**, Talk. **7.45**, Talk, Programme from **Warsaw**. **8.30**, Programme of Musical Riddles. **10.0**, Time Signal, Weather Forecast and Sports Notes. **10.20**, Miscellaneous. **10.40**, Dance Music Programme, relayed from the Palais Royal Restaurant. **12.0 Midnight** (approx.), Close Down.

PRAGUE (348.9 metres) ; 5 kW.—**7.0 a.m.**, Promenade Concert, relayed from **Carlsbad**, followed by Sacred Music and Agricultural Report. **11.0 a.m.**, Orchestral Concert. **12.0 Noon**, Musical Programme. **4.30**, Instrumental Concert. **6.0**, German Transmission, followed by Popular Music, relay from the Brünn Exhibition and News Bulletin.

RABAT, Call PTT (416 metres) ; 2 kW.—**1.30**, Selections by the Station Orchestra. **3.0 to 9.15**, No Transmission. **9.15**, "Le Journal Parlé," News Bulletin. **9.30**, Concert by the Station Orchestra. **11.30**, Programme of Music, relayed from the Jardin d'Été Cinema in Rabat. **12.0 Midnight** (approx.), Close Down.

RIGA (526.3 metres) ; 4 kW.—**9.0 a.m.**, German Divine Service. **10.15 a.m.**, Latvian Divine Service from the Mara Church in Riga. **1.0**, Programme for Children, followed by Agricultural Talks. **4.0**, Instrumental Concert, followed by Talks and Music. **9.0**, Weather Forecast, followed by Dance Music Programme. **11.0** (approx.), Close Down.

ROME, Call 1RO (447.8 metres) ; 3 kW.—**10.15 a.m.**, Opening Signal and Sacred Morning Recital of Music. **1.0 to 2.0**, Concert by the Radio Trio. **5.0**, Opening Signal, followed by Instrumental Concert. **6.0 to 6.30**, Dance Music, relayed from the Casinetta. **8.0**, Reports, Sports Notes and News Bulletin, Review of Current Events. **8.59**, Time Signal. **9.0**, Grand Symphony Concert with a Talk in the Interval "Scènes alsaciennes" (Massenet), (a) Dimanche matin, (b) Le cabaret, (c) Sous les Tilleuls, (d) Dimanche soir. **11.5**, News Bulletin. **11.15** (approx.), Close Down.

SAN SEBASTIAN (Union Radio), Call EAJ8 (335 metres) ; 0.5 kW.—**10.0 to 12.0 Midnight**, Relay of Orchestral Selections from the San Sebastian Casino. **12.0 Midnight** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF (21.96 and 31.4 metres) ; 30 kW.—**4.0**, Divine Service, relaye; from the First Presbyterian Church, Schenectadyd Address by Dr. George Alexander. **10.30**, Concert by the Ballad Singers, relayed from **New York**. **11.0**, Stetson Parade, American Legion Band Programme from **Boston**. **12.0 Midnight**, Concert by the National String Orchestra. **12.25 a.m.** (Monday), Baseball Scores from **New York**. **12.30 a.m.**, Capitol Theatre Programme from **New York**. **2.0 a.m.**, Talk : Our Government, from **Washington, D.C.** **2.15 a.m.**, Atwater Kent Programme from **New York**. **2.45 a.m.**, Correct Time. **2.47 a.m.**, Biblical Drama from **New York**. **3.15 a.m.**, Experimental Television Transmission. **3.30 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres) ; 5 kW.—**4.30**, Orchestral Concert. **5.30**, Market Prices. **6.15**, Concert of Turkish Music. **8.30**, Weather Report and Time Signal. **8.40**, The Station Orchestra. **10.30** (approx.), Close Down.

STUTTGART (379.7 metres) ; 4 kW.—**11.0 a.m.**, Instrumental and Vocal Morning Recital, followed by Outside Relay of Music with Gramophone Records in the Intervals. **2.0**, Children's Corner. **3.30** (approx.), Light Vocal and Instrumental Concert, followed by Talks and Reports. **8.0** (approx.), Vocal and Instrumental Programme, followed by Sports Notes and News.

TALLINN (408 metres) ; 2.2 kW.—**7.30 a.m.**, Early Morning Concert of Light Music. **8.30 a.m.**, Divine Service, relayed from a Church. **6.0**, Instrumental and Vocal Concert. **8.0**, Agricultural Talk. **8.30**, News Bulletin. **8.45** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (391 metres) ; 3 kW.—**12.30**, Concert of Instrumental and Solo Music. **1.0**, Carillon. **1.45**, Press Review. **8.0**, Exchange Quotations and Press Review. **8.30**, Concert of Trio and Solo Selections : The Fourth Concerto in G Major for Pianoforte and Orchestra (Beethoven) followed by Light Orchestral Music and North African News. **11.15** (approx.), Close Down.

VIENNA (577 and 517.2 metres) ; 1.5 and 5 kW.—Programme relayed by **Graz** (357.1 metres), **Innsbruck** (294.1 metres), **Klagenfurt** (272.7 metres) and **Linz** (254.2 metres) **11.0 a.m.**, Concert by the Vienna Symphony Orchestra. **4.0**, Concert of Orchestral Music, followed by Chamber Music Selections. **7.45**, "Papiermühle," Comedy in Three Acts (Georg Kaiser), under the Direction of Aurel Nowotny ; Musical Selections.

WARSAW (1,111 metres) ; 10 kW.—**10.15 a.m.**, Divine Service. **12.0 Noon**, Time Signal, Fanfare from Notre Dame in Cracow, Aviation Report and Weather Forecast. **3.55**, Agricultural Talks. **5.0**, Concert by the Philharmonie de Varsovie Orchestra. **6.30**, Miscellaneous. **6.50**, Talk, by Prof. L. Kulczycki. **8.15**, Concert by the Philharmonie de Varsovie : Soloists, J. Hirszfeld and M. Sowilski ; Peer Gynt Suite, No. 1, played by the Orchestra, (a) Morning, (b) The Death of Ase, (c) Anitra's Dance, (d) In the Hall of the Mountain King. **10.0**, Time Signal, Aviation Report and Weather Forecast. **10.5**, News, Police Information and Sports Notes. **10.30**, Dance Music Programme from the Oaza Restaurant. **11.30** (approx.), Close Down.

ZAGREB (310 metres) ; 0.35 kW.—**11.30 a.m.**, Military Music Selections. **5.0**, Sports Relay. **7.45**, Wireless Propaganda Talk. **8.0**, Relay of an Operetta given in the Zagreb National Theatre, followed by News Bulletin. **11.0** (approx.), Close Down.

ZURICH (588 metres) ; 1 kW.—**11.15 a.m.**, Orchestral Concert, followed by Weather Forecast. **12.30**, Instrumental Selections. **4.0**, Orchestral Concert from the Carlton-Elite Hotel. **7.30**, Divine Service and Address. **8.0**, Orchestral Concert. **8.30**, Song Recital by Marie Sineikal, of the Zurich Municipal Theatre, followed by Request Orchestral Concert. **10.0**, Weather Forecast and News Bulletin. **10.15** (approx.) Close Down.

TRANSATLANTIC SUCCESS ON 10 METRES.

A Description of the Apparatus Used in Successful Two-way Amateur Communication.

By PIERRE AUSCHITZKY, EF-8CT, Gironde, France.

SINCE February, 1925, I have been making attempts to communicate with America, using shorter and shorter wavelengths. In March, 1925, my first transmission on 16 metres was received by NU-2WC of New York. I was then using raw A.C. with an input of about 160 watts. An ordinary aerial of the cage type, aperiodically coupled, was employed.

This 16-metre transmission was also received in France, at Marseilles, on August 7th, 1925, by EF-8DE, who reported "QRK R7, Very Stable." The distance was about 560 kilometres, and I was still using raw A.C.

Since this time, except for more local work, a wavelength of 20 metres was used for general communication. During the winter of 1925-1926 tests were conducted on 23 metres and at definite times, reducing the wavelength to 21, 18, 16, 14, and 12 metres. These tests commenced at 14.00 G.M.T., always beginning with transmission on 23 metres. All these transmissions, with the exception of those on 12 metres, were received at Copenhagen, Denmark, where a wavelength of 14 metres was received "R6 and very stable," and the amateur who was listening apologised for being unable to listen on a lower wavelength.

Difficulties below 15 Metres.

An American, NU-1RD, of Waban, received my transmission on 14 metres well and very steady, strength about R7, and this reception was repeated several times. NU-1RD and EF-8CT were at that time in communication on 14 metres, and the same wavelength was used with success in communication with NU-2NZ, who reported signal strength R7.

Following on these experiments, several attempts to use shorter wavelengths for communication produced no results, apparently because the receivers of my correspondents would not go below 14 or 15 metres, and in the experiments I have carried out this seems to have been my principal trouble. Because of the difficulty of maintaining stability of reception on wavelengths below 14 metres, amateurs do not, up to the present, seem to have interested themselves in wavelengths of this order to any extent, and, consequently, very few of the regular transmitters employ receivers capable of satisfactory reception below 14 metres.

On December 11th, 1927, I made the acquaintance of NU-2JN, Mr. C. K. Atwater, of Upper Montclair, N.J., on 23 metres, and I asked him if he could listen for me on 10 metres. He said he could not then, but that to satisfy me he would rig up a receiver for the purpose. Then on December 26th, 1927, he announced to me that he had a receiver O.K. for 10 metres. I commenced to transmit exactly on that wavelength from 14.30 to 14.45, and the transmission was received during the last five minutes, and my correspondent reported "QRK R3 FB, all OK, Stbi." I continued to transmit on 10 metres, and congratulated my correspondent on his receiver, and for ten minutes he received my transmission consistently. At 14.55 signals faded to R1, and then to nothing; NU-2JN hearing nothing further of my transmission. Returning to 23 metres I told him that I had heard a lower harmonic of WIK, probably on 10.73 metres, QRK R3.

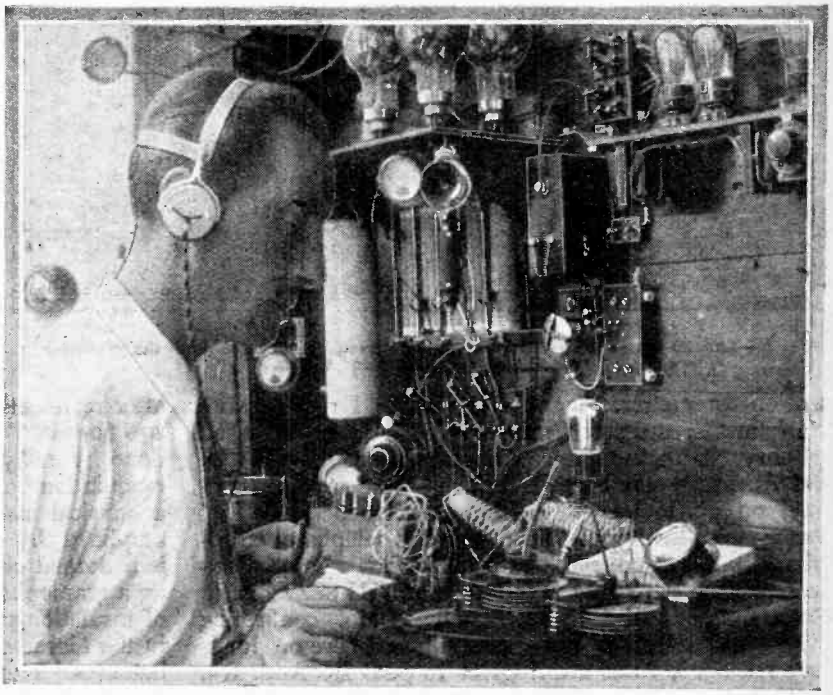

Fig. 1.—The author with his successful 10-metre receiver. The push-pull amplifier mentioned in the text can be seen at the top of the illustration.

Encouraged by these results, 2JN decided to put up a transmitter for the following Sunday, which was January 1st, 1928, and we established what I believe was the first transatlantic two-way communication on 10 metres. The signals were received from 14.15 G.M.T. until 16.45 G.M.T., strength R4 in America and R6 here; fading reduced signal strength at times

Transatlantic Success on 10 Metres.—

to R1. From 15.15 to 16.25 signals were very stable, reception here being R4-R3, and in America R6-R5. At 16.45 communication was interrupted, my correspondent having become too weak to read and my own transmission at this time being still R5 but with fading.

On the occasion of this first communication NU-2JN transmitted a message as follows: "Msg to EF-8CT, January 1st, 15.40 G.M.T., Fm NU-2JN, Congratulations on what we believe to be the first two-way contact on 10 metres, Signed NU-2JN." I replied with the following message "Msg Fm EF-8CT to NU-2JN, January 1st, 16.10 G.M.T., Congratulations for NU-2JN and American amateur stations for first contact, two-way, on 10 metres with France. Signed EF-8CT." During this test I made an attempt at telephony transmission but was not received by NU-2JN. Later, however, a QSL card was received from NU-8ZZZ, A.K. Mack Conney, of Cuyahoga Falls, Ohio, confirming "To Radio EF-8CT, Your 'phone heard here on January 1st, 1928, 10.20 a.m., QRH 10 QSB DC Aud. R5, Read R6," and he remarked further "You were QSO NU-2JN."

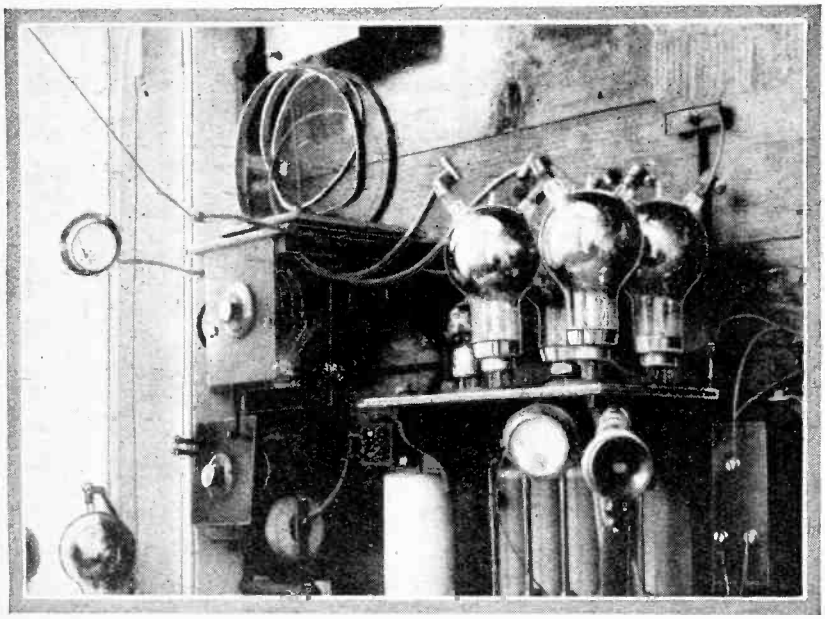

Fig. 2.—The 10-metre transmitter. Note the strip inductance and the "horned" oscillator and modulator valves.

This report seems to show how peculiar are the results obtainable with short waves. From that date I have been frequently in communication with NU-2JN with satisfactory signal strength, but on other occasions nothing was heard on 10 or 11 metres, not even the harmonic of WIK.

Another station, NU-2NM, which had been also taking part in tests since January 1st, received my transmission on March 11th and again on April 1st, and this station was heard by me on April 15th, a day which seemed very good for 10-metre reception, as in addition to NU-2JN I heard on that date NU-2EB, R6, NU-2GP, R3, NU-8ALY, R5. A number of other stations were also heard; probably they were harmonics.

So far I have had no success in communication with stations in California.

The transmitter which I use at my station has throughout been of a type normally for 3 to 200 metres with interchangeable inductances, and the circuits can be changed so as to employ reverse feed back, Hartley, or Mesny arrangements, and it was the latter which I used for wavelengths below 50 metres. For 10 metres the grid coil consists of one turn 18 centimetres in diameter; the plate coil, two turns of the same diameter, tuned with a small condenser; the aerial coil consists of three-quarters of a turn 14 centimetres in diameter, located within the magnetic field of the grid and plate coils.

Transmitter Details.

The aerial used is that known here as the "Lévy," specially designed for 23 metres, the height from the ground being 12 metres and connected between my house and a tree; the two horizontal wires directed north-south are 5.55 metres each and the two feeders, 10 metres. The aerial current is 0.5 amp. The A.C. supply is rectified by two kenotron "Fotos" valves rated at 60 watts each. The supply available after rectification is 1,200 volts, 125 milliamperes, using two 60-watt "Fotos" horned valves. The keying was done by relay in the return lead of the filaments and modulation for telephony as well as for production of a musical note was obtained by "Schoc" system, amplified by one low-frequency stage. The receiver is a normal circuit for low wavelengths and is mounted on a gramophone disc, which provides a very good form of insulation panel. Two 30-turn chokes are connected in the filament leads to stop the passage of H.F. to the batteries. The aerial inductance is 2 turns, the grid coil 2 turns, and the plate coil 3 turns, all having a diameter of 7 centimetres. The detector valve is a Philips A-409, followed by a low-frequency valve, B-406, or a push-pull amplifier for telephony. I am putting up a special new 10-metre station with which I hope to be able to experiment with different types of aerial systems in November next, and I look forward to hearing a number of European stations on 10 metres at about that time, I therefore take this opportunity of thanking in advance any future correspondents.

By Our Special Correspondent.

Autumn Picture Transmissions.—The "Prom" Season.—Programmes and the Regional Scheme.—Naming the New Stations.—More American Relays.

Picture Broadcasting in the Autumn.

I am now able to confirm the report that the B.B.C. will begin picture transmission in the autumn by means of a well-known British system which has been described in the pages of *The Wireless World*. Tests have already been conducted after broadcasting hours between 5XX, 2LO, and the Clapham research station, and I understand that the new service, when inaugurated, will also be given after the usual hours, in order to avoid interference with the ordinary programmes.

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A Poser.

"What pictures shall we send?" is the question which has been hovering on the lips of the Programme Department, who know more about tickling the ear than pleasing the eye. Perhaps they will dare to transmit a few portraits of the staff or some illustrated dressmaking hints. If they are wise they will proceed warily, knowing that legions of critics who have exhausted their vocabulary on the audible programmes will be ready to pounce on the visible ones.

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"Prom" Nights.

Readers may like to make a note of the "proms." broadcasts from the Queen's Hall during August. They are as follow:—2LO and 5XX: August 22nd and 28th; 5GB: August 16th, 18th, 21st, 24th, and 30th. The other stations in the provinces will broadcast one promenade concert a week, on the night when London is also broadcasting it, and, in addition, may, at the station director's discretion, transmit one on some other evening of the same week.

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Pride of Place.

One of the earliest problems which harassed those pioneer enthusiasts of the old B.B. Company was that of satisfying local dignity. Not every big town could be provided with a broadcasting station, but the big towns argued, quite rightly, that they were all entitled to a place in the ether.

The B.B.C. replied with the installation of relay stations, ostensibly to provide a 100 per cent. service everywhere, but actually to heal the sores of wounded pride. This was a good scheme in 1923, but the scene-shifters are now at work preparing the stage for the regional scheme, and the relay stations must go.

FUTURE FEATURES.

London and Daventry.

AUGUST 19TH.—Service from St. Mary's Abbey, Buckfast.
AUGUST 20TH.—Pianoforte Recital by Ponishnoff.
AUGUST 21ST.—"The Locked Chest," a play by Masefield.
AUGUST 22ND.—Promenade Concert.
AUGUST 23RD.—A programme of Students' Choruses.
AUGUST 24TH.—Voices we shall not hear again. A programme of Gramophone Records of Caruso and Patti.

Daventry Experimental (5GB).

AUGUST 20TH.—"All the To-morrows," a tragedy by Aubrey Millward.
AUGUST 21ST.—Promenade Concert, relayed from the Queen's Hall.
AUGUST 23RD.—A Summer Symphony Concert.

Cardiff.

AUGUST 22ND.—A programme from The Sunshine Carnival at Clarence Park, Weston-Super-Mare. First Day.
AUGUST 23RD.—Ditto. Second Day.
AUGUST 25TH.—A Popular Request programme.

Manchester.

AUGUST 20TH.—"On With the Show of 1928." The Concert Party Entertainment, produced by Ernest Longstaffe.
AUGUST 21ST.—International Vaudeville.

Newcastle.

AUGUST 22ND.—"My Programme," by "Wee Nora" of The Radioptimists.

Aberdeen.

AUGUST 22ND.—A Violoncello Recital by J. H. Shaw.

Belfast.

AUGUST 20TH.—"Circumstantial Evidence." A mystery play by Herbert P. Parsons.

The Grouping System.

The B.B.C. is tackling this new situation by the introduction of the programme grouping scheme, which is already being experimented with in the Manchester area. Mr. Edward Liveing, who is director of 2ZY, has been devoting much of his time to the development of this idea, and confidently predicts that the inauguration of a Pennine regional station (to follow that at Potters Bar) will result in a more general diffusion of broadcast talent from all the important towns in the Midlands. Thus towns such as Leeds, Sheffield, and Liverpool will actually provide more programme material under the regional scheme than is the case at present.

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Naming the Regional Stations.

To avoid associating the regional stations with the towns nearest to which they happen to be placed, it is suggested that the stations should be known by their compass direction on the map. We should thus have a "Northern," a "Southern," a "Western," a "Central," and perhaps a "Scottish" regional station, each deriving programme material from widely separated cities and towns.

Each regional station will provide one original programme, while it may give, as an alternative, a programme which is being transmitted by a distant station.

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Enter Sam Mayo.

Sam Mayo, one of the few leading comedians who have not yet appeared before the microphone, is to broadcast from 2LO and 5XX on August 20th.

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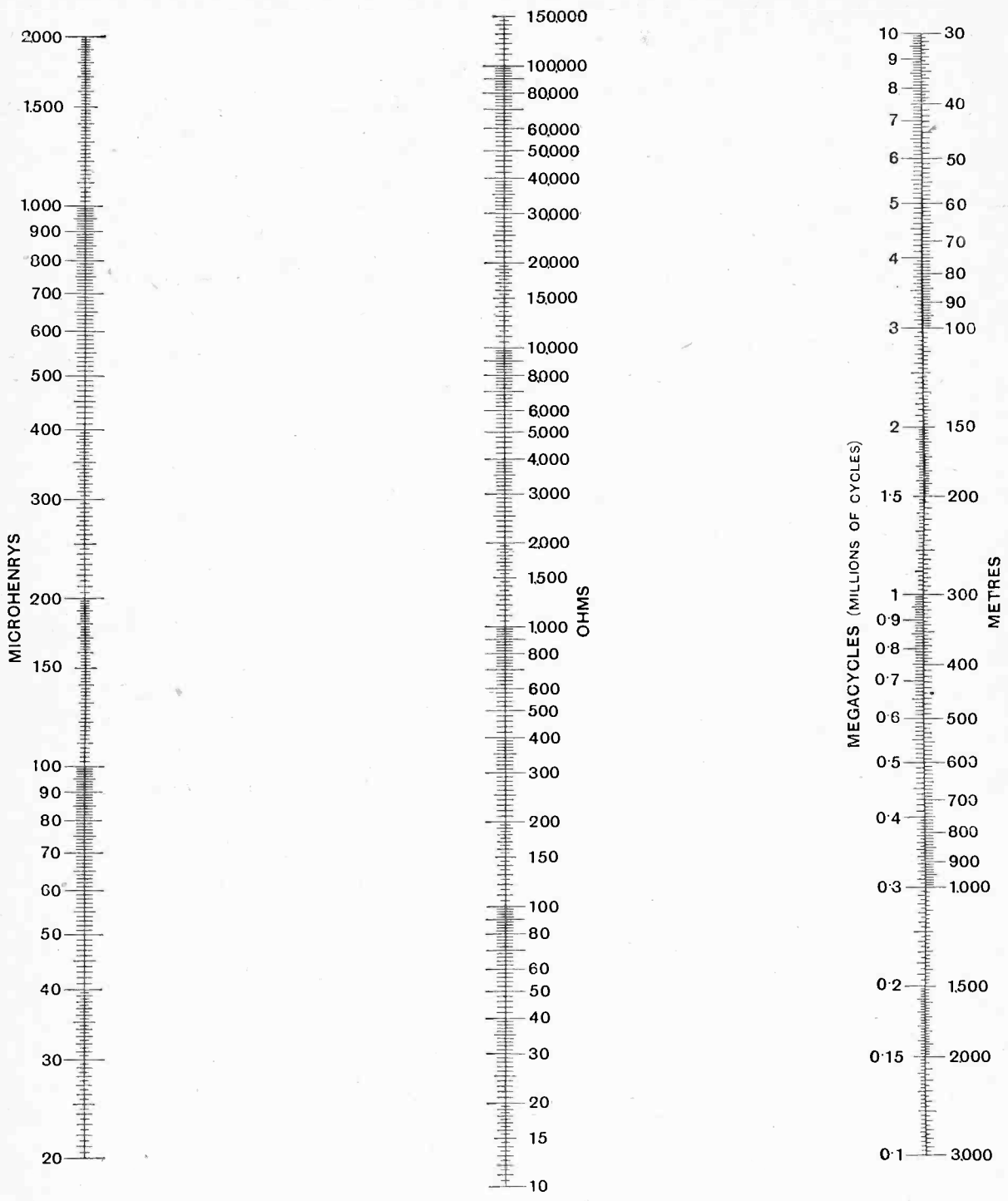
Keston in the Ascendant.

Last week I referred to the return to fame of the B.B.C. receiving station at Keston. The station will be still more in the public eye in the course of a few weeks when some new experiments are to begin in the reception and relaying of programmes from America.

Five separate receivers are to be used, on wavelengths varying between 16 and 50 metres, to pick up five individual transmissions of the same programme from the satellite stations of WGY at Schenectady. For relay purposes the five receivers will have a common output. This method of avoiding fading and atmospherics has been advocated by Dr. Alfred N. Goldsmith, of the U.S. National Broadcasting Company, as well as by Capt. Eckersley over here.



REACTANCE OF A COIL AT RADIO FREQUENCIES

W. W. ABAC

Nº 6

USEFUL DATA CHARTS (No. 6).

Reactance of a coil at radio frequencies. For a full explanation, reference should be made to the explanatory text preceding the abac in last week's issue.

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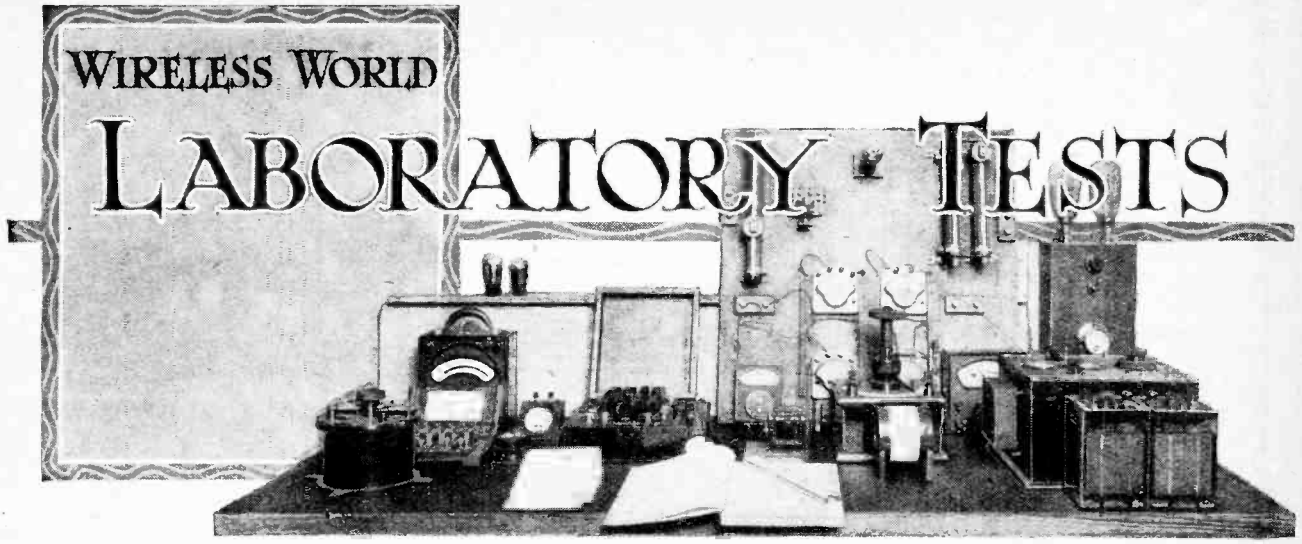

A Review of Manufacturers' Recent Products.

PEERLESS VALVE HOLDER.

The moulded shell of this valve holder is made in two parts, an outer circular base carrying the connecting terminals and a floating centre supported on flat hard brass springs. The valve sockets are pressed out of the same metal as the supporting springs; there are no soldered joints. The minimum of insulating material has been used, yet the strength of the finished product is quite adequate.

Peerless Shockproof valve holder.

The makers are the Bedford Electrical Radio Co., Ltd., 22, Campbell Road, Bedford, and the price is 1s. 3d.

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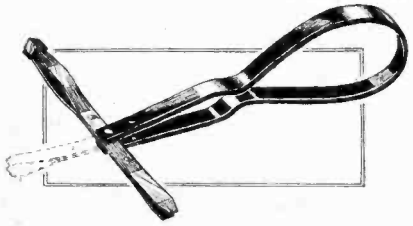
EXPANDING SCREWDRIVER.

Made by the Lewis Spring Co., Ltd., Redditch, these screwdrivers are designed for holding the screws for insertion in inaccessible positions, the larger type costing 3d. and the smaller 6d.

The principle of the expanding point is obvious from the accompanying sketch,



Lewis expanding screwdriver.

and it will be seen that by reversing the end, hexagon nuts can be held by the shaped clip provided.

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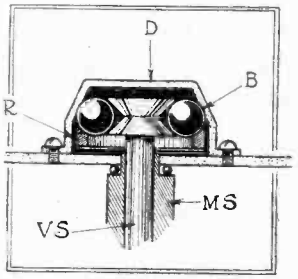
POLAR "IDEAL" CONDENSER.

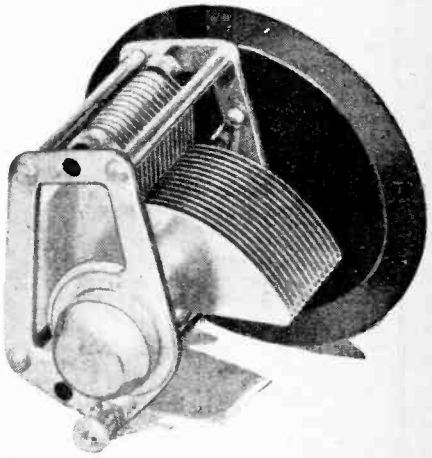
The Polar "All Brass" condensers were reviewed on page 559 of the May 23rd issue, and the remarks made on that occasion apply with equal force to the "Ideal" condenser which differs only in the method of applying the vernier control.

Instead of the well-known cam vernier which gives fine control over only a few degrees, the new "Ideal" condenser is fitted with a reduction gear giving continuous action over the whole of the tuning scale. The gear works on the epicyclic principle, and depends on friction



Sectional diagram of slow-motion gear in the Polar "Ideal" condenser.

for the drive. A set of large-diameter ball bearings B take the place of the "planet" wheels in a true epicyclic gear, and the "sun" wheel takes the form of a V-shaped groove turned in the end of the vernier spindle VS. The balls roll round the inside surface of the fixed dust cap D and the reaction is transmitted through a bezel ring R and spring disc SD to the hollow main spindle MS carrying the moving vanes The gear ratio is approximately 30 to 1, and the drive is free from "lumpiness." Direct movement of the vanes is possible by rotating the 180° dial which is fixed to the main spindle. The dial has a diameter of $3\frac{7}{8}$in., and the degrees are therefore well spaced, while the shallow bevel gives a handsome appearance.



Polar "Ideal" variable condenser.

Small diameter ball bearings are used also in both main bearings of the condenser. For short-wave work phosphor bronze balls can be supplied to order. Reduction ratios other than 30 to 1 can also be supplied to set manufacturers if the quantities ordered are sufficiently large.

The makers, Messrs. Wingrove and Rogers, Ltd., 188-189, Strand, London, W.C.2, have fixed the prices as follows: 0.0005 mfd., 12s. 6d.; 0.00035, 12s. 3d.; 0.0003 and 0.00025 mfd., 12s.; 0.00015 and 0.0001, 11s. 6d.

The 0.0005 mfd. specimen submitted for test had a minimum capacity of 16 micro-mfds. and a maximum of 0.00057 mfd.

BROADCASTING STATIONS

List of the Principal Broadcasting Stations of the World. Arranged in Order of Wavelength.

(1) EUROPE.

	Wavelength.
Königswusterhausen (AFP), Germany	4,000
Königswusterhausen (AFP), Germany	2,900
Eiffel Tower (F.L), Paris. Time signals in Code 0926 and 2226 G.M.T. and B.S.T.	2,650
Opening signal: Seconds counted in French.	
Berlin (Wolff's Bureau), News	2,525
Kovno (Kannas), Lithuania	2,000
Interval signal: Strokes on gong.	
Scheveningen, Holland	1,950
Huizen, Holland	1,950
Koszice (Kassa), Czecho-slovakia	1,870
Norddeich, Germany. Weather report, 11.0 p.m.	1,829
Angora, Turkey	1,806
Paris (Radio Paris CFR)	1,765
Opening signal: Electric gong at 12.30 and 8.30. Clock chimes at the hour.	
Kharkov, Russia	1,680
Daventry (5XX). Time signals 10.30 a.m. and 6.30 p.m.	1,604.8
Lahti, Finland	1,522
Moscow, Komitern (RA1), Russia	1,450
Motala, Sweden	1,304
Zeesen (Königswusterhausen), Germany	1,250
Opening and Interval signals: Metronome.	
Stamboul, Turkey	1,200
Boden (SASE), Sweden	1,190
Kalundborg, Denmark	1,153
Opening signal: 3 Strokes of a gong.	
Ryvang, Denmark	1,150
Novosibersk (RA33), Russia	1,117
Warsaw (AXO), Poland	1,111
Opening and Interval signals: W, *in Morse.*	
De Bilt (PCFF), Holland. Weather report 9.15 p.m.	1,100
Rostov-on-Don (RA14), Russia	1,075
Hilversum (ANRO), Holland)	1,071
Basle, Switzerland	1,010
Leningrad (RA42), Russia	1,000
Opening Signal: Gong on chimes.	
Tiflis, Russia	870
Nijni Novgorod (RA13), Russia	840
Kiev (RA5), Russia	775
Geneva (HB1), Switzerland	760
Opening signal: 3 long whistles.	
Ostersund, Sweden. Relays Sundsvall	720
Lausanne (HB2), Switzerland	680
Opening signal: Chimes amd Carillon.	
Moscow (Popoff), Russia	675
Zurich (HBZ), Switzerland	588.2
Interval signal: Gong.	
Vienna (Stubenring)	577
Freiburg, Germany	577
Cracow, Poland	566
Augsburg, Germany. Relays Munich	566
Bloemendaal, Holland. Sundays only	566
Mikeli (St. Michel), Finland	566
Hamar, Norway	555.8
Budapest, Hungary	555.5
Opening signal: 4 notes, repeated.	
Milan (IMI), Italy	548
Opening signal: Tuning Note.	
Sundsvall (SASD), Sweden	545.6
Munich, Germany	535.7
Opening and Interval signals: MUNG, *in Morse,* followed by 3 notes.	
Riga, Latvia	526.3
Vienna (Rosenhugel)	517.2
Aalesund, Norway	511
Brussels (SBR)	508.5
Opening signal: Whistle.	
Tromso, Norway	500
Aberdeen (2BD)	500
Uppsala, Sweden. Relay Station	500
Linkoping (SMUW), Sweden. Relay Station	500
Porsgrund, Norway. Relay Station	500
Daventry Experimental (5GB)	491.8
Berlin (Witzleben)	484
Interval signal: Clock chimes.	
Kharkov (RA24), Russia	477
Lyons (La Doua, P.T.T.), France Relays Ecole Superieure, Paris	476
Langenburg, Germany	468.8
Opening Signal: Chimes 4 bells. *Interval:* U, *in Morse.*	
Barcelona (EAJ13, Radio Catalana) Spain	462
Oslo, Norway	461.5
Paris (Ecole Superieure P.T.T.)	458
Stockholm (SASA), Sweden	454.5
Opening signal: Folk song on a spinet *Interval:* Rapid ringing of a bell.	
Moscow (Trades Union, RA2), Russia	450
Rome (1RO)	447.8
Opening signal: Oscillating valve, followed by "Pronto." *Interval:* Trumpet call and "Radio Roma."	
Rjukan, Norway. Relay Station	447.8
Malmberget, Sweden. Relay Station	446
Brunn (Brno), (OKB), Czecho-slovakia	441.2
Wilna, Poland	435
Seville (EAJ5, Union Radio), Spain	434.8
Frankfurt-on-Main	428.6
Opening signal: 3 Strokes of gong. *Interval:* Metronome.	
Kattowitz, Poland	422
Goteborg (SASB), Sweden)	416.5
Grenoble, France	416
Notodden, Norway. Relay Station	412
Berne (HBA), Switzerland	411
Opening signal: Post horn or Tuning Note. *Interval:* 2 Strokes of Gong.	
Tallinn (Reval), Esthonia	408
Glasgow (5SC)	405.4
Salamanca (EAJ22), Spain	405
Mont de Marzan (Radio Club Landrais), France	400
Aix-la-Chapelle, Germany	400
Cadiz (EAJ3). Spain	400
Opening signal: Metronome.	
Madrid (EAJ2, Radio España), Spain	400
Cork (6CK), Irish Free State	400
Plymouth (5PY). Relay Station	400
Tammerfors, Finland. Relay Station	400
Hamburg (H.A. in Morse), Germany	394.7
Toulouse (Radio du Midi), France	389.6
Interval signal: Metronome.	
Manchester (2ZY)	384.6
Stuttgart, Germany	379.7
Interval Signal: 3 Notes.	
Helsingfors (Helsinki), Finland	375
Madrid (EAJ7, Union Radio), Spain	375
Opening signal: Bugle Call.	
Bergen, Norway	370.4
Paris (Radio L.L.)	370
Leipzig, Germany	365.8
Interval signal: Metronome or RR *in Morse.*	
London (2LO)	361.4
Graz (V in Morse), Austria	357.1
Cardiff (5WA)	353
Prague, Czecho-slovakia	348.9
Barcelona (EAJ1, Radio Barcelona), Spain	344.8
Posen, Poland	342.9
Huizen, Holland	340.9
Paris (Petit Parisien)	340.9
Copenhagen	337.4
Opening signal: 3 Strokes of Gong.	
Cartagena (EAJ16), Spain	335
San Sebastian (EAJ8), Spain	335
Reykjavik, Iceland	333.3

	Wave-length.
Naples (1NA), Italy	333.3
Opening Signal: Oscillating valve. *Interval:* Metronome.	
Gleiwitz, Germany. Relay Station	329.7
Bournemouth (6BM)	326.1
Almeria (EAJ18), Spain	326
Breslau, Germany	322.6
Interval signal: Metronome.	
Dublin (2RN)	319.1
Opening signal: Tuning note.	
Falun (SMZK), Sweden	315.8
Newcastle (5NO)	312.5
Agen, France	310
Oviedo, Spain	310
Zagreb, Yugo Slavia	309
Opening signal: Metronome. *Interval:* 2 Strokes on bell.	
Belfast (2BE)	306.1
Bjorneborg, Finland. Relay Station	304
Königsberg, Germany	303
Interval signal: 2 Notes A♭ and D♭ repeated.	
Paris (Radio Vitus)	302
Marseilles, P.T.T., France	300
Bratislava (Pressburg), Czecho-slovakia	300
Interval signal: 4 Bells, F.A.C.C.	
Liverpool (6LV). Relay Station	297
Hanover, Germany. Relay Station	297
Interval signal: Strokes on gong, followed by HR *in Morse.*	
Varborg, Sweden. Relay Station	297
Jyvaskyla, Finland. Relay Station	297
Dundee (2DE). Relay Station	294.1
Hull (6KH). Relay Station	294.1
Stoke (6ST). Relay Station	294.1
Swansea (5SX). Relay Station	294.1
Innsbruck, Austria. Relay Station	294.1
Interval signal: Metronome.	
Udevalla (Sweden.) Relay Station	294.1
Lyons (Radio Lyon), France	291.3
Bordeaux Lafayette P.T.T., France	289.8
Edinburgh (2EH). Relay Station	288.5
Limoges, France	285
Cologne, Germany	283
Trollhattan, Sweden. Relay Station	279
Leeds (2LS). Relay Station	277.8
Kaiserslauten, Bavaria	277.8
Barcelona (EAJ13), (Radio Catalana), Spain	277
Dresden, Germany. Relay Station	275.2
Jacobstad, Finland	275.2
Norrkoping (SMVV), Sweden. Relay Station	275.2
Nottingham (5NG). Relay Station	275.2
Ghent, Belgium	275
Sheffield (6FL). Relay Station	272.7
Bremen, Germany. Relay Station	272.7
Danzig, Germany. Relay Station	272.7
Hudiksvall, Sweden. Relay Station	272.7
Klagenfurt, Austria. Relay Station	272.7
Interval signal: Metronome.	
Lille, P.T.T., France	267.3
Malmo (SASC), Sweden	260.9
Kiel, Germany. Relay Station	253
Interval Signal: KL *in Morse.*	
Kalmar (SMSN), Sweden	254.2
Linz, Austria. Relay Station	254.2
Bradford (2LS). Relay Station	252.1
Cassel, Germany. Relay Station	252.1
Montpelier, France	252.1
Saffle (SMTS), Sweden. Relay Station	252.1
Uleaborg, Finland. Relay Station	250
Eskilstuna (SMUC), Sweden. Relay Station	249.7
Munster (MS in Morse), Germany	249.7
Juan les Pins, Nice, France	246
Toulouse, P.T.T., France	246
Trondhjem, Norway	243.9
Nurnberg, Germany. Relay Station	241.9
Viborg, Finland	240
Nimes, France	240
Kiruna, Sweden. Relay Station	238.1
Bordeaux, France	238.1
Orebro, Sweden. Relay Station	236.2
Stettin, Germany. Relay Station	236.2
Boras (SMBY), Sweden. Relay Station	230.2
Schaerbeck, Germany	230
Halsingborg (SMYE), Sweden. Relay Station	229.4
Umea (SMSN), Sweden. Relay Station	229
Strasbourg, France	222.2
Karlstadt (SMXZ), Sweden. Relay Station	220.6
Luxembourg (LOAA)	217.4
Halmstad (SMSB), Sweden. Relay Station	216.3
Gavle (SMXF), Sweden. Relay Station	204.1
Kristinehamn (SMTY), Sweden. Relay Station	202.7
Jonkoping (SMZD), Sweden. Relay Station	201.3
Fécamp, France	200
Biarritz, France	198
Karlskrona (SMSM), Sweden. Relay Station	196
Ornskoldsvik, Sweden. Relay Station	187.5
Beziers, France	180
Zurich Radio Club (H9XD), Switzerland	85
Copenhagen "Radiolytteren" (D7RL)	84.25
Nogent-sur-Seine (F8AV)	80
Vienna (OHK2)	70
Doberitz, P. & T. Exp. (AFK), Germany	67.65
Paris, Radio L.L. (F8GC)	61
Khabarovsk (RA97), Russia	60.12
Nauen (AGJ), Germany	56.7
Karlsborg (SAS)	52.5
Rome, Via Savoia 80 (I1AX)	45.0
Lyons, Radio Lyon (YR), France	40.2
Doberitz, P. & T. Exp. (AFK)	37.65
Paris, Radio Vitus	37
Vienna, Electro. Techn. Inst. (EATH)	37
Caterham (G. Marcuse 2NM)	32.5
Copenhagen "Radioposten" (D7MK)	32.05
Paris, Eiffel Tower (F.L.), Time Signals	32
Zurich Radio Club (H9XD), Switzerland	32
Berne, Telegr and Radio Service (H9OC)	32
Helsingfors (Helsinki), Finland	31.5
Bergen, Norway	31.25
Eindhoven, Philips Lamp Works (PCJJ). Holland	31.4
Agen, France	30.75
Madrid (EAM), Spain	30.7
Bergen (LGN), Norway	30
Chelmsford (5SW)	24
Vienna	22.2
Kootwijk, State Telegraph (PCLL)	18.4
Nauen (AGC)	17.2
Nancy, France	15.5

(2) U.S.A.

Des Moines, Iowa (WHO)	535.4
Memphis, Tenn. (WMC)	516.9
San Antonio, Texas (WOAI)	499.7
Fort Worth, Texas (WBAP)	499.7
New York (WEAF)	491.5
Los Angeles, Calif. (KFI)	468.5
Boundbrook, N.J. (WJZ)	454.3
Pontiac, Mich. (WJR)	440.9
Harrison, Ohio (WLW)	428.3
Kearing, N.J. (WOR)	422.3
Chicago, Ill. (WGN)	416.4
St. Paul, Minneapolis, Minn (WCCO)	405.2
Glenview, Ill. (WBBM)	389.4
Oakland, Calif. (KGO)	384.4
Schenectady, N.Y. (WGY)	379.5
Devonport, Iowa (WOC)	374.8
Portland, Maine (WCSH)	365.6
Cincinnati, Ohio (WSAI)	361.2
Chicago, Ill. (WLS)	344.6
Nashville, Tenn. (WSM)	336.9
Springfield, Mass. (WBZ)	333.1
Council Bluffs, Iowa (KOIL)	319
East Pittsburg, Pa. (KDKA)	315.6
Desplaines, Ill. (WIBO)	305.9
Chicago, Ill. (WHT)	305.9
Kirkwood (St. Louis), Mo. (KMOX)	299.8
Baltimore, Md. (WBAL)	285.5
Columbus, Ohio (WAIU)	282.8
Rochester, N.Y. (WHAM)	280.2
Oklahoma City, Okla. (KEJF)	272.6
Atlantic City, N.J. (WPG)	272.6
Chicago, Ill. (WJAZ)	263
Mt. Vernon Hills, Va. (WTFF)	202.6
Springfield, Mass. (WBZ)	70
Los Angeles, Calif. (6XAL)	66.04
Cleveland, Ohio (8XF)	66.04
Newark, N.J. (2XAQ)	65.4
San Diego, Calif. (KFBC)	65.18
Richmond Hill, N.Y. (WABC)	64
East Pittsburg, Pa. (KDKA)	62.5
Council Bluffs, Iowa (9XU, S.W. of KOIL)	61.06
Bound Brook, N.J. (3XL)	59.96
New York (2XE, S.W. of WABC)	58.5
Columbus University, Ohio (8XJ)	54.02
Coney Island, N.Y. (2XBX)	54.02
Brooklyn, N.Y. (WCGV)	54
Harrison, Ohio (8XAL)	52.05
Cincinnati, Ohio (WLW)	52.02
East Pittsburg (KDKA)	42.95
New York (WJD)	37.01
San Francisco, Calif. (6XAR)	33
Detroit, Mich. (8XAO)	32
Schenectady, N.Y. (2XAF, S.W. of WGY)	31.4
New York (2XAL S.W. of WRNY)	30.91
New York (2XAG)	26.92
East Pittsburg (8XK)	26.5
New York (2XAB)	24
Houlton, Maine (2XAA)	22.99
Fort Wayne, Indiana (WOWO)	22.80
Schenectady, N.Y. (2XAD S.W. of WGY)	21.96
Rocky Point, N.Y. (2XG)	16.02

(3) AUSTRALIA.

Perth (6WF)	1,250
Hobart, Tasmania (7ZL)	516
Melbourne (3AR)	481
Sydney (2FC)	442
Adelaide (5CL)	395
Brisbane (4QG)	385
Melbourne (3LO)	371
Sydney (2BL)	353
Perth (6AG)	32.9
Sydney (2BL)	32.5
Melbourne (3LO)	32
Sydney (2FC)	28.5
Sydney (2ME)	28.5

(4) NEW ZEALAND.

Wellington (2YA)	420

(5) CANADA.

Calgary, Atla (CFCN)	435
Montreal, Que (CFCF)	411

(6) NORTH AND EAST AFRICA.

Carthage, Tunis (TNV)	1,850
Rabat, Morocco	416
Algiers, P.T.T.	353
Casablanca, Morocco (CNO)	305
Nairobi, Kenya	90
Casablanca, Morocco (AIN)	51
Constantine, Tunis (8KR)	42.8

(7) SOUTH AFRICA.

Johannesburg (JB)	443.5
Durban	406.5
Capetown	375
Johannesburg (JB)	32

(8) INDIA AND CEYLON.

Colombo, Ceylon (VPB)	800
Calcutta (7CA)	370.4
Bombay (7BY)	357.

(9) JAPAN.

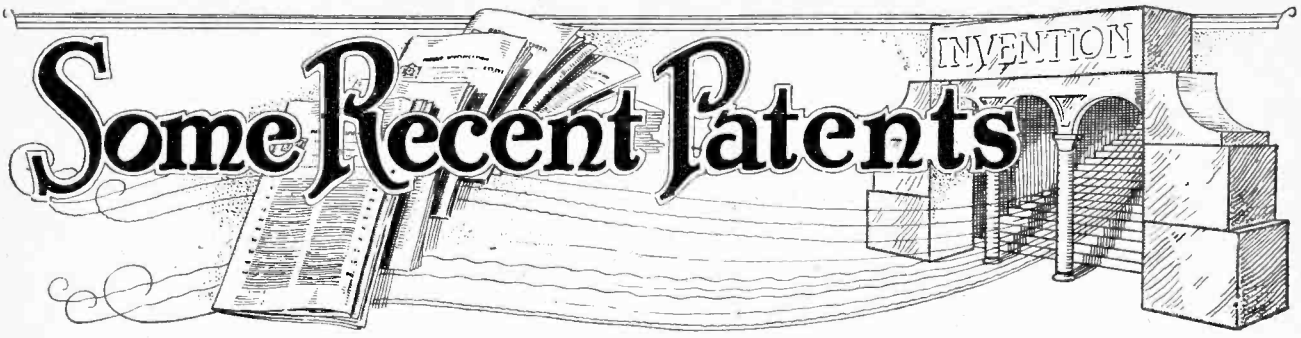
Osaka (JOBK)	400
Kumamoto (JOGK)	380
Hiroshima (JOFK)	353
Tokyo (JOAK)	345
Taipeh (JFAB)	39.5
Hiraiso (JHBB)	37.5

(10) JAVA.

Bandoeng (ANE)	31.86
Malabar (ANH)	17
Bandoeng (ANE)	15.93

(11) SOUTH AMERICA.

Lima, Peru (OAX)	389
Buenos Aires (LOS)	291.2
Buenos Aires (LON)	210



Some Recent Patents

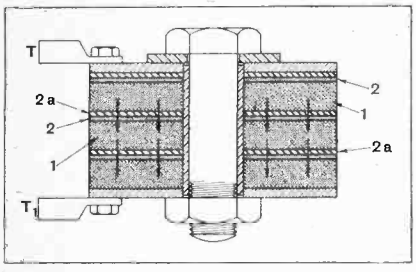
The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

Metal Rectifiers. (No. 283,901.)

Convention date (U.S.A.): January 19th, 1927.

Difficulty is sometimes experienced with the new type of metal-oxide rectifier in making a satisfactory electrical connection to the oxide layer. The rectifier element is usually formed by heating a copper blank in oxygen, so that a thin layer of red cuprous oxide is formed thereon. This combination passes current from oxide to copper much more readily than in the reverse direction.

In the present invention a part of the oxide layer is reduced again to copper by electrolytic action in a bath of potassium fluoride. After such treatment the original copper blank 1 will be coated



A metal-oxide rectifier modification. (No. 283,901.)

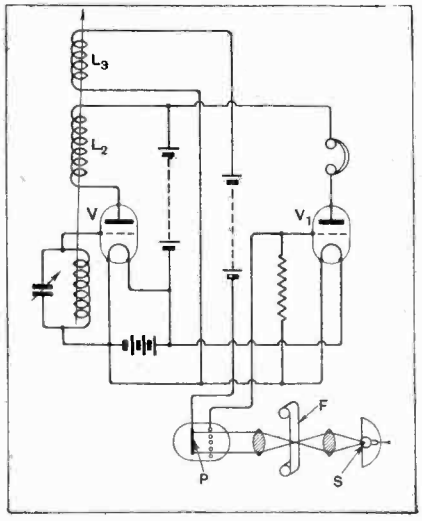
first with a layer 2 of the rectifying oxide, and outside this with a thin deposit 2a of "reduced" copper, sufficient to make a good electrical contact with any other metallic surface. The figure shows an assembly of three prepared blanks firmly bolted together and provided with terminals T, T_1. Patent issued to Metropolitan Vickers Electrical Co., Ltd.

o o o o

A Photo-Electric Modulator. (No. 266,288.)

Convention date (U.S.A.): February 16th, 1926.

Relates to a method of directly modulating an outgoing carrier-wave by variations in the light emitted from a luminous body, as in television or photo-transmission systems. The carrier-wave is generated by an oscillating valve V. Coupled to the output coil L_2 is a coil



Method of modulating a carrier wave by the varying current from a photo-electric cell. (No. 266,288.)

L_3 in series with a photo-electric cell P, connected to the grid of an amplifier valve V_1.

Light from a source S is focused by lenses, and after passing through a photographic film F, impinges upon the cell P. The brighter the light falling upon the sensitive cell, the greater is the conductivity of the circuit from the coil L_3 on to the grid of the amplifier, so that the output from the latter is modulated in proportion to the light and shade distribution on the film F. Patent issued to the Dubilier Condenser Co.

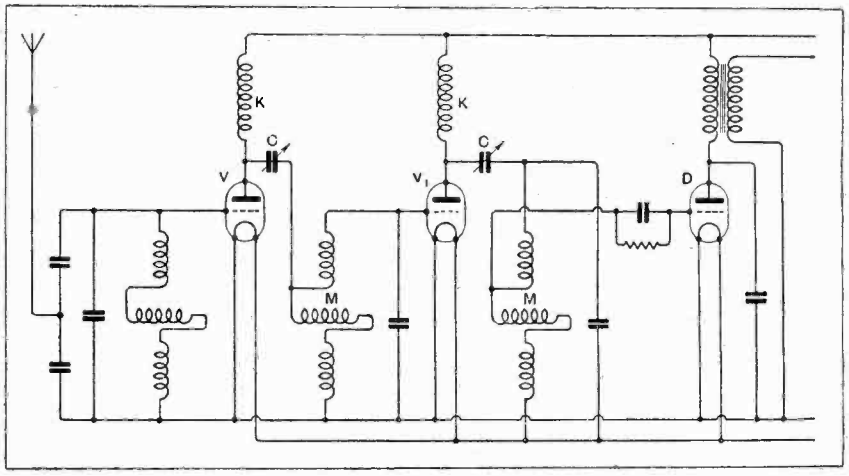
o o o o

A Stabilised H.F. Amplifier. (No. 286,991.)

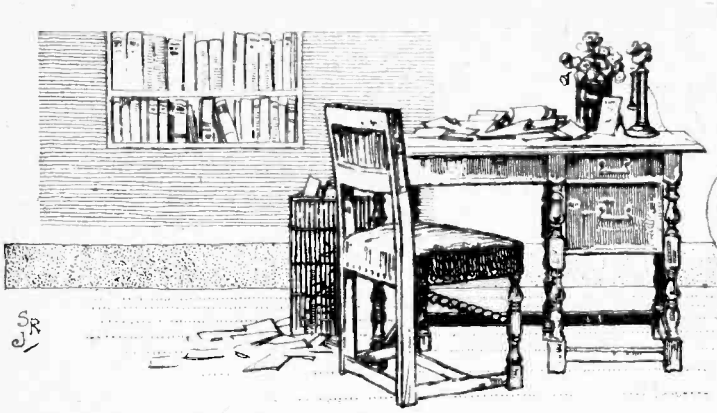
Application date: September 19th, 1927.

The figure shows two stages V, V_1, of high-frequency amplification characterised by a variometer-tuned input, and inter-valve couplings comprising a variometer winding M in series with an adjustable coupling-condenser C. By keeping the value of the coupling-condensers C below a certain critical point, the inductive reactance in the anode circuits at resonance is stated to be so small as to prevent any self-oscillation through the valve capacities.

Each of the variometers consists of three coils in series, the centre winding being rotatable with respect to the other two. The connection to the grid of the detector valve D is tapped from the end of the centre coil, in order to reduce damping. The high-tension supply to both amplifiers passes through choke coils K. Patent issued to Igranic Electric Co.



A shunt-feed stable H.F. amplifier using variometers. (No. 286,991.)



The Week's Postbag

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

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

LOCAL INTERFERENCE.

Sir,—It is with mixed feelings I learn from the July 18th issue of *The Wireless World* of the probable list of twin-wave stations to be erected and of the ultimate abolition of all relays. To take my own case, and there must be thousands in a similar position, I am pestered by the arcing of a local bakery's motors which blots out almost everything except the local relay, and seven nights a week at that, and the owner simply ignores a request to help us; also in another case—a local picture house, the reply is: "We were here before broadcasting."

Where are we going to be when the local relay is closed down? Ten high-power transmissions mean H.F. for selectivity. H.F. means more "muck" as each carrier is approached. Apart from electric trains and tramway systems, interference from small motors, including refrigerators, etc., can easily be eliminated, and a law should be made to stop all such unnecessary interference; I believe it has already been done in a country whose programmes are not a patch of ours (and ours are—well, they're improving). If the question is ignored I'm afraid it will mean a gradual losing of interest and a subsequent loss of licence revenue. It is up to the P.M.G. What is he going to do about it? T. W. B.

Hull.
July 19th, 1928.

WIRELESS AND THE ESPERANTO CONGRESS.

Sir,—With reference to the note in your number of July 25th, the lecturer on "The Applications of Wireless in Navigation" at the Twentieth Universal Esperanto Congress is, of course, Professor Mesny (and not Memy): the association of this name with the Eccles-Jordan-Vallauri-Mesny ("back to back") transmitting circuit, so greatly used by Continental amateurs, makes it desirable that it should be correctly given.

As an indication of the prominent part played by wireless in this Congress, I may add that, in addition to Professor Mesny's lecture, one of the general meetings of the Congress will be given up to a discussion of wireless as it affects Esperanto, and there will also be a sectional meeting for those specially interested in wireless.

R. RAVEN-HART,
Member Universal Esperanto Association.

Paris.
July 28th, 1928.

MOVING COIL REPRODUCTION.

Sir,—It is to be hoped that the correspondence in your columns on the subject of the "L.S.5 Brigade" and "Moving Coil Reproduction" will be continued for some time yet. There is still much to be said and quite a lot of people to say it.

Your correspondent "C. H. S.," of Wolverhampton, is very interesting. I am using the 220-volt D.C. mains, as he is, but I certainly find that D.E.5a valves are absolutely as good as L.S.5a on that voltage. I am using anode bend detector with reaction, coupled *via* 250,000 resistance, .01 condenser, and 1 megohm leak to a 40,000-ohm valve followed by an A.F.3 transformer feeding two D.E.5a valves in parallel. I use 220 volts on every valve, and my only trouble is that I am unable to find a high-impedance valve to use as a detector which is non-microphonic. I am using a 19,000-ohm valve at present, which is quite nice, and satisfies everybody but me. I know that last little bit of crispness is obtainable with a higher impedance valve, but every valve over 20,000 seems to suffer from the proximity of the speaker, and persists in ringing in spite of wax, sponge rubber, insulating tape and cotton wool.

The question has often arisen in my mind: "Where does faithful reproduction end and over-emphasis begin?" I agree with "C. H. S." that the dance band is a good test for an amplifier and speaker, but I must disagree with him on the subject of the drum. Nothing irritates me more than the monotonous "wump-wump-wump-wump" which I hear when using three stages of R.C., unless it is the muffled voice of the announcer. With my present arrangement, although the drum is unquestionably there, it is felt rather than heard, and the announcer's voice has a timbre which one instantly feels is natural.

Much more research work needs to be done on detector valves for use with coil-drive speakers. On Sunday evening last I plugged in a little H.F. unit to my set, which I converted to leaky-grid rectification. After I had finished my little saunter round the Continent I removed the H.F. but omitted to change back to anode bend. It was an hour before I realised what was wrong. I am convinced that for really good reproduction the aerial coupling should be flatly tuned and the detector valve insensitive, for I never get such good results as when, though the volume on the Daventry stations is really loud, no trace of a carrier wave, Morse or telephony is to be heard anywhere round the dials. "BM/BAQW."

Birmingham.
July 12th, 1928.

Sir,—The very interesting correspondence on this subject in your issue of August 1st calls for some comment. "A. H. B." criticises moving coil loud speakers because they do not give quite accurately the rasping throb of the double bass or the piercing brilliance of the trombone. This may be true, but I should be interested to know what other type of loud speaker can even approach the moving coil type for all-round accuracy of reproduction. As to piano music, a good moving coil speaker can reproduce this with uncanny realism. But the best speaker possible must be limited to the quality of transmission.

Perhaps the whole point about "A. H. B.'s" disappointment lies in his sentence: "Worked from an average set," etc. The better the loud speaker the more necessary it becomes to use a first class set. The average set is incapable of producing any real volume of undistorted music. A minimum

of about 350 volts H.T. with a couple of L.S.5a's appears to be necessary.

As to his comments on speech, this is chiefly the fault of the B.B.C. The moving coil speaker can and does often reproduce speech in a very natural manner.

Mr. P. B. C. Beasley draws attention to the horrible dithering from 5GB, usually, I think, from the Birmingham studio. This often occurs on singing, but never on instrumental music. I have heard the same effect on certain gramophone records. It is clearly a fault in either the microphone or the speech amplifier used. If some cure can be found Mr. Beasley's letter will have rendered a considerable service. I have already complained direct to the B.B.C., but the fault is still there on occasions.

I have recently tried a coil of 520 turns of 43 wire with three L.S.5a's, and there is certainly a very considerable increase in volume, especially at the higher frequencies. This is an improvement on wireless, but as I use gramophone records to a considerable extent I prefer the more mellow effect of a higher resistance coil. F. G. SACKETT.

Birmingham,
August 2nd, 1928.

Sir,—Your two correspondents, "A. H. B." and P. B. C. Beasley, writing in the August 1st issue of *The Wireless World*, raise very interesting points on the subject of moving coil speaker reproduction.

Taking the letter of "A. H. B." first, I should say that his dissatisfied attitude in regard to the unfaithful reproduction in which the double bass sounds like no instrument that "has yet appeared on earth" is due to his hearing the results of working the loud speakers from *an average set*—probably of the o-v-2 class with reaction used to its full limit. To my mind the complete answer to his rather long grumble is to be found in those two words "*average set.*"

In short, the average set, while giving results of a sort working a small horn or reed-cone, is totally unsuitable for providing the *quality* of input required to bring the reproduction from a moving coil instrument up to the level that "A. H. B." demands. If he were to hear the results obtainable from a collection of apparatus designed from the first valve to the last to pass on to the speaker an input free from low note boosting by reaction, high note cut-off by the so-called "distortionless" commercial resistance coupler, and using plenty of H.T. and a small stage-gain per valve, he would, I am sure, have no reason to say the trombone has no metallic brilliance or that the characteristic rasp of the double bass is lacking in either timbre or realism.

There must be, I am sure, many of your readers who, after going to the necessary trouble and outlay of £. s. d., can produce the quality of reproduction that "A. H. B." is seeking. The average set, however, is not capable of doing justice to a good moving coil speaker.

The violent trembling of P. B. C. Beasley's coil-drive cone is, I suggest, due to a low periodicity resonance existent in the suspension, which coincides with a resonant condition of the same frequency in one of the microphones at 5GB.

Should the double condition exist, it is quite feasible that the movements of the announcer (in silence) before the microphone, after the considerable amplification involved, will cause the cone to tremble in sympathy. This is enhanced during the silent periods if the modulation strength is put up while waiting for the announcer's commencement.

My own speaker will behave exactly as Mr. Beasley's if the suspension threads of the coil are tightened more than usual.

Mr. Beasley is on the right track in assuming the double number of turns required on his coil to suit the push-pull conditions. Personally I favour the parallel method when one's valves are of the D.E.5a class. There is more certainty of good results owing to the finality which can be reached.

Like "A. H. B.," I consider the "L.S.5 Brigade" are on the right track, but the mere possession of a good power stage and the necessary H.T. will not make up for distortion arising in the valves preceding it. One has to look to these, I find, for perfect results. We have to belong to the "point-one brigade" also.

Another point I should like to mention before I close. The fact of many amateurs adopting a 6-volt ½ to 1 amp. magnet winding on the commercial make of sets of parts of moving coil speakers is often the cause of distortion arising through having to overload the last valve to get sufficient volume.

In my own case, if the voltage to the pot magnet is raised to 10 or 12 the output strength is easy to get without distortion or blasting. On 6 volts, however, another L.S.5a valve would be necessary to produce the same results. This with a 10-watt anode feed and a grid voltage swing of 100 volts, bias 80 volts.

Retford, Notts. F. W. WOLSTENHOLME.
August 6th, 1928.

Sir,—I was very interested in the letters of Mr. Thomas and Mr. Beasley concerning moving coil operation.

At present my last stage consists of two D.E.5a's in push-pull with 180 volts on their plates. The output transformer has a ratio of 2.4/1, and the M.C. a resistance of 1,500 ohms. I have tried one L.S.5a on the same voltage, but it appears unable to deal with such a large grid swing. This trial was hardly fair on the L.S.5a, however, because my M.C. has too many turns for use with this valve.

Using the push-pull arrangement, quality is quite good, but there is room for improvement, and I am at present experimenting with the detector.

Ordinarily I use anode bend without a preceding H.F. valve, and I am convinced that, especially on 5GB, the input voltage swing is small enough not to introduce distortion at this point.

What particularly interested and cheered me was Mr. Beasley's remarks about unsatisfactory results on piano transmissions. I get exactly the same blasting effects in the treble, even during soft passages, but the bass is passably good. Then on rare occasions (usually when there is no one in the room whom I wish to impress) the reproduction becomes well nigh perfect, with no sign of blasting.

Such evidence suggests that the B.B.C. are the sinners, but I am not at all convinced about it, and shall be in no way surprised if I succeed in tracing this elusive trouble at my end.

However, I recollect some time ago many letters in your columns about piano transmissions, and so, if there are other moving coil users who have had similar trouble to mine, perhaps they would come forward and kindly offer an explanation and cure. R. C. PLAYER.

Bromsgrove, Worcs.
August 1st, 1928.

WHOA, MONSTER!

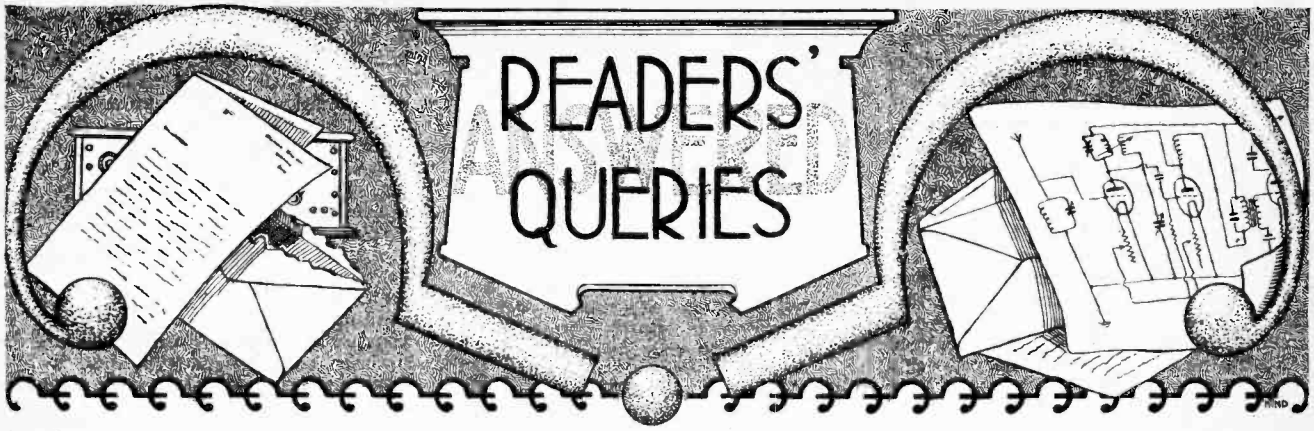
Sir,—I wish in no way to disparage the work done by people who are striving after perfection in any science, art or craft. I must confess that I have derived considerable entertainment of a lighter kind, as well as a very great deal of useful information, from your correspondence columns.

Our Frankensteins have been evolving monsters more suitable to the Albert Hall than to the ordinary private house. So far they have not worried me, as I have not had one for a near neighbour. Now, however, that their monsters have turned on them, and threaten to shout them out of house and home, they wish the B.B.C. to cut down their output so that these monsters, on a reduced diet, may be more amenable.

Now, Herren Frankenstein, may I point out to you there are people to whom radio has brought a great deal of good, supplying many cultural vitamines which they were previously deprived of. These are often busy people, who find that they can listen to a speaker even if they are busy at something else. Let me instance the lonely housewife. They have not the time always to be jiggering with controls, or running a straight-edge along the output of their speaker; . . . Horrors! It is often of the horn type! . . . to find with a loving smile that their reproduction is irreproachable. They are the real users of radio.

Franky, my boy, you are behind the times! Wireless is now a real live thing, not a new plaything for you to play with. The racing motorist is relegated to the racing track, take your monster to the laboratory. WILLIAM B. WEST.

Deal, Kent.
August 1st, 1928.



"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.

Inter-Circuit Coupling.

As I live on the coast, my "All-Wave Four" was originally constructed with the long-wave H.F. transformer only, and it gave (and gives) exceptionally good results, with complete stability. However, I have recently constructed a short-wave transformer of the design suggested for an A.C. receiver (THE WIRELESS WORLD, *March 7th and 21st*, 1928). *A few turns were added to the primary and neutralising windings, and the whole was mounted on a five-pin base. Unfortunately I am quite unable to find an adjustment of the neutralising condenser which holds good over more than a few degrees of the tuning scale, and should be obliged for your suggestions as to the cause of my failure.* B. H. C.

We are not surprised to hear that you are unable to stabilise the receiver on the short waves. The transformer specified for the A.C. receiver has an overall diameter of 4½in., and we should imagine that its field is linking up with the aerial-grid circuits. Your remedy is either to adopt more complete screening or else to use an H.F. transformer of a design similar to that used in the original receiver.

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An Unsuitable Detector.

Is there any real objection to using a super-power valve as a grid circuit detector? I have a spare valve of this kind, and find it works quite well, but should be glad to know if any special precautions should be taken. N. A.

A super-power valve is not highly suitable for this purpose, but it is capable of working passably well, although the sensitivity will be less than the maximum possible. In all probability you will find that, with the H.T. voltage ordinarily applied, the H.T. current consumed will be extravagantly high, and, moreover, it is quite possible that the consequent passage of a heavy current through the L.F. transformer primary (if one is used) will affect its characteristics adversely. We suggest that it would be as well to reduce the anode pressure to about 30 volts.

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Separating A.C. from D.C.

My receiver is giving a lot of trouble from "motor-boating," and I am wondering whether the anode feed resistance scheme is certain to stop this when an eliminator is used. I understand that it is a sure cure when anode current is derived from a battery, but have no information as to its efficacy when applied to mains-fed receivers. T. W.

The use of the de-coupling resistance scheme will not always prevent L.F. reaction troubles when battery eliminators are used, and it will sometimes be necessary to employ smoothing chokes in the H.T. feed leads of the detector and each L.F. valve. However, if you fit a choke filter output circuit, and insert feed resistances in the manner usually suggested, we think it probable that your trouble will disappear.

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A Disconnected Grid?

My "Everyman Four" receiver is fitted with parallel super-power valves in the output stage. I have noticed that the bulb of one of the valves gets quite hot after a few minutes' working, while the other remains comparatively cool. The possibility of a faulty valve seems to be ruled out, as I have tried another of the same make, which behaved in a similar way. What is wrong? M. S. P.

We are almost certain that you will find a disconnection in the grid circuit of the valve which becomes hot. As no negative bias will be applied, the grid will be at zero potential, with the result that an excessively high anode current will flow, thus accounting for overheating. You will probably find a fault in the connection between the valve-holder grid terminal and its corresponding socket; needless to say, the defect must be remedied at once, or the valve will be ruined.

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A "De-coupling" Tip.

In an attempt to avoid the possibility of "motor-boating" or L.F. reaction, I propose that my eliminator shall have separate smoothing chokes in the feed leads for the detector and each L.F. valve. Is it likely that any advantage will be gained if I adopt the same precaution with respect to the H.F. amplifier? R. C. N.

This depends entirely on whether you are using transformer or tuned anode coupling in the H.F. stage. If the former, there is no point in providing a separate feed for the H.F. amplifier, which may accordingly derive its H.T. current from the terminal supplying either the detector or the first stage L.F. amplifier, depending on the voltages available at these points.

RULES.

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

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

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

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

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

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

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

Capacity Effects.

Is there any easy way of preventing hand-capacity effects in a Hartley reaction circuit? I find that tuning is somewhat difficult for this reason, although otherwise the set is more than satisfactory. R. W. M.

Both fixed and moving vanes of the tuning and reaction condensers are at high oscillating potential in this circuit, and it is inevitable that hand-capacity effects will be troublesome, unless certain precautions are taken. These precautions are mechanical rather than electrical; it is advantageous to use screened condensers with a spindle insulated from the vanes, or alternatively, extension handles may be fitted.

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Non-corrosive Flux.

Can you tell me where prepared pure resin soldering flux may be obtained, or, alternatively, how it can be made up? F. P. W.

We do not know whether this preparation is on the market, but, in any case, you will not find any difficulty in making it yourself. A very satisfactory flux can be prepared by dissolving powdered resin in ether (which can be obtained from any chemist). The mixture should have the consistency of thin cream. The work must be cleaned carefully before starting operations.

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Valve Characteristics.

I am in doubt as to the method of determining the correct bias for my first stage L.F. amplifier. On the one hand, I am told that it is always permissible to supply a slightly greater negative voltage than that indicated by the characteristic curves published by the valve makers, while on the other, it has been stated that this is a mistake when dealing with a modern amplifier. Will you clear up the point? E. W. H.

This matter is dependent on the characteristics of the amplifier; if it is designed in such a way that the lowest frequencies are passed on at full strength, then the permissible negative bias will not greatly exceed that indicated by the static curve, but if there is considerable attenuation of these low frequencies, it will be permissible (and desirable) to apply a greater negative voltage. Speaking generally, your aim should be to use as much bias as possible, without causing anode bend rectification in the L.F. amplifier.

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A Simple Adaption.

Which is the easiest way of connecting a gramophone pick-up to a "Standard Four" receiver, and is it possible to do this without any serious alterations to the wiring? F. P. M.

It is a very simple matter to use a gramophone pick-up with this set, and no alterations whatsoever are required. All you have to do is to fit the pick-up leads with two plugs for insertion into the H.F. transformer sockets marked F and G. The transformer itself must, of course, be withdrawn. It would be convenient to connect a variable high resistance across the pick-up for volume control purposes.

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A Tuned Note Filter.

I have several 3,000-turn slab coils; would it be possible to use them in the construction of a 2-stage tuned anode selective L.F. amplifier for C.W. morse reception on the short waves? If so, please give me a circuit diagram. My idea is to reduce interference from "raw A.C." transmitters and from atmospherics. H. M.

Without full particulars of your coils we can only guess at their inductance, but in all probability they will be quite suitable for a tuned L.F. amplifier working at between 1,000 and 2,000 cycles; an arrangement of this kind will certainly reduce interference. A circuit diagram is given in Fig. 1, in which the tuned

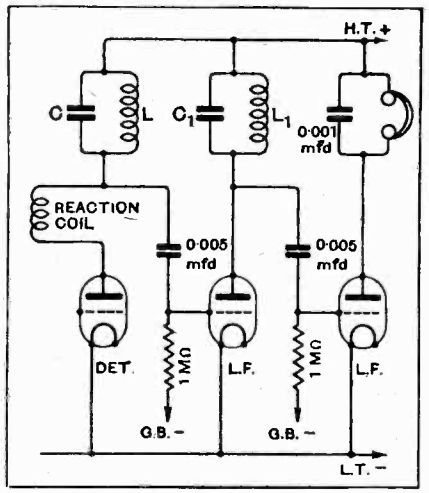

Fig. 1.—Tuned anode circuits for L.F. work: a selective amplifier for Morse reception.

coupling circuits are marked L, C, and L_1, C_1; these condensers should have a capacity of about 0.03 mfd., or perhaps slightly more. If you have four of the slab coils, you might try the effect of using two of them in series in each anode circuit, with smaller tuning condensers.

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How Detector Bias is Determined.

The negative grid voltage of my anode detector (an "R.C." valve) is controlled by a potentiometer in conjunction with two dry cells, the connections being those included in several receivers which you have recently described. How should one set about adjusting the potentiometer, and is it correct to reckon the applied voltages from the position where the slider is at the extreme negative end of the winding? S. W.

It should be pointed out that the negative voltage for best detection depends on such factors as valve characteristics, anode load, H.T. voltage, etc., and that it can hardly be determined except by trial and error. As a rule, however, the average "R.C." valve used under normal conditions requires from 1.75 to 2 volts negative for the best results. Now when your potentiometer slider is in contact with the negative end of the winding, the full voltage of the two bias cells (amounting to 3 volts) is applied, and the surplus must be "backed off" by impressing a suitable positive voltage derived from the L.T. battery. The position of the slider will, of course, depend upon the voltage of this battery. If you are using 2-volt valves, it will be towards the positive end, but with a 6-volt battery it will be nearer the negative end.

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An Eliminator Breakdown.

My H.T. eliminator, operating on D.C. mains, is fitted with a potential divider having 20 tappings, and, guided by information you have recently published on the subject, and with the help of a voltmeter of exceptionally high resistance, I have hitherto been able to measure with a fair degree of accuracy the voltages applied to the anodes of the various valves. However, I have recently noticed that variation of the tapping makes practically no difference to the indicated voltage, except on the output valve. The pressures on the first three valves are much higher than before, and the performance of the set is far from good. Can you assign a reason for this? H. B. M.

It seems certain that there is a lack of continuity in the winding of the potential divider, or in the connections to it. This break will probably be found at or near the negative end. If you consider the circuit diagram, you will see that when the circuit is interrupted in this way the potential divider acts as a series resistance; in all probability, its value is low in comparison with the various resistances in the anode circuits of the first three valves, and thus variation of the tappings will not have much effect; but in the last stage, where both valve impedance and D.C. resistance of the anode load are likely to be low, its relative value may be quite appreciable.

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The New All-Wave Four.

What H.T. voltage do you recommend me to apply to my "New All-Wave Four," which is now nearing completion? I gather that it would be desirable to exceed the usual figure of 120, in view of the fact that "decoupling" resistances are fitted. C. S.

Yes, it would be desirable to use an applied H.T. voltage in the neighbourhood of 140 volts, although good results would be obtained with no more than 120 volts. If you do not exceed this figure, however, we would recommend that the feed resistance R_9, in series with the H.F. valve anode, should be reduced in value to a few hundred ohms.

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Editor: HUGH S. POCOCK.

Assistant Editor: F. H. HAYNES.

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

Editorial Telephone: City 9472 (5 lines).

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CONTENTS OF THIS ISSUE.

VALVE CURRENT FROM ELECTRIC SUPPLY MAINS.

THIS issue of *The Wireless World* is devoted mainly to the subject of the operation of valve receivers from electric supply mains, and it is therefore a suitable occasion for making further reference to the question of the position of the user of D.C. wireless apparatus whose supply may be changed to A.C. We have already published some correspondence on this subject, and also referred to it editorially.

The Present Position.

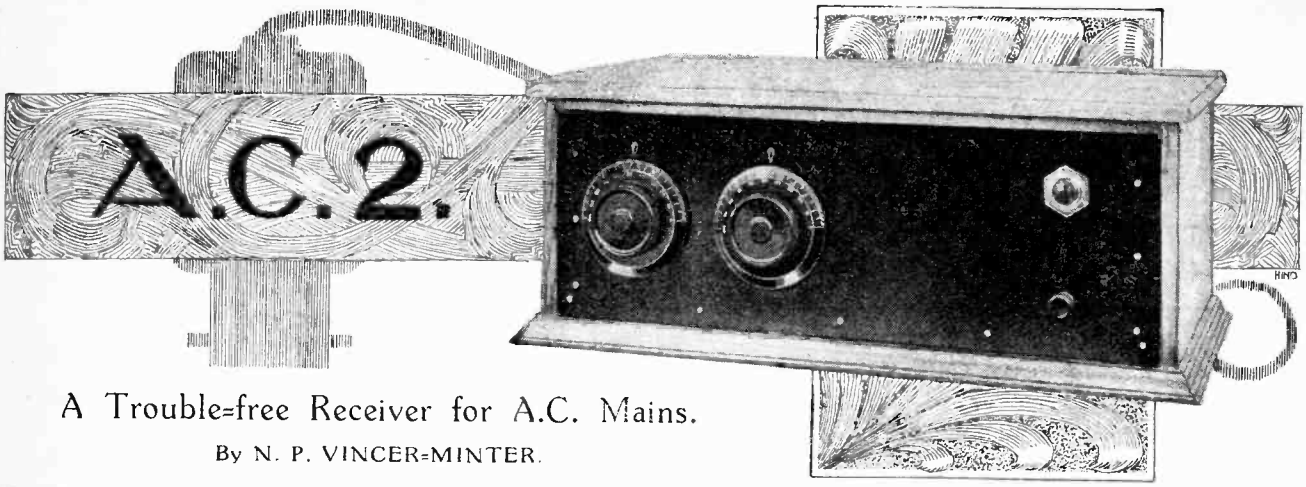
We feel that we are under an obligation to point out to users of D.C. the present position resulting from the attitude of the electric supply companies. Hitherto, the opinion commonly held has been that if a change in the nature of supply is made in order to suit the convenience of the supply companies, then the companies were under an obligation to make good any changes rendered necessary in the type of electrical apparatus which the consumer had in use at the time that the change over was notified to him. Now, however, that position appears to have changed, and, whilst one or two correspondents have disagreed with our description of the state of affairs as a "ramp" on the part of the electricity supply companies, yet we still feel that we are justified in so describing it. We are aware, of course, that mains units consume a very small fraction of current and are comparatively expensive items to replace. Let the supply companies say so and give that as their reason for not being prepared to meet the consumer, but when as their excuse they raise the objection of the risks involved, and that they have not given authority, then we think we are entitled to describe their attitude as a "ramp," especially in view of the fact that the recently published recommendations of the I.E.E., we understand, have been drawn up with the approval of fire insurance companies.

A Belated Attempt.

We are not yet satisfied ourselves that a general attitude of accepting no responsibility for wireless equipment operating from the mains, which has been installed and conforms to the new recommendations, can be upheld legally. It would seem to us that the supply companies have countenanced the practice for too long without issuing any warning, for their position to be secure. For several years now wireless sets operating from the mains and mains units have been sold commercially in large quantities. The supply companies have, therefore, known that such apparatus connected to their mains was being extensively used, and it would seem to us that their past silence is equivalent to acquiescence.

But whatever the position may be legally, it is most unsatisfactory to the would-be user of D.C. wireless equipment. Many manufacturers of mains units have, quite rightly, advertised the fact that, whilst such units may be somewhat expensive in initial cost, they soon repay for their purchase in what would be expended over a year or so on batteries, but if, as it seems probable, most D.C. supplies in the country are to be changed over to A.C. within a comparatively short period of time, then this argument no longer holds good, and we rather wonder what is the position of a manufacturer who sells such a piece of apparatus, unless he warns the purchaser that it is liable to become useless to him the moment the nature of his electric supply is changed.

It seems to us that this is a question of the utmost importance to the manufacturer of D.C. mains apparatus, and that it is even more his concern than, perhaps, that of the individual consumer, to endeavour to clarify the present position.



A Trouble-free Receiver for A.C. Mains.

By N. P. VINCER-MINTER.

MANY attempts are being made to-day, both in this country and abroad, to solve the problem of heating valve filaments from A.C. mains in order to produce a receiver which takes all its power from this source.

Now there are two methods of tackling this problem: first, to design a rather complicated unit, namely, a low-tension battery eliminator for connection to the L.T. terminals of a receiver in place of the accumulator; and, secondly, to use valves specially constructed to operate from A.C. mains, the necessary single transformer being either located outside the set and connected to the L.T. terminals or built into the set as fancy dictates.

Electrolytic Condensers.

The writer has very thoroughly tested out both methods, and has found the first-mentioned method good, but the second very much better—so much so that, in his opinion, it will eventually have the field to itself. During the first half of the year 1927 he was using the first arrangement, complete with smoothing chokes, voltage control, and electrolytic condenser, and very good results indeed were obtained. The day of the dry metal rectifier had not then dawned in the sense that such a device in suitable form could not be readily obtained, and so a valve-arc rectifier, price 12s. 6d., was used instead, and good service it gave, too, running for many months without trouble, and (according to a friend who borrowed it and forgot to return it) is still on the active list. At that time this unit appeared to be the ideal solution to the problem of taking L.T. from A.C. mains, because it could be used with any set and with any valves, and one was not tied down to the use of the special "A.C." type valves which had at that time just made their appearance. It gave a scarcely perceptible hum, the electrolytic condenser gave no trouble, and the writer was thus, over a year ago, satisfied that he had found an efficient substitute for his accumulator.

Later on, attention was turned to the special A.C.

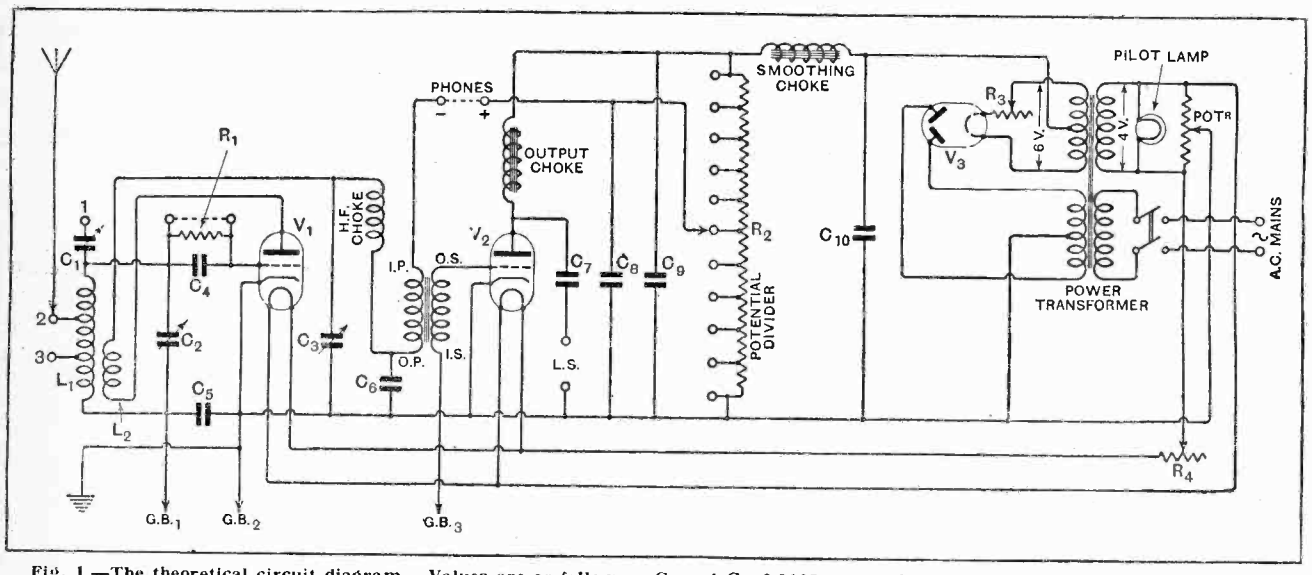


Fig. 1.—The theoretical circuit diagram. Values are as follows:—C_2 and C_3, 0.0005 mfd.; C_4 and C_8, 0.0003 mfd.; C_5, 0.25 mfd.; C_7, 2 mfd.; C_8, C_9 and C_{10}, 4 mfd.; R_1, 0.5 megohm; R_2, 15,000 ohms; R_3, 2 ohms; R_4, 1.5 ohms.

A.C. 2.—

mains valves, and one was tested in the H.F. stage of an ordinary three-valve receiver, the result being that the H.F. amplification obtained was approximately doubled, as theoretical considerations would lead one to expect. Then A.C. valves were used in all stages, and it was found that results fully equalled those obtained with the other arrangement from the point of view of absence of hum, but in the matter of range and volume, or, in other words, in the matter of overall efficiency, the valves with the indirectly heated cathode were vastly superior to the ordinary type of filamented valve. It should not be thought, however, that the mere fact that these filaments are heated from household mains puts any additional "punch" into them. Anybody who thinks this can easily run these valves from an accumulator—for since the filaments are of perfectly ordinary tungsten, albeit they require a current of 1 amp. at 4 volts (4 watts), they *can* be run from an accumulator—when it will be found that the "punch" has not departed.

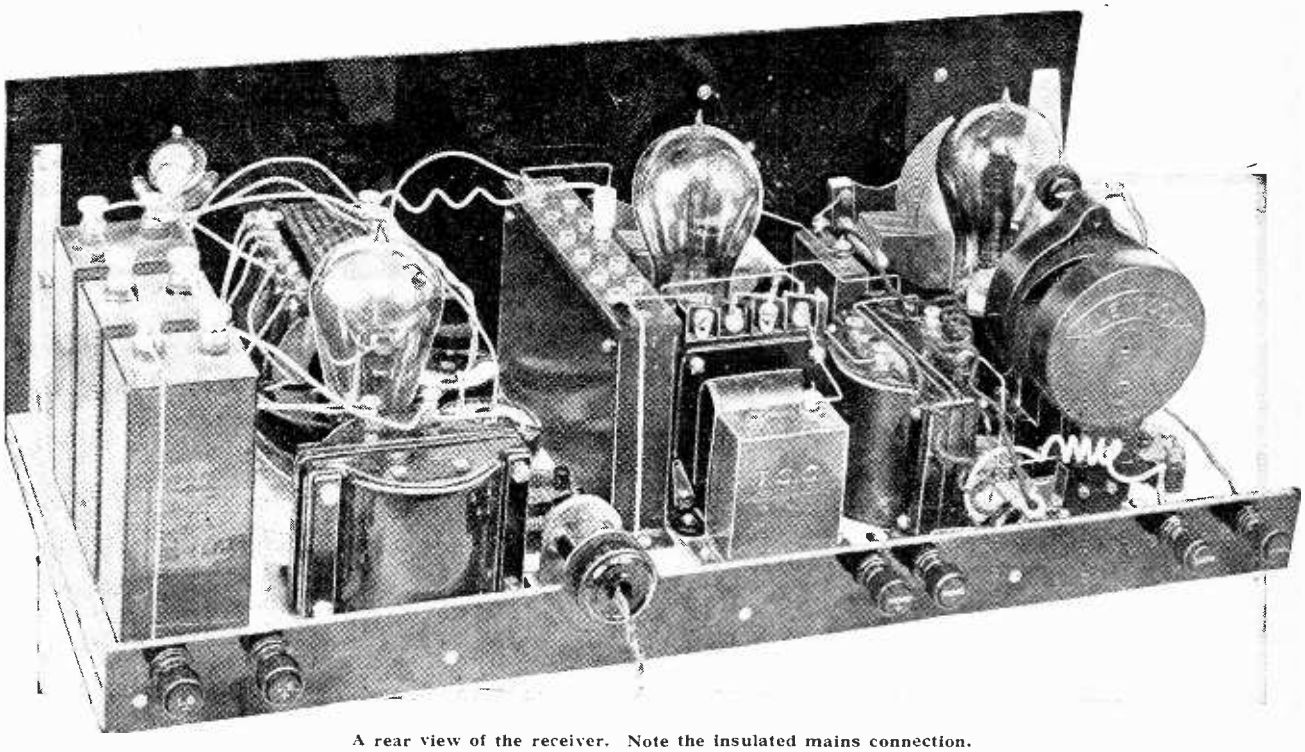
Why A.C. Valves are so Efficient.

The reason for their high efficiency is that instead of employing a filament to perform the dual office of emitting electrons—that is, acting as a cathode—and of carrying the cathode heating current, they have a separate cathode consisting of a hollow metal cylinder coated on the outside with certain oxides, so that when it is heated electrons are liberated freely; a filament passes along inside this hollow cylindrical cathode, thus heating it, without being in electric contact with it.

Just why this arrangement of things gives such vastly improved results it is not possible to dwell upon here owing to limitations of space. It can only be mentioned that at one fell swoop one gets rid of many disadvantages of the ordinary valve, such as the magnetron effect (which can be defined as an effect which limits the number of electrons which can pass to the plate owing to the attractive field around a directly heated cathode), the potential gradient down the filament, the cooling effect at each end of the filament (due to heat conduction down the supporting wires of the filament), the limited area of emissive surface, all of which are enormous drawbacks to the ordinary valve; and this, moreover, is entirely apart from the great advantage of being able to run the valves direct from the mains.

Paving the Way for the Hekatode ?

It should be pointed out that there is no fundamental reason why various special valves, such as the pentode, should not eventually be obtainable with an indirectly heated cathode for the benefit of the A.C. mains man. Indeed, the gap between the pentode and the heptode may be bridged more speedily than many suppose. For the information of those who might enquire why the writer calls such a valve a heptode instead of a hexode, it should be mentioned that it cannot be long before some remote genius, "unhonoured and unsung," comes to the rescue of those valiant supporters of the original type of tetrode (which, owing to its low H.T. voltage demands, fitted in so well with their 50-volt private lighting installations), and inserts a fourth grid into the pentode between the filament and the control grid,



A rear view of the receiver. Note the insulated mains connection.

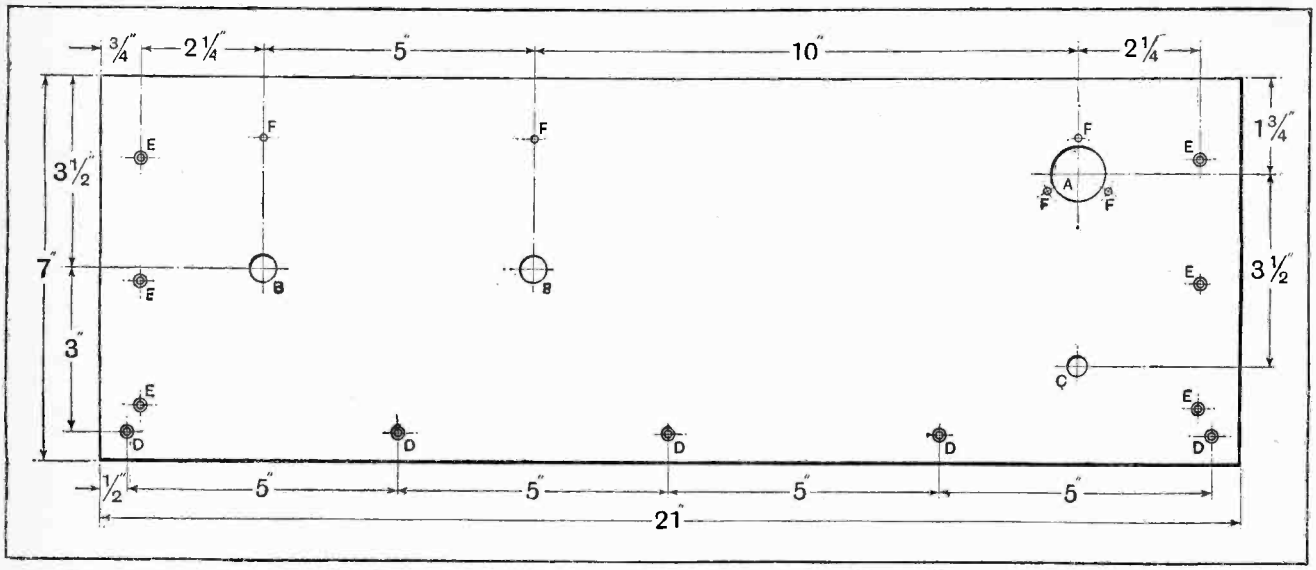


Fig. 2.—The layout of the front panel. Drilling details are as follows; A, 1 in. dia; B, ¼ in. dia.; C, ⅜ in. dia.; D, ⅛ in. dia., countersunk for No. 4 wood screws; E, ⅛ in. dia, countersunk for No. 6 B.A. screws; F, ⅛ in. dia.

which is, of course, the normal position of the space charge grid in the ordinary four-electrode valve.

With regard to D.C. users and those unprovided with any type of mains, it should be mentioned that the present A.C. valves could be used just as well as in the case of A.C. mains, but, of course, the running costs would be prohibitive. As has already been pointed out in this journal, users of the "Everyman Four" type of set will be well repaid by using one of these valves in the H.F. stage, even though an additional drain of nearly one ampere may be thrown on the accumulator, for approximately doubled H.F amplification will be obtainable without using another H.F. stage.

It is not at all improbable that D.C. users may soon find themselves in the happy position of the A.C. mains user, as it should not be difficult to arrange for the filament to take its watts in the form of 40 volts at 0.1 amp. or 20 volts at 0.2 amp., instead of 4 volts at 1 amp. as in the case of this A.C. valve.

So much for the theoretical aspect of the question, and now for some practical constructional details of a simple straightforward set embodying these valves with indirectly heated cathodes. As will be seen, the receiver is a perfectly orthodox two-valve circuit, with reaction,

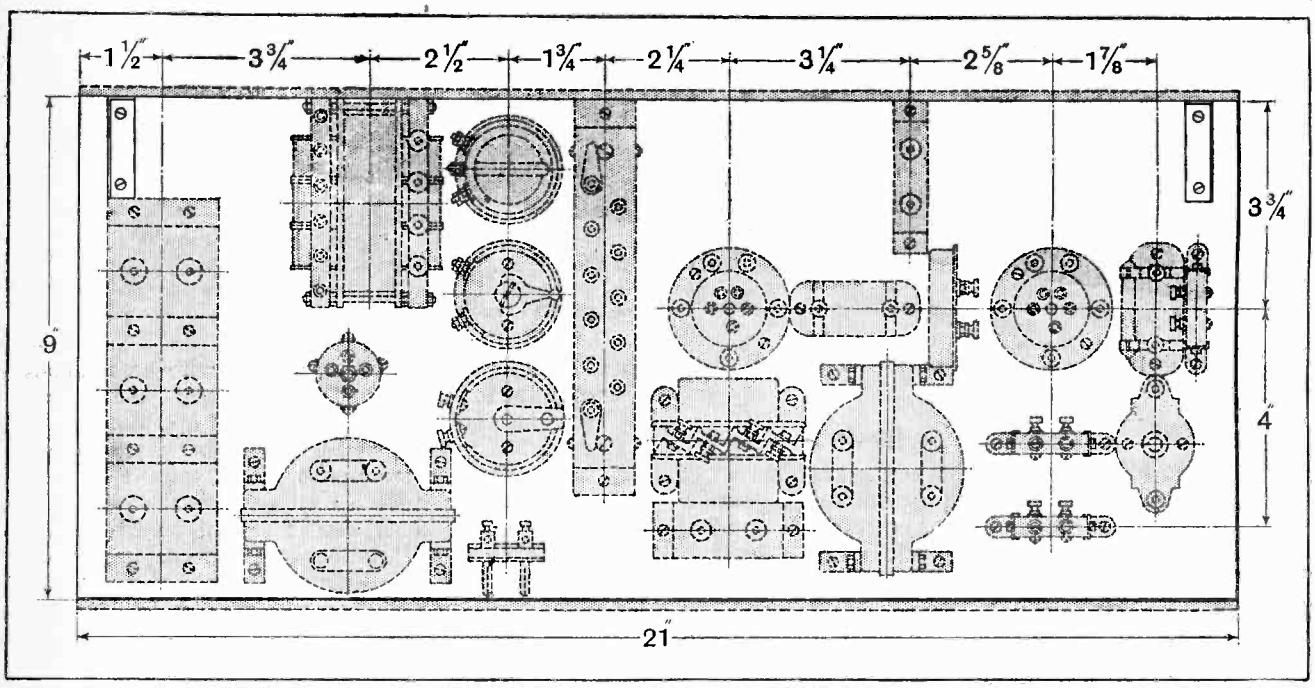


Fig. 3.—The baseboard layout.

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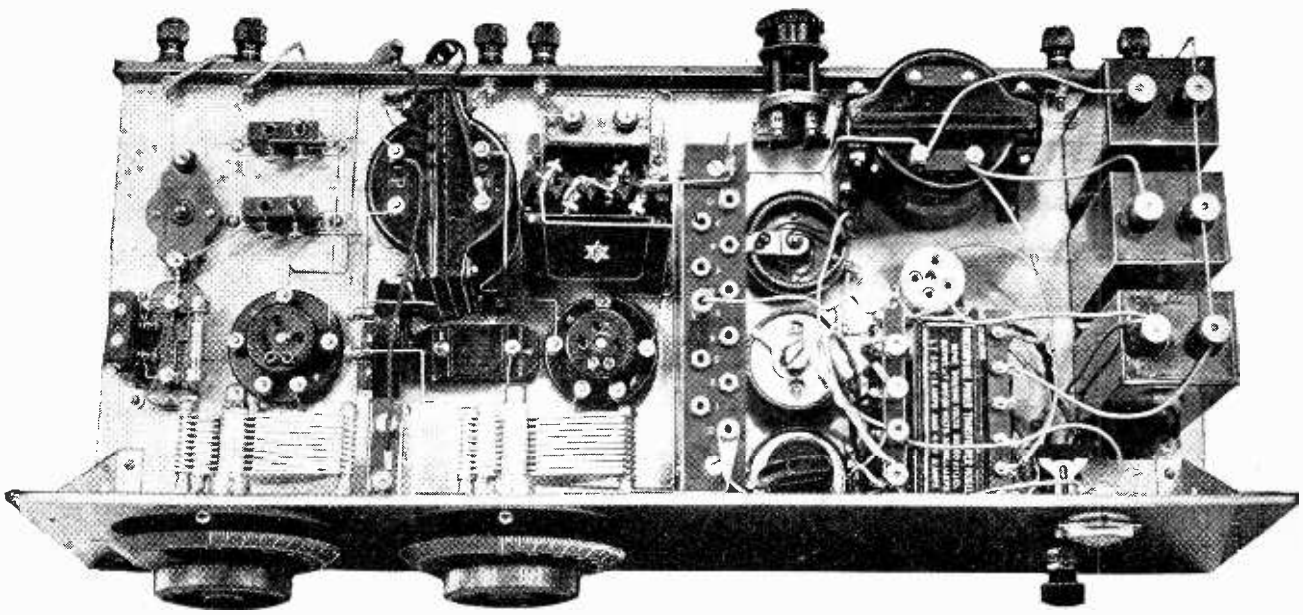
provision being made for using either anode bend or leaky grid rectification, the former *not* in conjunction, it will be noticed, with the customary R.C. coupling, but with a transformer of moderate primary inductance, which gives excellent results. In addition, provision is made for using a gramophone pick-up, both valves then acting as amplifiers.

A Plea to the Distance Chaser.

Since this receiver employs no H.F. stage, it is not intended for anything but nearby station reception. Although distant stations can be received under normal conditions, as in the case of any other regenerative receiver, the writer hopes that those who require distant stations will abandon reaction and put in an efficient H.F. stage. The circuit used in the set under consideration is one which will be found specially commendable from the point of view of smooth reaction control. The bad control often met with in condenser-governed reaction receivers due to choke resonance is avoided in this case by connecting the reaction coil in such a manner that it is virtually in parallel with the H.F. choke, thus lowering the resonant *frequency* of the choke considerably below that of the normal short and long broadcast wavelengths.



A view from above. The mains potential divider will not cause motor-boating.

In the matter of aerial coupling two methods may be tried, namely, connection of the aerial through a small "fixed-variable" condenser C_1, or tapping directly on to the grid coil, either on the centre tapping or down farther still on what has come to be known colloquially as the "X" tapping. On short indoor aerials it is usually best to connect the "crocodile clip" attached to the aerial terminal to No. 1 position and to put C_1 at the full capacity position.

Naturally, H.T. as well as L.T. is taken from the mains, and only one power transformer is used, there being separate secondary windings on it for both H.T. and L.T. purposes. This avoids the use of a separate filament transformer, and consequent bulkiness. A small point of interest is the pilot lamp, consisting of a specially made flash-lamp bulb holder and ruby window. This serves to show when the set is on or off, since, of course, all valves are inside, and in any case the light from the special A.C. valves used is scarcely perceptible. Special bulbs may be obtained, taking only 0.06 amp. at 4 volts, and giving quite a brilliant light. In an emergency an ordinary flash-lamp bulb, which is usually rated at from 0.2 to 0.3 amp. at 3.5 to 4 volts, may be used. The method of connection to the mains should also be noted, the plug being entirely insulated, which is a great advantage. There is no need whatever to provide heavy lighting flex and to use a power point with a set of this description, as many suppose. The current taken from the mains is quite small, being no greater than that taken by many household lamps.

Readers are specially urged to twist together the rubber-covered cables which are thus shown in the illustrations and Fig. 4. These wires are carrying raw A.C., and are liable to create severe interference, unless their magnetic fields are made to cancel out mutually in this manner. Lead-covered wire is quite superfluous and unnecessary.

And Now to Work.

With regard to constructional operations, these may be said to be relatively easy, since standard components are used throughout, and it becomes more or less a matter of strictly adhering to the layout given in Figs. 2 and 3. Great care should be exercised, as the set has been made as compact as possible without sacrificing efficiency. In particular, the grid battery must be carefully placed in the correct position in the back of the cabinet. It will be noticed that there is only one grid

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battery, the nuisance of having several small grid batteries scattered all over the receiver being absent. Probably the most difficult portion of the unit to some may be the drilling of the hole for the ruby lamp in the front panel. This may either be drilled direct, or a circle of the correct diameter may be marked out and a series of small holes drilled round it, they being eventually united with a small file. Since a metal panel has been avoided, and not even a screen is provided or is necessary, work is greatly simplified.

To get the receiver into operation, the valves must first be inserted. The potentiometer on the baseboard must be set so that its slider is roughly in the central position. Its setting is not critical, and it will require no further adjustment. The two rheostats should both be set so that they are about one-third from the off position. Here, again, their position is not critical, and once set as described they should not need further adjustment.

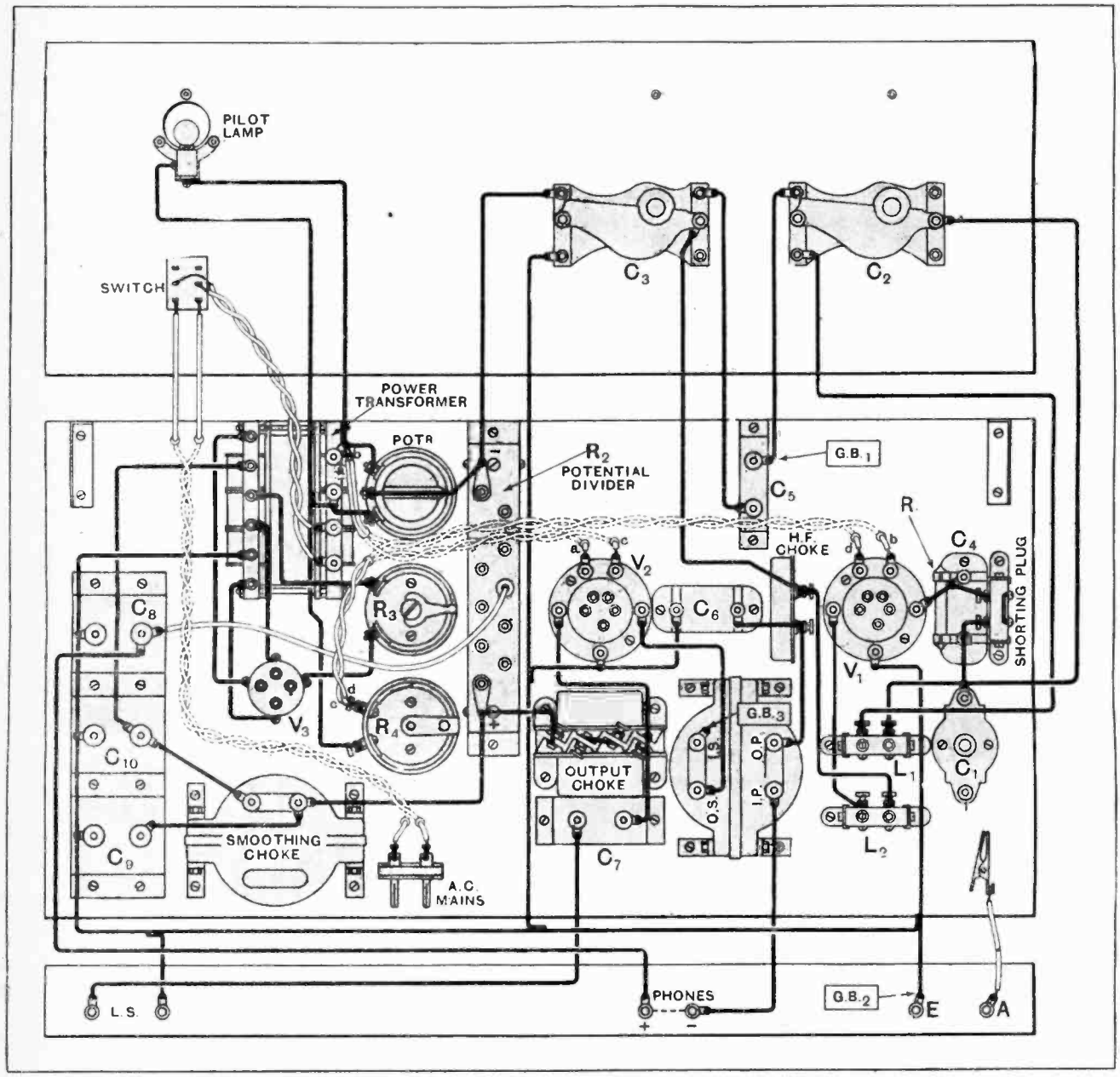


Fig. 4.—The practical wiring plan.

Assuming that we are going to receive signals using the leaky grid method of rectification, the first thing to do is to take the wander plug marked G.B$_2$ and insert it into the grid battery socket, which is 1½ volts from the

LIST OF PARTS.

1 Panel, black finish, 21 in. × 7 in. × 3/16 in. (Paxolin).
1 Terminal strip, black finish, 21 in. × 1½ in. × 3/16 in. (Paxolin).
1 Baseboard, five-ply, 21 in. × 9 in.
1 Cabinet, 21 × 7 in. × 9 in. (F. Adams & Co., 66, Finsbury Pavement, London, E.C.2).
2 variable condensers, 0.0005 mfd. ("Simplicon" Williams & Moffat).
3 Fixed Condensers, 4 mfd., 300 volt test (T.C.C.).
1 Fixed Condenser, 2 mfd., 300 volt test (T.C.C.).
1 Fixed Condenser, 0.25 mfd., 300 volt test (T.C.C.).
2 Fixed Condensers, 0.0003 mfd., No. 610 type (Dubilier).
1 Fixed-variable condenser, 30–270 m/mfd. with clips ("Pre-set" Igranic).
1 Grid Leak, 0.5 megohm (Dubilier).
1 Porcelain Valve Holder (Athol).
2 A.C. Valve Holders (Cosmos).
1 A.C valve (Cosmos type A.C./G.).
1 A.C valve (Cosmos type A.C./R.).
1 Rectifying valve (Marconi or Osram type U.5).
1 Baseboard-mounting fixed-variable resister, 2 ohms, ("Pre-set" Igranic).
1 Baseboard-mounting fixed-variable resister, 1.5 ohms (Marconiphone).
1 Potentiometer, 400 ohms, porcelain baseboard-mounting type (Igranic).
1 Power transformer, (Marconiphone Model C).
1 Intervalve transformer, 2.7 to 1 ratio, (Marconiphone "Ideal").
1 Smoothing choke, power type (Marconiphone).
1 H.F. choke (Igranic).
1 Output choke, (Igranic Type F).
4 Single coil holders (Lotus).
2 Plug-in coils, No. 50 and No. 100 (Lewcos).
2 Plug-in coils, No. 60 and No. 200 (Lewcos X type).
1 D.P. Switch, push-pull type (Wilkins & Wright "Utility").
1 Special insulated mains adapter, (Deckorem P.12).
1 Pilot lamp holder, (Deckorem F.1).
1 Pilot lamp, 4 volts, .06 amp. (Deckorem).
1 Ruby window, (Deckorem W.4).
2 Dial indicators (Deckorem).
2 G.B. clips (Deckorem).
1 Potential divider (Igranic).
2 Panel supporting brackets ("Etherplus" M. & A. Wolff, 9-15, Whitecross Street, London, E.C.1).
6 Terminals, ebonite shrouded A, E, Phones+, Phones−, L.S.+, L.S.− (Belling & Lee).
4 Wander plugs (Lissenin).
1 Grid battery, 16½ volts (Ever Ready).
1 Electric light adapter (G.E.C.).
1 Crocodile clip.
Length of lighting flex, No. 18 tinned copper wire, rubber-covered wire, nuts and bolts, wood screws, etc.
Approximate cost (excluding valves, coils and cabinet), £11 10s.

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.

positive end of the battery. This position is its permanent one. The wander plug $G.B_3$ should be set at full negative (*i.e.*, 16½ volts). $G.B_1$ should be put in the end (positive) socket of the grid battery, and the wander plug associated with the anode circuit of the detector valve must be inserted into No. 4 or No. 5 socket on the mains potential divider. One of these latter plugs, namely, $G.B_1$, will have to be changed over to other positions when anode bend rectification is being used, or when the instrument is being used as a gramophone amplifier, as we shall presently see. A single-coil mounting will be seen in parallel with the grid leak and condenser. This should be ignored at present. The aerial and reaction coils should be inserted, the value of the latter being governed by the same factors as in the case of an ordinary regenerative receiver. The right-hand condenser which controls reaction should be set at minimum, and the other rotated until a station is heard, the mains having first been switched on.

The writer finds that owing to the efficiency of the valves he is able to receive 5GB at loud speaker strength with the reaction condenser set almost at minimum. To use anode bend rectification, $G.B_1$ must be moved over to the other side of $G.B_2$, and must be plugged in to give 6 volts bias. The wander plug associated with the anode circuit of the detector valve should be inserted into the socket of the potential divider which is nearest the positive end. At the same time a single-coil mounting, whose terminals have been connected together, must be plugged into the one already on the baseboard near to the grid condenser, the purpose being to short-circuit both leak and condenser.

To use a gramophone pick-up the connections should be as for anode bend rectification, except that $G.B_1$ must be only 2 sockets (*i.e.*, 3 volts) on the negative side of $G.B_2$. The pick-up should be connected by a short length of flex to a fixed-coil mounting, this being thrust in position in place of the short-circuiting plug.

In carrying out all adjustments it is absolutely essential that the mains be switched off to avoid the discomfort of an electric shock. By giving a spasmodic movement of the hand due to a shock one can easily smash one of the valves. The volume obtained with a gramophone will be found to be very loud indeed, owing to the high valve efficiency; it will, indeed, be more than sufficient for quite a large room, considerably louder, in fact, than the volume obtained from an ordinary unaided gramophone.

Although a certain amount of heat is developed in the receiver, no risk of damage need be entertained. The writer specially tested this receiver for heat development by giving it a continuous 24 hours' run, the set being for part of this time in direct sunlight during the hot days in July. Lastly, it should be said that if instructions are carried out there is no fear of "motor-boating" occurring with this set, as there is only one intervalve stage, and the output speech currents tend to be deflected from the common source of H.T. supply by the choke in the anode circuit of the last valve.

A Necessary Compromise.

It is intended that a moderate amount of reaction be used in conjunction with anode bend rectification if the best quality is desired, and this was borne in mind when designing the L.F. amplifier, but it was fully realised that people do occasionally prefer to hear a man from Barcelona speaking Spanish with a Catalunian accent rather than to hear the drums and double basses from London, and a deliberate compromise was made in this amplifier in order to lessen somewhat the attenuation of the upper musical register when leaky-grid amplification was used with considerable reaction. Those who would fain grumble at the price of this receiver must remember that there are no L.T. or H.T. accumulators to purchase.

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

SAFETY FIRST FOR MAINS USERS.

How to Apply the I.E.E. Recommendations.

By "RADIOPHARE."

WHEN we come to consider conventional practice with regard to the insulation of wireless receiving apparatus, it becomes evident that some designers, who have doubtless graduated in the school of crystal detectors and valve receivers, with maximum H.T. pressures in the neighbourhood of 60 volts, have become set in their ideas, and have omitted to provide adequate safeguards for high anode voltages derived from the mains. Insulation which is perfectly satisfactory from the purely radio point of view may fail to afford protection against short-circuits or unpleasant shocks when the set is connected to an electric supply circuit, and all users of eliminators would do well to see that their apparatus conforms to the recommendations recently issued by the Institution of Electrical Engineers and published in *The Wireless World* for July 18th. It would be misleading to suggest that present practice is such that there is any real cause for alarm—accidents are few and far between—but should the apparatus ever be suspected (perhaps quite unjustly) as being responsible for any unfortunate occurrence, its owner is in a strong position if he can prove that its construction complies with the regulations of the governing body. It is comparatively seldom that extensive alterations will become necessary.

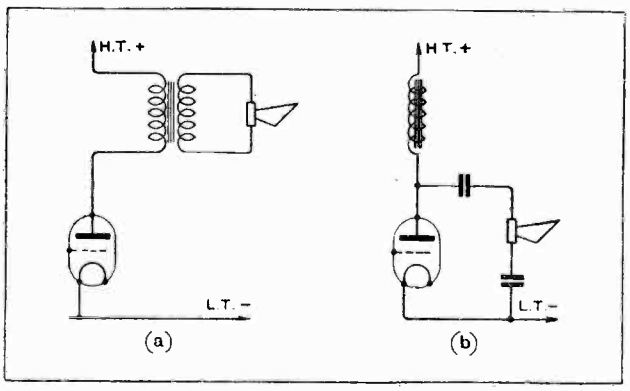


Fig. 1.—Alternative methods of connecting loud speaker (or telephones).

One of the most important points dealt with is the connection of the loud speaker or phones; these must be joined to the receiver either through a double-wound transformer or a choke filter in which condensers are inserted in *each* of the leads to the reproducer. Thus all possibility of shock to the user or of short-circuiting to metal work is obviated; in the case of a D.C. supply, equal protection is afforded whether the positive or negative pole be earthed. These arrangements are shown, respectively, in Fig. 1 (*a*) and (*b*); it should be borne in mind that each of the feed condensers should have double the capacity specified for a circuit with a single condenser.

In the matter of aerial and earth connections, it is laid down that the open circuit shall be thoroughly isolated from the mains. Various permissible methods are shown in Fig. 2, the first (*a*) being applicable to inductive couplings. The important point here is that there must be no metallic connection between the low-potential end of the aerial coil and the filaments; to bring many popular sets primarily intended for battery supply into conformity with this requirement, it is necessary only to remove the existing lead between the negative L.T. bus-bar and the earth terminal. To comply with both the spirit and the letter of this regulation, it would be well to assure oneself that the mountings of plug-in coils used in circuits of this kind cannot make contact with each other.

When the aerial and earth are joined directly to the grid coil, as in diagram (b), condensers are inserted in each lead. These condensers must withstand a test voltage of "500 volts D.C., or twice the supply pressure, whichever be the greater."

It should be made clear that these regulations as to aerial and earth connections do not apply when current is derived from A.C. mains through double-wound transformers, as in such cases the receiver is not in metallic connection with the supply circuits. Consequently, isolation of the aerial-earth system need be adopted only when energy is derived from D.C., from A.C. without a transformer, or from A.C. through an auto-transformer.

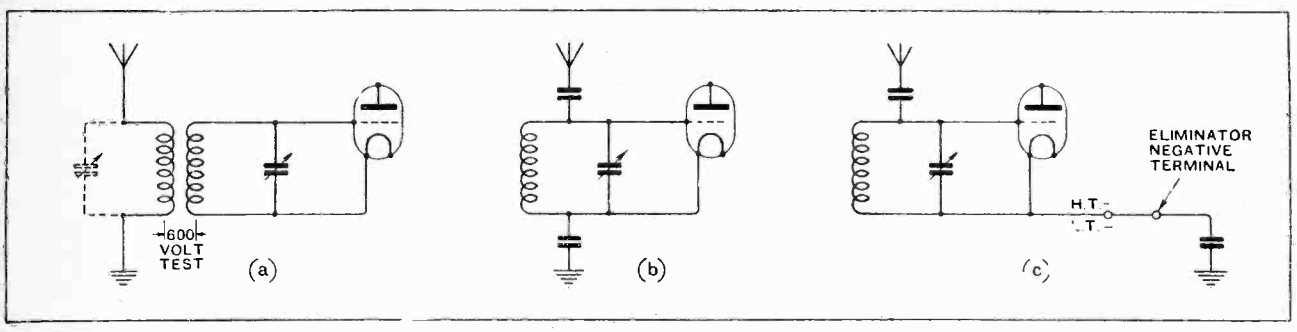


Fig. 2.—Connections of the aerial-earth system when using D.C. mains. Diagram (c) is essentially the same as (b), but the earth condenser is included in the eliminator.

D.C. MAINS RECEIVERS.

Some Notes on the Design of Mains-operated Sets.

By H. B. DENT.

GENERALLY speaking, it is preferable to design a set for mains operation rather than endeavour to convert a battery-driven receiver, as the modifications required to a four-valve set, for example, would be of such a far-reaching nature that the finished article would have little in common with the original. Moreover, the insulation would probably be totally inadequate to withstand the high D.C. potentials which must exist when the supply mains are employed. With regard to this point, too much stress cannot be given to the absolute necessity for good insulation throughout, and care must be taken to guard against mounting in exposed positions components in circuit with the supply mains. Two light fuses, one in each supply lead, and a well-insulated two-pole on and off switch should be arranged near to the point where the mains enter the set. The first will act as a safeguard against damage should a

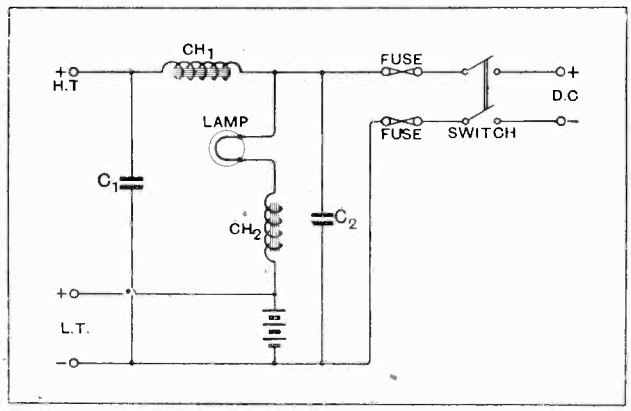


Fig. 1.—Diagram of connections for a mains eliminator suitable for use with simple two-valve sets.

short circuit inadvertently occur, and the switch will completely isolate the mains, so that adjustments can be made easily and without fear of "collecting" a shock.

Permissible Use of Complete Eliminators.

Although it is desirable to construct a special set for mains work, perhaps an exception to this rule could be made in the case of well-built simple two-valve sets for local reception only, as it is more than probable that the majority of these will take kindly to the addition of a unit for H.T and L.T. something on the lines of that shown in Fig. 1. It will be noticed that the L.T. accumulator is retained, and is being trickle charged through the lamp and smoothing choke CH2, which, incidentally, must be capable of carrying the current passed by the lamp without overheating and saturating the iron core. The function of the accumulator is two-fold; in the first case, it assists in smoothing, and, secondly, acts as a voltage regulator for the filament circuit. As the voltage in the H.T. circuit will be considerably greater than that normally taken by the valves in use, suitable resistances will be required in the anode circuit of each valve.

The filament smoothing choke should be placed always in the "live" conductor and, where the positive main is earthed, the position of the choke should be changed to the negative lead. Some systems are much more "rough" than others, and to obtain a smooth supply the addition of an extra filament choke in the earthed conductor may be found necessary.

Why the Valves are in Series.

The arrangement discussed above cannot be truly described as a mains-driven set, as an accumulator forms an integral part of the system. It would not be an economical proposition to supply the L.T. circuit of a three- or four-valve receiver direct from the supply mains if the filaments were connected in the normal manner, so it is the usual practice to rearrange the filament wiring and connect all filaments in series, the object being to utilise the current passing through one valve to light also all other valves in the set.

In putting this into practical form care must be taken to choose valves with similar filament characteristics, at least as far as current consumption is concerned; the voltage rating is quite incidental, as the filaments are series connected and not in parallel. The voltage rating of each valve must be taken into consideration, however, when calculating the amount of resistance necessary to limit the current to the requirements of the valves.

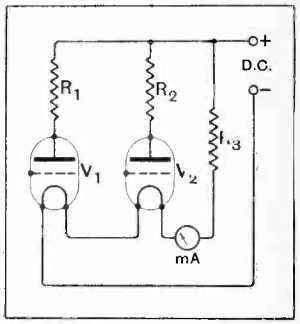


Fig. 2.—One method of connecting valves for D.C. mains operation.

In Fig. 2 is shown a fundamental circuit with unimportant features omitted. Here two valves are shown with their filaments in series and a current limiting resistance R_3 which must be wound with sufficiently robust wire to carry the current without overheating. It would be well to construct this in two parts, one fixed and the other variable, as this will allow for final adjustment to compensate for any slight discrepancy between true values and calculated values.

This simple arrangement is quite effective provided low-power valves are used throughout, as so far no account has been taken of the effect that the anode current has on the filament circuit. A little thought will show that the anode current taken by the last valve will pass through the filaments of all valves preceding it and augment the heating effect of the steady current

D.C. Mains Receivers.—

already flowing in the circuit. With certain types of output valves this might well reach a value sufficient to cause the preceding valves to be overrun to an extent that they will lose their emission or otherwise be damaged. It follows, therefore, that in designing a set consisting of four or more valves with a power output stage the effect of anode current must be taken into consideration.

A simple way out of the difficulty would be to shunt each valve, with the exception of the output stage, by a resistance to absorb the extra current; on the other hand, the circuit could be arranged in such a way that the anode current, associated with the output stage, does not pass through the filaments of preceding valves. This arrangement is shown diagrammatically in Fig. 3. It will be noticed that even with this arrangement the difficulty is not entirely overcome, as the anode current of the valves preceding the last stage must pass through the filament of the output valve. However, this is not very serious, as the valves used in the earlier positions of a set or amplifier are usually of the medium- or high-impedance type, and their total plate current will not exceed three or four milliamperes.

The anode feed resistance scheme, which has been developed essentially to combat all L.F. oscillation troubles with H.T. battery-fed receivers, and which has been discussed in this journal recently, has not been found to be a cure for all low-frequency troubles when battery eliminators are used, as this does not take into consideration the effect of the smoothing chokes which are invariably common to all valves. It would appear desirable, therefore, to provide each valve in the set with its own smoothing choke and connect large-capacity condensers (about 2 mfds. each) between the valve side of these and the L.T. minus of each valve. Connecting the low-potential sides of these by-pass condensers together and taking a common lead to some point on the filament circuit would not have the same effect.

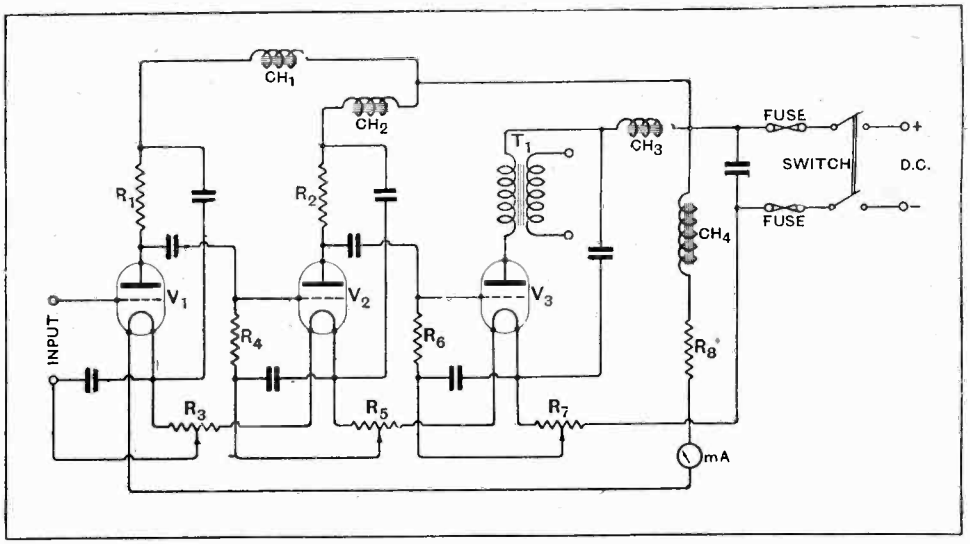


Fig. 3.—In this circuit the anode current taken by a power output stage does not pass through the filament of preceding valves. Note the special arrangement of smoothing chokes to counteract L.F. oscillation.

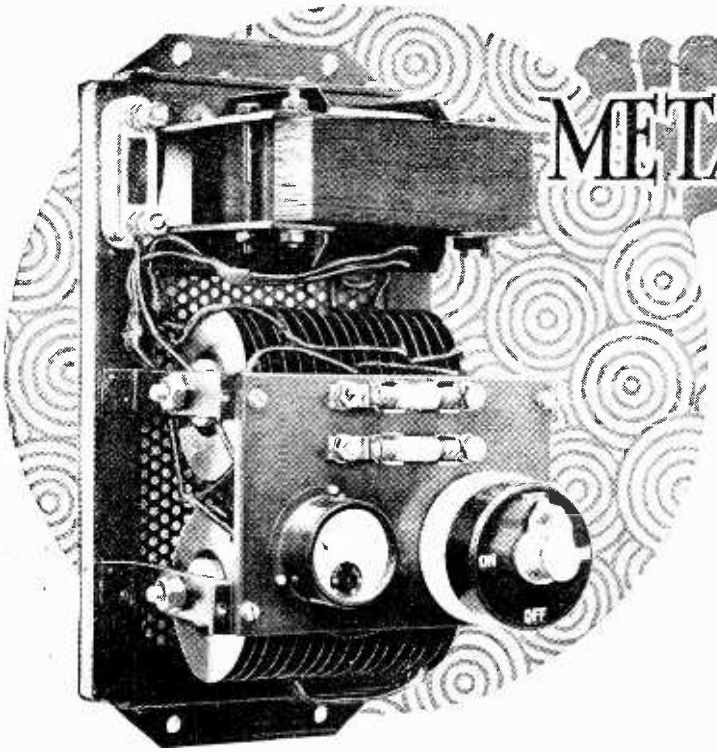
Advantage of Crystal Detection.

The disposition of the components in a receiver or amplifier of this type is equally as important as the design of the circuit, and the success of the apparatus will often stand or fall on this alone. One danger point is the relative position of the smoothing equipment and the detector circuit. Magnetic coupling between these two will lead to an objectionable hum which will not be amenable to treatment in the usual manner. In view of the readiness with which this circuit responds to any slight ripple in the filament supply, it is recommended that crystal rectification be used in place of the orthodox valve rectifier, as by adopting this policy a more simple smoothing equipment than would otherwise be necessary can be employed.

Grid Bias from the Mains.

In all receivers of the D.C. mains-operated type having the valves' filaments arranged in series, the grid bias for the valves can be obtained by returning the low potential end of each grid circuit to a point on the filament circuit which is more negative than its valve. For example, in Fig. 3 resistances are connected between each valve (R_3, R_5, and R_7) and the grids of the valves are brought down to adjustable contacts on these. The arrangement could be further simplified by adopting fixed resistances, the values of which had been chosen to give the required difference in potential. As an illustration, we will assume that V_1 requires a negative bias of $1\frac{1}{2}$ volts. We know that 0.1 ampere flows in the filament circuit; therefore, by applying Ohm's Law, R_3 must be 15 ohms ($R = \frac{1.5}{0.1} = 15$). The amount of resistance required for R_5 and R_7 can be calculated in a similar manner, though in the case of the last valve it might be an advantage to employ a potentiometer of slightly higher resistance than that really necessary to enable the bias to be adjusted to suit the actual valve in use.

With valve detectors the filament supply must be free from ripple, and this demands the use of a heavy-duty high-inductive smoothing choke. Perhaps two chokes may be necessary, one in each lead. When moving-coil loud speakers are in use, the field magnet, suitably wound, could be used in place of CH_4 and R_8 reduced in value accordingly. Discarded loud speaker field-magnet windings make admirable smoothing chokes, but if one is required in the negative conductor it must have a low resistance, such as one wound for a 6-volt supply.



METAL RECTIFIERS

How the New Rectifying Units are Used for H.T. and L.T. Supply.

It is due to a lack of practical information that the metal rectifier is only slowly gaining in popularity. As a substitute for the better-known rectifiers it has many attractive features. A perusal of this article will help readers to judge its merits for themselves and appreciate the conditions under which it should be operated to give maximum efficiency.

EVERY user of alternating current mains either for L.T. battery charging or for H.T. current supply is acquainted with the many forms of rectifiers—buzzer, rotary, electrolytic, arc, glow discharge, and thermionic. The failings of certain types have resulted in a discontinuance of their use, and for the specific purpose of operating a wireless set the arc rectifier is supreme for battery charging, while the thermionic valve rectifier is the most popular method adopted in H.T. battery eliminator construction.

Reverse Current and Wave Form.

Without enumerating the defects of the less successful forms of rectification, the obvious merits of the arc rectifier are worth considering. Of first importance is its ease and safety of operation, for the arc rectifier can be left on circuit in spite of accidental disconnection of the supply or the accumulator, a fact which, combined with a heavy charging rate, is to be found in no other type. There is, moreover, no momentary reversal of potential, such as results from a rectifier of the asymetric conductivity type, a condition which is well known to have a detrimental effect upon the accumulators on charge.

For the simple reason that the anode voltage-anode current characteristic of the two electrode thermionic rectifier is practically a straight line, it has become the favourite for H.T. supply. Rise of A.C. potential is accompanied by a corresponding rise of anode current in the rectifier, so that the wave form of the rectified output consists of loops representing voltage rises corresponding with the half sine wave of the A.C. supply. As there is a complete shutting off of anode current through a half-wave rectifying valve during one-half cycle, the wave form of the output is not impaired when a full-wave rectifying arrangement is adopted. Such an output is easy to smooth, and an appreciable wastage of energy does not result from a heavy A.C. component being passed by the shunt condenser.

Metal Rectifier a Mystery.

Very recently a complete change has come about in commercial forms of H.T. battery eliminators, in that a dry form of rectifying cell has been employed. For L.T. battery charging, also, rectifiers are now available built with the same type of rectifying cell. To wireless enthusiasts these new rectifiers are something of a mystery. Their operation is not precisely understood, and as a result one hesitates to incorporate in battery eliminator designs the units which are now manufactured by the Westinghouse Company. The first reference to this form of rectifier appeared in *The Wireless World* of September 22nd, 1926, when its construction was described, though at the time the rectifier was not available on the market.

Rectifiers for both H.T. and L.T. purposes differ only in the active area of the cells of which they are composed, those for heavy current output being of liberal area or consisting of an arrangement of parallel connected cells, while high-voltage rectifiers of small current output are built from numbers of small cells series connected. The actual metal rectifier cell now generally adopted is a junction between copper and one of the oxides of copper. Metals which are chemically classified as being in the chromium group have also been successfully used. These metals—chromium, uranium, molyb-

Metal Rectifiers.—

denum, and tungsten—are covered with a fused-on layer of a semi-conducting metal oxide, such as the oxides of manganese, iron, vanadium, and lead. It is stated that the conducting oxides of metals of maximum valency are preferable.[1]

The cell is made in the form of a small copper disc, the heavy current model being a little larger than a penny, and that made for anode current supply slightly larger than a sixpence. The rectifying contact faces are not exposed, and occur at the actual point of contact between the copper and the hard oxide deposit. A soft metal disc beds into the exposed outer face of the oxide and serves as a terminal connection, while the non-active side of the copper is, of course, left clean. The nature of the deposit and the precise method by which it is formed is not disclosed, and its thickness on the

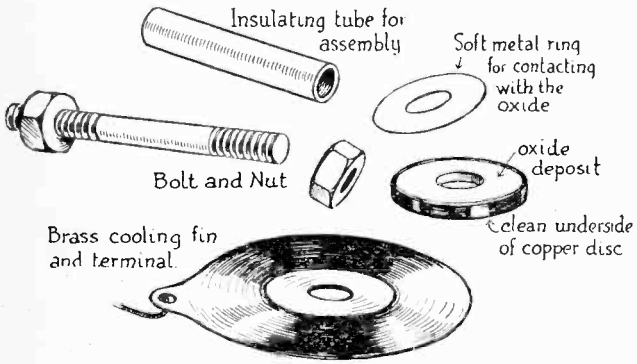


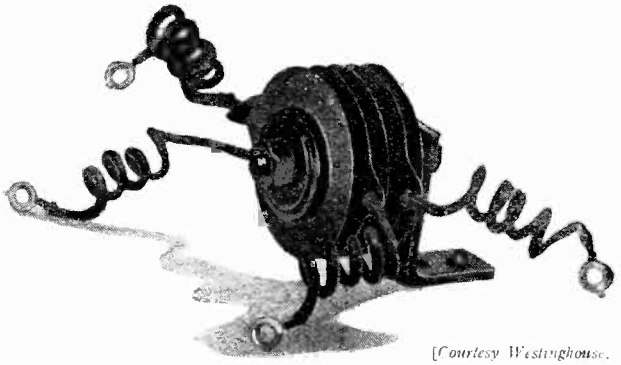
Fig. 1.—Dismantled rectifier cell. The rectifying contact is between the copper disc and the oxide coating.

smaller discs is three-thousandths of an inch, and on the larger five-thousandths of an inch.

Why Does the Contact Rectify?

As to the reason for the oxide-metal contact acting as a low resistance to a potential applied in one direction and as an exceedingly high resistance to a reversed potential, little is known. It has been stated that the cell is electrolytic in its action. This implies that a chemical reaction occurs, a condition that cannot be observed. More probable is it that the action is electrostatic, electrodynamic, or thermoelectric, or a combination of one or other of these physical conditions. Although the operation of a crystal detector of old has not as yet been completely explained, and the metal rectifying cell is probably equally as obscure in its behaviour, at least some working data concerning the results that can be expected with cells of given size on particular potentials are needed as a guide in eliminator construction.

From tests on the apparently varying resistance of the cell with various applied potentials a theory concerning the operation suggests itself. When a rise of temperature occurs across a junction of two dissimilar metals a current is generated, and similarly when a potential is applied to a junction between two different metals heating will result in one direction, while a reversal of potential may



[Courtesy Westinghouse.

Fig. 2.—A typical metal-oxide rectifier unit assembled.

create a fall in temperature. Now it is probable that the momentary temperature rise which occurs at the contact in the metal rectifier cell due to its resistance results in the generation of a potential, and the polarity of this heat-generated potential is the same, irrespective of the direction of the applied current. Thus, it is obvious that any tendency towards an increase in current flow in one direction would be limited by a thermo-electric counter potential, while if the potential is applied in the opposite direction a negative resistance effect or helping potential would be created.

Incidentally, the relationship between potential and temperature rise or fall across a thermo-junction is not linear, and the potential required to force a current through the contact is obviously always in excess of that which is created by the change of temperature. A necessary condition for rectification is that the resistance of the contacting surfaces must always be higher than that of either of the elements. It is safe, however, to regard the metal rectifier not as an electrolytic device, as is so often stated, but rather as a thermo-junction

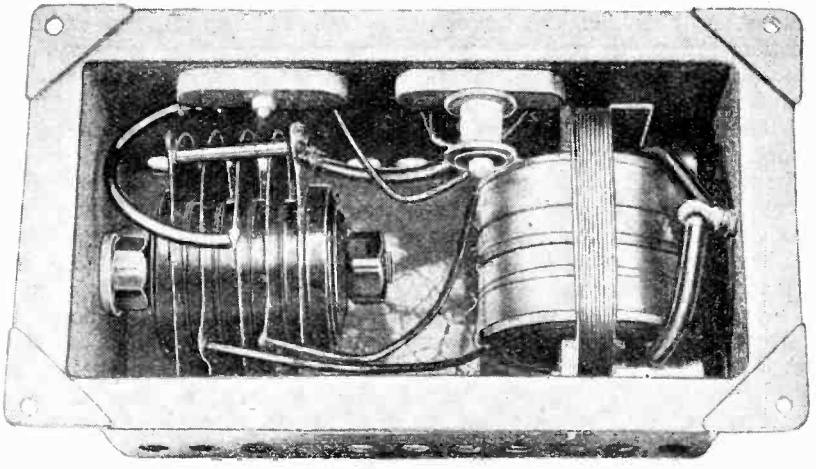


Fig. 3.—A bridge-connected metal rectifier (Ferranti), normally suitable for a 6-volt battery. The voltage is dropped across a tapped resistance for 2- and 4-volt batteries. Care should be taken not to reverse the polarity of the battery leads when connecting up.

[1] British Patent specification 277,103 (Ruben).

Metal Rectifiers.—

in which the heating or cooling effects which occur by the passage of an alternating current create counter or assisting potentials. In an accompanying diagram the relationship is shown between the change in the apparent resistance of a cell for various applied voltages. From the curves it will be seen that for a voltage drop across a disc of 0.5 its resistance is 1.25 ohm. In the reverse direction, however, the voltage of 0.5 forces such a small current through the cell that its apparent resistance is nearly 1,200 ohms.

Rectifying Cells are Bridge Connected.

We now come to the use of the cells for wireless purposes. In the case of battery charging the reverse current cannot be tolerated, and therefore some form of full-wave rectifying circuit must be employed. It should be observed that, if a rectifier cell were connected in series with a battery on charge and a suitable source of A.C. supply (*a*) of the accompanying diagram in the manner of an arc or thermionic rectifier, that the potential which would exist across the cell on one half cycle would be the sum of the peak A.C. potential and that of the battery, and for the other half cycle (when the battery is receiving a charge) the cell potential would be the difference. As the rectifying property of the metal cell is only at its best over a very limited range of applied potentials, it becomes essential that this sum and difference effect, produced by a battery on charge, must be avoided. Likewise, a full-wave rectifying circuit (*b*) possesses this same defect, and one of the cells at each half cycle will be subjected to an excessive reverse potential. Bridge circuits consisting of four elements are therefore adopted (*c*). It will be seen that the D.C. output circuit is always completed through two arms of the bridge, or, in other words, two of the four sections are always in series between input and output.

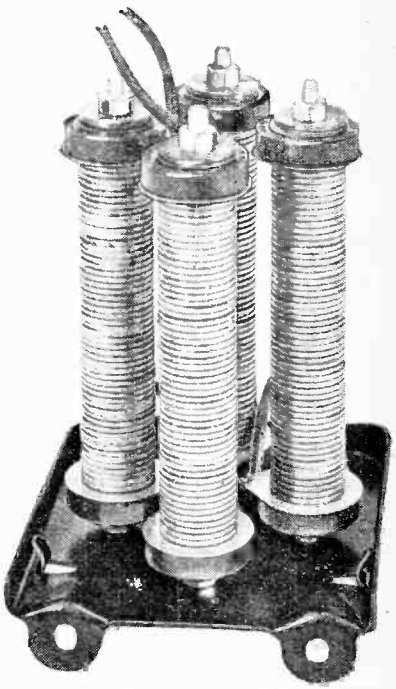
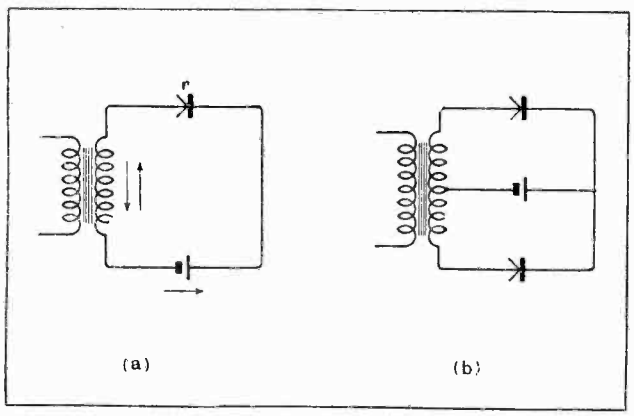


Fig. 5.—Showing the construction of a Westinghouse high-voltage rectifier for an H.T. battery eliminator.

Precautions.

As the rectifying properties of the metal cell become seriously impaired if an excessive current should be passed across its plates, particularly in the direction of high resistance, consideration should be given to the conditions existing in a bridge circuit such as (*d*). Supposing the D.C. load R is reduced or, in fact, disconnected, the output voltage from the transformer which has now risen is applied directly across the two parallel banks of cells, and is in excess of the normal working voltage which they are arranged to withstand. It must therefore be remembered that a bridge circuit metal rectifier should not be open circuited for any length of time, whilst it is inadvisable even to run such a rectifier for prolonged periods on a lighter load than its normal rating.



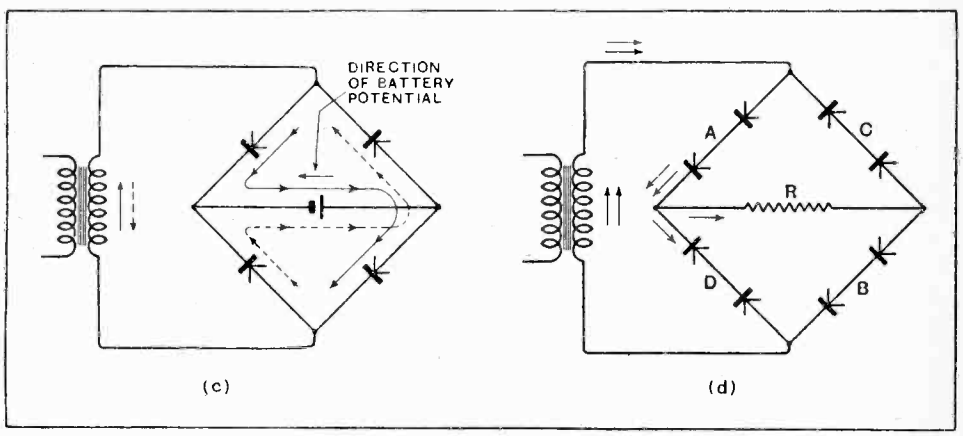


Fig. 4.—(a) The potential across the metal rectifier r is the sum of the A.C. peak potential and that of the battery in one direction and the difference in the other direction. (b) Although provision is made for full-wave rectification so as to avoid small current reversals through the battery on charge, the rectified cells are still subjected to excessive working potentials as in (a). (c) The bridge-connected circuit provides full-wave rectification, while the rectifying cells, which are serving at any interval of time as "stoppers," are not subjected to excessive voltages. (d) If a rectifier is worked on reduced load, R being of an excessively high value, then increased potentials are set up across the opposing cells of the rectifier. For a current flow in the direction of the arrows RB is a shunt path across the opposing cells D. Similarly, RA is a shunt across C. When the resistance of R is excessive, the potential applied to the opposing cells at C and D is also likely to be excessive.

Metal Rectifiers.—

Another condition must equally be guarded against. Overloading of the rectifier or a full short circuit will again bring about an excessive voltage drop across two of the banks of cells, though this time in the other limbs of the bridge. The chances of damage by overloading which, incidentally, is the property of all electrical apparatus, may be guarded against by the inclusion of a current limiting resistance in the output circuit as well as the provision of a voltage limiting adjustment on the transformer; the former is applied to battery chargers, and the latter to H.T. battery eliminators.

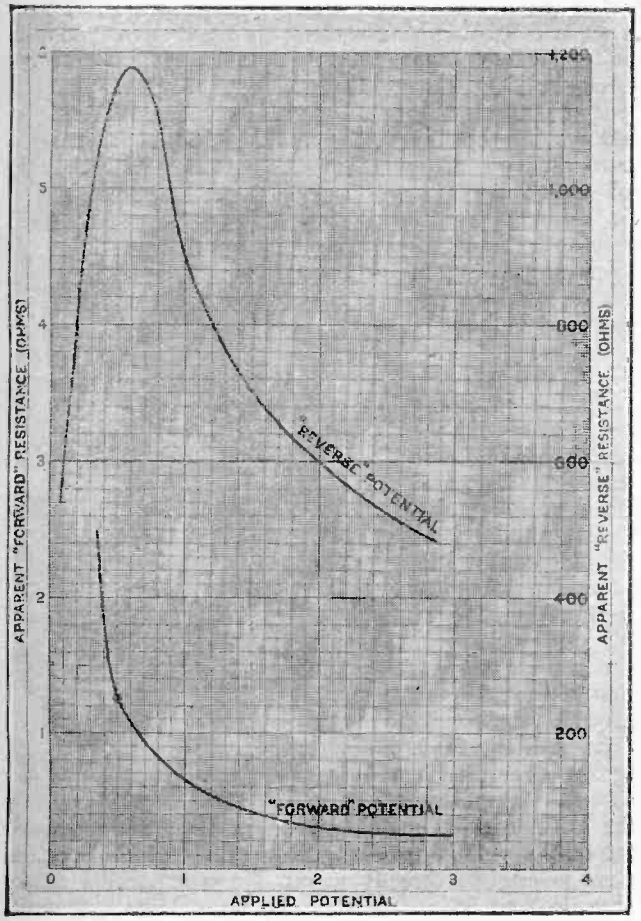


Fig. 6.—Resistance-voltage curves of small type rectifier cell. At 1.5 volts the "forward" resistance is about 1.25 ohms, whilst the "reverse" resistance exceeds 1,100 ohms. An examination of these curves shows that for a small increase of applied potential the ratio of "forward" to "reverse" resistance is much reduced.

These observations, although of practical importance, need not scare the prospective user, and attention has only been drawn to them as the properties of the metal rectifier are so little known. A high-voltage accumulator, motor generator, or a valve rectifier, are just as easily damaged by misuse, but in such cases the weaknesses are well known. The metal rectifier is noiseless in use, and being dry and clean can be conveniently assembled among the other components of a receiver. Its efficiency as a rectifier is high, and with ordinary care it is reliable and practically everlasting. It is of small bulk for the work it has to perform, and the slight rise of temperature which occurs under normal conditions does not call for special precautions by way of cooling.

Working Conditions.

It is as well to remember that the working peak potential per cell in the rectifiers on the market is about 1.5 volt. Thus, for charging a six-volt battery in a bridge circuit in which the accumulator at any interval of time is in series with two opposite limbs in the bridge, the other two being dormant, it is necessary to provide a transformer secondary potential of about 12 volts R.M.S., assuming the use of two series connected metal rectifying cells in each, as is commonly done. Similarly, there is on the market a high-voltage rectifying unit rated at 250 R.M.S. input, and stated to be suitable for an output of 200 volts at 100 milliamps. This rectifier consists of four bridge-connected banks, each of 55 rectifying cells. The working A.C. peak potential of about 350 volts will thus be distributed across some 110 cells at 1.5 volt per cell when the external load is regulated, so that the voltage drop across approaches 200.

F. H. H.

OLYMPIA EXHIBITION POSTER COMPETITION.

PRIZE-WINNING DESIGNS. The six posters arranged from left to right in order as selected by the R.M.A. in their poster competition. The Posters will be used in connection with the show.

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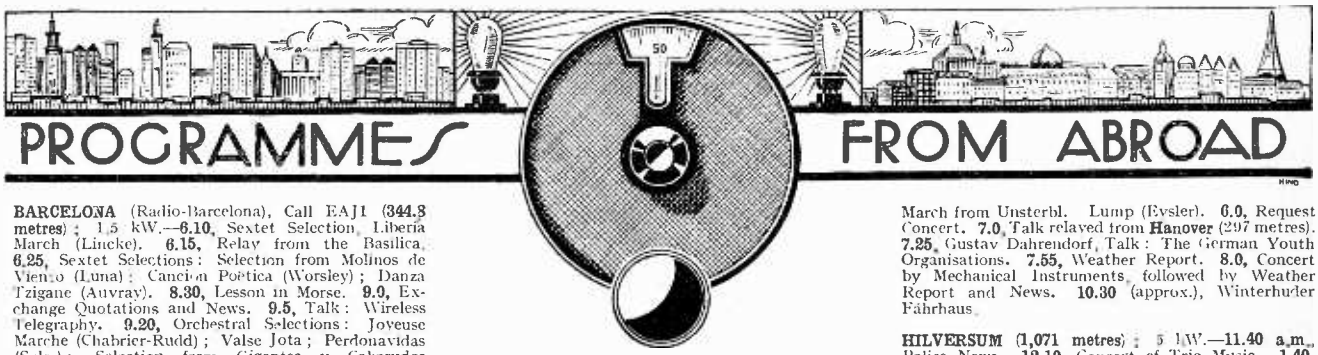


SATURDAY, AUGUST 25th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

BARCELONA (Radio-Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**6.10,** Sextet Selection, Liberia March (Lincke). **6.15,** Relay from the Basilica. **6.25,** Sextet Selections: Selection from Molinos de Viento (Luna); Cancion Poetica (Worsley); Danza Tzigane (Auvray). **8.30,** Lesson in Morse. **9.0,** Exchange Quotations and News. **9.5,** Talk: Wireless Telegraphy. **9.20,** Orchestral Selections: Joyeuse Marche (Chabrier-Rudd); Valse Jota; Perdonavidas (Soler); Selection from Gigantes y Cabezudos (Caballero); Sardana; Flors d'Ametller (Payas); Air de Ballet from Musette (Offenbach); Overture to Si j'étais Roi (Adam). **10.0,** Chimes, Weather Report and Exchange Quotations. **10.5,** Programme relayed from **Madrid,** EAJ7.

BERGEN (**370.4 metres**); 1.5 kW.—**11.15 a.m.,** Exchange Quotations and Weather Report. **12.15,** News, Weather Report and Market Prices. **8.0,** Orchestral Concert: Potpourri from Der Lustige Krieg; Russian Dance (Tchaikovsky); Romance (Tchaikovsky); Waltz (Gung'l); Potpourri (Morena); Egyptian March (Strauss). **9.0,** Recital by Alf Due. **10.0,** Weather Report, News and Time Signal. **10.15,** Recitations by Mr. Sverre Erichsen. **10.45,** Dance Music from the Hotel Norge.

BERLIN (Königswusterhausen) (**1,250 metres**); 40 kW. —**4.30,** Dr. Hoffmann, Talk: The Savings Bank and Political Economy. **5.0,** Programme from **Hamburg.** **6.0,** Talk by Kurt Heinig. **6.30,** Spanish Lesson by Gertrud van Eyseren and Cesar Mario Alfieri. **6.55,** Prof. Carl Grabau, Talk: The Duet. **7.20,** Dr. Himpel, Talk: Goethe and Eckermann. **8.15,** Programme from **Leipzig.** **9.15** (approx.), Programme from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**): 4 kW.—**10.10 a.m.,** Market Prices. **10.15 a.m.,** Weather Report, News and Time Signal. **11.0 a.m.,** Programme of Gramophone Records. **11.30 a.m.,** Exchange Quotations. **12.55,** Time Signal. **1.30,** Weather Report and News. **3.10,** Agricultural Prices and Time Signal. **3.30,** Programme of Gramophone Records. **4.30,** Talk by E. v. Michaelis. **5.0,** Tea Concert, relayed from the Hotel Esplanade, **Berlin.** **7.0,** Dr. Bartsch, Talk: The Police in Spain and Portugal. **7.30,** Eberhard Koebsell, Talk: The French Revolution. **8.0,** Dr. Ernst Rothe, Talk: Subconscious Forces. **8.30,** Viennese Programme. **10.15** (approx.), Weather Report, News, Time Signal and Sports Notes. **10.30,** Dance Music. **12.30 a.m.** (Sunday), Close Down.

BERN (**411 metres**): 1.5 kW. —**8.0,** Time Signal and Weather Report. **8.2,** Talk: Baptismal Customs in Switzerland. **8.30,** Concert of Orchestral Music and Ballad Recital. **9.45,** News and Weather Report. **10.0,** Selections by the Town Orchestra. **10.35,** Dance Music. **12.0 Midnight** (approx.), Close Down.

BRESLAU (**322.6 metres**); 4 kW.—**4.0,** Book Review. **4.30,** Concert: Orchestral Selections, (a) Potpourri from Lehàriana (Geiger); (b) Intermezzo, Kinderherzen (Kockert); (c) Intermezzo, Marrakesch (Percy); 'Cello Solos, (a) Elégie (Goens), (b) Scherzo (Goens); Orchestral Selections, (a) Waltz from Jadwiga (Dellinger), (b) Im Liebesgarten (Camusat), (c) Gedanken in der Ferne (Beyer), (d) Potpourri from Schlaraffenlieder (Lakomy), (e) Indischer Schleiertanz (Siède). **6.0,** Talk on Shorthand. **6.15,** Lesson in Esperanto by Margarete Polier. **6.30,** Talk: The Needs of Frontier and Provincial Towns. **7.25,** Talk: In a Match Factory. **7.50,** Talk on Political Science. **8.30,** Programme of Orchestral and Dance Music with Vocal Selections, by Robert Koppel. **10.30,** Concert and Dance Music, relayed from the Haus Oberschlesien, **Gleiwitz** (250 metres). **12 Midnight** (approx.), Close Down.

BRÜNN (**441.2 metres**); 3 kW.—**6.0,** Time Signal and German Transmission. **6.25,** Programme of Talks. **7.0,** Journalistic Review. **7.20,** "Dolly," Operetta (Hirsch). **10.0,** News from **Prague.** **10.25,** Exhibition Programme.

BRUSSELS (**508.5 metres**); 1.5 kW.—**5.0,** Concert of Dance Music from the St. Sauveur Palais de Danse. **6.0,** Talk: Some Great European Cities. **6.15,** Philological Talk. **6.30,** Orchestral Concert: In Madrid (May), Shanghai (Davis), Mary (Katscher), Five-Step (De Sylva); Song (Stolz); Fantasy for Pianoforte (Benoît), La Chaste Suzanne (Gilbert); Two Violin Selections (De Boeck), Dans un Bosquet de Roses (Siède), Marrakesch (Percy); Andante for 'Cello (Gilson), Isoline (Messager). **7.30,** Radio-Chronique. **8.15,** Gramophone Selections. **8.30,** Violin and Pianoforte Selections, Sonata for Violina du Piano (Mendelssohn). **9 0,** Orchestral Concert, relayed from **Ostend.**

BUDAPEST (**555.6 metres**); 35 kW.—**7.15,** Short Story Reading. **8.0,** Symphony Concert, relayed from the Zoological Gardens. **9.30,** Time, News and Sports Notes. **11.0,** Humorous Musical Programme.

COLOGNE (**283 metres**); 4 kW.—**10.35 a.m. to 12.50,** Programme from **Langenberg.** **1.5,** Concert, with Margot Gripekoven (Soprano). **2.30,** Talk for the Housewife. **4.30,** Programme from **Königswusterhausen.** **5.0,** Talk for Women by Dr. Elisabeth Kramer. **5.30,** E. Wimmers-Sonderegger, Talk: Lovely Townlets on the Rhine. **6.0,** Programme from **Langenberg.** **7.20,** Talk for Workers. **7.45,** Programme from **Langenberg.** **8.50,** Concert from **Dortmund,** followed by News, Sports Notes, Commerce Announcements and Orchestral Selections. **1.0 a.m.** (approx.) (Sunday), Close Down.

CRACOW (**566 metres**); 1.5 kW.—**7.0,** Miscellaneous Items. **7.30,** Review of Foreign Politics during the past week. **7.55,** Agricultural Report. **8.5,** News and Announcements. **8.15,** Programme from **Warsaw.** **10.30,** Restaurant Concert. **11.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**1.30,** Weather Report and Gramophone Selections. **7.20,** News. **7.30,** Recitations by May Pitchford. **7.45,** Irish Talk, by Seamus O'Duirinne. **8.0,** Mezzo-Soprano Solos by N. Milligan. **8.10,** Variety Programme by H. O'Donovan and Company. **9.10,** 'Cello and Soprano Recital by Joseph Schofield and Mary Maguire. **9.40,** Tenor Solos by Percy Bilsbury. **10.0,** Selections by De Valois' Trio. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**428.6 metres**), 4 kW.—**1.0,** Gramophone Selections. **3.0,** Children's Corner. **3.40,** Reading by O. W. Studtmann. **4.35,** Orchestral Concert, from the Works of Rhode and Leopold. **6.15,** Wireless Notes and other Announcements. **6.30,** Answers to Questions. **7.0** Lesson in Shorthand by Georg Kalis. **7.25,** Commercial Announcements. **7.30,** Gustav Lederer. Talk: The Aquarium in the Zoological Gardens. **8.0,** Programme from **Stuttgart.** **9.0** Variety Concert, followed by Programme from **Voxhaus.**

HAMBURG Call HA (in Morse) (**394.7 metres**); 4 kW.—**3.30,** Book Review. **4.0,** Labour Exchange Report. **4.15,** Illustrated Music Talk by Dr. Bernhard Engelke, relayed from **Kiel** (254.2 metres). **5.0,** Concert of Operetta Marches, March from Der liebe Augustin (Fall); March from The Merry Widow (Lehár); March from The Gipsy Baron (Strauss); March from Der Bettelstudent (Millöcker); March from The Grand-duchess of Gerolstein (Saro-Offenbach); Lieutenant's March from Miss Bagpipes (Nelson); March from Lumpenmädel (Platen); March from The Merry Peasant (Fall); March from Der arme Johann (Millöcker); March from The Dollar Princess (Fall); March from Light Cavalry (Suppé); March from Unsterbl. Lump (Evsler). **6.0,** Request Concert. **7.0,** Talk relayed from **Hanover** (297 metres). **7.25,** Gustav Dahrendorf, Talk: The German Youth Organisations. **7.55,** Weather Report. **8.0,** Concert by Mechanical Instruments, followed by Weather Report and News. **10.30** (approx.), Winterhuder Fährhaus.

HILVERSUM (**1,071 metres**); 5 kW.—**11.40 a.m.,** Police News. **12.10** Concert of Trio Music. **1.40,** Concert relayed from the Tuschinsky Theatre, **Amsterdam.** **3.40,** Thé Dansant, relayed from the Kurhaus, **Scheveningen**—Jack Raymond and his Orchestra, Casanova and his Argentines. **5.40,** Time Signal and Orchestral Concert; Overture to Nabucco (Verdi); Shadow Dance from Dinorah (Meyerbeer); Selection from The Mastersingers of Nuremberg (Wagner); Baritone Solos, (a) Air from Faust (Gounod); (b) Air from La Tosca (Puccini); Selection from Werther (Massenet); Baritone Solos: (a) Air from Rigoletto (Verdi); (b) Air from Carmen (Bizet); March from The Queen of Sheba (Gounod), followed by Musical Comedy Programme; Overture to Isabella (Suppé); Schatz-Waltz (Strauss); Selection from The Bird Fancier (Zeller); Finale. **7.25,** Police News and Time. **7.41,** Programme arranged by the Workers' Radio Society. **11.15** (approx.), Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits from **5.40** on 1,950 metres.—**12.10,** Concert of Trio Music. **5.10,** Concert of Gramophone Selections. **7.25,** Talk by Dr. Hoffmann. **7.55,** Vocal and Orchestral Concert.

JUAN-LES-PINS (Radio LL) (**244.5 metres**); 1.5 kW. —**1.0,** Orchestral Concert. **9.0,** News, Weather Report, Talk for Women by Mme. la Comtesse de Tremeuge, and Orchestral Selections. **10.0,** Dance Music. **10.30** (approx.), Close Down.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**7.30 a.m.,** Morning Gymnastics. **11.0 a.m.,** Weather Report. **3.0,** Concert of Instrumental Selections; in the Interval, Recitation (G. de Maupassant). **6.20,** Talk by Thyra Freding. **6.50,** Weather Report. **7.0,** News and Exchange Quotations. **7.15,** Time Signal. **7.30,** Talk by A. T. Höy. **8.0,** Chimes from the Town Hall. **8.2,** Concert of Popular Danish Music: Overture to Elverhoi (Kuhlau); Songs, (a) Nu Vaagner Alle Guds Fugle Smaa (Weyse), (b) En Sommeraften Silde (Heise), (c) Vildt Flyver Hög (Heise), (d) Lille Karen (Heise), (e) I Würzburg Ringe de Klokker Til Fest (Lange-Müller), (f) Serenade from Once Upon a Time (Lange-Müller); Scandinavian Folk Music (Hartmann), (a) Dans Og Skaemtevise, (b) En Sommerdag, (c) Halling Og Jolstring, (d) I Möllen, (e) Dans Og Vise; Songs, (a) Lette Bölge, Naar Du Blaaner (Gade), (b) Fluen (Gade), (c) Laer Mig Nattens Stjerne (Hartmann), (d) Air from Liden Kirsten (Hartmann); Der er saa Travlt i Skoven (Rung), followed by News. **9.30,** Programme of Old Dance Music: Zulu March (Alberti); Waltz, Court Dances (Lanner); Mazurka, Souveraine (Waldteufel); Polka, Brautschau (Strauss); Old Danish Folk Dances, (a) Den Röde Lue, (b) Tortur, (c) Minuet, (d) Korsfiretur, (e) Gudme Smed, (f) Fodsgang; Waltz, Sphärenklänge (Joh. Strauss); Pepita Polka (Lumbye); Mazurka, Liebeszauber (Ed. Strauss); American Tattoo (Dahl). **10.30,** Dance Music. **12.0 Midnight,** Chimes from the Town Hall. **12.15 a.m.** (approx.) (Sunday), Close Down.

KATOWITZ (**422 metres**); 10 kW.—**7.0,** Various Announcements. **7.30,** M. Kapiszewska, Talk: The Home of Amundsen—Norway, the Land of the Fjords and the Midnight Sun. **7.55,** Report on Agriculture. **8.15,** Programme from **Warsaw.** **10.0,** Time Signal, Weather Report and News. **10.30,** Dance Music.

KAUNAS (**2,000 metres**); 7 kW.—**12.0 Noon,** Carillon. **9.0,** Concert: Overture to Ruslan und Ludmila (Glinka); Andante from the Fourth Symphony (Tchaikovsky); Valse Caprice (Rubinstein); Ballet from The Nutcracker Suite (Tchaikovsky); Violin Solos, (a) Serenade (Galkin), (b) Salut d'Amour (Elgar); Preludes (Rachmaninoff); Romance, Op. 44 (Rachmaninoff); Lichtentanz der Bräute (Rubinstein); Suite Kaukasienne (Ippolitov-Ivanov).

KÖNIGSBERG (**329.7 metres**); 4 kW.—**6.30,** Talk by Hugo Laudien. **7.0,** Talk: A Hundred Years of the Steamship in Königsberg. **7.30,** Review of Current Events. **8.10,** Concert: March, Krambambuli

Programmes from Abroad.—

(Larsen); Song with Violin Obligato, Sorrentino (Curtius); Heimweh (Berlin); Song with Ukulele Accompaniment, Hawaiian Dreams; Tango; Songs; Songs with Ukulele Accompaniment; Potpourri from Das Muss Man Sehn (Holländer); Songs; Waltz, Der Liebe Freud und Leid (Lindsay-Theimer); Songs with Ukulele; March, Lachendes Leben (Blankenburg); Selections by Emil Glaas; March, Wir Haben Noch Ein Stündchen Zeit (Walther). **10.0,** Weather Report, News, Sports Notes and Dance Music. **12.0 Midnight** (approx.), Close Down.

LAHTI (1,522.8 metres); 35 kW.—**5.0,** Songs. **5.20,** Orchestral Concert: The Demon (Rubinstein); Selection from Tiefland (d'Albert); Songs (Renée), (a) Grotesque, (b) Gipsy Song, (c) Souvenir; Rhapsody No. 14 (Liszt); News in the Interval at **6.10. 7.30,** Songs by Rafael Ramstedt. **7.50,** Orchestral Concert (continued): French Military March (Saint-Saëns); Selection from The Rose of Stamboul (Fall); Romance (Ambrosio); Prayer and Temple Dance (Grieg); Destiny Waltz (Baines); Hungarian March (Berlioz). **8.45,** News and Announcements in Finnish and Swedish. **9.15,** Restaurant Relay. **10.0** (approx.), Close Down.

LANGENBERG (468.8 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres); **Cologne** (283 metres); and **Münster** (250 metres).—**10.35 a.m.,** Labour Market Notes. **12.10,** Gramophone Selections. **1.5,** Programme from **Cologne. 4.30,** Programme from **Königswusterhausen. 5.0,** Programme from **Cologne. 6.0,** Concert from **Düsseldorf:** Pavane in G Major (Ravel); Freiheit am Rhein (Sonnet); Ave Maria with Tenor Solo (Abt); Indian Cradle Song (Wesseler); Scherzo in B Flat Minor (Chopin); Cradle Song (Brahms); Waldandacht (Abt); Horch, was kommt von draussen rein (Rebbert); Träumereien am Klavier (Reger); Bei einer Flasche Mosel (Hansen); Ich hatte einst ein Schönes Vaterland (Hansen). **7.20,** Programme from **Cologne. 7.45,** Herman Löns Concert from **Münster.** Talk: The unknown Löns: Songs to the Lute (Degner), (a) Schab' ab, (b) Das stille Wasser, (c) Wegewarte, Tjawolla: A Story from the "Häusern vom Ohlenhof"; Songs to the Lute (Ruch), (a) Der Tausch, (b) Schäferlied, (c) Das Geheimnis; Auf der Brockenbahn (from the posthumous works of Hermann Löns); Songs to the Lute (Ruch), (a) Der Rosengarten, (b) Der Spuk, (c) Heckenkind; Brummelchen—Animal Story. **8.50,** Variety Concert, relayed from **Dortmund,** followed by Programme from **Cologne. 1.0 a.m.** (approx.) (Sunday), Close Down.

LEIPZIG (365.8 metres); 4 kW.—**6.30,** The Letter Box. **7.0,** Karl Schück, Talk: The American Weekend. **7.30,** Talk: Animal Life on the High Mountains. **8.0,** Weather Report and Time Signal. **8.15,** Hans Harbeck Recital. **9.15,** Pianoforte Recital, for two pianos: Marche caractéristique Op. 121, No. 2 (Schubert); Waltz Caprice Op. 10 (Nicodé); New Spanish Dances Op. 65 (Moskovsky): Moments du Bal, Op. 15 (Kronke). **10.15,** News and Sports Notes. **10.30,** Cabaret Programme. **12 Midnight** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 **(375 metres)** 3 kW.—**7.0,** Sextet Selections, Fantasia on Los Diamantes de la Corona (Barbieri); Fantasia on Martha (Flotow); Fantasia on Hijo del Sol (Quislant); Interlude by Luis Medina. **8.0,** Dance Music. **9.45,** Exchange Quotations and News. **10.0,** Chimes and Time Signal. **10.5** (approx.), "Le Bourgeois Gentilhomme"—Comedy (Molière). **12.0 Midnight,** Dance Music. **12.30 a.m.** (Sunday), Close Down.

MILAN, Call 1MI **(526.3 metres);** 7 kW.—**8.35,** Time Signal, Talk on Indian National Problems, and News. **8.50,** Concert: Overture (Mendelssohn): Fanciulla alla fontana (Signorini); Three Lyrics from Senza sole (Moussorgsky); Soprano Solo, Invocazioni a Venere (Parelli); Tenor Solos, Suite, The Sleeping Beauty (Tchaikovsky); Three Songs from Gli Astri (Nievadovsky); Soprano Solo from André Chenier (Giordano); La lavandaia di S. Giovanni (Seppilli). **10.55,** Dance Music from the Hotel Majestic Diana. **11.45** (approx.), Close Down.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (451.5 metres); **Boden** (1,190 metres); **Göteborg** (416.5 metres); **Malmö** (260.9 metres); **Ostersund** (720 metres); **Sundsvall** (545.6 metres).—**5.30,** Concert of Light Music. **6.30,** Children's Corner. **7.0,** Cabaret Selections. **7.30,** Folk Music Selections. **8.0,** Topical Talk. **8.15,** The Shoemaker's Daughter—Wireless Play adapted from the Novel by August Bland. **9.15,** News and Weather Report. **9.45,** Dance Music. **11.30,** Dance Music by Rolf's Dance Orchestra. **1.0 a.m.** (approx.) (Sunday), Close Down.

MUNICH (535.7 metres); 4 kW.—**2.30,** Concert of Gramophone Selections. **4.0,** Concert by the Wurzelhuber Trio, relayed from Nuremburg (241.9 metres).

Saturday, August 25th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

5.0, Talk by Dr. Georg Gustav Wieszner. **5.30,** Song Recital by Else Schuberth (Soprano), from the Works of Armin Knab and Brahms. **6.0,** Wireless Talk by Herr Leonhard Edelmann. **7.0,** Wireless Notes. **7.25,** Labour Exchange Report. **7.30,** Zither Recital by Fritz Mühlhölzl. **8.0,** Wireless Review. **8.20,** Vocal and Instrumental Concert: Orchestral Selection; Overture to The Merry Wives of Windsor (Nicolai); Hungarian Rhapsody for 'Cello and Orchestra (Popper); Air from I Pagliacci (Leoncavallo); Air from Ernani (Verdi); Fantasia on The Barber of Seville (Rossini); Piedmontese Dance No. 2 (Sinigaglia); Ballade and Polonaise for Violin and Orchestra (Vieuxtemps); Romance from Mignon (Thomas); Selection from Faust (Gounod); Waltz from Faust (Gounod); The Nutcracker Suite (Tchaikovsky). **10.0,** News. **10.30,** Dance Music. **12.30 a.m.** (Sunday), Close Down.

NAPLES, Call 1NA **(333.3 metres);** 1.5 kW.—**8.40,** Time Signal and News. **8.50,** Programme of Light Music: Overture to Il maniscalco (Paer); Ballet Suite from Coppélia (Delibes); Overture to Ten Maids and No Man (Suppé). **9.30,** Relay from a Theatre; In the Interval, Dance Music, relayed from the Trocadero. **10.50,** News, Calendar, Programme announcement and Close Down.

OSLO (461.5 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres); **Hamar** (555.6 metres); **Notodden** (411 metres); **Porsgrund** (500 metres); and **Rjukan** (448 metres).—**11.10 a.m.,** Exchange Quotations. **1.0,** Gramophone Selections. **1.15,** Weather Report and Agricultural Notes. **1.45,** Exchange Quotations. **7.45,** Weather Report, News and Agricultural Notes. **8.0,** Time Signal. **8.2,** Orchestral Concert. **9.0,** Recitation by J. Holst-Jensen. **9.30,** Weather Report and News. **9.45,** Topical Talk, followed by Dance Music from the Grand Hotel. **12.0 Midnight,** Close Down.

PARIS (Eiffel Tower), Call FL **(2,650 metres);** 5 kW.—**6.45,** Le Journal Parlé. **8.10,** Weather Report. **8.30,** Concert: Selection from Cocorico (Gamne); Invocation à la nuit (Turbert); Songs (a) Rien si ce n'est ton cœur (Missa); (b) Chanson du crépuscule (Delarue); Selection from La Chaste Suzanne (Gilbert); Songs, (a) Prière de Leila (Zucca), (b) Dernier vœu (Reynal), (c) L'amour de moi. Vers l'église dans le soir (Ladmirault); Le Fauteuil de grand'mère (Mendrot); Song, Je n'aime que toi (Persiani); Romance (Schumann); Mai (Hahn); Infidélité (Hahn); L'enamourée (Hahn); Pavane (Grumbach); Marche Barbare (Gaubert-Elgé).

PARIS (Petit Parisien) **(340.9 metres);** 0.5 kW.—**8.45,** Gramophone Selections, Talk, News and Announcements. **9.0,** Concert: Overture to Les Cent Vierges (Lecocq); Nocturne (Massenet); Sérénade inutile (Brahms); Selections from Le Roi s'amuse (Delibes); Symphony Orchestra, (a) Deuxième Danse Piedmontese (Sinigaglia), (b) Selection from La Bohème (Puccini), (c) Carnaval (Guiraud), (d) Nymphs of the Wood (Purcell); Suite from Marouf (Rabaud); Green (Debussy), Méditation (Glazounoff), 5th Slavonic Dance (Dvořák); Rajah's March (Fourdrain). News in the Intervals.

PRAGUE (348.9 metres); 5 kW.—**6.0,** German Transmission. **6.25,** Agricultural Report. **6.35,** Talk for Workers. **7.0,** Operetta, relayed from **Brünn. 10.0,** Time Signal, News and Programme from **Brünn.**

POSEN (344.8 metres); 1.5 kW.—**6.0,** Children's Corner. **7.0,** Miscellaneous Items. **7.30,** Programme from **Warsaw. 8.0,** Finance Report. **8.15,** Programme from **Warsaw. 10.0,** Time Signal, News, Announcements, Weather Report and Variety Selections. **10.40,** Dance Music from the Carlton Restaurant. **12.0 Midnight,** Maison Philips Concert. **2.0 a.m.** (approx.) (Sunday), Close Down.

ROME, Call 1RO **(447.8 metres);** 3 kW.—**8.30,** Sports Notes, News and Weather Report. **8.47,** Talk and Time. **9.0,** "Mephistopheles," Opera (Boito); In the Intervals: Talks, (a) Literature and Art; (b) Topical Events. **11.5,** News. **11.15** (approx.), Close Down.

RIGA (526.3 metres); 1.5 kW.—**6.0,** Programme of Talks. **7.0,** Concert: Overture to Ten Maids and No Man (Suppé); Selection from Der Obersteiger (Zeller); Waltz from Coppélia (Delibes); Dance (Eilenberg); Songs, Violin Solos, Songs; Overture to Raymond (Thomas); Spring Song (Gounod); Romance (Klughardt); Dance Motives (Meyer-Helmund); Murmelndes Lüftchen (Jensen); Lumpenmarsch (Goetze). **9.0** Weather Report and News. **9.10** (approx.), Dance Music. **11.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF **(21.96 and 31.4 metres);** 30 kW.—**11.55,** Baseball Announcements. **12.0 Midnight,** Statler's Pennsylvanians directed by Johnny Johnson, from **New York. 12.30 a.m.** (Sunday), Concert from the Hotel Sagamore, **Rochester. 1.0 a.m.,** Keystone Duo with Balladeers relayed from **New York. 1.30 a.m.,** Time Signal. **1.32 a.m.,** The New York Philharmonic Orchestra, conducted by Willem Van Hoogstraten, from the Lewissohn Stadium. **3.20,** Organ Recital by Robert Berentsen, from **Rochester. 4.0 a.m.,** Dance Music from **Buffalo. 5.0 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**8.40,** Concert: Symphony No. 6 (Haydn); Duet from Madame Butterfly (Puccini); Duet from The Tales of Hoffmann (Offenbach).

STUTTGART (379.7 metres); 4 kW.—**6.0,** Time Signal and Weather. **6.15,** Talk, relayed from **Freiburg** (577 metres). **6.45,** Dr. Friedrich Luther, Talk: The Play. **7.15,** L. Leibfried, Talk: The Promise of Marriage. **7.45,** Report of the South-West German Labour Exchange, Time Signal, Weather Report, and Sports Notes. **8.15,** Concert of Alsatian Music of the 18th Century: Introductory Address; Chamber Symphony in A Major (Richter); Sonata da Camera in A Major (Richter); Ballet Music (Rudolf); Flute Concerto in C Major (Wendling), followed by Stop Press Programme: The Verdict on the Metal Fraud Case; A New Polar Expedition; Terrible Railway Accident; Anniversary Celebration of the Soldiers' League; Murder or Accident?; The Exchange Fluctuates; First Results of the Six Day Races; The Unidentified Corpse; Epoch-making Changes in Women's Fashions; Elections in America; Sole Report of the Ocean Flight; League of Nations Revises Peace Treaty; followed by News, Sports Notes and Concert from the Hindenburg Buildings.

TOULOUSE (Radiophonie du Midi) **(391 metres);** 3 kW.—**12.30,** Beethoven-Dvorák Concert, followed by Dance Music. **8.0,** Exchange Quotations and News. **8.30,** Symphony Concert: Overture to Der Schauspieldirektor (Mozart); Prelude to L'Après Midi d'un Faune (Debussy); Selection from La Féria (Lacôme); La Dolorès (Breton); Waltz, Schlittschuhläufer (Waldteufel); Waltz, Estudiantina (Waldteufel). **9.0,** Concert: Air from La Bohème (Puccini); Air from The Barber of Seville (Rossini); Ave Maria (Gounod); Air from Fortunio (Messager); Duet from La Bohème (Puccini); Songs from Véronique (Messager); Duet from Madame Butterfly (Puccini); Air from Sapho (Massenet); Air from Le Jongleur de Notre Dame (Massenet); Aubade from Le Roi d'Ys (Lalo); Song from The Girl of the Golden West (Puccini); Neapolitan Melody (de Curtis); Neapolitan Melody (Nutile); Air from La Fille de Madame Angot (Lecocq); Air from The Fair Maid of Perth (Bizet); Duet from Mireille (Gounod); Serenade from Iris (Mascagni); Air from I Pagliacci (Leoncavallo); Air from Lakmé (Delibes); followed by Dance Music. **10.15,** North African News. **10.30** (approx.), Close Down.

VIENNA (577 and 517.2 metres); 1.5 and 5 kW.—**5.50,** Concert: Songs, (a) Von Ewiger Liebe (Brahms), (b) Der Maie (Pamer), (c) Air from Samson and Delilah (Saint-Saëns); Violin Solos, (a) Polonaise in A Major (Wieniawsky), (b) Volga Song (Kreisler), (c) Caprice (Paganini-Kreisler); Songs, (a) Schmied Schmerz (Eiken), (b) Verlorener Klang (Häusler), (c) Erwacht (Häusler); Pianoforte Solos, (a) Toccata (Paradies), (b) Rondo Favori (Hummel), (c) Sarabande (Lully). **6.40,** Sonata Recital: Sonata in G Major for Violin and Pianoforte (Mozart); Spring Sonata in F Major for Violin and Pianoforte (Beethoven). **7.30,** Reading from the Works of Dr. Ratislav and Dr. Schreyvogl. **8.30,** "Adieu Mimi," Operetta in Three Acts (Benatzky).

VILNA (435 metres); 1.5 kW.—**7.0,** Gramophone Selections. **7.25,** Talk: The First Northern Fair at Vilna. **7.45,** News and Announcements. **8.0,** Symphony Concert, relayed from the Grounds of the First Northern Fair at Vilna. **10.0,** Programme from **Warsaw. 10.30,** Dance Music. **11.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**7.0,** Miscellaneous **7.30,** "Radio Chronique." **7.55,** Agricultural Report. **8.5,** News and Announcements. **8.15,** Orchestral Concert; News in French in the Interval. **10.0,** Time Signal, Aviation Notes, Weather Report, News and Sports Notes. **10.30,** Dance Music from the Oaza Restaurant. **11.30** (approx.), Close Down.

Programmes from Abroad.—

BARCELONA (Radio-Barcelona), Call EAJ1 (**344.8 metres**) ; 1.5 kW.—**12 Noon,** Chimes, relayed from the Barcelona Cathedral, followed by Weather Report for the District and for Europe. **1.30,** Instrumental Trio Selections and Gramophone Records. **2.45 to 9.0,** No Transmission. **9.0,** Sports Notes, Exchange Quotations. **9.15,** The Station Orchestra and Song Recital. **10.0,** Chimes from the Cathedral. **10.5,** "La Tempestad," Lyrical Drama in Three Acts ; Text by Miguel Ramos Carrión, Music by Ruperto Chapi. **12.0 Midnight** (approx.), Close Down.

BERGEN (**370.4 metres**) ; 1.5 kW.—**10.30 a.m.,** Religious Service. **12.30,** Weather Forecast. **1.0,** Relay of the Norwegian National Swimming Contest. **8.0,** Selections by the Station Orchestra. **9.0,** Talk and Selections of Music. **10.0,** Weather Forecast, News Bulletin and Time Signal. **10.15,** Concert. **12.0 Midnight** (approx.), Close Down.

BERLIN (Königswusterhausen), (**1,250 metres**) ; 40 kW.—**6.30 a.m.,** Early Morning Vocal and Instrumental Concert, relayed from **Voxhaus.** **7.0 a.m.** (in the interval), Gymnastic Exercises. **8.55 a.m.,** Potsdam Garrison Church Chimes. **9.0 a.m.,** Choral, Solo and Instrumental Concert from **Voxhaus** ; Chimes from the Berlin Cathedral. **11.30 a.m.,** Light Orchestral Music, relayed from **Voxhaus.** **3.30,** Talks for Farmers, followed by Music and Talks, relayed from **Voxhaus.** **6.30,** Talks by Prof. Friebel and Margarete Wallmann, followed by Outside Relay.

BERLIN (Voxhaus), (**484 metres**) ; 4 kW.—**6.30 a.m.,** Early Morning Instrumental Concert. **7.0 a.m.** (in the Interval), Gymnastic Exercises. **8.55 a.m.,** Potsdam Garrison Church Chimes. **9.0 a.m.,** Concert of Organ, Choral and Vocal Solos and Instrumental Music with Address ; Chimes from the Berlin Cathedral. **11.30 a.m.,** Concert of Light Orchestral Music. **2.0,** Children's Corner. **3.30,** Programme of Talks for Farmers with Review of Agriculture ; Market and Weather Conditions for the past week, followed by Musical Items and Talks. **7.0,** Programme of Talks. **8.30,** Musical Programme. **10.15,** News, Weather Report, Time Signal and Sports Notes. **10.30,** Dance Music Programme. **12.30 a.m.** (approx.) (Monday), Close Down.

BERN (**411 metres**) ; 1.5 kW.—**10.30 a.m.** (approx.), Divine Service Relay. **1.0,** Time Signal and Weather Forecast. **1.0 to 2.30,** Orchestral Selections. **8.0,** Time Signal and Weather Forecast. **8.5,** Concert of Instrumental and Solo Music with Mme. Louise Carmel (Soprano), Divertimento No. 8 in F Major for Flute, Oboe, Clarionet, Horn and Bassoon (Mozart). **9.45,** Sports Notes, News Bulletin and Weather Report. **10.0,** Bern Municipal Orchestra. **10.35** (approx.), **Close Down.**

BEZIERS (**158 metres**) ; 0.6 kW.—**8.15 to 9.30,** Programme of Modern Dance Music. **9.30** (approx.), Close Down.

BRATISLAVA (**300 metres**) ; 1 kW.—**7.0 a.m.,** Open Air Concert, relayed from **Carlsbad.** **9.0 a.m.,** Programme, relayed from **Prague.** **11.0 a.m.** (approx.), Outside relay of a Concert. **6.0 to 9.0,** Programme of Talks and Music, followed by Outside Relays from **Brünn** and **Prague.**

BRÜNN (**441.2 metres**) ; 3 kW.—**7.0 a.m.,** Open Air Musical Programme, relayed from **Carlsbad.** **9.0 a.m.,** Talks, followed by Church Music Recital. **11.0 a.m.,** Concert of Orchestral Music. **12.0 Noon,** Musical Programme, relayed from the Exhibition, followed by Popular Concert. **6.0,** German Transmission. **7.0,** Musical Programme. **11.0** (approx.), Close Down.

BRUSSELS (**508.5 metres**) ; 1.5 kW.—**5.0,** Modern Dance Music Programme, relayed from Outside. **6.0,** Programme for Children. **6.30,** Concert of Instrumental Music with Flute, Clarionet and Pianoforte Solos. **7.30,** "La Radio Chronique," Programme of Talks. **8.15,** Concert of Instrumental Music. **10.15** (approx.), Last News Bulletin. **10.30** (approx.), Close Down.

BUDAPEST (**555.6 metres**) : 35 kW.—**9.0 a.m.,** News Bulletin and Beauty Culture Hints. **10.0 a.m.,** Divine Service. **12.0 Noon,** Chimes, Weather Forecast and Instrumental Selections, followed by Talks. **4.15,** Children's Corner ; Musical and Dramatic Programme. Sports Notes in the Interval. **12.0 Midnight** (approx.), Close Down.

BRESLAU (**322.6 metres**) ; 4 kW.—**8.45 a.m.,** Christ Church Chimes. **11.0 a.m.,** Vocal and Instrumental Morning Concert ; Address, followed by Talks. **2.35,** Chess Problems Talk. **3.0,** Programme for Children. **3.30,** Talk for Farmers, followed by Programme of Music and Talks. **8.30,** Musical Programme. **10.30,** Relay of Dance Music Programme. **12.0 Midnight** (approx.), Close Down.

SUNDAY, AUGUST 26th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

CHATELINEAU (**220 metres**) ; 1.5 kW.—**8.0,** Concert from the Works of Mozart, Wagner and Puccini, with a Talk in the Interval. **10.0** (approx.), Close Down.

COLOGNE (**283 metres**) ; 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (468.8 metres), and **Münster** (250 metres).—**9.0 a.m.,** Catholic Religious Recital. **11.0 a.m.,** Talk by Fritz Worm : The Worth and Honour of the German Language, relayed from **Düsseldorf.** **11.30 a.m.** (approx.), Programme of Talks. **1.0,** Instrumental Concert, followed by Talks and Music, and Probable Sports relay. **7.45,** Sports Notes. **8.0,** "Der Orlow," Operetta in Three Acts (Granichstaedten), followed by Last News Bulletin and Sports Notes and Orchestral Selections with Dance Music. **12.0 Midnight** (approx.), Close Down.

CORK, Call 6CK (**400 metres**) ; 1.5 kW.—**8.30,** Concert by the No. 2 Army Band, conducted by Lieut. A. Duff, Mus. B., with Tenor and Soprano Solos in the Intervals. **11.0,** National Anthem. **11.5** (approx.), Close Down.

CRACOW (**566 metres**) ; 1.5 kW.—**8.15 a.m. to 9.0,** Relay of the Harvest Festival Programme from **Spala.** **8.15 a.m.,** Part I : Divine Service Relay, followed by Procession of Delegations, Presentation of Crown to the President, etc. **12.0 Noon,** Fanfare from the Church of Notre Dame. **2.0,** Harvest Festival Programme Part II : Programme of Talks, Placing of Wreaths, Songs, Games and Dance Music, followed by Evening Programme of Vocal and Instrumental Music. **10.0,** Programme relayed from **Warsaw.** **10.30,** Orchestral Concert, relayed from a Restaurant in Cracow. **11.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**) ; 1.5 kW.—**8.30,** Concert relayed from **Cork** ; Selections by the No. 2 Army Band, Fedora Turnbull (Soprano) and Percy Bilsbury (Tenor). **11.0,** National Anthem. **11.5** (approx.), Close Down.

FRANKFURT (**428.6 metres**) ; 4 kW.—**8.0 a.m.,** Sacred Morning Concert, followed by Programme of Talks. **1.0,** Notes by the Wiesbaden Chamber of Agriculture, followed by Talks and Music. **6.30** (approx.), Programme of the Rhein-Main Association for Popular Education, and Musical Programme.

HAMBURG, Call HA (in Morse) (**394.7 metres**) ; 4 kW.—Programme relayed by **Bremen** (272.7 metres), **Hanover** (297 metres), and **Kiel** (254.2 metres).—**6.30 a.m.,** Early Morning Concert, relayed from **Voxhaus.** **8.25 a.m.,** Time Signal. **8.30 a.m.,** Weather Forecast and News Bulletin, followed by Musical Programme (for **Hamburg, Bremen** and **Hanover**). **9.15 a.m.** (for **Kiel** only), Divine Service, relayed from the Kiel University Church. **11.30 a.m.** (for **Hamburg, Bremen** and **Hanover** only), Talk on a Commercial Topic. **12.0 Noon,** Concert of Instrumental Music. **12.55,** International Time Signal from **Nauen.** **1.0** (for **Hamburg** and **Kiel** only), Instrumental Concert. **1.0** (for **Bremen** only), Special Sunday Concert. **1.0** (for **Hanover** only), Selections of Gramophone Music. **2.0,** Musical Programme for Children. **3.0,** Concert of Orchestral Music, followed by Programme of Talks and Music. **9.30** (approx.), Weather Forecast, Last News Bulletin, Weather Conditions for Shipping, followed by Talk on Topical Events. **10.0** (approx.), (for **Hamburg** and **Kiel** only), Concert, relayed from the Café Wallhof in **Hamburg.** **10.0** (approx.) (**Hanover** and **Bremen** only), Concert from the Café Continental in Hanover. **11.0** (approx.), Close Down.

HILVERSUM (**1,071 metres**) ; 5 kW.—**12.40 to 2.10,** Lunch Time Instrumental Trio Selections. **2.40** Orchestral Concert. **5.40,** Concert of Instrumental Selections. **7.40,** Weather Forecast, News Bulletin and Sports Notes. **7.55,** Musical Programme. **10.15** (approx.), Close Down.

HUIZEN (**340.9 metres**) ; 4kW.—Programme on 1,950 metres after **5.40. 8.10 to 9.10,** Religious Address and Recital. **12.10,** Instrumental Trio Selections, relayed from **Amsterdam,** followed by Programme of Talks and Music and Special Items for Hospital Patients. **5.0,** Divine Service, relayed from **Gröningen,** Psalms, Organ Music, Bible Readings, with Sermon by the Rev. G. Tichelaar. **7.25,** Talk. **7.55,** Instrumental Concert. **10.25,** Choral Epilogue, followed by Close Down.

JUAN-LES-PINS (Radio L.L.) (244.5 metres), 1.5 kW.—**1.0,** Instrumental Concert with Children's Talk by Marcel Laporte (Radiolo). **2.0 to 9.0,** No Transmission. **9.0,** News Bulletin, Weather Forecast and Concert. **10.0,** Jazz Orchestra from the Juan-les-Pins Casino. **10.30** (approx.), Close Down.

KALUNDBORG (**1,153 metres**) ; 7 kW.—Programme also for **Copenhagen** (337 metres). **10.0 a.m.,** Divine Service and Address, relayed from a Church. **11.30 a.m.** (for **Kalundborg** only), Weather Forecast. **2.0,** Church Service. **3.30** (approx.), Instrumental and Vocal Concert. **6.0,** Chimes from the Town Hall. **6.50,** (for **Kalundborg** only) Weather Forecast. **7.0,** News Bulletin. **7.15,** Time Signal, followed by Talk. **8.0,** Chimes from the Town Hall. **8.5,** Concert from the Works of Mendelssohn ; Orchestral, Vocal and Instrumental Solo Selections : "A Midsummer Night's Dream," (a) Overture, (b) Scherzo, (c) Nocturne, (d) Wedding March, followed by News Bulletin and Musical Programme. **11.0** (approx.), Modern Dance Music Programme ; In the Interval at **12.0 Midnight,** Chimes from the Town Hall. **12.30 a.m.** (approx.) (Monday), Close Down.

KATOWITZ (**442 metres**) ; 10 kW.—**12.0 Noon,** Time Signal and Weather Forecast. **4.0** (approx.), Talk for Gardeners. **4.20,** Agricultural Programme. **5.0,** Instrumental Selections, followed by Miscellaneous Announcements, Talks and Musical Selections. **8.15,** Concert of Vocal and Instrumental Music. **10.0,** Time Signal, Weather Forecast and News Bulletin. **10.30,** Dance Music Programme. **11.30** (approx.), Close Down.

KAUNAS (**2,000 metres**) ; 7kW.—**12.0 Noon,** Chimes **12.10,** Church Music Relay. **12.30,** Fairy Tales, Children's Songs and Orchestral Music. **5.0,** Programme of Farmers' Reports with Musical interludes. **6.0,** Programme for Children. **6.30,** Household Topic Talk for Women, followed by lowering of the Flag Ceremony, relayed from the Kaunas War Museum. **7.45,** Miscellaneous Items and Programme of Talks. **8.30,** Time Signal, Weather Forecast and Review of Politics. **9.0,** Variety Concert of Quartet Selections, Bass Solos by J. Katele, Flute Solos by C. Stupel, Violin, Pianoforte and 'Cello Solos by M. Hofmekler.

KÖNIGSBERG (**329.7 metres**) ; 4 kW.—Programme, relayed by **Danzig** (272.7 metres).—**9.0 a.m.,** Morning Address with Sacred Songs and Organ Music. **11.0 a.m.** (approx.), Weather Forecast, followed by Musical Selections. **12.55,** International Time Signal, relayed from **Nauen,** followed by Programme of Talks and Music with Chess Problems talk by P. S. Leonhardt. **8.0,** Concert of Popular Selections from Opera, relayed from the Zoppot Kurgarten ; Arias from the Works of Verdi and Gounod by Fredy Busch. **10.0,** News Bulletin and Sports Notes, followed by Dance Music Programme. **12.0 Midnight** (approx.), Close Down.

LAHTI (**1,522.8 metres**) ; 35 kW.—Programme also for **Helsingfors** (375 metres).—**9.0 a.m.,** Finnish Divine Service. **10.30 a.m.,** Review of the Press. **11.0 a.m.,** Vocal and Instrumental Programme. **11.50 a.m.,** Weather Forecast and Time Signal. **12.0 Noon,** Swedish Divine Service. **5.0,** Concert by the Station Orchestra, conducted by Erkki Linko. **7.30,** Recital of Finnish Songs by Aapo Similä. **7.50,** The Station Orchestra (continued). **8.45,** News Bulletin in Finnish, and Swedish. **9.15,** Musical Selections, relayed from a Restaurant. **10.0** (approx.), Close Down.

LANGENBERG (**468.8 metres**) ; 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres), and **Münster** (250 metres).—**9.0 a.m.,** Religious Recital, relayed from **Cologne.** **11.0 a.m.,** Talk by Fritz Worm : The Worth and Honour of the German Language, relayed from **Düsseldorf.** **11.30 a.m.** (approx.), Programme of Talks. **1.0,** Instrumental Concert, followed by Programme of Talks and Music. **6.0,** Relay of a Running Commentary on the International Riding Tournament from **Aix-la-Chapelle.** **8.0,** Programme from **Cologne.** **12.0 Midnight** (approx.). Close Down.

LAUSANNE (**680 metres**) ; 1.5 kW.—**4.0** (approx.), Programme relayed from **Bern.** **8.30** (approx.), Religious Service, followed by Musical Selections.

LEIPZIG (**365.8 metres**) ; 4 kW.—**8.30 a.m.,** Probable Organ Recital from the Leipzig University Church. **9.0 a.m.,** Instrumental and Vocal Morning Concert. **11.0 a.m.,** Open Air Concert of Instrumental Music. **12.0 Noon,** Programme of Talks arranged by the Hans Bredow Foundation. **1.0,** Talks for Farmers. **2.0,** Review of the Foreign Press. **2.15,** Programme by the Deutscher Sprachvercin. **2.30,** Concert by the Dresden Wireless Orchestra, conducted by Gustav Aguntc. **3.30,** Programme of Readings, followed by Musical Selections and Talks. **8.0,** "Manasseh," Oratorio for Soloists, Choir and Orchestra (Friedrich Hegar), relayed from St. Thomas' Church, Leipzig ; Artistes : Lotte Mäder-Wohlgemuth (Soprano), Paul

Programmes from Abroad.—

Beinert (Tenor), Max Spilcker (Baritone), and the Leipzig Symphony Orchestra, conducted by Prof. Gustav Wohlgemuth. **10.0,** Sports Notes. **10.30,** Selections of Dance Music. **12.30 a.m.** (approx.) (Monday), Close Down.

LYONS (Radio-Lyon) **(291 metres)**; 1.5 kW.—**11.0 a.m.,** Concert of Sacred Music, organised by the Maison Rabut. **12.0 Noon to 7.30,** No Transmission. **7.30,** News Bulletin, Review of the Press, Talk on Current Events, followed by "Le Dimanche Sportif," and Notes on Agriculture. **8.15,** Instrumental Concert in the Programme, Prélude, Cortège and Air de Danse (Debussy). **9.15,** Concert of Dance Music, Ancient and Modern. **10.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 **(375 metres)**; 3 kW.—Programme relayed by **Salamanca,** EAJ22 (405 metres).—**2.0,** Popular Orchestral Selections. **3.30 to 7.0,** No Transmission. **7.0,** Children's Corner: Kiki and his Friends, with Luis Medina and the Station Sextet. **8.0 to 8.30,** Sextet Dance Music Selections. **10.0,** Chimes and Time Signal. **10.5,** "A Midsummer Night's Dream"; Orchestral Suite (Mendelssohn), (a) Overture, (b) Scherzo, (c) Nocturne, (d) Intermezzo, (e) Dance, (f) March. **10.45,** Concert by the Municipal Band, conducted by Señor Villa, from the Paseo de Rosales and Probable Dance Music Relay. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, Call 1MI **(526.3 metres)**; 7 kW.—**10.30 a.m.,** Recital of Sacred Music, Vocal and Instrumental. **12.30,** Time Signal, followed by Instrumental Selections. **5.0,** Concert of Instrumental and Vocal Music. **5.25,** Agricultural Talk. **5.30,** Relay of Concert from the Majestic Hotel, Diana. **6.0 to 8.25,** No Transmission. **8.25,** Opening Signal, followed by Programme of Talks. **8.45,** Sports Notes. **8.50,** "Fedora," Opera (Giordano); News Bulletin between Acts II and III. **11.45** (approx.), Close Down.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Goteborg** (416.5 metres), **Malmo** (260.9 metres), **Ostersund** (720 metres), and **Sundsvall** (545.6 metres).—**11.0 a.m.,** Church Service. **12.45,** Exchange Quotations. **12.55,** Time Signal. **5.0,** Children's Programme. **5.55,** Chimes, relayed from the Town Hall. **6.0,** Evensong. **7.15,** Musical and Literary Programme, followed by Old-time Dances. **11.0** (approx.), Close Down.

MUNICH (535.7 metres); 4 kW.—Programme relayed by **Augsberg** (566 metres), **Kaiserlautern** (204.1 metres), and **Nuremburg** (241.9 metres).—**11.0 a.m.,** Relay of Chimes from the Town Hall, Munich. **11.15 a.m.,** Weather Forecast, followed by Talks and Music. **5.50,** Festival Programme: "Il Seraglio," Opera (Mozart), preceded by Introductory Talk on the Opera and details of performers, etc., Programme followed by News Bulletin and Concert Relay.

NAPLES, Call 1NA **(333.3 metres)**; 1.5 kW.—**10.0 a.m.,** Concert of Sacred Music. **4.45,** Programme for Young People. **5.0,** Concert of Orchestral Music with Soprano Song Recital. **5.30,** Time Signal. **8.20,** Reports and Time Signal. **8.50,** Concert of Instrumental Music, followed by "L'Infedle," Comedy in Three Acts (Robert Bracco). **10.0,** Sports Notes. **10.55,** Calendar and Programme Announcements for the following Day. **11.0** (approx.), Close Down.

OSLO (461.5 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), **Rjukan** (448 metres).—**10.30 a.m.** (approx.), Chimes and Divine Service. **7.45,** Weather Forecast and News Bulletin. **8.0,** Time Signal. **8.5,** Vocal and Instrumental Concert. **9.30,** Weather Forecast and News Bulletin. **9.45,** Seen and Heard: Review of Current Events. **10.0,** Orchestral Selections; Dance Music Relay from the Hotel Bristol. **12.0 Midnight** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT **(458 metres)**; 0.5 kW.—Programme relayed at Intervals by the following Stations: **Bordeaux,** PTT (275 metres); **Eiffel Tower** (2,650 metres); **Grenoble** (416 metres); **Lille,** PTT (264 metres); **Limoges** (285 metres); **Lyons,** PTT (476 metres); **Marseilles** (303 metres); **Rennes** (280 metres); **Toulouse,** PTT (260 metres).—**8.0 a.m.,** Press Review and Time Signal. **10.25 a.m.,** Time Signal and Weather Report. **1.30,** Instrumental Selections. **6.0,** "Le Radio-Journal de France." **8.30,** Sports Notes. **9.0,** Concert of Instrumental and Vocal Music, followed by Modern Dance Music from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(2,650 metres)**; 5 kW.—**8.56 a.m.,** Time Signal on 32.5 metres. **10.26 a.m.,** Time Signal on 2,650 metres. **6.45,** Le Journal Parlé, par T. S. F.: Programme of Talks on Health, Police Anecdotes, Review of Sports, etc., by the Regular

Sunday, August 26th.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

Contributors. **8.10,** Weather Forecast. **8.30,** Programme of Orchestral Music. **8.56,** Time Signal on 32.5 metres. **11.26,** Time Signal on 2,650 metres.

PARIS (Petit Parisien), **(340.9 metres)**; 0.5 kW.—**8.45,** Selections by Gramophone, Talks Programme and Press Review. **9.0,** Concert of Vocal and Instrumental Music. **9.25,** News Bulletin. **9.30,** Symphony Concert. **10.0,** News Bulletin, followed by Concert of Instrumental Music from the Works of Gaune, Planquette, Gounod, etc. **11.0** (approx.), Close Down.

PARIS (Radio L.L.), **(370 and 60 metres)**; 1 kW.—**12.30,** Programme, arranged by Radio-Liberté, Music, Talks and News Items. **3.0,** Concert of Fox-Trots, Tangos, and Valses organised by the Compagnie Nationale de Radiodiffusion. **9.0,** Musical Programme. **10.30** (approx.), Close Down.

PARIS (Radio-Paris), Call CFR, **(1,750 metres)**; 6 kW.—**8.0 a.m.,** Review of the Press. **12.0 Noon,** Concert of Choral and Instrumental Sacred Music, and Address, News Bulletin. **12.45,** The Albert Locatelli Orchestra. **4.30,** Dance Music Programme by the Grand Vartel Jazz Band; News in the Interval. **8.0.** Agricultural Report. **8.15,** News Bulletin. **8.30,** Vocal and Instrumental Programme, Ballet Music from Ascanio (Saint-Saëns), News in the Interval.

PITTSBURGH, Call KDKA **(63 and 27 metres)**; 25 kW.—**4.0,** Church Service. **7.0,** Roxy's Stroll, relayed from WJZ, **New York. 9.0,** Telechron Time Signal. **9.2,** Dr. Sockman's Question Hour from WJZ. **10.0,** Miscellaneous Programme from WJZ. **11.0,** Telechron Time, Baseball Scores and Musical Selections. **11.30,** KDKA Ensemble Concert, conducted by Victor Saudek, relayed from the William Penn Hotel, Pittsburgh. **12.0 Midnight,** Telechron Time, Baseball Scores, Ensemble Concert (continued). **1.45 a.m.,** Programme of the Whittall Anglo-Persians from WJZ. **2.15 a.m.,** Goldman Band Selections from WJZ, Longine Time. **3.15 a.m.,** Baseball Scores, Telechron Time. **10.30 a.m.** (approx.), Close Down.

POSEN (344.8 metres); 1.5 kW.—**10.15 a.m.,** Divine Service, relayed from a Polish Church. **12.0 Noon,** Time Signal. **5.0,** Programme from **Warsaw. 6.50,** Programme from **Warsaw. 7.15,** Talk, followed by relay of the **Warsaw** Programme. **8.30,** Vocal and Instrumental Concert by the Mozart Club, conducted by M. Venceslas Napieraka, with Sophie Fedyczkowska (Soprano), Sylvester Wesolowski (Humorist and Accordion Player), Works of Strauss, Fall, etc. **10.0,** Time Signal, News Bulletin and Sports Notes. **10.20** Miscellaneous Items. **10.40,** Programme of Dance Music, relayed from the "Palais Royal" Restaurant, Posen. **12.0 Midnight,** (approx.), Close Down.

PRAGUE (348.9 metres); 5 kW.—**7.0 a.m.,** Open Air Musical Programme, relayed from **Carlsbad. 9.0 a.m.,** Agricultural Report, followed by Church Music Recital. **11.0 a.m.,** Outside relay of an Orchestral Concert. **12 Noon,** Popular Instrumental Concert. **4.30,** Instrumental Concert. **5.0,** Programme for Workers. **6.0,** German Transmission, followed by Musical Programme. **10.0,** Time Signal, News Bulletin and Outside Relay.

RABAT, Call PTT **(416 metres)**; 2 kW.—**1.30.** The Station Orchestra. **2.30 to 9.15,** No Transmission **9.15,** Talks and News Bulletin. **9.30,** Orchestral Concert. **11.30,** Orchestral Music, relayed from the Jardin d'Eté Cinema in Rabat. **12.0 Midnight** (approx.), Close Down.

RIGA (526.3 metres); 4 kW.—**10.15 a.m.,** Divine Service, relayed from the Mara Church in Riga. **1.0,** Programme of Tales, Songs and Music for Children, followed by Talks for Farmers. **4.0,** Afternoon Concert, followed by Programme of Talks. **7.0** (approx.), Concert of Vocal and Instrumental Music, followed by Dance Music Programme, and News Bulletin; in the Interval, at **9.0 p.m.** Weather Forecast. **11.0** (approx.), Close Down.

ROME, Call 1RO **(447.8 metres)**; 3 kW.—**10.15 a.m.,** Opening Signal followed by Concert of Vocal and Instrumental Sacred Music. **1.0 to 2.0,** Instrumental Trio Selections. **5.0,** Opening Signal. **6.0, to 6.30,** Programme of Light Dance Music, relayed from the Casinetta. **8.0,** Opening Signal, Notes and Reports, followed by Agricultural Talk. **8.30,** Sports Notes, followed by News Bulletin. **8.46,** Review of Current Events. **8.59,** Time Signal. **9.0,** Concert by the Grand Symphony Orchestra, with Instrumental Solos; Orchestral Suite from "The Fair Maid of Perth" (Bizet) (a) Prelude, (b) Serenata, (c) Tempo di Marcia (d) Gipsy Dance; in the Interval, Review of Reviews. **11.5,** Last News Bulletin. **11.15** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF **(21.96 and 31.4 metres)**; 30 kW.—**3.45,** Christian Science Church Service. **10.30,** The Ballad Singers of New York in their Repertoire. **11.0,** Stetson Parade Programme from **Boston,** Mass. **12.0 Midnight,** Selections by the National String Orchestra. **12.25 a.m.** (Monday), Baseball Scores from **New York. 12.30 a.m.,** Capitol Theatre Programme from **New York. 2.0 a.m.,** Address: Our Government, by David Lawrence, from **Washington D.C. 2.15 a.m.,** Atwater Kent Programme from **New York. 2.45 a.m.,** Time, followed by Biblical Drama from **New York. 3.15 a.m.,** Experimental Transmission of Television Signals. **3.30 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**4.30,** Concert of Orchestral Music. **5.30,** Market Prices of Cereals. **8.15,** Selections of Music on Turkish Native Instruments. **8.30,** Weather Report and Time Signal. **8.40,** Concert of Instrumental Music. **10.0,** News Bulletin. **10.30** (approx.), Close Down.

STUTTGART (379.7 metres); 4 kW.—**11.0 a.m.,** Morning Recital of Instrumental and Vocal Sacred Music. **12.0 Noon,** Promenade Concert with Gramophone Records in the Intervals. **2.0,** Children's Corner, relayed from **Voxhaus,** followed by Programme of Vocal and Instrumental Music, Talks and Reports. **8.0** (approx.), Light Musical Programme, followed by Sports Notes and News.

TOULOUSE (Radiophonie du Midi) **(391 metres)**; 3 kW.—**12.30,** Instrumental Concert. **1.0,** Chimes. **1.45,** Review of the Press. **8.0,** Exchange Quotations and News Bulletin. **8.30,** Instrumental Concert. **9.0,** Verdi Festival: Selections from the Works of Verdi, sung in Italian, German and French—Rigoletto, (a) Orchestral Fantasia, (b) O Doux Noms, (c) Tous Deux Egaux, (d) Comme la Plume au Vent, (e) Miserere (in Italian), (f) Vocal Quartet in Italian (g) Aria in German.

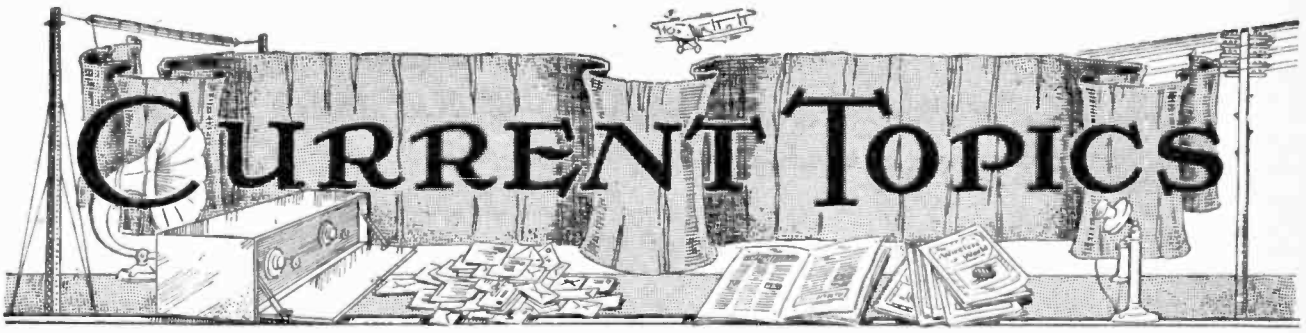
VIENNA (577 and 517.2 metres); 1.5 and 5 kW.—Programme relayed by **Graz** (357.1 metres), **Innsbrück** (294.1 metres), **Klagenfurt** (272.7 metres), and **Linz** (254.2 metres).—**11.0 a.m.,** Vienna Symphony Orchestra, Selections and Songs. **4.0** (approx.), Light Instrumental and Vocal Selections, followed by Talks Programme. **7.0,** "The Magic Flute," Opera in Two Acts (Mozart), relayed from the Festival Hall, **Salzburg,** followed by Popular Selections of Light Music and Dance Music.

VILNA (435 metres); 1.5 kW.—**10.15 a.m.,** Divine Service, relayed from the Vilna Cathedral. **12.0 Noon,** Musical Programme, News Bulletin, followed by Programme of Talks and Music. **8.15,** Programme relayed from **Warsaw,** followed by Dance Music Programme. **11.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**8.0 a.m. to 9.0 p.m.,** Special Harvest Festival Programme, relayed from **Spala**; Part I: Mass relayed from the Camp, followed by Procession of the Delegations; Parade of Agricultural Implements and Carts and Agricultural Workers; Presentation of a Crown to the President. **12.0 Noon,** Time Signal, Fanfare from the Tower of the Church of Notre Dame in Cracow; Aviation Report and Weather Forecast. **2.0,** Harvest Festival Programme; Part II: Placing of Wreaths, Speeches, Recitations and Songs, followed by Sports, Dramatic and Orchestral Programme and Dance Music. **10.0,** Time Signal, Aviation Report and Weather Forecast. **10.5,** News Bulletin, Police Information and Sports Notes. **10.30,** Programme of Fox-Trots and One-Steps, relayed from the Oaza Restaurant, Orchestra conducted by W. Roszkowski and I. Karbowiak. **11.30** (approx.), Close Down.

ZAGREB (310 metres); 0.35 kW.—**12.15,** Instrumental Selections. **5.0,** Relay of Sports Events. **7.45,** Wireless Propaganda Talk. **8.0,** "The Magic Flute," Opera in Two Acts (Mozart), relayed from the Festival Hall, **Salzburg,** followed by News Bulletin.

ZURICH (588 metres); 1 kW.—**11.15 a.m.,** Concert by the Station Orchestra. **12.29,** Weather Forecast. **12.30,** Instrumental Concert. **4.0,** Concert by the Carlton-Elite Hotel: The Carlotti Orchestra. **7.30,** Religious Address. **8.0,** Concert by the Bern Wood Wind Quintet, relayed from **Bern,** with Songs and Pianoforte Music in the Intervals. **10.0,** News Bulletin and Weather Forecast. **10.15** (approx.), Close Down.



Events of the Week in Brief Review.

PLEASANT SUNDAY AFTERNOONS.

A wireless set with loud speaker is to be installed for the entertainment of tramps detained on Sundays in the Sleaford (Lincs) Institution.

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A RARE RANK.

Telegraphist-Lieutenant Walter Turnbull, who has just been appointed officer-in-charge of Aden wireless station, is one of the only three naval officers who at present hold the rank of Telegraphist-Lieutenant, which dates from 1918.

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"BLISSFUL IGNORANCE."

At the Westminster Police Court a few days ago a South Kensington wireless "pirate" said: "I plead guilty, but I was in blissful ignorance that I had to take out a licence at all."

The Magistrate: "You mean you were in ignorance."

A penalty of 20s. was imposed with 10s. costs.

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BIG BUSINESS IN AMERICA.

During the past half year the Radio Corporation of America made a net profit of 4,524,000 dollars as compared with 552,000 dollars in the corresponding period last year.

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FIRST YEAR OF INDIAN BROADCASTING.

The Calcutta broadcasting station celebrates its first anniversary on Sunday next. The Bombay station was a year old on July 23rd last.

While admitting that the first year of working has not been so satisfactory as had been hoped, the Indian Broadcasting Company expresses confidence in its ability to make "far more substantial progress in the months to come."

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BERLIN WIRELESS SHOW.

The Berlin Wireless Exhibition is to be held this year from August 31st to September 9th inclusive.

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SET TESTING IN THE AIR.

All the homely, old-fashioned ways of testing the anti-microphonic properties of receivers such as turning the loud speaker setwards, stamping the feet or coughing, seem rather tame beside those now being practised by the Pilot Electric Manufacturing Company, of Brooklyn, N.Y. This company conducts such tests in an aeroplane radio laboratory, presumably in the belief that the set which preserves its non-microphonic virtues while looping the loop or side-slipping through the air, is unlikely to respond too readily to the domestic vibrations of the average home.

Mr. M. B. Sleeper, the company's chief research engineer, also uses the 'plane for transmission tests from the air, and even, it is rumoured, for television experiments.

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PHOTO TRANSMISSION TO SCOTLAND.

The Belin photo transmission system has been adopted by "The Scotsman" newspaper, thus enabling photographs to be sent by telephone from the London branch to the editorial office in Edinburgh.

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TRIBUTE TO R.A.F. WIRELESS.

A special tribute is paid to the R.A.F. Signals Branch by the organisers of the King's Cup Air Race round Britain. It is stated that the R.A.F. sent wireless outfits to all the controls except Nottingham and Leeds, and that during the two days of the race something like 1,500 messages were put through. The promptness and accuracy of the transmission won special commendation.

SHORT AND SWEET?

WRNY, New York, is reported to be transmitting images by television to 2,000 lucky patrons who possess the necessary receiver. At the conclusion of each item the face of the singer appears for a few seconds.

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JAPAN KEEPS PACE.

JOAK, JOSK and JOCK, the three Japanese broadcasting stations which are situated at Tokyo, Osaka and Nagoya respectively, have each had their power raised from one to ten kilowatts. Relay stations are to be erected.

A licence to transmit on 5, 38 and 80 metres has been granted to the Tokyo Electric Company.

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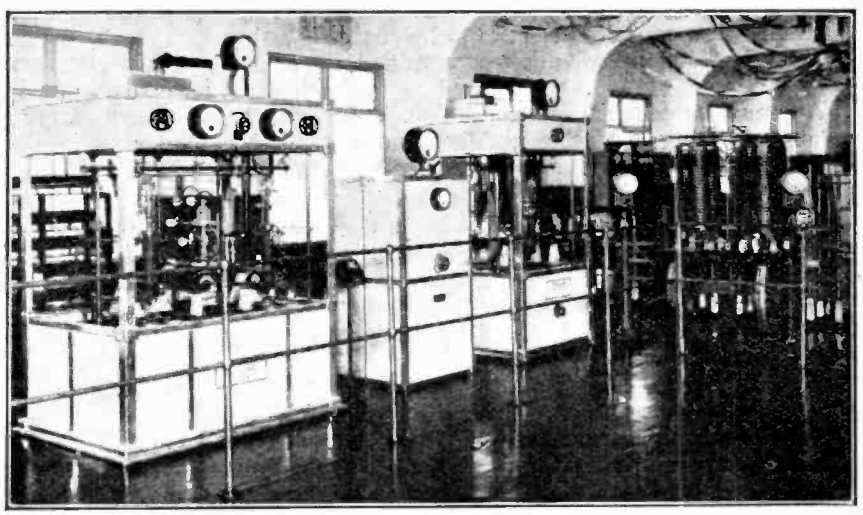
SUNSPOTS AND SIGNAL STRENGTH.

The effect of sunspots on wireless transmission and reception is to be studied by special apparatus which has been installed in the Astronomical Laboratory at Harvard, says *The Scientific American*. The instruments have been designed by the well-known Boston radio engineer, Mr. Greenleaf W. Pickard, who photographs the sun daily, comparing the incidence of sunspots with the quality of radio reception. Measurements are to be made on the carrier wave of WBBM, Chicago.



IN MODERN JAPAN. The new 10 kilowatt Marconi transmitter at the Osaka broadcasting station, which is heard clearly in Tokyo, 500 miles distant.

IN FAVOUR OF A.C.

Some Useful Hints for Users of A.C. Mains.

FOR amateur and experimental requirements an A.C. is preferable to a D.C. supply.

* * *

It is an easy matter to create a source of D.C. from A.C. at potentials greater or less than the supply voltage. It is not so with D.C.

* * *

An A.C. or rectified A.C. output is entirely isolated from direct connection to the supply mains. Accidental earthing of the supply is avoided.

* * *

So long as certain definite requirements are fulfilled rectified A.C. is easily smoothed. True, D.C. may in some cases need only a meagre smoothing equipment, yet in others smoothing proves exceedingly difficult.

* * *

Accumulator charging for L.T. supply is economical with the aid of a step-down transformer. D.C. cannot be so transformed.

* * *

Experience shows that an arc rectifier is a good method of battery charging from A.C. supply. A liberal output is obtainable. The small type metal rectifier will keep a battery of modest size in good condition by trickle charging.

* * *

A single arc rectifier can be used for charging both L.T. and H.T. batteries. The transformer secondary is arranged to give both high and low voltage outputs, while a high value of current limiting resistance is used when charging an H.T. battery.

* * *

There is really little purpose, however, in using an H.T. accumulator when an A.C. supply is available. A well-designed eliminator is preferable.

* * *

If small low-capacity cells are to be charged, a thermionic two-electrode valve is recommended.

* * *

Accumulator cells are sometimes thought to be a good solution to the grid biasing problem, but a small thermionic rectifier will be found cheaper and gives less trouble.

* * *

It is inadvisable to attempt to obtain grid biasing potentials by a potential divider associated with the H.T. battery eliminator, or to use the " free grid bias " system by causing the anode current to create a voltage drop across the grid biasing resistance.

* * *

Use a small independent rectifier if a high grid biasing potential is required for the output stage. After smoothing, a shunt resistance should be floated across the leads. This need only pass a milliampere yet it will keep the voltage constant as well as protect the smoothing condensers.

Remember that the voltage of a rectifier on open circuit is nearly half as much again as the secondary (R.M.S.) voltage of the transformer. Bear in mind also that the smoothing chokes cause voltage surges. It is, therefore, advisable to adopt condensers rated to withstand at least twice the rated D.C. output of the eliminator.

* * *

When using an A.C. battery eliminator, always turn off the H.T. before the L.T. supply, and turn the L.T. on before the H.T., so as to avoid excessive stress being set up across the smoothing condensers.

* * *

A high resistance leak across the condensers affords protection and prevents shocks.

* * *

Valves of the indirectly-heated cathode type afford a solution to the L.T. battery problem. No corresponding D.C. operated valves are as yet available.

* * *

If a floating L.T. battery be used with an L.T. battery charger as a source of L.T. supply, then a pair of heavy current chokes are needed together with an electrolytic condenser. Without the floating accumulator, the regulation is bad, or, in other words, the switching off of one valve in a set may cause the burning out of another, owing to high internal resistance of rectifying device.

* * *

Output valves of the L.S.5 A type may be heated with A.C. without fear of hum.

* * *

A.C. filament heating or heater leads should be run as a twisted pair and well separated from the rest of the wiring. No. 24 enamelled wire closely twisted up is useful for this purpose. True, there is a danger of short circuit across such thin insulation as enamel, yet the pair can be tested before use. The nearness of the two leads localises the A.C. field.

* * *

The effectiveness of a smoothing choke declines as the current passed increases. Chokes should be of liberal current carrying capacity with high inductance and low resistance.

* * *

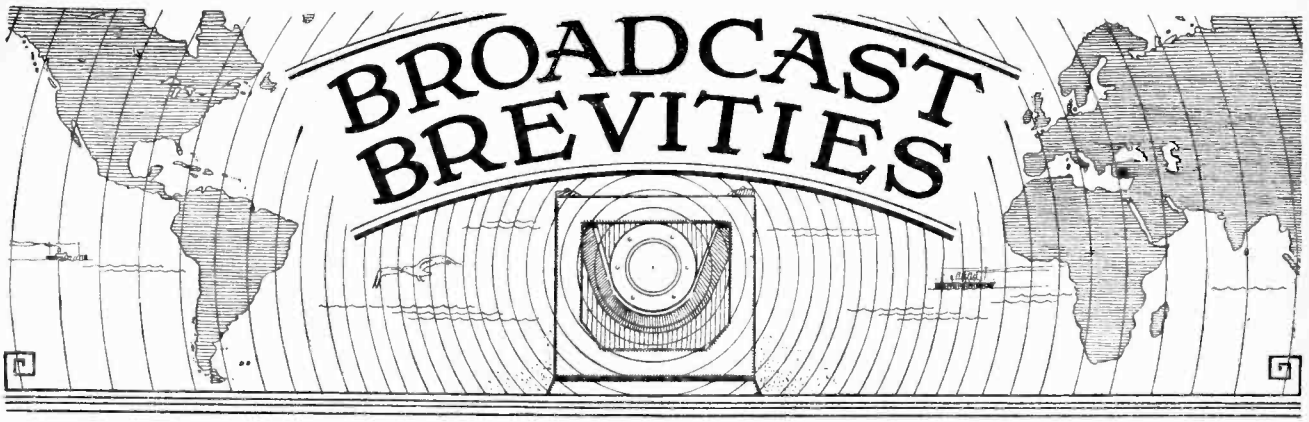
The lower the frequency of the supply the larger must the chokes and smoothing condensers be.

* * *

It is safer, in order to guard against the possibilities of " motor boating " and threshold oscillation to feed each eliminator-operated amplifying stage through a series-connected voltage regulating resistance rather than to use a potential-dividing resistance.

* * *

Derive field energising current for a moving-coil loud speaker from an arc rectifier. A floating battery is desirable for smoothing. Provided the winding is accommodated on a metal-ended spool, no A.C. hum will be present.



By Our Special Correspondent.

Going Ahead with the Regional Scheme.—In the Pennines.—A Compliment from Holland.—Something New in Variety.—Belfast's Turn.

Permission to Go Ahead.

The alarmists have been spreading tales to the effect that Potters Bar is about as far as the B.B.C. are likely to get with the regional scheme for many moons to come. This time the alarmists are definitely wrong. Potters Bar is no bar, so far as the rest of the scheme is concerned, and I am able to state that the Postmaster-General has granted permission to the B.B.C. to "go ahead" with any or all of the additional regional stations so far as the purchase of land and the erection of buildings are concerned.

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Activity at Potters Bar.

What the Corporation must not do at first is to attempt twin-wave transmission. Very searching tests are first to be carried out with single transmitters on the selected sites to determine whether interference is caused to official services and other interests.

The mobile transmitter which carried out such exhaustive tests before the Potters Bar site was definitely chosen is remaining there for the present, occasional transmissions still being carried out on low power for the purpose of testing relative signal strength in all directions of the compass.

The foundations for the new buildings are being prepared, and already a kind of road serves to guide the inquisitive pedestrian who deserts the Great North Road in search of the new station.

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Site of Pennines Station.

With regard to the Northern regional station, which will be proceeded with very shortly, no site has definitely been chosen, but I understand that the station will be situated in the Pennines approximately on a line drawn west of Huddersfield between 10 and 15 miles north of Manchester.

The remaining stations in the scheme will be located near Glasgow, Cardiff and Belfast. The exact sites are to be chosen very shortly.

A Shakespearean Announcer.

If Uncle Rex Palmer is holding his head rather high nowadays it is due to perfectly legitimate pride. He has seen in a well-known Dutch paper, "Radio Bode" (and I have read a translation myself), the following :—

"Whenever we have a difference of opinion regarding the correct pronunciation of an English word we can regard Rex as a standard. His English, in the real sense of the word, is the King's English, or the English of Shakespeare."

What price the Pronunciation Committee now?

FUTURE FEATURES.

London and Daventry (5XX).

AUGUST 26TH.—Service from Westminster Congregational Church.

AUGUST 29TH.—"Nurse Henrietta," a one-character play.

AUGUST 31ST.—Orchestral programme relayed from Folkestone.

Daventry Experimental (5GB).

AUGUST 28TH.—"Let's all go down the Strand," orchestral programme.

AUGUST 29TH.—"Pitch and Toss," a play by Bertha N. Graham.

Cardiff.

AUGUST 26TH.—Orchestral concert by National Orchestra of Wales.

AUGUST 31ST.—"The Prize Pigeon," a play by Laurence Housman.

Manchester.

AUGUST 27TH.—Variety programme contributed by Manchester, Liverpool, Leeds, Hull and Sheffield.

AUGUST 31ST.—Gilbert and Sullivan programme and a play.

Newcastle.

AUGUST 30TH.—Concert relayed from the Spa, Whitby.

Glasgow.

AUGUST 27TH.—"A Night Out" with the Station Orchestra and John Henry.

Aberdeen.

AUGUST 31ST.—Musical comedy programme.

Belfast.

AUGUST 29TH.—"The Shadowy Waters" (W. B. Yeats), presented by Richard Hayward.

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New Station Director at Hull.

Mr. W. M. Shewen, who has just been transferred from Manchester to succeed Mr. G. C. Dailey as station director at Hull, is not unknown to listeners in the latter city. He served as assistant station director at 6KH before being transferred to Manchester as chief announcer in March.

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Two Famous Comediennes.

I hear that those famous artistes, Clarice Mayne and Hettie King, may shortly appear before the microphone for the first time. Contracts are under consideration.

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Tantalising.

"Something entirely new in variety turns" is promised for the end of September. "It would be a pity to give away the secret," a B.B.C. official told me, "but I can say that Miss Kathleen Hamilton, who has originated this unusual form of entertainment, has never appeared on the stage, nor is her work known to the public at large. But she has delighted the guests at many private parties." With this tantalising remark he changed the subject

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More Relays from Belfast.

Belfast listeners have had to digest a good many London programmes in the past few years, so it seems perfectly fair that they should be allowed to reciprocate. This they intend to do on an extensive scale in the near future.

Hitherto the poor studio accommodation at Belfast has militated against such a project, but conditions will be vastly changed with the new studio, now in course of erection. This is to be of the new "double decker" type, 28ft. high, and as up to date as any studio in the world.

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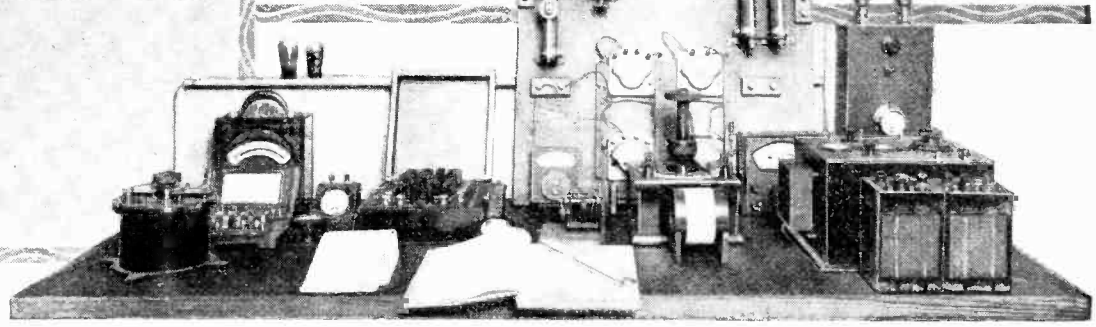
How the News Travelled.

Flight-Lt. R. S. Sugden, the winner of Ulster's first air race, a running commentary on which was broadcast the other day, told a B.B.C. official that when the machines returned to the aerodrome the results were not through. On reaching his home in Belfast, however, he found a telegram of congratulation awaiting him from his father, who had listened to the results broadcast in Liverpool, over 200 miles away.

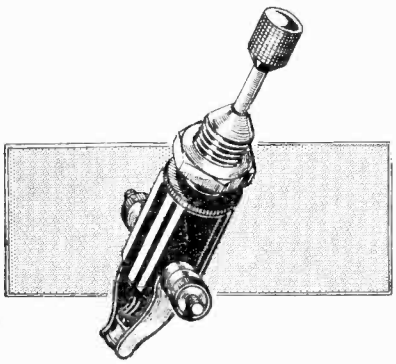
WIRELESS WORLD LABORATORY TESTS



A Review of Manufacturers' Recent Products.

RED DIAMOND SWITCH.

This L.T. switch works on the conventional push-pull principle and is built up on an insulator cut from ebonite rod. Together with the one-hole fixing bush, this gives a bearing length of 1¼in., and there is a complete absence of side play.



Red Diamond on-and-off switch.

The contact springs are strong and the on-and-off action is positive.

Made by the Jewel Pen Co., Ltd., 21 and 22, Great Sutton Street, London, E.C.1, price 1s. 6d.

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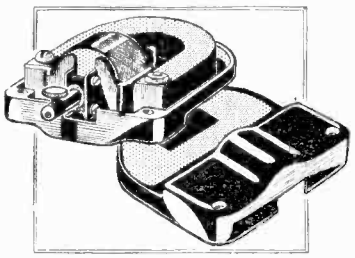
BURNDEPT ELECTRIC SOUND BOX.

The Burndept pick-up gives results quite equal to many of the more expensive makes, yet the price is reasonable, being £1 for the pick-up alone, or £1 12s. 6d. complete with volume control, valve plug adaptor, and 9ft. flex lead.

Tested on a set of special records giving examples of individual instruments of the orchestral, no fault could be detected aurally in the reproduction. The maximum sustained voltages produced by each instrument were measured and ranged from about 0.4 volt R.M.S. in the case of the double bass and cor anglais, to 4.1 for the tenor trombone.



Magnet system of the Burndept pick-up.

The average output hovered in the neighbourhood of 1 volt R.M.S. and it would therefore appear necessary either to bias the first valve considerably or to use the volume to cut down the input. Without the volume control a single pentode should give sufficient amplification for normal purposes.

The excellent sensitivity is due to the use of an unusually large permanent magnet with a differential or balanced armature movement. Rubber damping is employed, and the restoring force on the reed is not abnormally high, so that record wear should not be excessive.

The movement is suspended on rubber in a light moulded case and is remarkably quiet as regards mechanical noise emanating from the sound box itself.

Burndept gramophone pick-up with volume control and adaptor.

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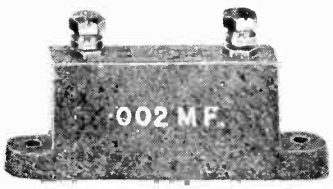
MAGNUM FIXED CONDENSERS.

The elements of these condensers consisting of ruby mica and copper foil are clamped under pressure and hermetically sealed in vertical type moulded cases of dark red material. Hexagonal terminal

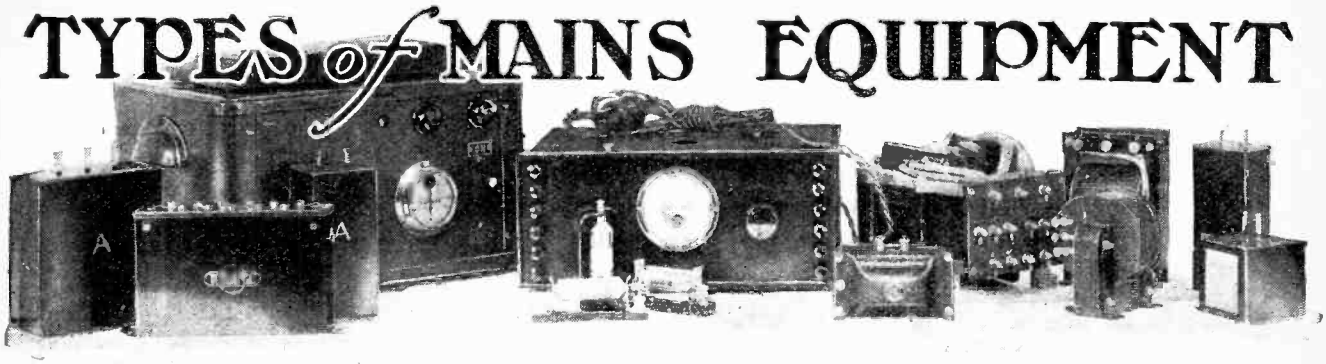


Magnum fixed condenser.

nuts slotted for screwdriver are provided, and all capacities below 0.001 are fitted with grid leak clips. Capacities from 0.0001 to 0.001 mfd. cost 1s. 6d., 0.002 to 0.006 mfd. 2s.; 0.007 to 0.01 mfd. 2s. 6d. A "0.002 mfd." condenser was measured and found to have a capacity of 0.0019 mfd.; all rated capacities are guaranteed to within 10 per cent.

The makers are Messrs. Burne-Jones and Co., Ltd., 288, Borough High Street, London, S.E.1.

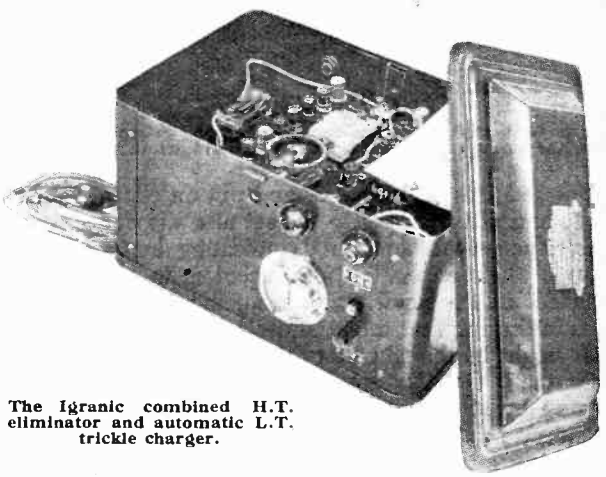
TYPES of MAINS EQUIPMENT



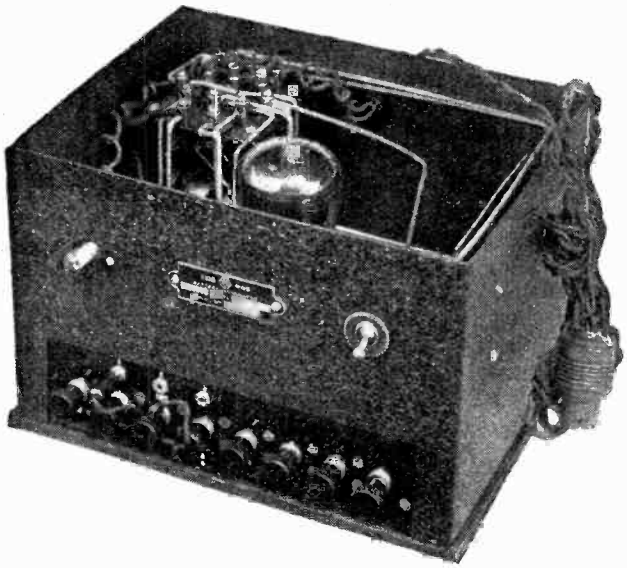
A Review of Current Commercial Practice.

AN article of this nature written at the time when broadcasting first began, would probably have occupied half a page, the illustrations consisting of a couple of ex-Government 2 mfd. fixed condensers, a ditto " 1,000-ohm " choke, and a few carbon lamps. The vast strides that have been made in this particular department of wireless technique since then can be gauged by comparing the state of affairs just mentioned with the present as reviewed in the ensuing article. This applies no less to complete H.T., L.T., and G.B. battery eliminators, and to those that eliminate the H.T. battery only, than it does to separate components. It is proposed, therefore, to discuss complete eliminators first, and for this purpose a number of eliminators have been chosen. They have been selected for no other reason than that they represent distinctive *types* of apparatus, and are good illustrations of their particular class.

Dealing with A.C. apparatus first, we come to the instrument made by Metro-Vick Supplies, Ltd. Its purpose is to dispense completely with *all* batteries without leaving even a small stray 1½-volt cell or two which the writer has sometimes objected to in complete mains sets claiming to derive all their power from the mains; but, of course, the claim is a perfectly just one, as small grid cells do not supply power but voltage only.



The Igranic combined H.T. eliminator and automatic L.T. trickle charger.



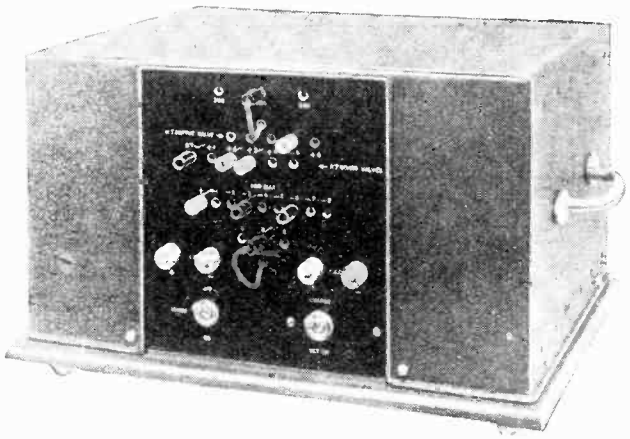
The Power unit by Messrs. Metro-Vick Supplies, Ltd., which replaces *all* batteries.

The leading features of this eliminator are the power transformer and choke, which are built on very generous lines speaking from the electrical point of view, although it is pleasing to note that the instruments have been constructed so that they occupy a minimum of floor space in the cabinet. The transformer occupies only a four-inch square on the baseboard; its height is such that it could be used in standard types of cabinet. Similar remarks apply to the choke, which can be made to occupy very small floor space indeed. They are thus very suitable for the home constructor who does not wish his complete mains apparatus to resemble a dimensional nightmare by Swift. The output terminals provide for H.T. and G.B. (both with several " tappings "), and finally two terminals provide for heating the valve filaments. A noteworthy point is that, although the series resistance feed scheme is used for enabling various H.T. voltages to be obtained, the arrangements for automatically discharging the smoothing condensers have not been neglected, as they so often are. The whole apparatus is switched on or off by means of a single pole switch, which fully complies with the regulations of

Types of Mains Equipment.—

the Electricity Advisory Board. A fuse lamp is mounted on the front panel.

The Igranic eliminator is also of generous design, and provides H.T., L.T., and G.B., but, unlike the instrument just described, makes use of a small accumulator and a trickle charger. The technical design of the eliminator is such that when the " Off " button is depressed, not only is the accumulator automatically disconnected from the receiver and put on charge, and the H.T. and G.B. supply to the set also disconnected, but simultaneously a small red indicating lamp (which is always alight when the instrument is in use) is extinguished, and a small green lamp lights up in its place thus indicating that the accumulator is on charge.

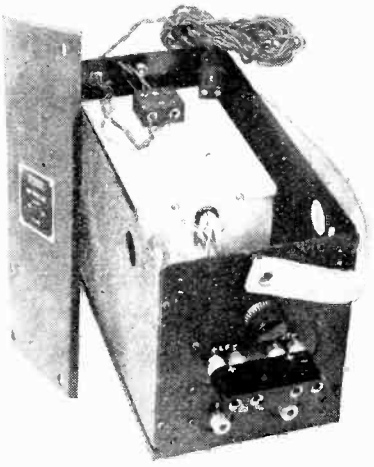


In the Gambrell unit the customary rectifying valves are replaced by the metal oxide type for H.T., L.T., and grid bias purposes.

It might be thought that this state of affairs continues until the " On " button is again manipulated in order to put the set on again. If this were so, there would be grave risk of overcharging the small accumulator if the set were left idle for any length of time, even though the charging rate were very small. This risk has not been forgotten by the manufacturers, who have catered for it in a very ingenious manner by means of a cleverly contrived automatic cut-out device. The voltage of the transformer rises slowly under the influence of the charge until it is equal to the charging voltage. Immediately this happens the device already mentioned comes into play automatically and cuts off the charge and the green light goes out, leaving the instrument ready for immediate service at any time. There is also a special switch on the eliminator for greatly increasing the charging current temporarily when special circumstances dictate. A point specially worthy of consideration is the arrangement made for ventilation by means of a specially designed lid. The instrument is also fitted with what is known as a " Boost " switch, upon manipulation of which the charging process is carried on at a much greater rate, such as would be necessary in certain circumstances. Care must be taken to put this switch back to the normal position as soon as the extra charging rate is no longer required.

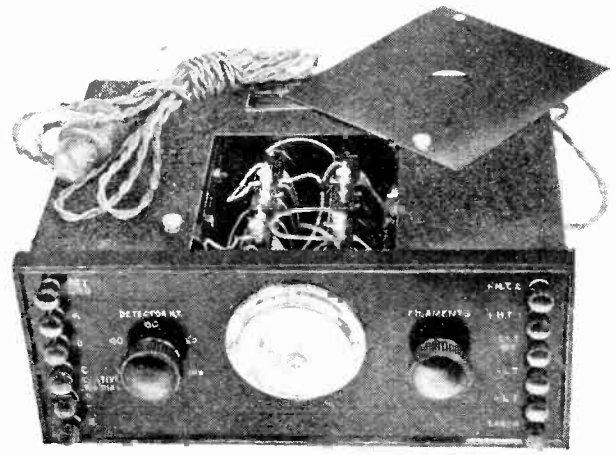
Efficiency and compactness are special features of the Regentone de Luxe H.T. eliminator.

The type of instrument which we have considered here is U.208 A, and extremely lucid instructions accompany this mains unit.



The G.E.C. H.T. battery eliminator combines portability with efficiency.

The Gambrell eliminator which also caters for the replacement of all batteries is designed on entirely different lines, insomuch that no valves whatever are employed, use being made of metal rectifiers on both the H.T. and L.T. side of the instrument. The arrangements on the H.T. side are the conventional full-wave type for use with metal rectifiers, and the L.T. side consists of a trickle charger operated by a switch on the panel. The maximum voltage available for the output valve is 170 at 20 milliamperes, or 135 at 50 milliamperes. Five separate H.T. tappings are provided for the output valve, and five for other valves in the set, each separate tapping being taken through a separate anode feed resistance.



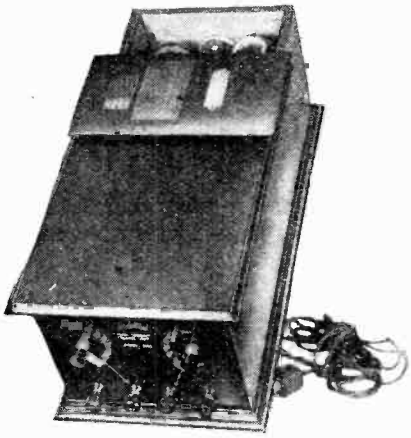
The Marconi All Power Unit for D.C. mains replaces all batteries.

The " Radielle " H.T. eliminator has two variable tappings and one fixed tapping. The rheostat fitted at

Types of Mains Equipment.—

the back of the instrument acts as a control to the whole output, and it should be turned on only sufficiently to obtain good results. Any alteration of the rheostat position will necessitate a readjustment of the variable tappings. It is necessary to switch off the eliminator before the filaments in order to protect the condensers in the unit from undue electrostatic strain. The actual instrument with which we have dealt is " model R.K."

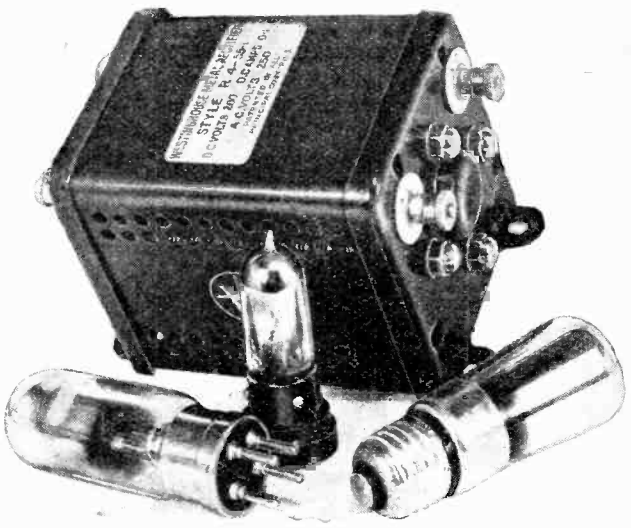
The " Marconiphone All Power Unit " does more than its name implies, and eliminates also the grid battery. Being D.C. it is unfortunately necessary for the would-be user to partially rewire his set, the filaments being put in series, and special arrangements made for connecting up to the appropriate grid bias terminals on the eliminator. All valves must be of the same current consumption, such as 0.1 amp. Only people who do not mind the size of their electric light bill can afford to take filament current from the mains with all valves in parallel, and possibly two L.S.5 valves in the last stage. The Marconiphone instrument is singularly well designed and, realising the difficulties of home constructors, they publish a well-written and informative booklet. It includes several circuit diagrams, and is, therefore, especially useful. The meter shown on the front panel is used in conjunction with the variable filament control, a red mark being marked on the dial at 0.1 amperes, passing which means damage to valve filaments.



The Radielle eliminator for A.C. mains is capable of providing half- or full-wave rectification as desired owing to the use of two half-wave valves.

The Regentone de Luxe D.C. eliminator shown on the opposite page is compact and well built, the maximum power output being 50 milliamperes at 160 volts. Two tappings which are continuously variable from a very low value up to 200 volts are provided, together with one fixed tapping for the output valve.

The G.E.C. eliminator illustrated opposite is provided with a leather strap, and is easily portable, thus rendering it quickly transportable from room to room with the set with which it is to be used. Two tappings are provided, one for feeding the output and other amplifying valves, and one for the detector, the latter being continuously variable by means of one of the well-known " Bradleyohm " resistances connected in series. An ingenious idea is the non-reversible plug which connects to the battery leads, an important point of this being that it is fitted with what are known as " floating " plugs, this making for greater ease in insertion and withdrawal.

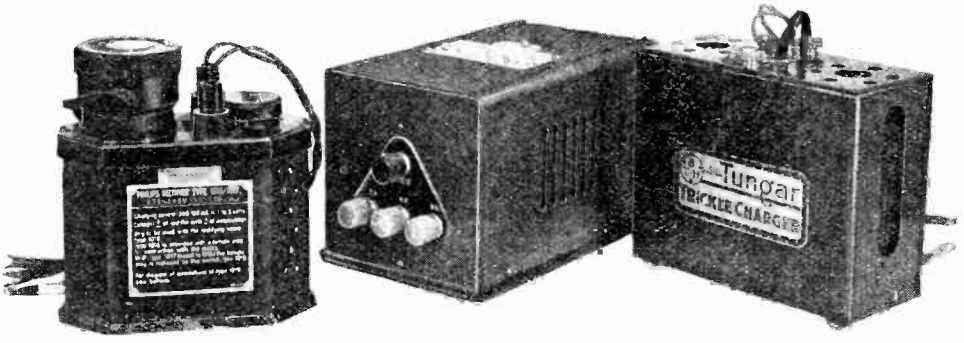


A group of well-known valve rectifiers, together with one of the new metal oxide instruments.

Passing now from the question of complete eliminators to components for building them or apparatus to use in conjunction with them, we can only consider a very few instruments which are truly typical.

Above are shown some modern rectifiers which include one of the metal rectifiers by Westinghouse. Since, however, this last type is discussed separately in this issue, it will not be dealt with further here. With regard to the valves, that on left-hand side of the photograph illustrates the well-known Philips rectifying valve whose output is 1.3 amperes, its main purpose being L.T. accumulator charging. This is in striking contrast to the new midget valve by the same makers, and the new Tungar valve, both of which give an output of a little over a quarter of an ampere, and are meant for the trickle charging of L.T. accumulators.

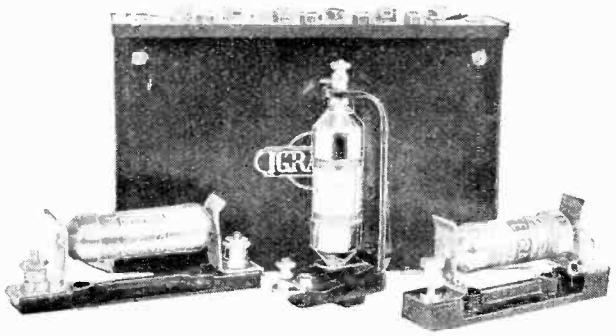
Below, the new Philips and also the Tungar trickle chargers appertaining to the two valves we have just discused are shown. The former instrument has a



Three popular trickle chargers. The Philips and the Tungar employ a valve rectifier, the Ecko, in the centre, employs a metal oxide one.

Types of Mains Equipment.—

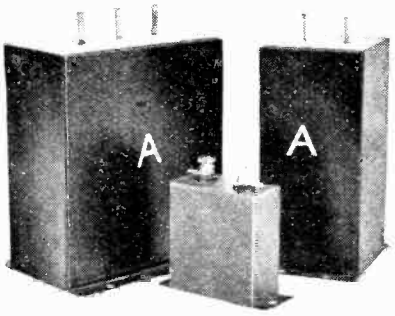
highly ingenious arrangement for fitting the valve within the case, so protecting it, and in addition possesses a special switch which switches off the receiver, including the disconnection of the H.T. battery eliminator from the mains if such is used, and at the same time putting the accumulator on very slow charge. Moving the switch in the other position reverses this process. The latter instrument, which is made by the well-known Rugby firm (to wit, the British Thomson-Houston Co.), is one of the most compact and efficient upon the market. The valve screws into a special holder, and is then completely enclosed. The third

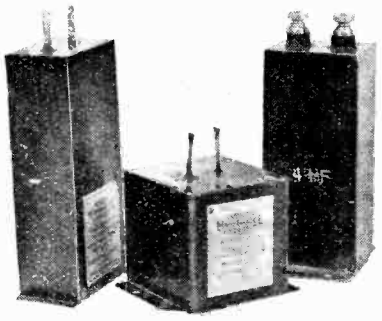


A group of modern potential regulating apparatus, in which several well-known devices can be recognised.

instrument is the Ecko trickle charger by E. K. Cole, Ltd., and employs a metal rectifier. The charging rate is 0.5 amperes, and it must, therefore, be put into the trickle charger class.

Below we see two of the most interesting pieces of apparatus extant to-day, namely, two " dry " electrolytic condensers, which for purposes of dimensional comparison are shown with an ordinary type of 2-mfd. condenser. They are not completely dry any more than a so-called dry cell is really dry, but are unspillable. It will be seen that in the case of the instrument on the right it is no bigger than the ordinary

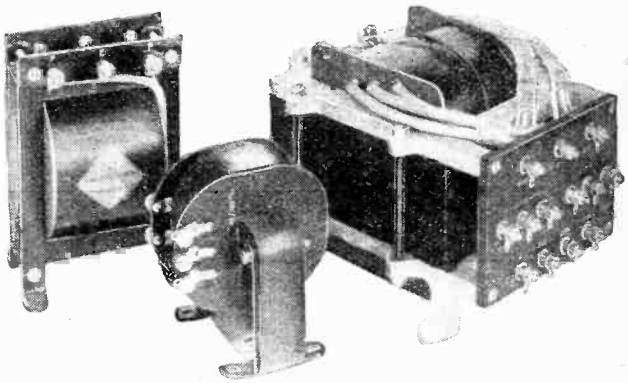




(Above) Dubilier electrolytic condensers of over 1,000 mfds. capacity, compared with a standard 2 mfd. condenser, and with

(Left) a group of 4 mfd. condensers of the "600-volt test" type.

" 600-volt test " type condenser of 4-mfd. capacity, as will be seen by reference to the adjoining illustration. and yet its capacity is well over one thousand microfarads. The instrument on the left is merely two of

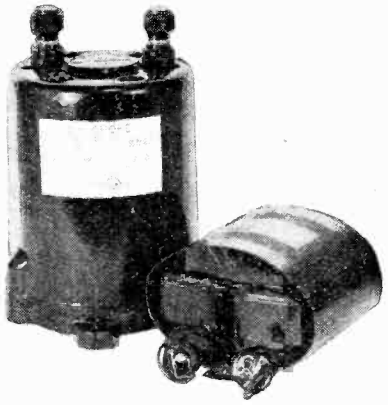


The Regentone and Pye transformers on the left are designed for metal rectifiers, the Parmeko on the right being for valve rectifiers. The maximum output voltage of the latter is 500.

these condensers built into one case, one terminal being common. The possibilities which these devices offer in the direction of smoothing L.T. energy are enormous. These two condensers are by the Dubilier Condenser Co., Ltd., and can be obtained with screw terminals if desired.

The advent of the dry metal rectifier postulates the coming of special transformers from the various manufacturers. An excellent example is the " Pye," shown in the centre of the above illustration.

The " Regentone " is another excellent instrument for use with metal rectifiers, and has an additional earthing terminal. A noteworthy point is that the transformer possesses two variable voltage tapping points on its secondary side instead of the one tapping which is encountered in some transformers.



The R.I. & Varley adjustable choke will maintain various inductance values up to 42 henrys when passing a 200 mA. current. The Heybeard full-wave power transformer will deliver up to 150 volts.

Considering the question of L.F. chokes, one could scarcely find a better example of sound modern practice than in the case of the R.I. and Varley adjustable heavy-duty power choke. This is an extremely large instrument, and is fitted with a special screw device which enables the inductance to be continuously varied from 27 to 23 henrys when screwed out, and from 42 to 15 henrys when screwed in. In each case these inductance figures are fully maintained with a current of 200 milliamperes, or, in other words, almost a quarter of an ampere. Side by side is shown the Heaybeard type No. 700 transformer, designed for full-wave rectification, giving an output voltage of 150.

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.

WIRELESS AND ELECTRICITY SUPPLY.

Sir,—I have been reading with interest the various letters which have been published in your paper recently on the above subject. I am now in a position to give you the Manchester Electricity Supply authorities' views on this subject. In the first place they sent letters to all consumers stating no wireless apparatus could be connected to their mains without their approval. I wrote and stated I was using a high tension eliminator, and stated the make. I received this morning a letter stating that *no* D.C. eliminators were permitted in Manchester. This seemed a sweeping statement, so I telephoned the department. I was informed that even if all the latest I.E.E. regulations were complied with, e.g., condensers in aerial and earth leads and double wound output transformer, no official approval could be given. The Electricity Department were of opinion that even then there was a possibility of danger to the public. As regards A.C. eliminators, these would be permitted so long as a double-wound input transformer was used and other reasonable precautions taken. I venture to think the dangers of shock are at least as great with an A.C. equipment of this type as with a D.C. equipment, even if the latter is in direct connection with the mains. The house fuses are surely an adequate protection to the company's mains.

Be it noted, however, that this solicitude for the public's safety relieves the Electricity Department from any shadow of a claim for changing over the thousands of D.C. eliminators that are already installed to A.C.

I think the above will be of particular interest to Mr. G. Bourne, of Blackpool, whose letter is published in your issue of the 8th inst.

Lastly, I think it is significant that I have been given to understand, more or less officially, that I can continue to use my D.C. eliminator so long as I appreciate I have been warned and any accidents are on my own head; *and* I can make no claim when they change me over to A.C., as is likely fairly soon. *Verb. sap*

A. D. K.

Manchester.

August 10th, 1928.

Sir,—I read with great interest your leader in July 11th's number under the heading "An Electricity Supply Ramp," which seems to me to be also directed to the supply authorities in this district, who are changing over their current from D.C. to A.C. in such a manner that the user of battery eliminators are suffering rather badly.

In one case I know of the apparatus had only been installed a few weeks prior to the change over, and the consumer in question was told that "the company were extremely sorry, but could do nothing towards either allowing for the cost of the eliminator or replacing it with one for A.C. supply." This seems to be their attitude to all users of the old D.C. for H.T. purposes, and your leader upon the question should go a long way towards getting a definite ruling upon the subject.

Regarding the permission of the company being necessary before any apparatus may be connected to their mains, the notice being sent round here definitely points this out, and says "that no apparatus will be changed or modified that may have been connected without permission."

I consider that the Commission should enquire into the whole matter as soon as possible, as the position is intolerable.

N. Kensington. "DISGUSTED."

July 11th, 1928.

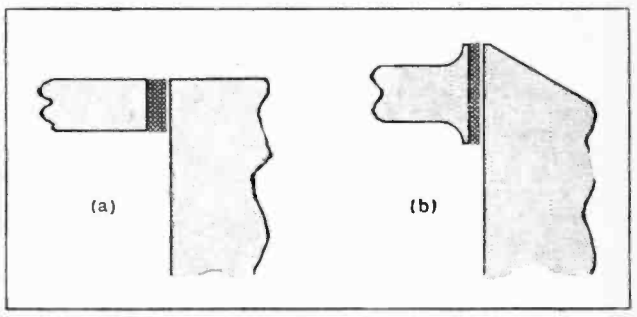
FIELD MAGNET DESIGN.

Sir,—I was much interested in the article on "The Design of the Field Magnet" in your issue of June 20th, the subject being one to which I have given some thought.

I cannot claim to be an expert on the subject, but should like to put forward my reasoning. I am more particularly concerned with the region of the air-gap and pole faces, which in the designs at present seem to me to be very inefficient.

To illustrate, we will assume a core of mild steel 2in. diameter (I consider cast-iron out of the question), then, according to magnetisation curves, it is not economical to work at a higher density than about 100,000 lines to the square inch, or 15,500 to the square cm.; this gives a total flux of about 300,000 lines for the core. If, now, we assume a leakage of 25 per cent., the area of the air-gap for a density of 10,000 lines to the square cm. must be 3.5 square inches, and this divided by the circumference of the core gives a width of 0.55in., say $\frac{5}{8}$in., whereas most of the designs appear to be about $\frac{3}{8}$in. only, which must mean a greater density in the core and greater leakage.

Now, if the width of the moving coil is increased and the thickness reduced in proportion, the length of the gap parallel to the lines of force can be reduced also, and since the ampere turns are proportional to the length of the path, an appreciable reduction in ampere turns could be effected. Further, since the ampere turns per unit length of path are proportional to the flux density, would it not be preferable to further increase the width and reduce the length as is done in dynamo design, still retaining the same total flux, e.g., if the width is doubled and the density halved, the ampere turns per unit length is halved, and, again, if the length is halved the ampere turns required are only one-fourth of the original for the same total flux. By so doing the pole faces can be so shaped so as to considerably reduce leakage, which, as shown by Mr. Castellain, is a very serious loss.



Two gap designs giving equal flux density.

I am aware that reducing the density in the gap will give a proportionately reduced output for the same number of turns in the moving coil, but could not this be compensated for by increasing the number of turns so as to keep the product of turns and flux the same? The ohmic resistance of the coil would be increased, also the weight, but the motional E.M.F. would remain the same.

What appears to me at present is that the efficiency of the magnet is too much sacrificed to considerations of the moving coil, hence only those who have convenient means to supply the magnet can avail themselves of moving-coil loud speakers, whereas I feel it should be possible to bring them within the range of the domestic set.

To summarise, I would suggest that the air-gap width be increased and the length reduced, and arrange the coil accordingly, thereby reducing leakage and the expenditure in ampere turns considerably.

I give herewith a sketch of the air-gap in two cases for the same flux density in which (*a*) has four layers of winding in the coil and (*b*) is broadened out into only two. The leakage path in (*b*) is increased and the ampere turns reduced by half, the turns and the flux density being the same for both cases.

Barnet. W. G. LEE.

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 herewith; 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.

Mains-fed Filaments.

My four-valve receiver derives its L.T. current from the mains, and all the filaments are connected in series. Its performance has never been really satisfactory, and I have come to the conclusion that a good deal of the trouble is due to L.F. instability, which would probably be cured by adopting the decoupling method of wiring, and also by fitting anode feed resistances. However, the former plan seems to be quite inapplicable when the filaments are connected as in my receiver. Can you offer a suggestion? H. F. T.

As you say, the complete realisation of the decoupling wiring scheme is impossible unless you alter your filament connections, but a good many of the benefits resulting from the isolation of the various circuits can be obtained if you wire your grid and plate circuits on the lines suggested in Fig. 1. We have assumed that your set is the usual combination of H.F. amplifier, detector, and two L.F. stages. From the diagram you will see that each grid circuit is returned through its bias battery to the negative side of its filament, and that no attempt is made to obtain "free" bias by using the drop in voltage across one or more of the filaments, or by making one battery serve for several valves.

As for the anode circuits, you do not specify the source of supply, but we presume that current is also derived from the mains. In any case, the alternating component of the various anode currents, whether H.F. or L.F., may be prevented from circulating in the external common circuit by fitting the usual feed resistances and by-pass condensers shown at R and C. Assuming a mains supply, still greater immunity from trouble will be obtained if you fit separate smoothing circuits for the detector and each L.F. valve.

RULES.

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

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

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

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

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

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

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or photographs.

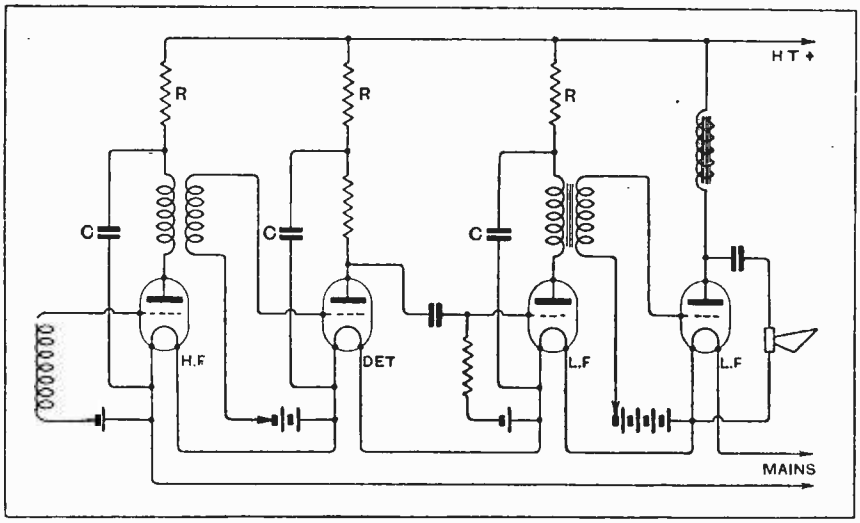


Fig. 1.—Precautions against instability in a receiver having series-connected filaments fed from D.C. mains. The diagram is simplified by the omission of tuning condensers, etc.

o o o o

A.C. Filament Heating.

I have been running a pair of L.S.5 output valves from raw A.C. with very satisfactory results, and am now thinking of replacing my first L.F. amplifier with an L.S.5B supplied in a similar way. Do you consider that this alteration would be likely to introduce trouble from A.C. hum? A. C. C.

The fact that you have been successful in using raw A.C. for filament heating in the output stage does not imply that the filament of the first L.F. amplifier could be heated in the same way without introducing trouble. A number of suitable and economical valves for this stage are available, and as you apparently intend to use an accumulator for the earlier valves, we think that any advantages obtained are offset by the risk of encountering difficulty. We do not recommend the plan.

o o o o

House-lighting Accumulators.

I have a 110-volt accumulator house-lighting plant, and intend to use it for H.T. supply to my receiver. Is it necessary to insert a smoothing choke and condensers? W. A. E.

Generally speaking, it is unnecessary to use any smoothing devices, although a possible exception exists in cases where the accumulator supply is used for operating electric motors. Also, if you wish to operate the set while the batteries are being charged, it will almost certainly be found necessary to take some precautions.

o o o o

H.T. Accumulators.

The charging rate of my H.T. accumulator battery is stated by the makers to be 100 milliamps. This is considerably more than the maximum output of the valve specified for the "H.T. Trickle Charger" described in "The Wireless World" for August 3rd, 1927, and I am doubtful whether this instrument would be suitable for my requirements. Would you recommend me to modify it in any way? M. T. C.

A higher charging rate could be obtained by fitting a rectifying valve giving a greater output, but we should point out that there is no need to charge a battery at the maximum current specified. In many cases it is convenient to charge at a much lower rate, and we expect that the unit to which you refer would be quite suitable without midification.

The Wireless World

AND RADIO REVIEW

(16th Year of Publication)

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Editor: HUGH S. POCOCK.

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CONTENTS OF THIS ISSUE.

THE NEW VALVES.

EVERY step in the direction of improvement of apparatus for wireless reception in the past has been linked up with the question of the types and efficiency of valves available. It so happens, no doubt, that progress in the development of components other than the valve has coincided to some extent, but it is quite certain that the progress in receiver development as a whole could not have proceeded very far unless valves had at least kept pace with the times. As it is to-day, it is probably correct to say that it is the valves which lead the way in efficient receiver design, and probably at no time in the history of broadcasting has the wireless user had placed at his disposal all at once such a wonderful choice, both in new valves and improved types, as become available to him this autumn.

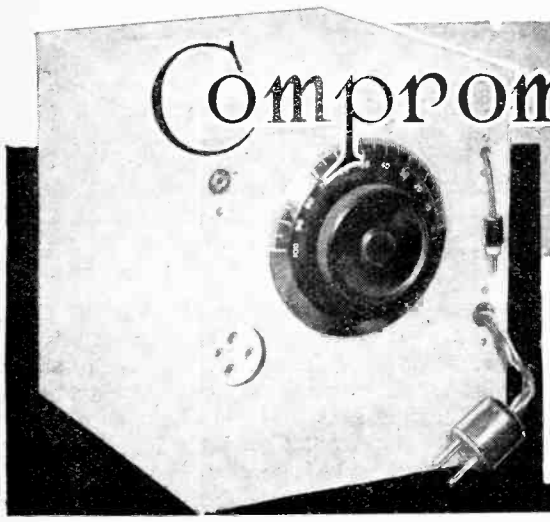
The Olympia Radio Show, now just a month ahead of us, is already responsible for bringing new products to light, but undoubtedly the most important indication of progress, so far, is revealed in the pages of this issue devoted to a list of the principal types of valves and their characteristics. Some of the valves listed are entirely new to our readers; others, whilst comparatively old in name, are new in their characteristics, a radical change for the better, in the shape of an increase in the amplification factor and a reduction of A.C. resistance having been brought about as a direct result of a greatly improved filament. In addition to the appearance of a wider selection of screened grid valves, various makers now announce the new "Pentode," operating at different voltages, whilst of special interest to those using A.C. current is the series of heavy filamented valves taking 0.8 amp., so that the filament can be heated from raw A.C., dispensing with the necessity for rectification or the alternative expedient of indirectly heating the filament.

If these new valves are to be regarded as a foretaste of what other manufacturers in different branches of the industry may have in store for release at the Show, then there is indeed something to look forward to.

PICTURE BROADCASTING.

THE broadcasting of "still life" pictures has, as we know, become a practical possibility, and can be achieved by several different systems at present in existence. The B.B.C. has given a promise that it will shortly undertake some regular experimental transmissions of this nature, and we may, therefore, expect that there would be a demand for apparatus to receive these transmissions at home. In connection with the broadcasting of pictures a new problem arises, for in order that a picture may be satisfactorily received it is necessary that the receiving apparatus should operate on the same principle and be of the same pattern as that used for the transmission. Now if the B.B.C. decides to make use of a particular system and exclude others, they may find themselves linked up with some commercial undertaking which, by reason of its patents, may control the source of apparatus suitable for the reception of the transmissions.

It would seem to us that if the broadcasting of pictures by any one system is to be adopted by the B.B.C. then, before the Postmaster-General gives authority for the transmissions, he should satisfy himself that any *bona fide* manufacturer can construct and sell apparatus for the purpose under a reasonable licence agreement with the patentees. In this way this new branch of the wireless industry would be put on the same footing as was the parent broadcasting industry when the General Licence Agreement between the Marconi Company and other manufacturers was arrived at before the licence to commence broadcasting was granted by the Postmaster-General.



Compromise in Receiver Design. Part 5.

THE H.F. AMPLIFIER

How the Tuned Circuits Affect Quality.

IF the spirit of compromise in design can be said to preside more over one part of a receiver than another, that part must surely be the high-frequency amplifier. For here, in addition to the conflicting factors of quality, efficiency, cost, and all the other points with which the designer has to cope, we have thrown in, as extra complications, the difficulties of attaining stability, selectivity, and convenience in manipulation, all of which must also play their part in deciding the final form which this section of the receiver will assume.

The addition of these extra factors makes the scope of the present section, in which a discussion of the relative importance of these matters will be attempted, so overwhelmingly vast that it will not be possible to give even so sketchy a *résumé* as has been done in dealing with the remainder of the set. The most that can be attempted is some more or less disjointed remarks which may serve to indicate the difficulties which exist, and to suggest means by which they can be partially overcome.

Screened Valve or Neutrodyne ?

The first point that must be settled in tackling seriously the question of design is the choice of a mode of amplification. We will rule out at once circuits of all types save two; one, the simple neutrodyne, as exemplified in the "Everyman Four" and other receivers of its type, and the other, tuned anode circuits based on the screened grid valve. The bulk of modern receivers fall into one or other of these classes, and it is therefore thought that the scope of our discussion should be kept within these limits. It cannot be denied, however, that for special purposes the older, unstabilised circuits still have their uses, and there may yet be a revival of that astonishing circuit, the "Armstrong Super."

So far as ease of handling and efficiency of amplification are concerned, the screened valve and the neutrodyne using ordinary valves are very much alike, though each has advantages denied to the other. Those who wish to go more deeply into the comparison are referred to a recent article in these pages;[1] it will suffice here to give a very brief summary of the position.

The most-advertised advantage of the screened-grid valve, that it enables stable operation to be obtained without the need for adjusting a neutralising condenser, does not appeal greatly to the amateur set builder, though it is a point of enormous importance to firms who have to turn out receivers in quantity and hand them over for working to completely unskilled users. From the point of view of the more technical amateur, a far greater advantage is found in the facts that the circuit used is simple, and that the coils employed can very readily be made interchangeable. One of the greatest bugbears of the set designer, that of arranging special coils for Daventry 5XX and the other stations between 1,000 metres and 3,000 metres, is thus done away with altogether. It is true, of course, that interchangeable coils can be used with neutrodyne circuits, too; but, in addition to the fact that more connections are required to the transformers employed in such circuits, we must remember that the over-wound primaries of fine wire that we have learnt to associate with the highest efficiency in these transformers are too delicate to survive long if the coils are subjected at all frequently to unsympathetic handling.

The greatest advantage of the neutrodyne circuit is that one stage appears to be capable of giving greater amplification than can be attained with a single stage using the screened grid valve. Especially is this the case if it is possible to use a valve with an indirectly heated cathode, the best of which have a mutual conductance about double that of most ordinary valves. If two stages are to be used, much of this advantage disappears owing to the difficulty of so constructing the neutrodyne circuits that each stage is a perfect bridge. Some slight sacrifice in efficiency, therefore, appears

[1] "Screened Valve *versus* Triode," *Wireless World*, February 18th, 1928; p. 143.

Compromise in Receiver Design—The H.F. Amplifier.— essential if perfect stability is to be attained over the whole tuning range. With the screened valve a second stage equal in efficiency to the first can readily be added, so that the overall amplification attainable by either method is, for two stages, much the same.

Other points, such, for example, as the extra cost of the screened grid valve, and the mechanical limitations implied by having to carry a valve, instead of only a wire, through the metal screening between circuits, will readily occur to the reader, and need not be elaborated here. Those who like to do their designing with complete thoroughness may note that the calculations connected with screened-valve amplification are on the whole the simpler.[2]

Screening.

Another question that arises in settling the general arrangement of the high-frequency amplifier is the extent to which screening is to be adopted, and how far it is possible or advisable to substitute for it the use of fieldless coils which do not require to be protected with screens to prevent interaction with one another.

The writer is inclined to look upon this subject from an unorthodox angle, and to consider the use of fairly complete screening essential to stop stray couplings between the various tuned circuits for other reasons than those connected with stability. It is perfectly possible to design an amplifier which is quite stable in spite of some small coupling between successive circuits, so that on that score alone screening is not always essential; but it nevertheless has a very important influence on the selectivity of the receiver as a whole. The reason for this is not far to seek, for it is due to the fact that with complete screening signals can only take the official route from aerial to detector, passing through every tuned circuit on the way. The very considerable falling-off in selectivity occasioned by running the aerial lead-in close to the detector valve will probably be familiar enough to most readers to emphasise this point without further discussion.

The chief need for compromise in this direction, however, arises from the relationship between coil efficiency and screening. The less the high-frequency resistance of the coils used, the greater the liability of the receiver to be unstable. If, in the endeavour to regain stability elaborate screening is resorted to, the effective resistance of the coils is raised owing to the production of eddy currents in the material of which the screen is composed, for it must be remembered that the energy of these currents is derived entirely from the signals in the coils. Thus it may easily happen that ultra-efficient coils in a completely screened receiver may lead to no appreciably greater amplification than could have been attained by using less efficient coils with less screening. It is therefore necessary to strike a balance between the efficiency of the coils and the degree of screening used, remembering that a greater measure of coil efficiency is worth striving for if the box surrounding it is to be large than if it is to be small, for the additional resistance introduced will be greater in the latter case than in the former.

Although fieldless coils do not call for very elaborate screening, their special construction can at most do no more than eliminate unwanted couplings due to their magnetic field, leaving capacity couplings practically unchanged. In an amplifier in which several stages are in use, screening will consequently be required, even if these coils are employed, though it will not usually be necessary to surround each circuit separately with a completely closed metal box. A further factor tending to permit a reduction in screening is found in the fact that these coils have a comparatively high high-frequency resistance, which assists considerably in attaining stability, though to the detriment of amplification.

If, in the interests of selectivity, it is decided to enclose each tuned circuit in its own screening box, another point arises. The fieldless coil sets up only small eddy currents in the metal screens (the ideal fieldless coil, of course, would set up none), and in consequence it may be surrounded quite closely by the screen without any appreciable raising of its resistance. If a compact design is desired, it may therefore prove more profitable in the end to use a fieldless coil, which, *when within the screen,* may quite conceivably have a lower resistance than a coil of orthodox shape, even if the latter is far superior in this respect when measured outside the set.

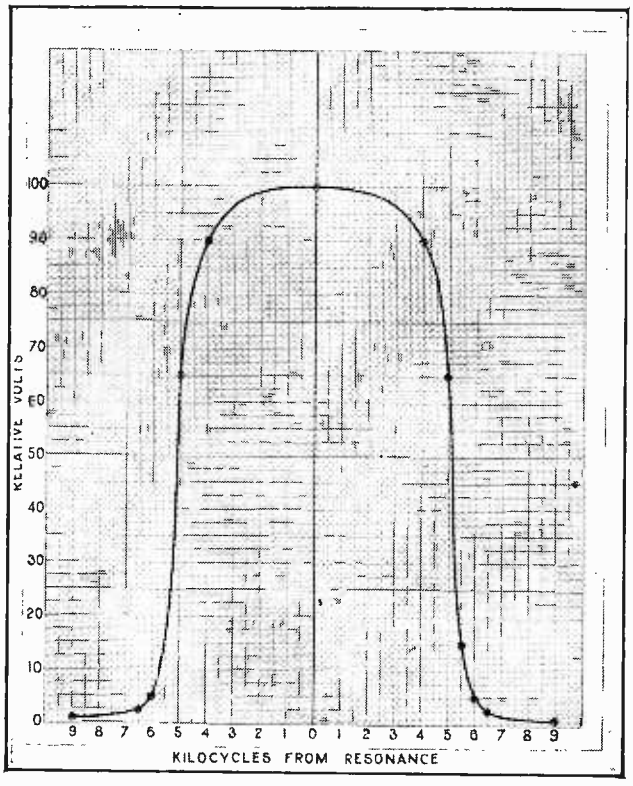


Fig. 1—The ideal resonance curve of the tuned circuits of a receiver. The side bands of 5 kilocycles on either side of the fundamental are embraced. These side band frequencies are created by note frequencies up to 5,000 cycles.

[2] *Experimental Wireless*, January, 1928, p. 3, and October, 1927, p. 597.

Compromise in Receiver Design—The H.F. Amplifier.—

It is everyone's ambition to possess a receiver giving the highest possible measure of sensitivity and selectivity, for both these qualities are essential if the set is to be capable of tuning in at will any desired station.

Sensitivity and Selectivity *versus* Quality.

Roughly speaking, sensitivity and selectivity go hand in hand, for if an extra stage of high-frequency amplification is added for the sake of improving sensitivity, selectivity also benefits through the presence of the additional tuned circuit that the extra stage implies. Unfortunately, high quality of reproduction is also likely to be required, and of this selectivity is the determined enemy. If we so design a receiver that, at half a dozen miles' distance from the local station the latter can be cut out completely in favour of a faint station on a neighbouring wavelength many miles away, it is almost inevitable that this station, when received, should be so sharply tuned that its side-bands and with them the high notes, are very seriously attenuated. In an endeavour to retain these side-bands we may perhaps reduce the overall sharpness of tuning by increasing the resistance of the tuned circuits; if we do so the local station will at once reappear and drown out the distant transmitter we are trying to hear.

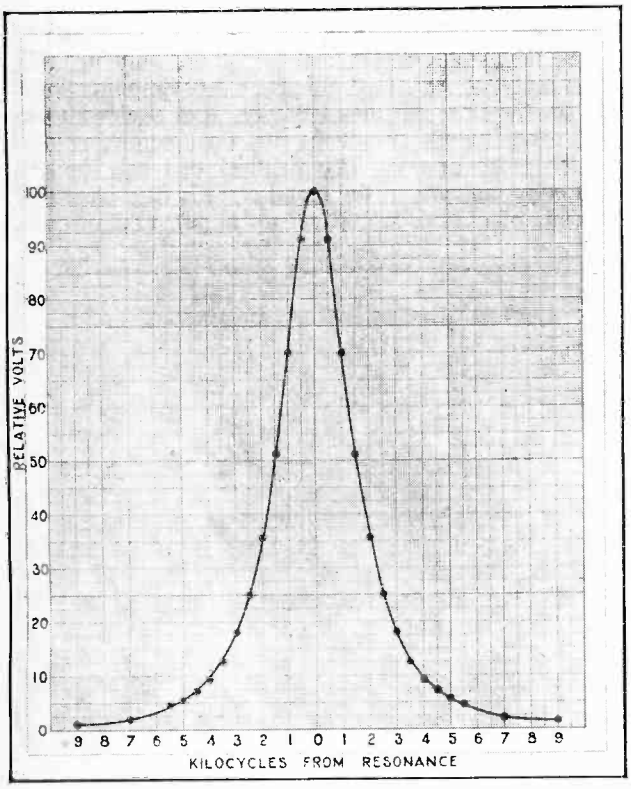


Fig. 2.—Resonance curve of receiver embodying three tuned circuits of reasonably low H.F. resistance.

It would appear, then, that there is no hope whatever of receiving with really good quality any station whose wavelength is close to that of the local transmitter—and this dismal conclusion is very nearly true. To combine high selectivity with really good quality, it is essential to use a very large number of tuned circuits, each of them of fairly high resistance. If this is done the overall resonance curve of the receiver tends to approximate to the ideal shown in Fig. 1, which shows a flat-topped curve with a sharp cut-off at about 5 KC. on either side of the point of resonance.

Contrast this with the resonance curve of Fig. 2, which shows the resultant curve of three tuned circuits, each of effective resistance 7 ohms, in cascade. In this diagram the really alarming way in which the side-bands are cut off by such a combination can be seen very clearly. If we remember that the side-bands out to 5 KC. from resonance are required if we wish to reproduce notes up to 5,000 cycles, we shall have some idea of the effect on quality of a high-frequency amplifier embodying three such circuits. If the detector that follows the amplifier is of the anode-bend type, the loss of high notes will be even greater than the curve would imply, for the response of this detector to applied high-frequency voltages of constant modulation is not linear, but follows a square law. This means that if the highest note is reduced to one-tenth of its legitimate amplitude in the tuning circuits, it will only be present to the extent of one-hundredth of its correct volume in the rectified signals. If the detector is of the leaky-grid type, this accentuation of the high-note loss does not occur; for certain values of signal strength there may even be a partial suppression of this undesired effect, quite apart from that due to the damping imposed by the detector on the last of the tuned circuits.

Judged aurally, the effect of this loss of side-bands is not nearly so terrible as one might expect from the appearance of Fig. 2. This is largely due to the fact that the human ear is comparatively insensitive to changes in sound intensity over quite wide ranges. In practice, it is found, even when using an anode-bend rectifier, that the loss of high notes occasioned by the use of two Litz circuits of the lowest practicable resistance is detectable, but does not force itself upon the attention unless it is looked for, or unless the resistance of one of the circuits is still further decreased by the application of reaction. If three such circuits are used, the high notes are quite noticeably diminished in strength, and the addition of a fourth tuned circuit renders the resulting music definitely unpleasant.

Detuning and Quality.

In this connection, therefore, we have to find a happy mean which will give us adequate selectivity with reasonable reproduction of high notes, remembering that as we flatten the tuning of each circuit by adding resistance to it we are decreasing the sensitivity of our receiver at the same time as we reduce the selectivity to an amount suitable for our purpose. In the interests of quality, therefore, we must use as many tuned circuits as convenience of handling and our financial resources permit, keeping the resistance of each to as high a value as is possible without making the sacrifice of sensitivity and selectivity too great.

When trying to settle upon a satisfactory compromise in this direction, it must not be forgotten that if we are receiving a station which comes in strongly, the various circuits can be detuned to a greater or less extent. By

Compromise in Receiver Design—The H.F. Amplifier.—

this means the overall sensitivity and selectivity of a receiver can be artificially and temporarily diminished, to the great advantage of quality. Some idea of the effect of this detuning can be gathered from the curves of Figs. 3 and 4.

Good quality with high selectivity is possible.

Curve *a* in this diagram is a repetition of Fig. 2, and shows, as before, the resultant resonance curve for three 7-ohm circuits in cascade. It is here assumed that all three circuits are tuned exactly to resonance with the incoming signal. Curve *b* is calculated on the assumption that only one of the three circuits is tuned exactly to the station being received, the other two being tuned respectively one kilocycle above and below resonance. Curves *c* and *d* represent an exactly similar state of affairs, but with the extent of the detuning increased to 2 KC. and 3 KC. respectively. The relative heights of the peaks of the curves indicate the relative strength of signal obtained with the different settings, but a better idea of the effect on quality can be had from an inspection of Fig. 4, in which all four curves are drawn with the same height at the central point. The gain in strength of the side-bands as detuning is increased is very evident in this figure; and the effect can be extended very considerably by further detuning.

It will be seen, then, that with the aid of a little juggling with the tuning knobs, we can combine in the one instrument a receiver capable of picking up really faint stations without much regard for quality, and a receiver with which we can hear the more powerful stations with really good quality. In practice it is found that a compromise made on these lines is the most satisfactory for general use.

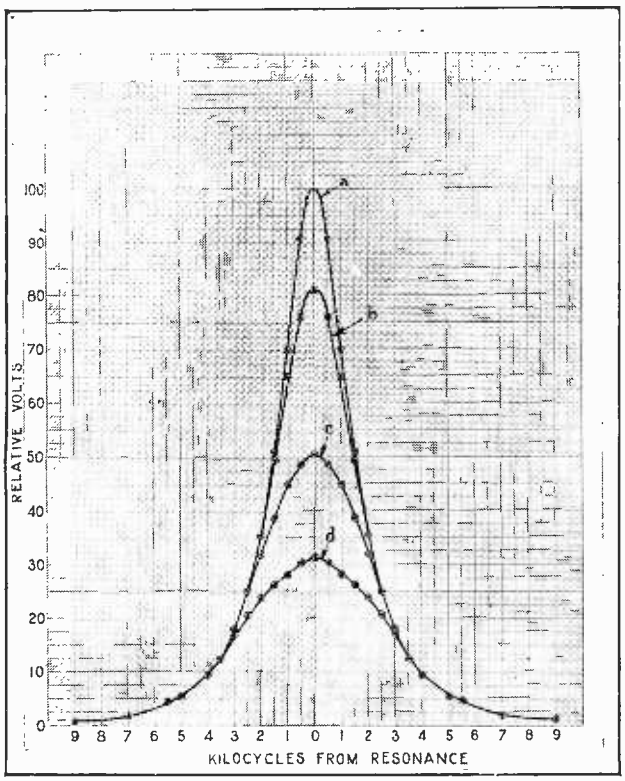


Fig. 3.—The effect of detuning in a three-circuit tuner as a means of broadening the response curve. (a) All circuits tuned to resonance. (b) One circuit at resonance, and the other two tuned respectively to 1 kilocycle above and below. (c) and (d) curves obtained with displacement of 2 kilocycles and 3 kilocycles respectively.

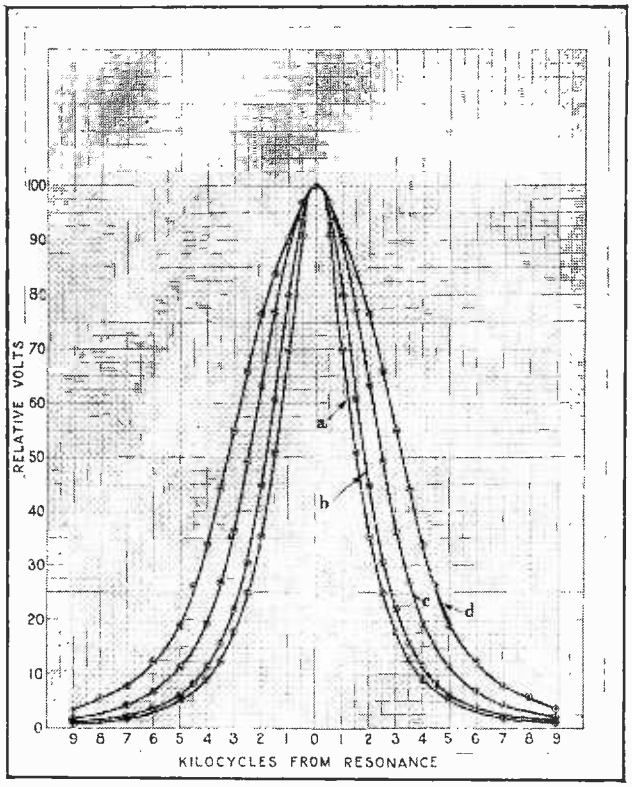


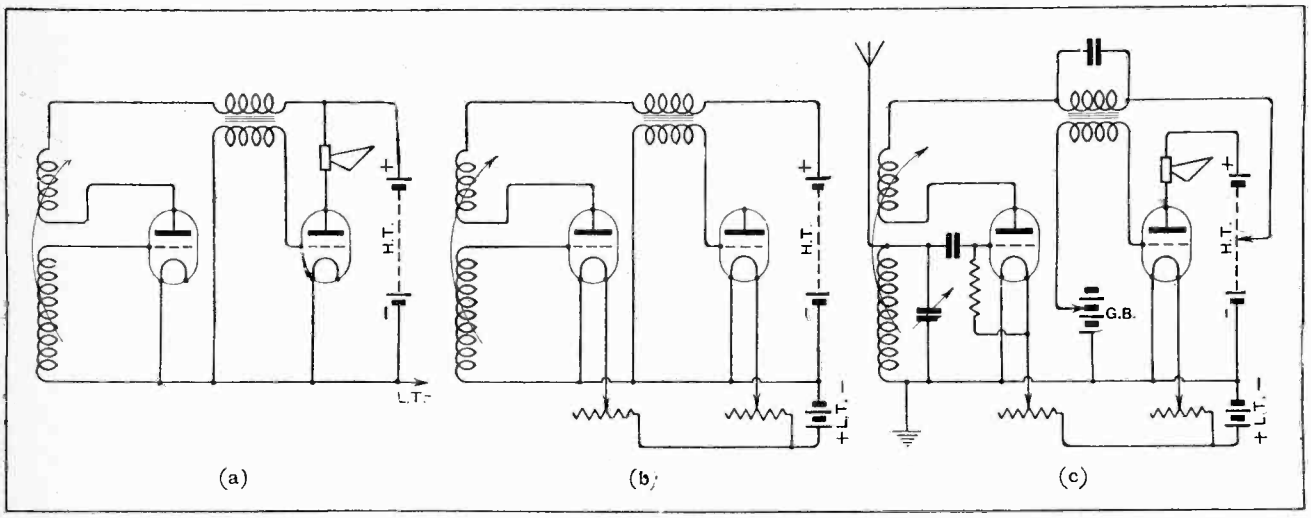
Fig. 4.—In order to make better comparison between the curves shown in Fig. 3, they are here replotted to be of equal height.

READING CIRCUIT DIAGRAMS.

Hints on Acquiring an Almost Essential Art.

By "RADIOPHARE."

WITH the help of the clear practical wiring plans which are now published, it is possible for anyone with little or no experience to build even a complex receiver, provided always that no attempt is made to deviate from the designer's specification. However, unless one has some knowledge of the purpose of the different connecting leads, difficulties will inevitably arise if alterations—even of a minor character—are introduced. Moreover, the tracing of any fault which may subsequently develop is infinitely more difficult if the amateur has not mastered the art of reading circuit diagrams. Practical wiring plans are all very well in their proper sphere, but it is a mistake to consider them as an aid to ascertaining the features of a circuit arrangement; for this, the conventional diagram is infinitely more convenient and much less cumbersome.



Showing how the circuit of a detector-L.F. receiver may be resolved into its simplest form.

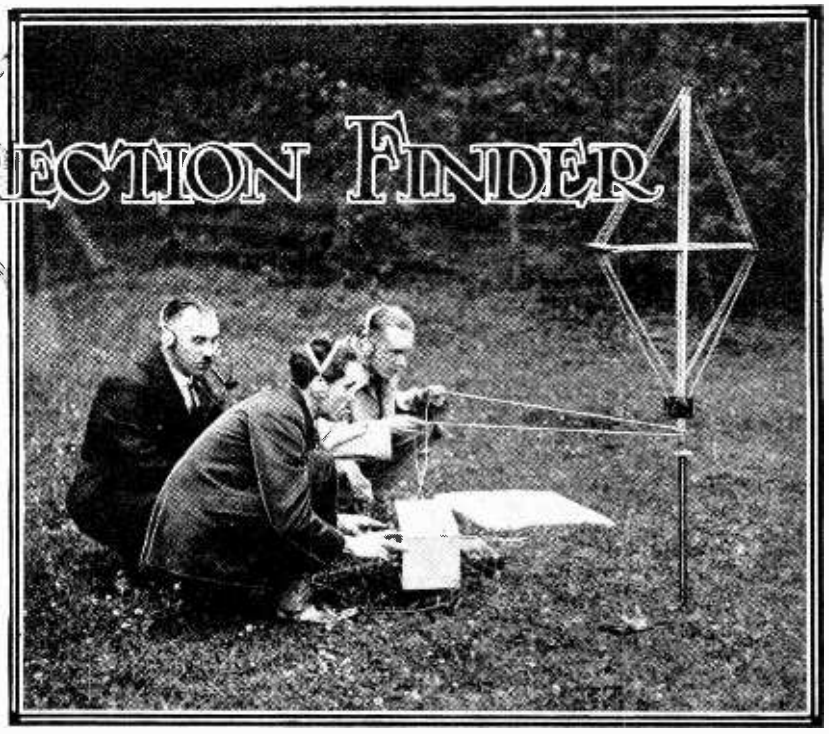
This mistaken impression that these circuit diagrams are difficult to understand is probably due to the fact that there is a tendency to consider them as a whole, rather than to follow the correct procedure of sorting out the various simple circuits which go to make up a receiver in its entirety. Some time ago a series of "Dissected Diagrams," showing how this process could be applied to every conceivable type of set, was published in this journal; although complete treatment of the points likely to lead to confusion is beyond the scope of the present short article, the writer hopes to show, by slightly different means, that the matter is no way beyond the capabilities of the beginner. It will be assumed that he is, or can make himself, familiar with the accepted symbols, which are printed in the majority of text-books.

In the accompanying Fig. (*a*) is shown what may be called the skeleton diagram of the typical detector L.F. set which is completed in Fig. (*c*). All complications have been removed, leaving only the simple series circuit; it is suggested that the reader who is studying any particular diagram should apply—if only in his mind's eye—a similar process of elimination. From a consideration of the first diagram, it is easy to trace out the four individual circuits, which are those from the grids and plates of each valve back to the respective filament connections. Thus the grid of the first valve includes only the coil, while its anode circuit is completed through reaction winding, L.F. transformer primary, and H.T. battery.

In the diagram (*b*) is introduced the next step towards completion, in the shape of the filament circuit wiring. In spite of the fact that this part of the receiver consists of simple direct current paths, it may sometimes appear to be complicated, due to the introduction of switching devices and rheostats.

We now come to the completed diagram (*c*) in which the various additions necessary to make a practical receiver are included. It is worth while tracing out grid and plate circuits again, comparing them with (*a*), when it will be observed that, in spite of apparent complexity as compared with the first sketch, the basic framework still remains, although extra components have been connected, either in parallel or series. For instance, a condenser is inserted in the detector grid circuit to give rectification, while the associated leak is joined between grid and positive filament. A tuned circuit is formed by connecting a variable condenser in parallel with the coil, across which the aerial-earth system is joined. If we consider all the components except the device actually in series with the anode and H.T. battery as belonging to the grid circuit of the succeeding valve, it will be easier to visualise the dividing line when stages are coupled by tuned anode or resistance arrangements.

RADIO DIRECTION FINDER



FOR THE EXPERIMENTER

Part II.—General Arrangement and Constructional Details.

By R. L. SMITH ROSE, D.Sc., Ph.D., A.M.I.E.E.

(*Concluded from p. 188 of August 15, issue.*)

THE diagram in Fig. 5 gives a general idea of the manner of the arrangement of the direction-finding coil inside the screen, while Fig. 6 shows the schematic circuit of the whole receiver, employing one detector valve with a two-valve low-frequency amplifier. It will be seen from these diagrams that the whole of the receiver is screened from the top of the coil right down to the output terminals to the telephones. The coil itself is inside a wire screen broken at the top to avoid closed loops, while the leads from the coil enter directly into the screened box containing the rest of the receiver. The coil is connected to the first valve in the manner of the well-known shunt-fed Hartley circuit arrangement, the centre of the coil being "earthed" to the screen which forms the common negative filament connection.

Obtaining a Good Minimum.

With this arrangement, however, the two ends of the coil, being connected to anode and grid of the valve, have a small and sensibly equal capacity to "earth" (i.e., screen). (Cf. Fig. 4.) To secure exact equality in the manner described in Part I,[1] however, a small balancing condenser C_2 is connected as shown in Fig. 5, and is adjusted while taking bearings to sharpen up the signal minimum. A slight disadvantage of this arrangement is that the balancing condenser forms a shunt across the tuning condenser C_1, and so alters the tuning of the whole coil to a small extent, but the advantage of a better minimum outweighs this small effect.

By keeping the tuning condenser of reasonably large capacity, however, this drawback is diminished, and incidentally the antenna effect of the whole system is also reduced. In the design described below a coil of six turns on a framework 2ft. square is employed. Such a coil has an inductance of about 55 microhenrys, and with a variable condenser of maximum capacity 0·0003 microfarads should give a comfortable working wavelength range of 120 to 240 metres. A condenser of capacity 0·0005 microfarads may be used if it is desired to work on higher wavelengths.

The Frame Coil and Screen.

The general arrangement of the frame coil and its support is shown in the diagrams forming Fig. 7, while a photograph of the complete apparatus is shown in Fig. 8.[2]. The receiving coil is a square of 2ft. side, wound on a wooden X-shaped framework with one of its diagonals vertical. This framework is supported in a brass tube 1¼in. diameter, through which pass the leads from the coil to the receiving apparatus. This brass tube forms the vertical axis about which the coil is rotated, and it is supported in a simple bearing formed on the top of the screened receiver box. An upper bearing is provided for the tube at the top of a simple wooden tripod clamped to the box. A pointer attached to the brass axis moves over a graduated scale also mounted on the box, and the direction of the coil can be read from this scale. The lower part of the brass tube passes through its bearing collar and a clearance hole in the top of the screened box. The tube and box are connected together by a short length of flexible wire, which serves the dual purpose of limiting the rotation of the coil to,

[1] See *The Wireless World*, August 15th, 1928, p. 188.

[2] The direction finder shown in Fig. 8 is similar to, but not identical with, that described in this article. It has been fitted with a supersonic heterodyne type of receiver to secure a much greater range for the taking of long-distance bearings.

Radio Direction Finder.—

say, ±360°, and of forming a definite connection between these two parts of the screen.

The X frame is made of strong wood, such as teak or mahogany, to the dimensions shown in Fig. 7; triangular strengthening pieces are added at the centre as indicated. The bottom end of the vertical part of the cross is rounded to fit inside the brass tube, into which it is packed tight and bolted. The method of constructing the coil and the screen surrounding it can be understood from the smaller diagrams included in Fig. 7. It will be seen that a pair of keramot or ebonite spacing-plates, 3in. square, is attached to the end of each arm of the wooden framework, the plates being drilled to carry the wires forming the turns of the coil and the screen. For these spacing-plates the material keramot is recommended instead of ebonite, as it forms the only insulation between the wires, and keramot is likely to withstand the effects of sunlight and exposure to weather generally better than ebonite. The receiving coil consists of six turns of No. 18 or 20 S.W.G. bare hard-drawn copper wire, which are passed in order through the six holes numbered 1 to 6 in the centre of the plates, as shown in Fig. 7. The ends of the coil terminate at the bottom of the frame, and rubber-covered flexible leads are connected to them and enter the brass tube immediately. The centre of the coil is connected to the screen.

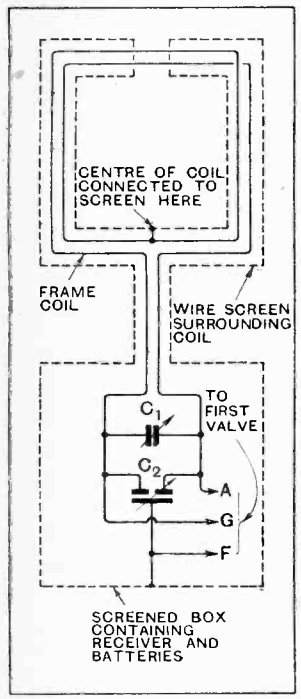


Fig. 5.—Diagram showing the connections of the direction-finding coil to the tuning and balancing condensers and the general form of the screening arrangements.

Surrounding this coil, and supported in the outer ring of holes in the plates, are the wires forming the screen. These wires are twelve in number, and may be of No. 20 S.W.G. bare copper or tinned copper wire, with a spacing of about 1in. Each wire consists of a single turn loop, electrically interrupted by a small gap at the top of the coil (see Fig. 7 (a)). The screen wires are all connected together at the two bottom plates, and the junctions are connected by several wires to the brass tube which forms the axis of the set.

The method of carrying the leads from the coil terminals to the tuning condenser in the screened box is indicated in Fig. 7 (b). A small ebonite terminal block is fixed into the bottom of the brass tube as indicated, and two thin rubber-covered flexible leads are attached to these terminals inside the tube. These flexible leads are previously passed down the tube from two holes near the bottom spacer plates inside the ring of screen wires. After the terminal block is fixed in the tube the wires are drawn taut and then soldered to the two ends of the coil near their terminating points. In this manner the leads from the frame coil to the receiver never emerge from within the screen.

The method of constructing the simple wooden tripod with the top brass bearing-plate is shown in the small diagrams at the bottom of Fig. 7. This tripod is secured to the top of the receiver box by simple slotted brass feet clamped under thumb-screw terminals. The collar forming the lower bearing is fixed to the brass tube by three grub-screws at such a height that the bottom of the tube projects inside the box for about 1in. A simple brass pointer is also attached to the tube and arranged to read over the graduated scale mounted on the top of the box. This pointer should be set at right angles to the plane of the coil; and it is convenient to provide a wooden handle, as shown in Fig. 7, with which to rotate the coil while bearings are being taken. Two sites should also be provided on the horizontal part of the wooden frame for setting the coil with the aid of a compass.

The Screened Receiver.

The whole of the receiving apparatus and its associated batteries are contained in the screened box forming the base of the set. This box is of suitable dimensions, constructed of plywood, lined outside, and preferably inside also, with tinned iron sheet, and it is provided with a well-fitting lid at the front as shown in the photograph, Fig. 8. As previously mentioned, it is important that this lid makes good electrical contact with the lining of the box. All joints of the box should be carefully lapped and soldered to ensure good electrical connection. The box may be painted except where the lid fits on to it. (There is on the market a brand of plywood to which is cemented metallic sheeting, which is admirably suited for the construction of such a screened box.)

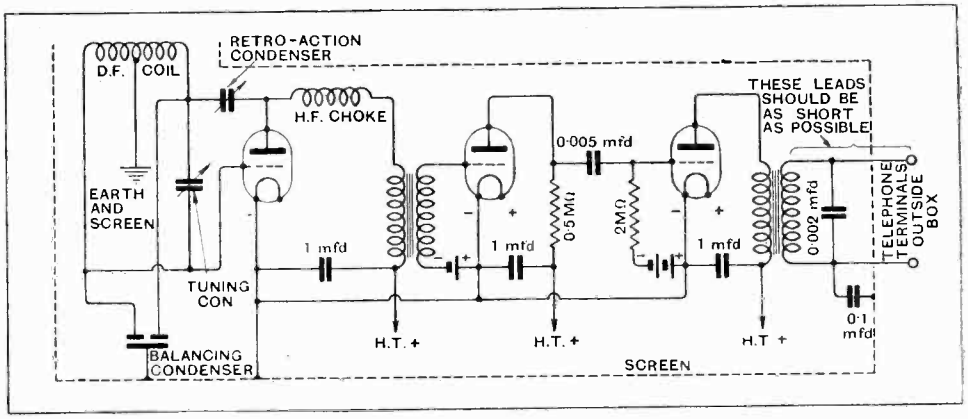


Fig. 6.—Schematic circuit of direction finder with three-valve receiver.

Radio Direction Finder.—

Inside the box short flexible leads are taken from the terminals at the end of the brass tube to the input terminals of the receiver. These leads should be twisted together in order to minimise change in wavelength as the coil is rotated. As shown in the main diagram in Fig. 7, a small flexible cord connection is provided between the brass tube and the top of the box. This serves both to connect the tube to the screen box and to limit the rotation of the coil, thus preventing the unnecessary twisting up of the leads inside the box.

It is not considered that a detailed description of the receiver is necessary in this article. The experimenter may already possess a suitable type of receiver, which he can build into a screened box suitable for carrying the D.F. coil. For the taking of bearings at moderate ranges a receiver constructed to the scheme shown in Fig. 6 would be quite suitable. This set comprises a detector valve with capacity retroaction, by means of which the tuned input circuit can be made to oscillate for reception on the autodyne principle. This detector valve is followed by a two-valve audio-frequency amplifier. If greater sensitivity is required for work at longer distances, one or more stages of high-frequency amplification may be added, or, alternatively, a supersonic heterodyne type of receiver may be employed. In this case it is convenient to use a separate local heterodyne oscillator operating at the intermediate frequency for C.W. reception. This oscillator should be separately screened in the manner shown by the small box to the left of the D.F. set in the photograph, Fig. 8. Whatever type of receiver is employed, it will be found

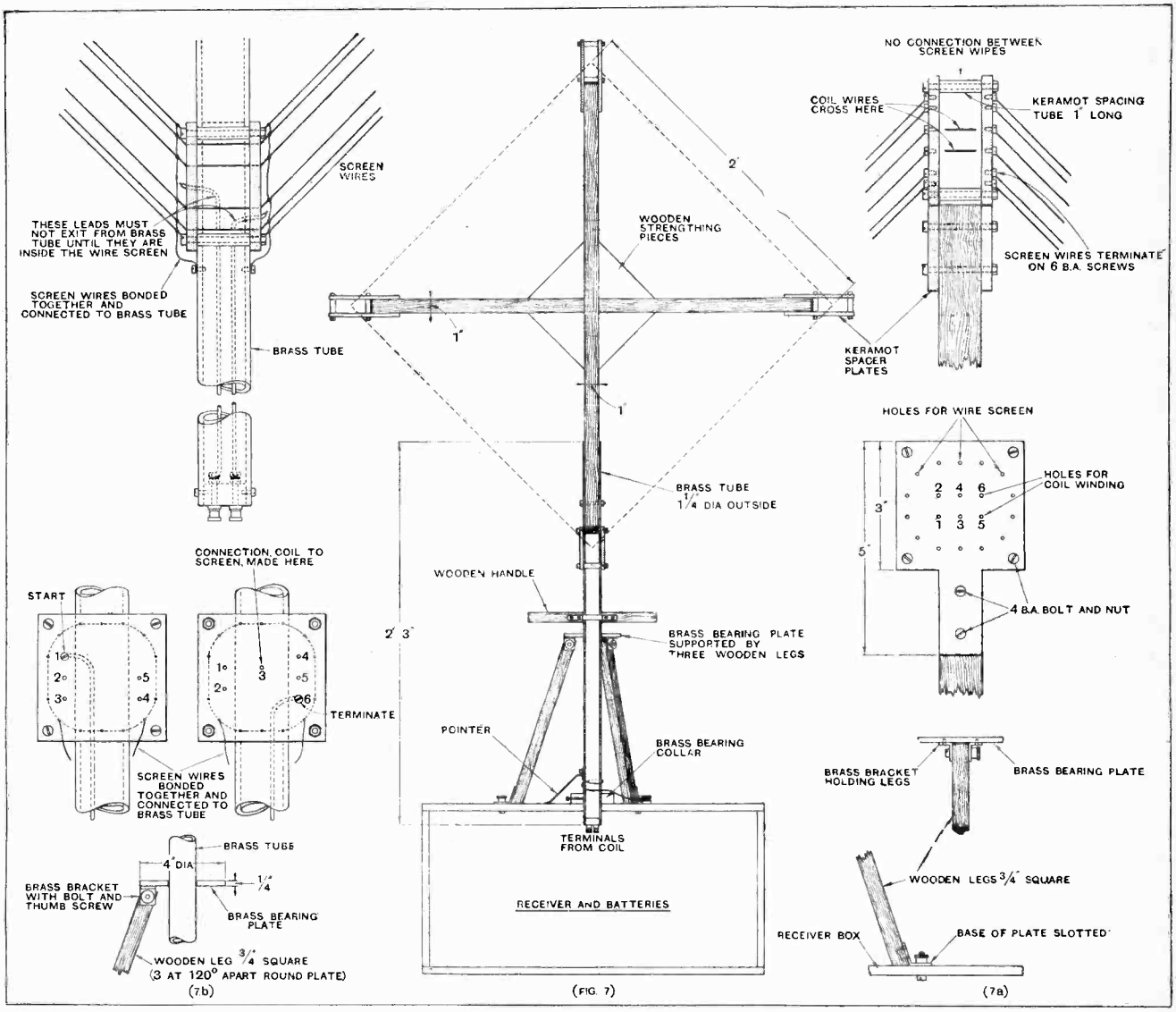


Fig. 7.—Dimensioned drawing of framework and support for direction finder, with details of component parts. (a) Shows the arrangement of the spacer plates and wires at the top of the coil. (b) Shows the corresponding arrangement at the bottom of the coil, with the method of leading the coil connections down the brass tube to the terminals inside the box.

Radio Direction Finder.—

advisable to mount it, together with all its batteries, on a separate baseboard, so that it may be withdrawn from the box as one unit for inspection and making adjustments. It is also advisable to mount strips of rubber underneath this baseboard to reduce jolting of the set during transport.

A telephone transformer is preferable at the output end, so that accidental contact between the telephones and the screened box does not short-circuit the H.T. battery. As indicated in the circuit diagram, Fig. 6, the leads from the telephones are connected to the screen by a condenser immediately on entering the box. This ensures that the telephones are at screen potential for radio frequencies, and so reduces any pick-up effect on the telephones or operator.

Operating the D.F. Set.

Assuming that the apparatus is already set up as shown in the photograph forming Fig. 8, and that all connections are made, the following procedure may be followed in the taking of bearings. With the aid of a good magnetic compass, the bearing of some distant landmark, such as a church tower, tree, or flagstaff is taken from a point close to the D.F. set. Care must be taken that the compass is free from any effects of ironwork or magnetised articles in the pockets of the observer. By subtracting the magnetic variation for the place (of the order 13° in the London area) from the compass reading, the true bearing of the landmark is obtained. The D.F. coil frame is now turned to lie in the direction of the chosen mark and accurately adjusted by means of the sights provided on it. If the scale of the D.F. is adjustable, it should be set so that the pointer now reads 90° plus the true bearing determined above. In this condition all wireless bearings observed on the signal minimum will give the true direction from geographical north. If the scale is not adjustable, the difference between the corrected compass bearing, plus 90° and the D.F. scale reading, must be used as a correction to the wireless bearings read from the scale.

In this section it may be as well to point out that various local conditions, such as the proximity of cliffs, steel buildings, railway lines, or overhead wires, may give rise to serious errors in the D.F. readings. If accurate bearings are required, it is therefore necessary that the direction finder be set up on a good open site, such as the centre of a large field or common clear of trees and other obstacles.

The Degree of Accuracy Obtainable.

After the desired signals are tuned in on the receiver, the coil is swung round to the minimum signal position and the balancing condenser is adjusted until the signal minimum is as crisp as possible. While it may be possible to obtain in this manner a signal zero which is readable to a fraction of a degree, it must not be assumed that the wireless bearing is accurate to this extent. In the first place, the D.F. coil should be rotated through 180°, and the bearing observation repeated. After making the appropriate 180° correction it will probably be found that the two readings do not quite agree. Should the difference be within 1° the set is probably working very satisfactorily, and in any case the mean of the two readings is the correct value to take for the wireless bearing. If the signal is inaudible over an arc of several degrees, the scale readings at which it is just perceptible on either side should be noted, and the mean of these taken as the true position of the signal minimum. In all cases, however, it must be remembered that the wireless bearing is only related to the geographical north direction through the

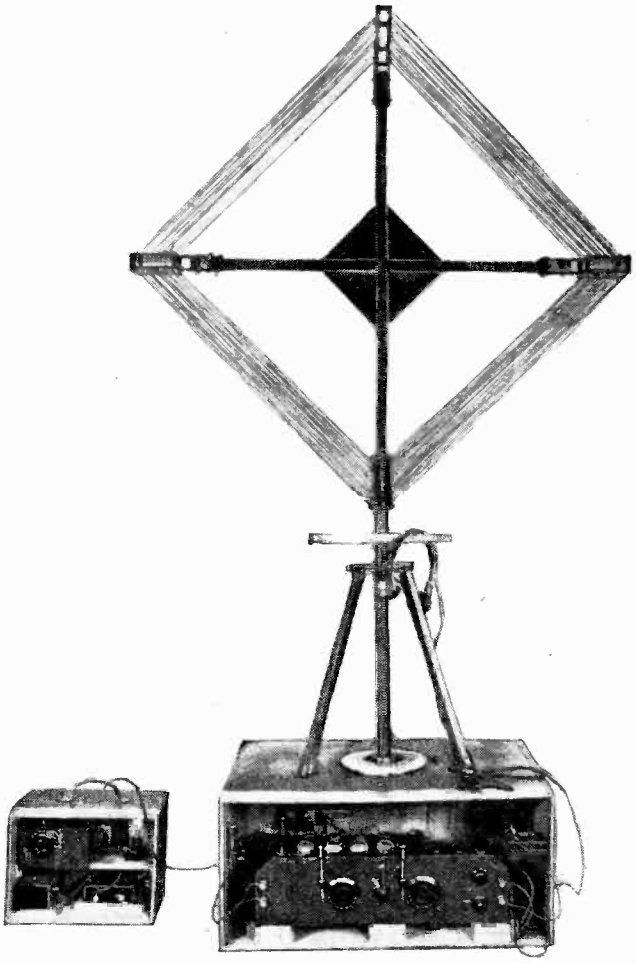


Fig. 8.—View of complete direction finder set up ready for operation on wavelengths above 100 metres. The small box to the left contains a screened local oscillator operating at the intermediate frequency of the supersonic heterodyne receiver used in this direction finder.

medium of the magnetic compass employed, and that the real accuracy of the D.F. set is therefore limited to that of the compass. On account of instrumental error and lack of detailed knowledge of the magnetic variation, few portable compasses are accurate to within half a degree, and most of them will be subject to possible errors of one or two degrees. It is therefore not being too pessimistic to state that the probable maximum accuracy of bearings taken with a portable direction finder of the type described above will be of the order of 1°.

Radio Direction Finder.—

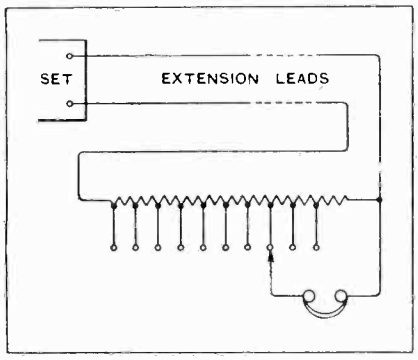
For transporting over short distances the D.F. set completely erected will ride comfortably on the back seat, in the dickey, or even on the luggage grid of a light motor car. When required for taking bearings it is then a simple matter to lift out the set and operate it on the ground in the manner described above. It is not recommended that the set be operated in the car itself, as the presence of the metal framework of the car may introduce an error of two or three degrees, although this could, if necessary, be corrected by a previous careful calibration.

When it is required to be carried over long distances the set should be dismantled in the following manner:— The leads are disconnected from the coil terminals inside the box, and the flexible wire between the brass tube and the top of the box is also disconnected. The pointer is removed from the brass tube and then, after slackening the grub-screws securing the collar to the tube, the whole frame coil may be lifted clear of the receiver and tripod, which may be removed if necessary by releasing the three thumb-screws securing it to the top of the box. In this condition the box, tripod, and small accessories may be carried in the back seat or dickey, while with a little ingenuity the frame coil may be securely fixed to the running board on one side of the car. A simple wooden foot is fixed to the board to take the terminal end of the brass tube, while a suitable clamp is easily devised to hold the coil to the side of the car. Arranged in this manner, the D.F. set can be carried for hundreds of miles under all conditions in perfect safety. When the D.F. set is required to be assembled for taking bearings, the above series of operations is reversed, and it will be found that, after a little practice, the set can be erected and ready for taking bearings within ten minutes after stopping the car.

NOVELTIES FROM OUR READERS.

EXTENSION FOR TELEPHONES ON LOUD SPEAKER SET.

It is often desired to use telephones in series with the loud speaker. The volume from a pair of telephones used in series with a loud speaker is, of course, overwhelming, and usually the expedient is adopted of connecting a volume control, consisting of a variable non-wire wound resistance, across the telephones. Unfortunately, the resistance range covered by many of these volume control devices is often far too great,



Simple method of controlling volume when using telephone receivers on a loud speaker outfit.

such, for instance, as 0 to 500,000 ohms. In such a case all the control of volume will be found to lie within a very small arc of the half circle or full circle described by the rotating member of the volume control.

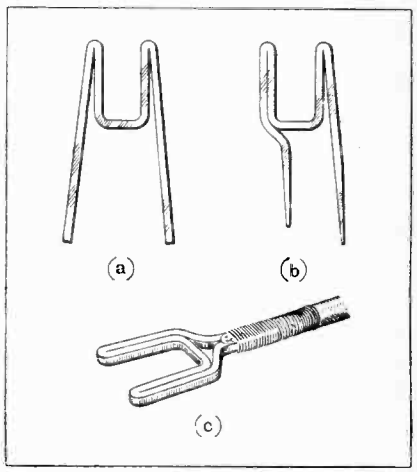
The difficulty can be got over in a very simple manner by making use of one of the many twenty or thirty thousand-ohm tapped potentiometers designed for use with battery eliminators. Such devices are, of course, wire wound, and are on the whole less expensive than volume controls. The connections are as given, the various taps from the resistance being taken to sockets, and one of the telephone leads attached to a suitable plug. This method is not suitable for receivers which do not employ an output transformer or choke filter circuit. In actual practice it will be found that this device works exceedingly well. Many people might think that a 20,000 ohm resistance shunted across a pair of telephones would reduce the volume obtained to a very great extent, but this is not so, and when the telephones are tapped across the whole resistance the effect will be the same as if an extra pair of telephones were in parallel with the pair being used. A very simple and practical method of volume control can be had in this manner. H. A. G.

° ° ° °

THE CONSTRUCTION OF SPADE-ENDS.

It not infrequently occurs that one desires to use a spade-end at the end of a wire as a convenient method of rapid connection and disconnection to a terminal. In some cases it is found, especially with experimental receivers made up from spare parts and odds and ends of the junk box, that the terminal shank is too large for the ordinary type of inexpensive spade-end on the market. The difficulty can be got over, however, in a very simple manner.

All that is necessary is a few inches of No. 16 S.W.G. tinned wire, preferably, although not necessarily,



Good spade terminals are easily made from tinned copper wire.

of the square-section type sold for the internal wiring of sets. The wire is merely bent as shown in the illustrations, and then soldered. A flexible wire may now be soldered on the shank of the terminal, and the whole finished off with a length of adhesive tape. The resulting improvised spade-end is quite robust and satisfactory. F. M.

USEFUL DATA CHARTS. (No. 7.)

The Reactance of a Condenser at Audio Frequencies.

THE reactance of a condenser is given by the formula:

Reactance in ohms $= \frac{1}{\text{capacity in Farads} \times 2\pi \times \text{frequency in cycles}}$,

or, in the usual units,

$$\text{Ohms} = \frac{10^6}{\mu\text{F} \times 2\pi \times \text{cycles}}.$$

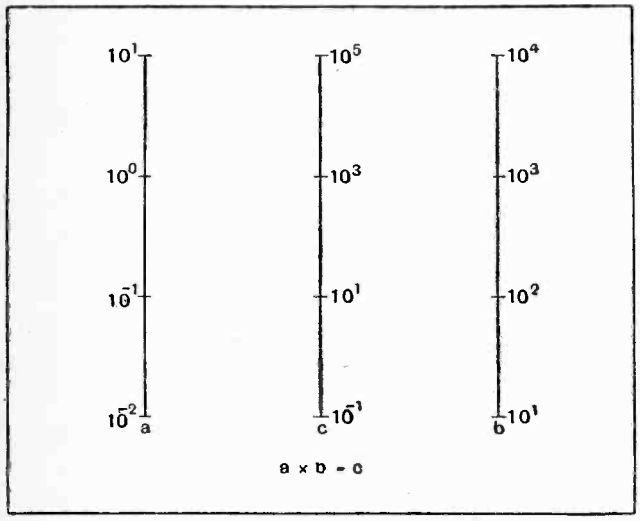


Fig. 1.—A simple abac in which a × b = c.

This formula is always difficult to calculate mentally because, after multiplying the microfarads by the cycles and by 2π, we have to divide 10^6 by the product, and the use of an abac is almost a necessity. The formula is of the type $a \cdot b = 1/c$, neglecting the constant figures for the moment. In abac No. 5, published three weeks ago, it was shown that $a \cdot b = c$ is given as in Fig. 1, in which "c" is drawn half size compared with "a" and "b." In order to get $a \cdot b = 1/c$, we must evidently change the sign of each power of 10 in scale "c" as in Fig. 2.

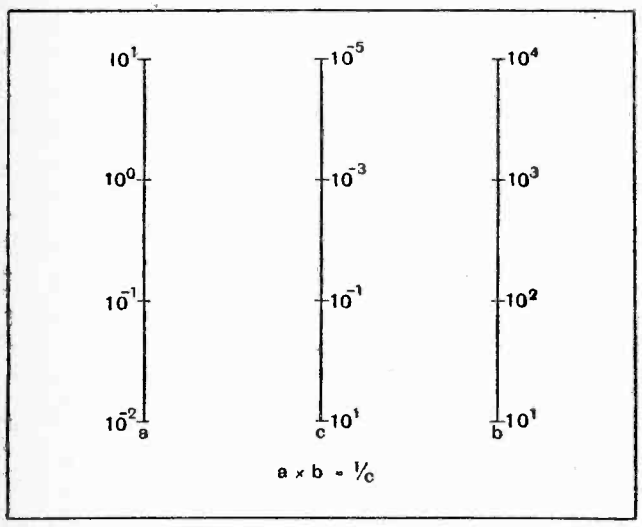


Fig. 2.—If the sign of each power of 10 shown in scale c of Fig. 1 is changed an abac is obtained in which a × b = 1/c.

Calculating Condenser Capacities for Eliminators.

The audio condensers with which we have to deal lie between 10 μF. and 0.01 μF. It would be better to go down as far as 0.001 μF., but the scale of the abac would then become too small for sufficient accuracy in reading. The audio cycles lie between 50 and 5,000, and we shall actually have room on the right-hand scale of Fig. 3 for a range from 10 to 10,000 cycles. On account of the constants in the formula (namely, 10^6 and 2π), the scale of ohms must be displaced from its position in Fig. 2. It is best to find one point on it by calcu-

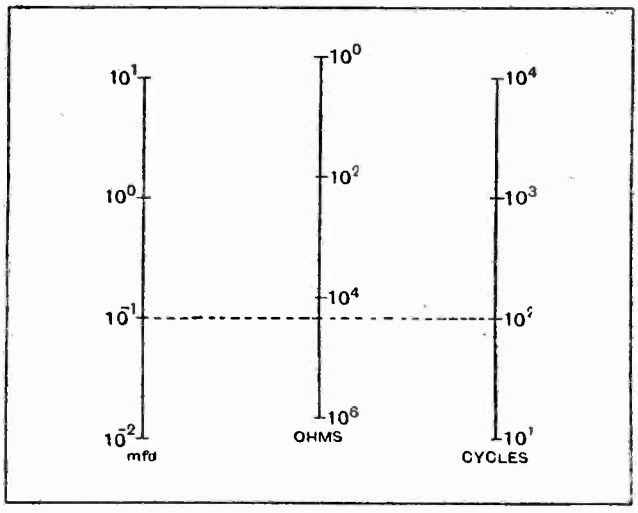


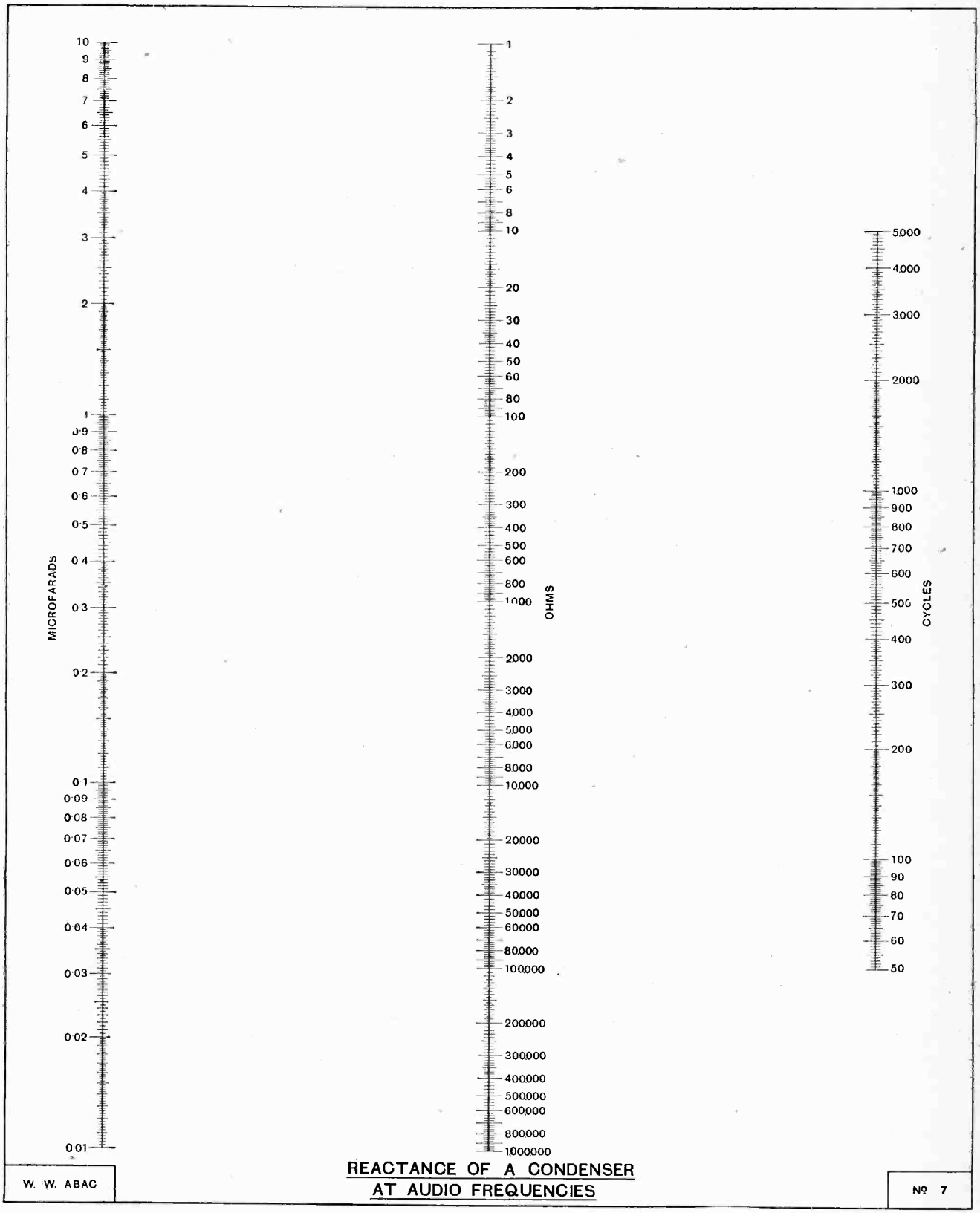
Fig. 3.—By suitable displacement of the ohms column (col. c of Fig. 2) the abac is made to conform to the equation giving the reactance of a condenser.

lation, thus with 0.1 μF. and 100 cycles, ohms $= \frac{10^6}{0.1 \times 2\pi \times 100} = 15{,}900 = 1.59 \times 10^4$, and so the dotted line should intersect the scale of ohms at this point.

The fully figured abac is shown as a full-page illustration, and we may take a few examples to show its use. A set in which H.T. is supplied by D.C. mains requires a ripple filter, which is often of the simple type shown in Fig 4.

At 100 cycles the filter inductance has a reactance of 19,000 ohms (abac No. 5), while the reactance of the capacity is 160 ohms, and so the ripple voltage across the 10 μF. will be reduced to $\frac{160}{19{,}000 - 160} = 0.0085$ of its value across the generator (we subtract in the denominator because the reactances are of opposite sign).

Again when using a grid leak and condenser in the



Useful Data Charts (No. 7).—

L.F. amplifier the reactance of the condenser C must not be too large compared with the resistance of the grid leak, otherwise only a small fraction of the voltage applied between P and Q (Fig. 5) may appear at R. If we use a 0·003 μF. condenser, its reactance at 50 cycles is 1·06 megohms, and with a grid leak of $\frac{1}{4}$ megohm the

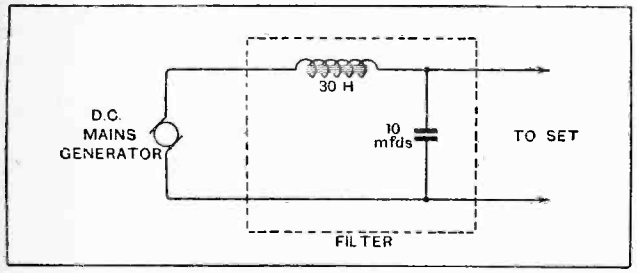


Fig. 4.—A simple filter circuit for deriving plate current from D.C. mains. The abac given this week is of great assistance in determining condenser values required.

voltage at R would be $\frac{0{\cdot}25}{[1{\cdot}06^2+0{\cdot}25^2]^{\frac{1}{2}}}=0{\cdot}23$ of the impressed value, so that the low notes would suffer.

The 0·003 μF. value actually lies outside the range of the abac, but we find that 0·03 μF. gives 106,000 ohms, and so a condenser ten times smaller will give a reactance ten times greater, *i.e.*, 1·06 megohms.

A larger condenser should accordingly be used to preserve the low notes, but there is a limit which should not be exceeded, otherwise, when a very loud musical passage is being received, the excessive charge received by the condenser may not leak away fast enough through the grid leak, and the valve will remain paralysed for an appreciable time; this is the phenomenon known as "blocking," and results in a fluttering or periodic intermission in the loudness of the sound; the time over which blocking lasts is proportional to the product CR, *i.e.*, the time constant of the condenser and grid leak, and an abac will be given in a future issue from which the blocking effect can be read off.

R. T. B.

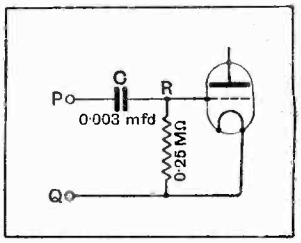


Fig. 5.—Typical condenser-leak combination in L.F. coupled circuits The value of c must be within certain limits to prevent loss of low notes and to avoid too large a time-constant.

Norwegian Radio Relay League.

Amateurs in Norway have recently formed a Radio Relay League with the object of conducting and organising short-wave work among its members, arranging international tests and representing Norwegian amateurs in national and international matters.

The Executive Committee is :—

President : L. Salicath (LA 1G), Voksenlia, near Oslo. Vice-President : G. H. Petersen (LA 1D), Voksenkollen, near Oslo. Capt. B. L. Gottwaldt, who was wireless operator on the airship "Norge" during the polar flight from Kingsbay to Teller, and Olav Moe, the owner and editor of "Norsk Radio," the official organ of the League.

Correspondence may be sent c/o The President, N.R.R.L., or via "Norsk Radio," Oslo.

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American Call-signs.

Article 14 of the International Radiotelegraph Convention of Washington requires that commercial land stations shall use only three-letter call-signs, and ship stations four letters. It will, therefore, become necessary for land stations at present using four-letter signs to be re-allotted three-letter signs and, conversely, ship stations with three-letter signs will have to adopt four letters.

Although these requirements will not generally take effect until January 1st, 1929, the authorities in U.S.A. have decided to effect the change as from October 1st next.

This will naturally affect several familiar stations, among which KDKA, East Pittsburgh, will become WKA; Dallas, Texas, will change from WFAA to KFB, and Fort Worth, Texas, from W3AP to KMB.

TRANSMITTERS' NOTES

Modifications of "Q" Code.

We understand that American amateurs have made several modifications to the International "Q" code to adapt it to their own needs. According to our correspondent, the following interpretations are given by them to the code letters :—

QSP—I will relay to . . . . . free of charge (instead of the orthodox meaning, "Inform . . . . . that I am calling him").

QSR—The distress call received from . . . . . has been attended to by . . . . . (instead of "I will forward the radiotelegram.").

QTA—Cancel telegram No. . . . . as if it had not been sent (instead of "Repeat the radiotelegram you have just sent. Reception doubtful.").

QRL—I am busy (instead of "I am receiving badly. Transmit . . . ——. 20 times for me to adjust my apparatus.").

These modifications appear at present to relate more to local messages than to transatlantic communications, but there may be others tending to cause confusion or misunderstanding between amateur transmitters in correspondence with stations in U.S.A. We shall, therefore, welcome any information from readers, either in Great Britain or America, on the subject of agreed modifications of the International "Q" code.

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Stricter Observance of Wavelengths.

We understand that after December 31st, all amateur transmitting licences in Great Britain will embody the condition that the station must be provided with a Piezo-crystal or other accurate type of wavemeter approved by the G.P.O., in order that their wavelengths may be kept steady within the limits prescribed by the Washington Convention.

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Amateurs in the Azores.

The Western Union Radio Club at Horta, Fayal, Azores, of which Mr. M. S. Killen is the Hon. Secretary, has changed its call-sign from EP 3MK to EP 2AA, and will be very pleased to work with English stations.

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Russian Ship Stations.

The Russian station EU LSKW has kindly forwarded us, *via* Mr. H. D. Price (G 6HP), the call-signs and particulars of some vessels fitted with short-wave transmitters. EU LSKW is a station in Leningrad whose special duty is communicating with ships and expeditions from Russia, Siberia and Turkestan :—

XEU VEGA A sailing ship from Leningrad cruising round Europe to Odessa, on the Black Sea; carrying an amateur operator who transmits on the 40-metre waveband. This vessel was in the North Sea on August 13.

XAU 2RS A Russian-German Expedition at Pamir in Turkestan, transmits on about 41 metres with an input of about 30 watts D.C.

XEU KS An amateur station on board the Ice-cutter Krassin, now at Stavanger.

All reports will be welcomed, and should be sent *via* S. K. W, Moscow.

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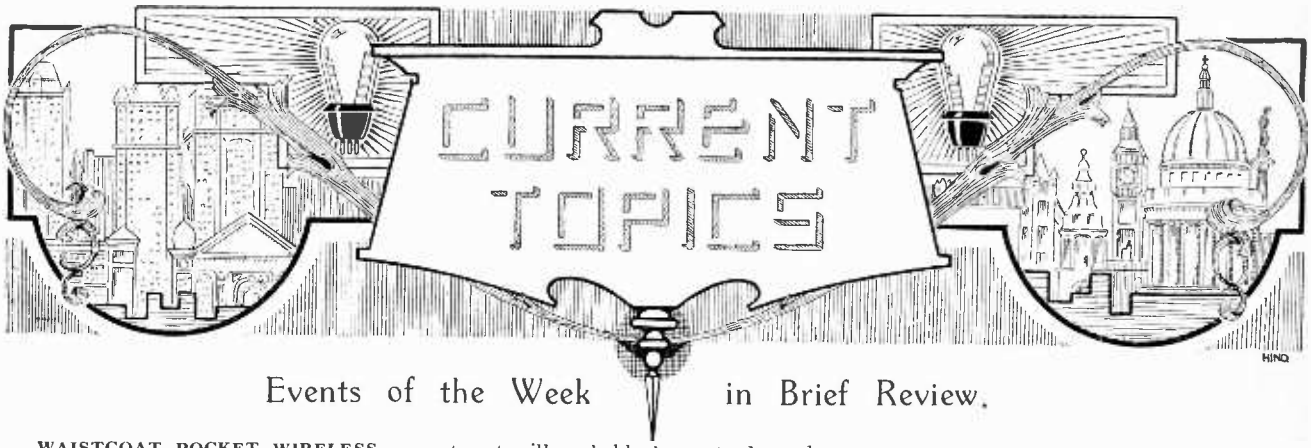
Calibration Waves.

Mr. G. W. Thomas will transmit a series of calibration waves from his station (5YK), at 169, Hills Road, Cambridge, on Sunday, August 26th, at 1300 G.M.T. on 46 metres, 1305 G.M.T. on 45 metres, and 1310 G.M.T. on 44 metres. The exact wavelength will be announced after each transmission. We understand that he also intends transmitting a similar schedule on Sunday, Sept. 9th, at 0900 G.M.T.



Events of the Week in Brief Review.

WAISTCOAT POCKET WIRELESS.

Professor Esau, of Jena University, claims to have invented a "waistcoat pocket transmitter," working on three metres and less, which will cover distances up to 250 miles.

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BLAMING WIRELESS.

The South Australian Government, in urging a campaign against gaming-houses and hotel betting, holds that the broadcasting of sporting events is responsible for the prevalence of these practices.

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POLICEMAN'S LOT IS A HAPPY ONE.

The Reading Borough Police Station has been provided with a new wireless set for the billiard-room and lounge.

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NO DABBLERS NEED APPLY.

In granting experimental television licences to applicants, the American Federal Radio Commission states that the licences are "subject to revocation unless the applicant makes satisfactory progress in the work."

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A HARDY ANNUAL.

Last year we learnt that French wireless operators had chosen Joan of Arc as the patron saint of wireless "because she heard voices." Apparently the operators have short memories, for the daily Press announced last week that the French wireless operators had just chosen Joan of Arc as their patron saint. It is understood that next year French wireless operators will choose Joan of Arc as their patron saint.

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BERLIN "HEARS" DAVENTRY PICTURES.

Several Berlin wireless amateurs have recorded successful reception from Daventry of pictures transmitted on Captain Fulton's system, says *The Times*. The receiving station of the "Berliner Tageblatt," which owns a "Fultograph," obtained in one day, in the trying conditions of summer, 13 clear pictures, "only slightly disturbed by atmospherics."

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NEW METHOD OF RECEPTION.

In "The Spy," a picture which makes its début at the Marble Arch Pavilion on Monday next, September 3rd, great interest will probably be centred, we learn, in the device which the master spy employs for obtaining news from his associates. Wireless apparatus is attached to motor cars, and vital information is wirelessed to the master spy sitting in his inner sanctum. Instead of the messages reaching him through phones, or a loud speaker, the words appear in illuminated letters in the slots of a sign facing his desk.

We sometimes wish that our neighbours discarded their loud speakers in favour of the same device.

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RADIO RAIDERS.

Six portable receivers were stolen on Sunday week from the showrooms of Messrs. Read Radio, Ltd., 67, Newman Street, London, W. Three of the instruments were of the firm's latest type, and bore the numbers 130, 131, and 132.

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PUBLIC WIRELESS TO KENYA.

A direct wireless service is now available between this country and Kenya. The rates of charge for telegrams to all places in Kenya and Uganda are as follows: Deferred telegrams, 9d. per word; daily letter telegrams, 20 words or less, 7s. 6d.; and each word after 20, 4½d.

A BIG "HOOK-UP."

More than 57,000 miles of wire were used in the national broadcast on Wednesday last of the speech of Governor "Al" Smith, the Democratic candidate for the U.S. Presidency. The speech was delivered at Albany, New York, and relayed by more than 70 stations associated with the National Broadcasting Company.

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OUTBURST AT THE MICROPHONE.

The danger of allowing even a responsible speaker to address the microphone without an approved manuscript was appreciated by the programme officials at the Brünn broadcasting station a few days ago. According to a Vienna report, Dr. Najmann, the Czecho-Slovakian Minister of Railways, was delivering a speech of protest against the municipal tramways when his pent-up feelings suddenly became manifest in a flow of language too offensive to be tolerated. To spare the ears of Czecho-Slovakian listeners, the station staff promptly switched off, leaving the Minister alone with a "dead" microphone.

WAVEMETER MYSTERIES EXPLAINED. Members of the 609th City of London Squadron of the Auxiliary Air Force (Territorials) receiving instruction in the use of the Townsend wavemeter.

NEXT: POTTERS BAR, LTD.?

A private company has been registered at Preston, to carry on wireless business, under the title "Daventry and Co., Ltd."

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METAPHORICALLY SPEAKING.

A Northern writer, discussing the autumn wireless circuits says: "When 'boiled down,' they will be nothing more than old circuits redressed."

No better, in fact, than mixed metaphors.

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WIRELESS PAYS FOR WIRELESS.

To defray the cost of a wireless set recently installed in the nurses' home at the Bristol General Hospital, a wireless concert was reproduced on loud-speakers on the Downs, £25 being collected from the hire of chairs.

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BURNDEPT DIRECTORS.

The directors of the reconstructed Burndept Wireless Company are Mr. Charles W. Rooke, the receiver, Mr. W. H. Lynas, late managing director of Graham Amplion, Limited, Lieut.-Col. Adrian Simpson, late deputy-managing director of Marconi's Wireless Telegraph Co., Mr. T. H. Barson, a director of the old Burndept Company, and Capt. W. Horridge.

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WHY NOT THE "CAT"?

Wireless "piracy" is still rampant in South Africa. Advocating an increase in the fines levied on offenders, *Wireless Weekly* says: "We are firmly convinced that piracy will continue unabated until such time as the penalty inflicted is so severe as to afford a reasonable deterrent against the practice. It only requires a few fines of the order of £50 to make the cheerful pirate realise that his miserable game is played out."

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DEAD ROMANCE.

How wireless has changed the life and outlook of the watchers at the humble coastal signal stations is related in a delightful essay which appeared last week in *The Times*.

"You may sit," says the writer, "near the station for a whole afternoon, with plenty of ships passing, and see the pennant hoisted only once, or not at all. Wireless has wrought a fundamental change in the signalman's activities. The ships make the Headland as of old, nor can it be said that they keep farther out; Atlantic mammoths, with tier upon tier of cabins and three or four vast smoking funnels, pass regularly some three miles off shore. But all steamers over 1,600 tons now have to carry wireless, and consequently seldom trouble to make their number with flags. Only the coasters and short sea traders are now dependent on flags. The station does not take in wireless reports; but a good many ships can be induced to signal at night by calling them up with a flash lamp; as regards signalling, the night watches are often a good deal busier than those by day.

"It was in the great days of the sailing ship that the Headland signalmen reaped their richest harvests," adds the writer; and, although he does not say so, one fancies that he regrets this newfangled invention that makes a flag an ornament and nothing more.

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"A B C" BY LOUD SPEAKER.

The Turkish Government, which is busily engaged in introducing a new alphabet incorporating Latin, instead of Arabic letters, is teaching the public by means of loud speakers. Outdoor lessons take place in three of the big squares in Stamboul.

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THE BROADCAST CINEMA.

Regular broadcast transmission of motion pictures from KDKA, Pittsburgh, will begin in a few weeks, says the Westinghouse Technical Press Bureau. When produced commercially the apparatus will be sold through the Radio Corporation of America.

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DO WIRELESS WAVES EXPLORE THE POLE?

Phenomena which go to show that wireless waves can return to the transmission point in the form of "echoes" are being investigated by Dr. J. Burton Hoag, of Chicago University.

In Dr. Hoag's laboratory, says a "Monitor" correspondent, film moving at the rate of five feet a second on a revolving drum shows a series of multiple diminishing echoes, which cannot be detected by the ear, coming in at an interval of .01 to .04 of a second after the main signal. According to the research workers, these cannot be the ordinarily repeated sounds sometimes heard on short wavelengths when signals travel round the world, because such a journey takes one-seventh of a second. Therefore, it is held, the waves must be reflected from an unknown point. Whilst admitting that this may be in the Heaviside layer, Dr. Hoag advances the theory that many vagrant waves return to their point of origin after circling the North Pole!

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ARCTIC EXPLORERS SAVED BY ACCUMULATORS.

While it is common knowledge that General Nobile and those of his polar exploration party whose lives were saved owed their rescue to wireless, it may not be generally known that this was partly due to the timely arrival of fresh accumulator batteries dropped from an aeroplane.

It will be remembered that a few days after the airship "Italia" crashed, the wireless operator Biagi succeeded in getting his equipment to work, and he was able to report the accident and to give the position of his group. The strength of the station, however, decreased daily, and finally all signals from the group ceased.

Among other stores dropped to the group from aeroplanes were batteries, but these were all either crushed in falling or failed to operate on account of the extremely low temperature. The aeroplane "Uppland," however, carried three "Nife" steel plate batteries which survived the ordeal of being dropped from the air; with the arrival of these the situation changed entirely.

The signals were again powerful and regular, and although the party were continually drifting on the ice they were able to keep in touch with the Citta di Milano, and to give all necessary information to the rescue parties. Even at the moment when the "Krassin" saved the Viglieri group the transmitting station was still at full strength, the "Nife" batteries apparently having been unaffected either by their novel method of delivery or the low temperature.

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CANADA'S SEVENTY-THREE BROADCASTING LICENCES.

Ontario, the most populous province in Canada, owns twenty-five broadcasting stations, i.e., more than double the number to be found in any other province in the Dominion. Alberta follows with eleven broadcasting licences. Saskatchewan and British Columbia come next with ten licences each, while Quebec has nine and New Brunswick three. Prince Edward Island and Manitoba have two licences each, and Nova Scotia owns one.

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TRAGIC MOTHS.

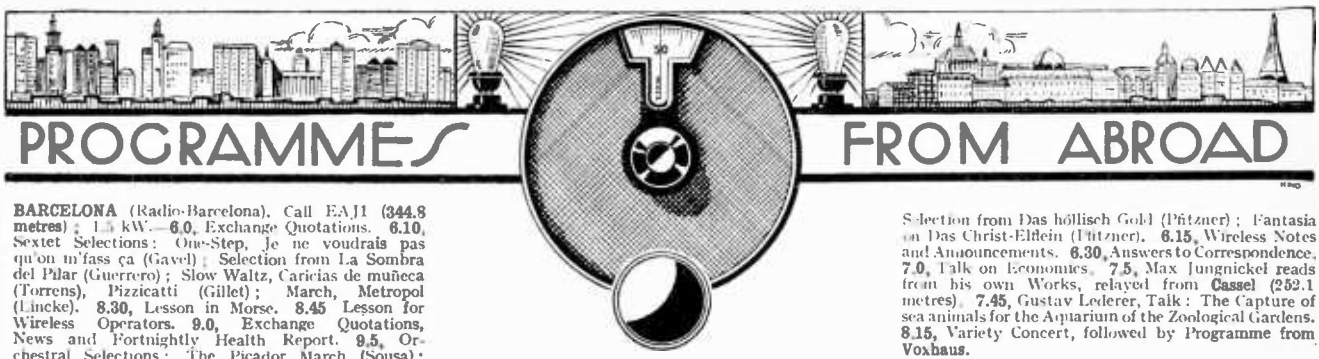
Something was wrong the other day with the WEAF transmitter of the U.S. National Broadcasting Company. The efficiency dropped alarmingly, and for a time the engineers had to confess themselves beaten. Then Mr. O. B. Hanson, manager of plant operation, ordered a thorough investigation.

The seat of the trouble was an intermediate amplifier where hundreds of small moths had crawled between the plates of an illuminated condenser, thereby electrocuting themselves and causing a short circuit.

To save further massacres the engineers have surrounded the apparatus with mosquito netting.

BOOK RECEIVED.

Radio Guide, 1928. — Compiled by Amalgamated Wireless (Australasia), Ltd., and devoted primarily to matters concerning wireless activities in Australia, New Guinea, and the Pacific Islands, with notes on receivers, components, and accessories, useful tables and data and lists of broadcasting, coast, ship and experimental stations in Australia and New Zealand. Pp. 216, with numerous illustrations and diagrams. Published by Amalgamated Wireless (Australasia), Ltd., Sydney, price 1s. 6d.



SATURDAY, SEPTEMBER 1st.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

BARCELONA (Radio-Barcelona). Call EAJ1 (**344.8 metres**); 1.5 kW.—**6.0**, Exchange Quotations. **6.10**, Sextet Selections: One-Step, Je ne voudrais pas qu'on m'fass ça (Gavel); Selection from La Sombra del Pilar (Guerrero); Slow Waltz, Caricias de muñeca (Torrens), Pizzicatti (Gillet); March, Metropol (Lincke). **8.30**, Lesson in Morse. **8.45** Lesson for Wireless Operators. **9.0**, Exchange Quotations, News and Fortnightly Health Report. **9.5**, Orchestral Selections: The Picador March (Sousa); Valse Boston, Apassionat (Casademont); Selection from La Verbena de la Paloma (Bretón); Le plus joli rêve (Arezzo); Csardas, Nadja (Michiels); Minuet from La Viejecita (Caballero). **10.0**, Chimes and Weather Report. **10.5**, Programme from **Madrid**, EAJ7.

BERGEN (**370.4 metres**); 1.5 kW.—**7.0**, Programme for Children. **7.30**, Talk for Girls. **8.0**, Orchestral Concert. **8.30**, Talk: Voyages to Chile for Saltpetre in the golden days of sailing vessels. **9.0**, Violin Recital: Adagio from the Violin Sonata in E Minor (Kuula), Nocturne (Chopin), Canzonetta (d'Ambrosio), Romance (Sinding); Hungarian Dance in F Minor (Brahms-Kreisler). **9.30**, Herr Blich. Talk: The Tordenskjolds' Artic Cruise. **10.0**, Weather Report, News and Time Signal. **10.15**, The Exhibition Orchestra. **12.0 Midnight** (approx.), Close Down.

BERLIN (Königswusterhausen), (**1,250 metres**); 40 kW.—**4.30**, Talk by Schulrat Wolff. **5.0**, Programme from **Hamburg**. **6.0**, Dr. Geyger, Talk: The Worker and the Adult School. **6.30**, Elementary Spanish Lesson. **6.55**, Talk: The Chamber Orchestra. **7.20**, Prof. Minde-Pouet, Talk: Do we still read Goethe's Novels? **8.0**, Programme from **Voxhaus**.

BERLIN (Voxhaus), (**484 metres**); 4 kW.—**10.10 a.m.**, Market Prices. **10.15 a.m.**, Weather Report, News, Sports Notes and Time Signal. **11.0 a.m.**, Programme of Gramophone Records. **11.30 a.m.**, Exchange Quotations. **12.55**, Time Signal. **1.30**, Weather Report and News. **3.10**, Agricultural Prices and Time Signal. **3.30**, Programme of Gramophone Records. **4.0**, Talk by Dr. C. E. W. Behl. **4.30**, Dr. Georg Bartsch, Talk: The English Police Force. **5.0**, Concert from the Wireless Exhibition: Overture to Raymond (Thomas); Suite from Der Minnesänger (Amadei); Potpourri, Musikalische Seifenblasen (Urbach); Fantasia on Carmen (Bizet); Ballet Music from Faust (Gounod); Waltz, Tesoro Mio (Becucci); Potpourri, Vom Rhein zur Donau (Rhode); Programme Announcements in the Interval. **7.0**, Leopold Lehmann, Talk: Should we Emigrate? **7.30**, Dr. Ernst Rother, Talk: The Power of Suggestion. **8.0**, Garden Concert from the Wireless Exhibition; Overture to The Merry Wives of Windsor (Nicolai); Peer Gynt Suite No. 2 (Grieg); Torch Dance No. 1 (Meyerbeer); The Second Hungarian Rhapsody (Liszt); The Invitation to the Dance (Weber); Entry of the Guests to the Wartburg from Tannhäuser (Wagner); Selection from Tiefland (D'Albert); Waltz, Künstlerleben (Joh. Strauss); Slavonic Dance, Op. 46 (Dvorák); Radetzky March (Joh. Strauss), followed by Weather Report, News, Time Signal and Sports Notes. **10.30**, Dance Music. **12.30 a.m.** (approx.), Close Down.

BERN (**411 metres**); 1.5 kW.—**8.0**, Time Signal and Weather Report. **8.2**, Relay from **Vienna**, or Popular Concert from **Bern** and **Zurich**. **9.45**, News and Weather Report. **10.0**, Selections by the Town Orchestra. **10.35**, Dance Music. **12.0 Midnight** (approx.), Close Down.

BRESLAU (**322.6 metres**); 4 kW.—**4.30**, Orchestral Concert. **6.0**, Willy Koch, Talk: Norway. **6.25**, Lesson in Esperanto by Elsa Koschate. **6.35**, Talk by Heinrich Koltz, relayed from **Gleiwitz** (250 metres). **7.25**, Herbert Brunar, Talk: Landscapes of Western America. **7.50**, Technical Talk by M. Marcus. **8.30**, Berlin Pilaster—Concert: Berliner Pilaster Marsch from Madame Revue (Nelson); Overture to Frau Luna (Lincke); Berlin Songs; Selection from Die Frau ohne Kuss (Kollo); Selection from Drei arme, kleine Mädels (Kollo); Berlin Songs, Potpourri from Musikalisches Wettrennen (Lincke); "The Pinneberg Case," Sketch (Rosenhayn); Potpourri, Lincke-Winke (Lincke); Selection from Annamarie (Gilbert). **10.0**, News and Announcements. **10.30**, Orchestral Selections and Dance Music, from the Café Hindenburg **Gleiwitz**.

BRÜNN (**441.2 metres**); 3 kW.—**6.0**, Time Signal and German Transmission, followed by Talk. **7.0**, Programme from **Prague**. **10.25**, Programme relayed from the Trencianské Teplice.

BRUSSELS (**508.5 metres**), 1.5 kW.—**5.0**, Dance Music from the St. Sauveur Palais de Danse. **7.15**, Talk: The Decay and Revival of Languages. **6.30**, Orchestral Concert: Overture to Les Dragons de Villars (Maillard); Selection from La Belle Hélène (Offenbach); 'Cello Solo, Serenade (Schubert); Mascarade (Lacôme); Flute Solos, Andante and Scherzo (Ganne); Selections from Cavalleria Rusticana (Mascagni); Clarinet Solo, Pastoral (Busser); Dances from Tom Jones (German). **7.30**, Radio-Chronique. **8.15**, Gramophone Selections. **8.30**, Concert of Chamber Music. **8.50**, Topical Talk. **9.0**, Symphony Concert relayed from the Kursaal, **Ostend**.

BUDAPEST (**555.6 metres**); 35 kW.—**4.45**, Time Signal and Weather Report. **5.0**, Talk. **5.45**, Guitar Trio Selections. **7.0**, Humorous item. **7.45**, "Medi" Operetta (Schubert). **10.15**, Time Signal and News, followed by Tzigane Music from the Café Emke.

COLOGNE (**283 metres**); 4 kW.—**12.10**, Programme from **Langenberg**. **1.5**, Orchestral Concert: March, Deutschlands Heldensöhne (Derksen); Waltz, Bruderlein fein (Fall); Overture to Hunyady Laszlo (Erkel); Selection from Das Nachtlager von Granada (Kreutzer); Soprano Solo, Der Minnesänger (Amadei-Haensch); Lioubove Idylle (Poussigue); Intermezzo, Amina (Lincke). **2.30**, Household Hints. **4.0**, A. Tölle-Honekamp, Talk: Detlev von Liliencron as revealed by his letters. **4.30**, Programme from **Königswusterhausen**. **5.0**, Recitations: Mother and Child in Poetry. **5.30**, Programme from **Langenberg**. **6.0**, Orchestral Concert. **7.20 to 8.5**, Programme from **Langenberg**. **8.15**, "The Shirt Button," Comedy (Hans Müller), followed by Late News, Sports Notes, Commercial Announcements, Concert and Dance Music. **1.0 a.m.** (approx.) (Sunday), Close Down.

CRACOW (**566 metres**); 1.5 kW.—**7.0**, Miscellaneous Items. **7.30**, A Review of Foreign Politics during the past week. **7.55**, Agricultural Report and News. **8.15**, Programme from **Warsaw**. **10.30**, Concert from a Restaurant. **11.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**1.30**, Weather Report and Gramophone Selections. **7.20**, News. **7.30**, Talk. **7.45**, Irish Lesson by Seamus O Duirinne. **8.0**, Liam Breathnach (Irish Pipes). **8.15**, Mezzo-Soprano Solos by May Mortell. **8.30**, Selections by the Station Orchestra. **9.0**, Tenor Solos by W. F. Watt. **9.15**, Selections by the Station Orchestra. **9.30**, Operatic Selections by a Male Chorus. **10.0**, Old Time Dances by the Station Orchestra. **10.15**, Bass Solos by T. W. Hall. **10.12**, Selections by the Station Orchestra. **10.30**, News, Weather Report and Close Down.

FRANKFURT (**428.6 metres**); 4 kW.—**1.0**, Gramophone Records. **3.5**, Programme for Children. **3.40**, Reading by O. W. Studtmann. **4.35**, Concert: Selection from Hänsel and Gretel (Humperdinck); Song from Die Königskinder (Humperdinck); Two Selections from The Tempest (Humperdinck); Fantasia on Die Königskinder (Humperdinck); Two Selections from Der Bärenhäuter (Wagner); Songs (Bittner); Selection from Das höllisch Gold (Pfitzner); Fantasia on Das Christ-Elflein (Pfitzner). **6.15**, Wireless Notes and Announcements. **6.30**, Answers to Correspondence. **7.0**, Talk on Economics. **7.5**, Max Jungnickel reads from his own Works, relayed from **Cassel** (252.1 metres). **7.45**, Gustav Lederer, Talk: The Capture of sea animals for the Aquarium of the Zoological Gardens. **8.15**, Variety Concert, followed by Programme from **Voxhaus**.

HAMBURG, Call HA (in Morse) (**394.7 metres**); 4 kW.—**10.15 a.m.**, News. **11.0 a.m.**, Programme of Gramophone Records. **12.10**, Weather Report. **12.15**, Exchange Quotations. **12.30**, Concert from **Hanover** (297 metres). **12.45** (in the Interval), Shipping Forecast. **12.55**, Time Signal. **1.10**, News. **2.40**, Exchange Quotations. **3.30**, Review of Books. **4.0**, Labour Exchange Report. **4.15**, Hölty Commemoration Programme, relayed from **Hanover**. **5.0**, Concert of Melodramas and Ballads; Bergliot—Melodrama (Grieg); Text by Björnson; Die Frist ist um—Ballad from The Flying Dutchman (Wagner); Young Olaf—Melodrama (Schillings); Text by Wildenbruch. **6.0**, Orchestral Selections. **7.0**, Theobald Bieder, Talk: Astronomy in September. **7.30**, Talk by Ernst Held. **7.55**, Weather Report. **8.0**, Till Eulenspiegel Festival in Mölln, an actual transmission from the town in which this German Jester lies buried. **10.15** (approx.), Weather Report, News and Sports Notes. **10.30** (approx.), Concert from the Café Wallhof.

HILVERSUM (**1,070 metres**); 5 kW.—**11.40 a.m.**, Police News. **12.10**, Concert of Trio Music. **1.40**, Concert from the Tuschinski Theatre, **Amsterdam**. **5.40**, Time Signal. **5.42**, Concert: Overture to The Black Domino (Auber); Ballet Music from La Source (Delibes); Humoresque (Dvorák); Soprano Solos, (a) Theme and Variations (Proch), (b) Recitative and Romance from Acis and Galathea (Suppé); Selection from The Huguenots (Meyerbeer); Soprano Solos, (a) Letzer Frühling (Grieg), (b) To-morrow (R. Strauss); Madrigal (Drdla); Diesen Kuss der Ganzen Welt (Ziehrer); Rheinischer Sang (Hannemann); Finale. **7.25**, Police News and Time Signal. **8.42**, Programme arranged by the Workers' Radio Society. **11.15** (approx), Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits from **5.40** on 1,870 metres.—**12.10**, Concert of Trio Music. **5.10**, Gramophone Selections. **7.25**, Talk by M. Père Tempel, O.P. **7.55**, Concert from **Vlaardingen**: Choral and Instrumental Music and Talk by M. Vermeulen. **10.10**, News and Close Down.

JUAN-LES-PINS (Radio LL) (**244.5 metres**); 1.5 kW.—**1.0**, Concert: Marche Religieuse (Gluck); Les Patineurs (Waldteufel); Serenade Lointaine (Filippucci); Aube Sous Bois (Fourdrain); Maritana (Wallace); Valse des Sirenes (D'Ambrosio); Chant du Cygne (Schubert); Tannhäuser (Wagner). **9.0**, News, Weather Report, Talk for Women by Mme. de Tremeuge, and Concert. **10.30**, Dance Music.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**7.30 a.m.**, Morning Gymnastics. **11.0 a.m.**, Weather Report. **3.0**, Trio Concert: Selection from The Mute of Portici (Auber); Waltz, The Blue Danube (Joh. Strauss); Minuet, Mozart (Bendel); Violin Solo, Rêverie (Vieuxtemps) Fox-Trot, Me and Jane in a Plane (Gilbert); Polonaise from Harlequins Millions (Drigo); Intermezzo from Naila (Delibes); Recitation; March, Entry of the Gladiators (Fucik); Waltz, Traumideale (Fucik); Selection from Three Little Girls (Kollo); Au Champagne (Gillet); Tango, Two Brown Eyes (Lacome); Romance (Sibelius); Fox-Trot, Bobby (Johnstone). **6.20** Talk by A. R. Nielsen. **6.50**, Weather. **7.0**, News and Exchange Quotations. **7.15**, Time Signal. **7.30**, Dr. Frode Krarup, Talk: The Insane and We Others. **8.0**, Chimes from the Town Hall. **8.2**, Experimental Relay from the Studio in Axelborg—Orchestral and Solo Concert. **10.0**, News. **10.15**, Dance Music from Restaurant Wivel. **12.0 Midnight**, Chimes from the Town Hall. **12.15 a.m.** (approx.) (Sunday), Close Down.

KATOWITZ (**422 metres**); 10 kW.—**5.0**, Programme for Children. **6.0**, Programme from Vilna. **7.0**, News. **7.30**, Talk by M. Thadé Meyerhold. **7.55**, Agricultural Report. **8.15**, Programme from **Warsaw**. **10.0**, Time Signal, Weather Report, and News. **10.30**, Dance Music.

Programmes from Abroad.—

KAUNAS (2,000 metres) ; 7 kW.—**9.0,** Concert : Spass muss sein (Morena) ; Selection from La Chaste Susanne (Gilbert) ; Selection from The Merry Widow (Lehár) ; Berlin, Wie es Weint und Lacht (Conradi) ; Potpourri of Lithuanian Songs ; Potpourri from La Bayadère (Kálmán) ; The Negro's Dream (Myddleton) ; Der Wink mit dem Zaunpfahl (Spoliauski).

LAHTI (1,522.8 metres) ; 35 kW.—**5.0,** Orchestral Concert : Torch Dance (Meyerbeer) ; Wo die Citronen blühn (J. Strauss) ; Romance (Tchaikovsky) ; Viola Selections ; Air from La Bayadère (Kálmán) ; Song ; First Movement of Violin Concerto (Mendelssohn) : Air (Bach) ; Romanza Andalousa (Sarasate) ; Song ; Talk : Choral Selection ; Overture to William Tell (Rossini) ; Selection (Kálmán) ; Melodies (Bizet) ; Songs. **8.45,** News in Finnish and Swedish. **9.15,** Dance Music. **10.0** (approx.), Close Down.

LANGENBERG (468.8 metres) ; 20 kW.—Programme also for **Aix-la-Chapelle** (100 metres), **Cologne** (283 metres), and **Münster** (250 metres).—**12.10,** Gramophone Selections. **1.5 to 4.30,** Programme from **Cologne.** **4.30,** Programme from **Königswusterhausen.** **5.0,** Programme from **Cologne.** **5.30,** Legends from the Mines, arranged by W. Büscher, from **Dortmund.** **6.0,** Programme from **Cologne.** **7.20,** On the Track of the Elephant—Reminiscences (Thea de Haas), from **Dortmund.** **7.45,** The Westphalian Intellectual Circle, from **Münster.** **8.15 to 1.0 a.m.** (Sunday), Programme from **Cologne.**

LEIPZIG (365.8 metres) ; 4 kW.—**4.30,** Concert : Overture to Jean de Paris (Boieldieu) ; Air (Brogi) ; Albumblatt (Wagner) ; Sérenade for String Orchestra (Klengel) ; Northern Dances (Grieg) ; in the Interval, Wireless Notes. **6.0,** The Letter Box. **6.15,** Talk on Taxation. **6.30,** Programme from **Königswusterhausen.** **6.55,** Dr. Hermann Boeszneck, Talk : Self-Knowledge. **7.25,** Fritz Münch, Talk : The Lüneberg Heath in Bloom. **7.55,** Weather Report and Time Signal. **8.0,** "The Marriage of Figaro"—Opera (Mozart) from the Chemnitzer Opera House. **10.30,** News and Sports Notes. **10.45,** Programme from **Voxhaus.**

MADRID (Union Radio), Call EAJ7 **(375 metres)** ; 3 kW.—**7.0,** Sextet Selections : Fantasia on Polenblut (Nedbal) ; Suite from Escenas de hadas (Massenet) ; Interlude by Luis Medina. **8.0,** Dance Music. **9.45,** Market Prices. **10.0,** Chimes, followed by Symphony Concert : Overture in the Italian Style (Schubert) ; Chorale from Cantata No. 140 (Bach) ; Irish Dance (Grainger) ; Fourth Symphony (Brahms) ; Andante (Mozart) ; Two Nocturnes (Debussy). **11.50,** News. **12.0 Midnight,** Dance Music. **12.30 a.m.** (approx.) (Sunday), Close Down.

MILAN, Call 1MI **(526.3 metres)** ; 7 kW.—**9.0,** Variety Concert : Quintet Selections, (a) Overture to Maritana (Wallace), (b) Scènes napolitaines (Massenet) ; Baritone Solo from La Traviata (Verdi) ; Soprano Solos, (a) Ombra di carne (Tirindelli), (b) Se incoree l'agnelletta (Sazzi) ; Tenor Solo from The Queen of Sheba (Goldmark) ; Quartet Selections, (a) Träumerei (Schumann), (b) Scherzo (Cherubini) ; Tenor Solo (Parelli) ; Selections, (a) A Masked Ball (Verdi), (b) O fior del campo (Billi) ; Soprano Solos (Rossini and Tarenghi) ; Quintet Selections, (a) October (Tchaikovsky), (b) The Mill in the Wood (Seybold). **10.15,** News, followed by Dance Music from the Hotel Majestic Diana, and Close Down.

MOTALA (1,380 metres) ; 30 kW.—Programme also for **Stockholm** (454.5 metres) ; **Boden** (1,190 metres), **Göteborg** (118.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres). **5.30,** Concert of Light Music. **6.30,** Programme for Children. **7.0,** Accordion Selections. **7.30,** Talk : Workers and Workmen. **7.45, Readings. 8.0,** Band Selections. **9.0,** Topical Talk. **9.15,** News and Weather Report. **9.45,** Dance Music. **12.0 Midnight** approx.), Close Down.

MUNICH (535.7 metres) ; 4 kW.—**6.0,** Hans Ziegler, Wireless Talk : Low Frequency. **6.30,** Labour Exchange Report. **7.0,** Answers to Correspondents. **7.30,** Bandoneon Recital by George Weinschutz. **8.0,** German Folk-Songs by Mixed Choir. **8.35,** Concert : Overture and Entr'acte to the 4th Act of Carmen (Bizet) ; Two Pieces for Harp (Posse). (a) Neckerei, (b) Wellenspiel ; Entr'acte and Ballet Music from Rosamunde (Schubert) ; Trumpet and Orchestral Selection ; Der Postillion, Op. 11 No. 2 (Volkmann) ; Nocturne from A Midsummer Night's Dream (Mendelssohn) ; Horn and Orchestral Selection (Ziehrer), (a) Mitten in den grünen Wiesen, (b) Selection from Der Fremdenführer ; Sleeping Beauty Suite (Tchaikovsky) ; Two Pieces for Xylophone. (a) Valse caprice (Peter), (b) Polka, Klein, aber fein (Krüger) ; 's kommt ein Vogerl geflogen (Ochs) ; Radetzky March (Joh. Strauss). **10.0,** News and Announcements. **10.25,** Dance Music.

Saturday, September 1st.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

NAPLES, Call 1NA **(333.3 metres)** ; 1.5 kW.—**8.20** Wireless Notes. **8.40,** Time Signal and News. **8.48,** Harbour Notes. **8.50,** Concert of Light Music : Overture to Pique Dame (Suppé) ; Selections from The Grenadiers (Valente) ; Selections from Ballo Excelsior (Marengo). **9.50,** Relay from a Theatre ; in the Intervals, Dance Music. **10.50,** News and Calendar. **11.0** (approx.), Close Down.

OSLO (461.5 metres) ; 1.5 kW.—Programme relayed by **Fredriksstad** (431.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), and **Rjukan** (448 metres).—**7.45,** Weather Report, News and Agricultural Report. **8.0,** Time Signal. **8.2,** Orchestral Concert : Academic Festival Overture (Brahms) ; The First Rhapsody (Svendsen) ; Valse, Elegie and Heimat (Grieg) ; Selection (Olsen) ; Potpourri, Chansons des étudiants (Oehlschlägel). **9.30,** Weather Report and News. **9.45,** Talk on Topical Events. **10.0,** Dance Music from the Hotel Bristol. **12.0 Midnight** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT **(458 metres)** ; 0.5 kW.—**4.15,** Symphony Concert. **6.30,** Radio Journal de France. **8.0,** Sports Talk. **8.30,** Concert of Light Music, followed by Dance Music. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(2,650 metres)** ; 5 kW.—**6.45,** "Le Journal Parlé." **8.10,** Weather Report. **8.30,** Concert : Part I—The Works of Fauré ; Sonata for Violin and Pianoforte ; Pianoforte Solo, Barcarolle ; Fantasy for Flute and Pianoforte ; Pianoforte Solo, Impromptu ; 'Cello Solos, (a) Elégie, (b) Sicilienne ; Violin Solo, Andante ; Orchestral Selection, Dolly. Part II.—Polonaise in B Flat (Schubert) ; Le Jardin de Paradis (Silven) ; Sérénade du marchand de masques (Wolff).

PARIS (Petit Parisien) **(340.9 metres)** ; 0.5 kW.—**8.45,** Gramophone Selections, Talk, News and Announcements. **9.0,** Concert : Overture to The Torment of Tantalus (Suppé) ; Song, Le Rossignol (Rimsky-Korsakoff) ; Selection from Eugen Onegin (Tchaikovsky) ; Symphony Orchestra, (a) España (Chabrier), (b) Selection from Manon (Massenet), (c) Waltz of the Sylphs from The Damnation of Faust (Berlioz) ; Selection from Le Huila (Rousseau) ; Song, Amour d'antan (Chausson) ; Two Dances from Gladys (Puget) ; Demande (Lazzari) ; Gothic March (Casadesus), News in the Intervals.

PARIS (Radio Paris), Call CFR **(1,750 metres)** ; 6 kW.—**12.30,** Gramophone Selections : Fourth Symphony in B Flat (Beethoven) ; Invocation to Nature from The Damnation of Faust (Berlioz) ; L'Ile heureuse (Chabrier) ; Septuor (Saint-Saëns) ; I'm in Love Again ; Just like a Butterfly ; Tango, Desengaño ; One-step, Constantinople ; Fox-trot, Get out and get under the Moon ; News in the Intervals. **1.50,** Market Prices and Religious Announcements. **4.45,** Dance Music ; News in the Intervals. **8.0,** Agricultural Report. **8.15,** Talk, followed by Market Prices and News. **8.30,** Concert : Le joli rôle (Raymond Gentil) ; Orchestral Music and Songs ; News in the Intervals.

POSEN (344.8 metres) ; 1.5 kW.—**6.0,** Divine Service from **Vilna.** **7.0,** Topical Talk. **7.30,** Programme from **Warsaw.** **7.55,** Financial Report. **8.15,** Popular Concert from **Warsaw.** **10.0,** Time Signal, News and Weather Report. **10.20,** Miscellaneous Items. **10.40,** Dance Music from a Restaurant. **12.0 Midnight,** Concert arranged by La Maison Philips. **2.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (348.9 metres) ; 5 kW.—**6.0,** German Transmission. **6.35,** Talk for Workers. **7.0,** "Polenblut," Operetta (Nedbal). **10.0,** Time Signal, News, and Programme from the Exhibition.

RIGA (526.3 metres) ; 4 kW.—**6.0,** Programme of Talks. **7.0,** Popular Concert : Overture to La Dame Blanche (Boieldieu) ; Selection from Eugen Onegin (Tchaikovsky) ; Waltz, Waldeszauber (Vollstedt) ; Parade of the Gnomes (Wetzel) ; Songs ; Violin Solos ; Songs ; Overture to Eliza (Cherubini) ; Selection from The Flying Dutchman (Wagner) ; Wedding Scenes (Smetana) ; En café orientale (Volstedt). **9.0,** Weather Report and News, followed by Dance Music from the Café de la Opera. **12.0 Midnight** (approx.), Close Down.

ROME, Call 1RO **(447.8 metres)** ; 3 kW.—**8.30,** Sports Notes, followed by News and Weather Report. **8.47,** Topical Talk and Time Signal. **9.0,** "The Girl of the Golden West," Opera (Puccini) ; In the Interval, Review of Literature and Art and Topical Talk. **11.5,** News and Talk. **11.30** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF **(21.96 and 31.4 metres)** ; 30 kW.—**11.55,** Baseball Announcements. **12.0 Midnight,** Statler's Pennsylvanians, directed by Johnny Johnson, from **New York.** **12.30 a.m.** (Sunday), Musical Selections from the Hotel Sagamore, **Rochester.** **1.0 a.m.,** Keystone Duo with Balladers, from **New York.** **1.30 a.m.,** Time Signal. **1.32 a.m.,** The New York Philharmonic Orchestra, conducted by Willem Van Hoogstraten, from the Lewissohn Stadium. **3.20 a.m.,** Organ Recital by Robert Berentsen, from **Rochester.** **4.0 a.m.,** Dance Music from the Hotel De Witt Clinton, **Albany.** **5.0 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres) ; 5 kW.—**6.15,** Concert of Turkish Music. **8.30,** Time Signal and Weather Report, **8.40,** Concert : Pianoforte Quartet (Mozart) ; Songs from Opera ; Andante from the Sonata Pathétique (Beethoven) ; Festival March from Lohengrin (Wagner). **10.0,** News and Close Down.

STUTTGART (379.7 metres) ; 4 kW.—**6.0,** Time Signal and Weather Report. **6.15,** Talk by Prof. Krebs, relayed from **Freiburg** (577 metres). **6.45,** Dr. F. Luther, Talk : Sleep, Dreams and Death. **7.15,** Albert Ehrenstein, Talk : Chinese Poetical Works. **8.0,** Labour Exchange Notes, Time Signal, Weather Report and Sports Notes. **8.30,** Chamber Music ; La Folia, Variations in D Minor (Corelli) ; Trio in E Flat Major (Mozart) ; Sonata in E Major (Pugnani) ; followed by Variety Concert : Capriccio Italienne (Tchaikovsky) ; Ira Wogenden Tanz (Tchaikovsky) ; Warum ? (Tchaikovsky) ; Air from Aïda (Verdi) ; Der Grenzlauf (Otto Ernst) ; Air from Prince Igor (Borodine) ; Overture to Rosamunde (Schubert) ; Der Doppelgänger (Schubert) ; Liebesfeier (Weingartner) ; Der Papagei (Löwe) ; Overture to Tancred (Rossini) ; Derbyritt, Sketch in One Act (Gerhard Grindel) ; Leuchtkäferchens Hochzeit (Siede) ; News.

TALLINN (408 metres) ; 2.2 kW.—**5.30,** Programme for Children. **6.0,** Review of the Week. **6.30,** News, followed by Programme of Gramophone Selections, **8.15,** Dance Music from the Estonia Veissem Saal.

TOULOUSE (Radiophonie du Midi) **(391 metres)** ; 3 kW.—**12.30,** Concert. **8.0,** Exchange Quotations and News. **8.30,** Concert of Spanish Ballet Music with Castagnet Accompaniment : Valenciana (Colorado) ; Jota Aragonesa (Colorado) ; La Corrida (Stierkampf) ; Danza (Granados) ; Malaguena (Guerrero) ; Lagarterana (Guerrero) ; Cordoba (Granados) ; Andalusian Tango (Albéniz). **9.0,** Concert : L'Adieu des Gladiateurs (Blankenburg) ; Overture to The Drum-Major's Daughter (Offenbach) ; Overture to The Great Mogul (Audran) ; Waltz, The Syrens (Waldteufel) ; Concert Mazurka, La Hongroise (Pares) ; Overture to Madame Favart (Offenbach) ; Overture to La Petite Mariée (Lecocq) ; March, Les Cadets de Picardie (Allier) ; in the Interval, Selections by Children's Choir. (a) Hymne à la Forêt (Mendelssohn), (b) La Nuit de Grenade (Kreutzer). **11.0,** North African News.

VIENNA (577 and 517.2 metres) ; 1.5 and 5 kW.—**4.15,** Concert : Overture to Ruy Blas (Mendelssohn) ; Waltz, Immer Oder Nimmer (Waldteufel) ; Fantasia on Faust (Gounod) ; Minuet in D Major (Mozart) ; Blumengeflüster (Blon) ; Brief an das Glück (Goetz) ; Song, Still, wie die Nacht (Bohm) ; Song, Wenn am Abend in Wien (Reitinger) ; Potpourri, Auf der Wanderschaft (Mannfred) ; Potpourri from Der Vogelhandler (Zeller) ; Egerländer-Marsch (Kopetzky). **6.15,** Vocal and Instrumental Concert : Songs, (a) Air from Claudine von Villa Bella (Schubert), (b) Suleika's Second Song (Schubert), (c) Frühlingsglaube (Schubert) ; 'Cello Solos, (a) Rondo in G Minor (Dvorák), (b) Caprice (Reger) ; Songs, (a) Air from Louise (Charpentier), (b) Air from The Pearl Fishers (Bizet) ; Selections (Löwe), (a) Süsses Begräbnis, (b) Trommelständchen, (c) Die Mutter an der Wiege. **7.10,** Duologue. **8.15,** "Mädi," Operetta in Three Acts (Stolz).

VILNA (435 metres) ; 1.5 kW.—**5.0,** Gramophone Selections. **5.30,** Talk for Women by Mme. Ela Buncler. **6.0,** Divine Service. **6.50,** Talk : The First Northern Fair at Vilna. **7.15,** Literary Programme. **7.55,** News and Announcements. **8.15,** Programme from **Warsaw.** **10.0,** Programme from **Warsaw.** **11.30** (approx), Close Down.

WARSAW (1,111 metres) ; 10 kW.—**5.0,** Programme for Children. **6.0,** Divine Service from **Vilna.** **7.0,** Miscellaneous Items. **7.30,** Wireless Talk by Dr. M. Stepowski. **7.55,** Agricultural Report and News. **8.15,** Concert ; News in French in the Interval. **10.0,** Time Signal. Aviation Notes, Weather Report, Police News and Sports Notes. **10.30,** Dance Music from the Restaurant Oaza. **11.30** (approx.), Close Down.

Programmes from Abroad.—

BARCELONA (Radio-Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—12 **Noon**, Barcelona Cathedral Chimes, followed by Regional Weather Report and Weather Report for Europe. **1.30**, Instrumental Selections by the Iberia Trio; in the Intervals Gramophone Records. **2.45 to 9.0**, No Transmission. **9.0**, Opening Signal, followed by Exchange Quotations and Market Prices. **9.15**, Concert of Orchestral and Vocal Music. **10.5**, "La Tempestad" Lyrical Drama in Three Acts: Text by Carrion. Music by Chapi; in the Interval, Sports Notes. **12.0 Midnight** (approx.), Close Down.

BASLE (**1,010 metres**): 1.5 kW.—**8.30**, Programme of Music. **10.0**, News Bulletin and Weather Forecast. **10.15** (approx.), Close Down.

BERGEN (**370.4 metres**); 1.5 kW.—**10.30 a.m.**, Divine Service, relayed from a Church. **12.30**, Weather Forecast and News Bulletin. **8.0**, Concert by the Station Orchestra. **9.0**, Talk. **9.30**, Concert by the Braga Male Voice Choir, Conducted by Mr. Heggen. **10.0**, Weather Forecast, News Bulletin and Time Signal. **10.15**, Musical Programme. **12.0 Midnight** (approx.), Close Down.

BERLIN (Königswusterhausen), (**1,250 metres**); 40 kW.—**6.30 a.m.**, Early Morning Concert, relayed from **Voxhaus**. **8.55 a.m.**, Relay of Chimes from the Potsdam Garrison Church. **9.0 a.m.**, Morning Recital from **Voxhaus**, followed by Berlin Cathedral Chimes. **11.30 a.m.**, Orchestral Concert, relayed from **Voxhaus**. **2.0**, Funkheinzelmann's Programme for Children, relayed from **Voxhaus**. **3.45**, The Week's Market and Weather Reports, from **Voxhaus**. **3.55**, Talk for Farmers, from **Voxhaus**, followed by Light Musical Programme. **6.30**, Two Talks, followed by relay from another German Station.

BERLIN (Voxhaus), (**484 metres**); 4 kW.—**5.30 a.m.**, Orchestral Concert. **8.55 a.m.**, Chimes from the Potsdam Garrison Church. **9.0 a.m.**, Sacred Recital of Vocal and Instrumental Music, and Religious Address, followed by Chimes from the Berlin Cathedral. **11.30 a.m.**, Musical Programme. **2.0**, "Funkheinzelmann's" programme for Children, arranged by Hans Bödenstedt. **3.30**, Practical Hints for Farmers. **3.45**, The Week's Market and Weather Reports for Agriculturists. **3.55**, Talk for Farmers, followed by Orchestral Concert and Talks. **7.30**, Dr. J. E. Poritzky, Talk: Pan Europe and World Literature. **8.0**, Talk. **8.30**, Programme of Music, followed by News Bulletin, Weather Report, Time Signal and Sports News. **10.30**, Programme of Dance Music. **12.30 a.m.** (approx.) (Monday), Close Down.

BERN (**411 metres**); 1.5 kW.—**10.30 a.m.**, Morning Service and Sermon. **1.0**, Time Signal and Weather Forecast. **1.5**, Concert of Orchestral Music. **8.0**, Time Signal and Weather Forecast. **8.5**, Instrumental Concert. **9.45**, Sports Notes, News Bulletin and Weather Forecast. **10.0**, Concert by the Bern Municipal Orchestra. **10.35** (approx.), Close Down.

BRATISLAVA (**300 metres**); 1 kW.—**7.0 a.m.**, Concert relayed from **Carlsbad**. **10.0 a.m.**, Musical Programme. **5.0** (approx.), Programme of Talks, Concerts and Gramophone Selections. **12.20**, Programme relayed from Outside.

BRESLAU (**322.6 metres**); 4 kW.—**8.45 a.m.**, Chimes, relayed from Christ Church. **9.0 a.m.**, Evangelical Morning Recital, followed by Programme of Music, and Talks. **2.35**, Talk for Chess Players. **3.0**, Fairy Tale Recital. **3.30**, Programme for Farmers, followed by Programme of Talks and Music. **8.30**, Musical Programme. **10.0**, News Bulletin. **10.30**, Relay of Dance Music Selections. **12.0 Midnight** (approx.), Close Down.

BRÜNN (**441.2 metres**); 3 kW.—**7.0 a.m.**, Concert, relayed from **Carlsbad**, followed by Agricultural Report. **10.0 a.m.**, Concert of Sacred Music. **11.0 a.m.**, Concert of Instrumental Music. **12.0**, Musical Selections. **3.0**, Programme relayed from the Exhibition, followed by Popular Items, and Evening Musical Programme.

BRUSSELS (**508.5 metres**); 1.5 kW.—Jazz Band.—**6.0**, Programme for Children with the Clowns Bonzo and Sylva. **6.30**, Instrumental Music. **7.30**, La Radio-Chronique—Journal Parlé of Radio-Belgique. **8.15**, Instrumental Selections. **10.15** (approx.), News Bulletin. **10.30** (approx.), Close down.

BUDAPEST (**555.6 metres**); 35 kW.—**9.0 a.m.**, News Bulletin and Talk on Beauty Culture. **10.0 a.m.**, Divine Service. **12.30** (approx.), Musical Programme. **3.30**, Agricultural Talk, followed by Musical and Dramatic Programme and Sports News. **7.40** (approx.), Musical Programme. **9.30** (approx.), Time Signal and Weather Forecast.

CHATELINEAU (**EB4CE**) (**220 metres**): 1.5 kW.—**8.0**, Concert of Instrumental Music; In the Interval, a Talk. **10.0** (approx.), Close Down.

SUNDAY, SEPTEMBER 2nd.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

COLOGNE (**283 metres**); 4 kW.—Programme also for Aix-la-Chapelle (400 metres), **Langenberg** (468.8 metres), and **Münster** (250 metres).—**9.0 a.m.**, Evangelical Morning Recital: Sacred Music by Choir and Soloists and Instrumental Selections. **11.0 a.m. to 1.0**, Programme of Talks. **1.0**, Instrumental Concert, followed by Programme of Talks and Music. **8.0**, "Der Waffenschmied"—Opera Comique (Lortzing), followed by Sports Notes, Last News Bulletin, Concert of Orchestral Music and Dance Music Selections. **12.0 Midnight** (approx.), Close Down.

CORK, Call 6CK (**400 metres**); 1.5 kW.—**8.30**, Carillonade by Dr. Staf Gebruers relayed from St. Coiman's Cathedral, Cobh, followed by Concert of Vocal and Instrumental Music, Tenor and Soprano Solos. **11.0**, National Anthem. **11.5** (approx.), Close Down.

CRACOW (**566 metres**); 1.5 kW.—**10.15 a.m.**, Probable Divine Service Relay. **12.0 Noon**, Fanfare from the Tower of Notre Dame Church in Cracow, Time Signal and Weather Forecast. **4.0**, Talks for Farmers followed by Dr. St. Wasniewski's Agricultural Chronicle. **8.0**, Fanfare from Notre Dame, News Bulletin and Sports Notes. **8.30**, Concert of French Songs and Music including Seventeenth and Eighteenth Century Songs, (a) C'est la Bergère Nanette, (b) Il faut que je file, (c) jamais je faisais tant, (d) Roeseli, sung by Mme. M. Onyszkiewicz, accompanied by Mlle. O. Martusiewicz. **10.0**, Programme relayed from **Warsaw**. **10.30**, Relay of Orchestral Selections from a Restaurant. **11.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**8.30 to 11.5** (approx.), Programme relayed from **Cork**, Concert of Tenor and Soprano Solos, Instrumental Music and Gaelic Traditional Songs with Dr. Staf Gebruers (Carillonneur), William Watt (Tenor), Hilda Dobbs (Soprano), Labhras O Cadhla (Gaelic Songs), Miss E. Evans (Pianoforte Solos), The Grossi Trio and The Station Quintet. **11.0**, National Anthem followed by Close Down.

FRANKFURT (**428.6 metres**); 4 kW.—**8.0 a.m.**, Concert of Sacred Music, followed by Talks and Music. **1.0**, Wiesbaden Chamber of Agriculture Report, followed by Musical Selections and Talks. **6.30**, Rhein-Main Popular Educational Programme. **8.30** (approx.), Musical Programme, followed by relay of Dance Music Programme from **Voxhaus**. **12.30 a.m.** (approx.) (Monday), Close Down.

HAMBURG, Call HA (in Morse) (**394.7 metres**); 4 kW.—Programme relayed by **Bremen** (272.7 metres), **Hanover** (297 metres) and **Kiel** (251.2 metres).—**6.30 a.m.**, Concert of Instrumental Music relayed from **Voxhaus**. **8.25 a.m.**, Time Signal, Weather Forecast, News Bulletin, Commerce Notes and Programme Announcements. **9.15 a.m.**, Musical Morning Recital. **10.55 a.m.** (for **Kiel** only), Matins relayed from the Kiel University Church. **11.0 a.m.** (for **Hamburg**, **Bremen** and **Hanover**), Talk. **11.30 a.m.** (approx.) (for **Hamburg**, **Bremen** and **Hanover**), Talk on a Commercial Topic. **12.55**, Nauen Time Signal. **1.5** (for **Hamburg** and **Kiel**), Orchestral Selections. **1.5** (for **Bremen**), Instrumental Concert. **1.5** (for **Hanover**), Selections of Gramophone Records. **2.0**, Programme for Children—Fairy Tales. **3.0**, Instrumental Concert. **4.30** (approx.), Programme of Talks, and Concert from the Café Wallhof, followed by Sports Notes and Musical Programme. **9.30** (approx.), Weather Forecast and Topical Talk. Concert from the Café Wallhof (for **Hamburg** and **Kiel**), Concert from the Café Continental or the Georgs-Palast (for **Hanover** and **Bremen**). **11.0** (approx.), Close Down.

HILVERSUM (**1070 metres**): 5 kW.—**12.40 to 2.10**, Concert of Instrumental Selections by the Wireless Trio. **3.10 to 5.10**, Military Band Concert followed by Concert of Instrumental Music. **7.40**, Weather Forecast, News Bulletin and Sports Notes. **7.55**, Concert by the Residence Orchestra conducted by Professor Georg Schneevoigt, relayed from the Kurhaus, **Scheveningen**. **10.15** (approx.), Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Programme on 1,870 metres after **5.40**.—**8.10 a.m.**, Divine Service, relayed from a Church. **12.10**, Selections by the Winkels Trio, followed by Talks and Musical Items. **5.20**, Divine Service from the Middelburg Noordekerk, Address by the Rev. Dr. Scheele, Organ Solos and Psalms. **7.25**, Talk. **7.55**, Concert of Instrumental Music. **10.25**, Epilogue by a Choir and Close Down.

JUAN-LES-PINS (Radio LL); (241.5 metres) 1.5 kW.—**1.0 to 2.0**, Concert of Instrumental Selections, Szechenyi (Farbach). **2.0 to 9.0**, No Transmission. **9.0**, News Bulletin, Weather Forecast and Orchestral Concert. **10.0**, Wireless Jazz by the Juan-les-Pins Casino Dance Band. **10.30** (approx.), Close Down.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**10.0 a.m.**, Church Service with Sermon. **11.30 a.m.** (**Kalundborg** only), Weather Forecast. **3.0** (approx.) to **6.50**, Programme of Music. Items for Children and Religious Service. **6.50** (**Kalundborg** only), Weather Forecast. **7.0**, News Bulletin. **7.15**, Time Signal. **7.30**, Talk. **8.0**, Chimes, relayed from the Copenhagen Town Hall, followed by Miscellaneous Programme. **9.30**, Concert of Waltzes, Polkas and Operetta Selections, Vocal and Instrumental from the Works of Joh. Strauss and Lanner. **10.45**, Modern Dance Music Selections; in the Interval at **12.0 Midnight**, Chimes from the Copenhagen Town Hall. **12.30 a.m.** (approx.) (Monday), Close Down.

KATOWITZ (**422 metres**); 10 kW.—**12.0 Noon**, Time Signal and Weather Forecast, followed by Programme of Talks and Musical Selections. **10.0**, Time Signal, Weather Forecast and Last News Bulletin. **10.30**, Selections of Modern Dance Music. **11.30** (approx.), Close Down.

KAUNAS (**2,000 metres**); 7 kW.—**12.0 Noon**, Chimes and Weather Forecast. **12.10**, Sacred Music Recital. **12.30**, Programme for Children. **5.0**, Programme of Talks with Music in the intervals. **6.0**, Programme for Young People. **7.0** (approx), Lowering of the Flag, Ceremony relayed from the War Museum in Kaunas. **8.30**, Concert of Lithuanian National Items: Songs and Music.

KÖNIGSBERG (**329.7 metres**); 4 kW.—Programme relayed by **Danzig** (272.7 metres).—**9.0 a.m.**, Address, Organ Solos. **11.0 a.m.** (**Königsberg** only), Weather Forecast, followed by Concert of Instrumental Music. **12.55**, International Time Signal, relayed from **Nauen**. **3.0**, Talk on Chess Problems by P. S. Leonhardt, followed by Talks and Concert. **8.30** (approx.), Orchestral Concert: The Pastoral Symphony, Op. 68, No. 6 (Beethoven), (a) Allegro ma non Troppo, (b) Andante molto moto, (c) Allegro, (d) Allegro, (e) Allegretto. **10.0**, News Bulletin and Sports Notes. **10,30**, Programme of Dance Music, relayed from **Voxhaus**. **12.30 a.m.** (approx.) (Monday), Close Down.

LAHTI (**1,522.8 metres**); 35 kW.—Programme also for **Helsingfors** (375 metres).—**8.0 a.m.**, Divine Service in the Finnish Language. **10.50 a.m.**, News Bulletin. **11.0 a.m.**, Song Recital and Instrumental Concert. **11.59**, Weather Forecast and Time Signal. **12.0 Noon**, Divine Service in the Swedish Language. **5.0**, Orchestral Concert, with Solo Selections in the Interval. **5.57**, Time Signal and Weather Forecast, followed by Concert of Orchestral Music and Songs. **8.45** Last News Bulletin in Finnish and Swedish. **9.15**, Concert relayed from a Restaurant. **10.0** (approx.), Close Down.

LANGENBERG (**468.8 metres**); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres), and **Münster** (250 metres).—**9.0 a.m.**, Evangelical Morning Recital, relayed from **Cologne**. **11.0 a.m. to 1.0**, Programme of Talks. **1.0**, Concert of Instrumental Music, followed by Talks. **4.0**, Melodrama Selections by Dr. Oscar Kaiser. **8.0**, Programme relayed from **Cologne**: Musical Programme, Last News Bulletin and Sports Notes, followed by Light Music and Dance Music Selections. **12.0 Midnight** (approx.), Close Down.

LAUSANNE (**680 metres**); 1.5 kW.—**4.0** (approx.), Musical Programme, relayed from **Bern**. **8.30**, Protestant Address, followed by Programme of Music. **10.0** (approx.), Close Down.

LEIPZIG (**365.8 metres**); 4 kW.—**8.30 a.m.**, Organ Recital, relayed from the University Church in Leipzig, Prof. Ernst Müller. **9.0 a.m.**, Morning Recital of Vocal and Instrumental Music, followed by Programme of Talks and Music. **2.30**, Concert of Orchestral Music by the Dresden Wireless Orchestra, relayed from the Jahresschau, **Dresden**, followed by Literary and Musical Programme, and Talks. **7.30**, Concert of Selections from Unknown Operas by the Dresden Wireless Orchestra and Charlotte Viereck (Soloist). **10.0**, Sports Notes. **10.30**, Programme of Dance Music, relayed from **Voxhaus**. **12.30 a.m.** (approx.) (Monday), Close Down.

MADRID (Union Radio), Call EAJ7 (**375 metres**); 3 kW.—Programme relayed by **Salamanca**, EAJ22 (105 metres).—**2.0**, Orchestral Concert. **3.30 to 7.0**, No Transmission. **7.0**, Programme for Children, followed by Sextet Selections from Images Infantines (Strens), (a) La Princesse, (b) Quand rêve un enfant,

Programmes from Abroad.—

(c) Dansc excentrique. **8.0,** Danse Music Programme. **8.30 to 10.0,** No Transmission. **10.0,** Time Signal. **10.5,** Concert by the Station Orchestra. **10.45,** Municipal Band Concert conducted by Senor Villa, followed by Probable Dance Music Programme. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, Call 1MI **(526.3 metres)** ; 7 kW.—**10.30 a.m.,** Vocal and Instrumental Sacred Music. **11.15 a.m. to 12.30,** No Transmission. **12.30,** Time Signal. **12.32,** Concert of Instrumental Music. **1.50 to 5.0,** No transmission. **5.0,** Variety Concert of Quintet and Vocal Selections. **5.25,** Talk for Farmers. **5.30,** Orchestral Selections relayed from the Majestic Hotel Diana. **6.0 to 8.25,** No Transmission. **8.25,** Opening Signal, Reports, Talks and Sports Notes. **8.50,** "L'Amico Fritz"—Opera (Mascagni), Talk in the Interval between Acts 1 and 2. **11.45** (approx.), Close Down.

MOTALA (1,380 metres) ; 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), and **Sundsvall** (545.6 metres).—**11.0 a.m.,** Matins relayed from a Church. **12.45,** Exchange Notes and Time Signal. **5.0,** Programme for Children. **5.55,** Town Hall Chimes. **6.0,** Evensong relayed from a Church. **7.15,** "Pygmalion"—A Comedy (Bernard Shaw), followed by Evening Musical Programme. **9.40,** Selections of Dance Music. **10.30** (approx.), Close Down.

MUNICH (535.7 metres) ; 4 kW.—Programme relayed by **Augsberg** (566 metres), **Kaiserlautern** (204.1 metres) and **Nuremburg** (241.9 metres).—**11.0 a.m.,** Town Hall Chimes. **11.15 a.m.,** Weather Forecast. **12.0 Noon,** Concert of Instrumental Music, followed by Literary Reading and Selections of Music. **8.0,** "Das Musikantenmädel"—Operetta in Three Acts (Georg Jarno), followed by News Bulletin and Concert including Dance Music Selections.

NAPLES, Call 1NA **(333.3 metres)** ; 1.5 kW. **10 a.m.** —Recital of Vocal and Instrumental Sacred Music. **4.45,** Children's Corner. **5.0,** Concert of Orchestral Music with Soprano Solos by Signora Carla Spinelli. **5.30,** Time Signal. **8.20,** Programme of Reports. **8.40,** Time Signal. **8.48,** Report of the Naples Harbour Authorities. **8.50,** Concert of Light Instrumental and Solo Selections with "Fiori d'Arancio"—Idyll in One Act (R. Bracco). **10.0,** Sports Notes. **10.55,** Calendar and Forthcoming Programme Announcements. **11.0** (approx.), Close Down.

OSLO (461.5 metres) ; 1.5 kW.—Programme relayed by **Fredriksstad** (134.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), **Rjukan** (448 metres).—**10.50 a.m.** (approx.), Chimes and Divine Service relayed from an Oslo Church. **7.45,** Weather Forecast and News Bulletin. **8.0,** Time Signal. **8.5,** Programme of Songs, Music and Recitations. **9.30,** Weather Forecast and News Bulletin. **9.45,** Talk, followed by Dance Music relayed from the Hotel Bristol, Oslo. **12.0 Midnight** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT **(458 metres)** ; 0.5 kW.—Programme relayed at intervals by the following Stations: **Bordeaux PTT** (275 metres), **Eiffel Tower** (2,650 metres), **Grenoble** (416 metres), **Lille PTT** (264 metres), **Limoges** (295 metres), **Lyons PTT** (476 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse PTT** (260 metres).—**8.0 a.m.,** News Bulletin. **10.25 a.m.,** International Time Signal and Weather Forecast. **12.0 Noon,** Instrumental Selections. **1.0,** Reports. **1.30,** Concert of Orchestral Music, followed by relay of the Concours Lepine Concert. **8.0,** Talk arranged by the Union des Grandes Associations. **8.30,** Instrumental and Vocal Concert followed by News Bulletin, Time Signal and Weather Forecast, with Dance Music Programme relayed from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(2,650 metres)** ; 5 kW.—**8.56 a.m.,** Time Signal on 32.5 metres. **10.26 a.m.,** Time Signal on 2,650 metres. **6.45,** Le Journal Parlé par T.S.F., Talks by Mme. Paule Hellès, MM. André Volvey, George Delamare, Julien Maigret, etc. **8.10,** Weather Forecast. **3.30,** Programme of Orchestral Music by Mario Cazes and his Orchestra. **8.56,** Time Signal on 32.5 metres. **11.26,** Time Signal on 2,650 metres.

PARIS (Petit Parisien) **(340.9 metres)** : 0.5 kW.—**8.15,** Concert of Gramophone Music, followed by Short Talk and News Bulletin. **9.0,** Concert of Vocal and Instrumental Music, including Selections from the First Movement of Beethoven's Symphony in D Major. In the Intervals at **9.25** and **10.0,** News Bulletins. **11.0** (approx.), Close Down.

Sunday, September 2nd.

All Times are reduced to British Summer Time and are p.m. except where otherwise stated.

PARIS (Radio LL) **(370 and 60 metres)** ; 1 kW.—**12.30,** Radio Liberté Transmission, Light Songs by Mlle. Néra Valprez, followed by News Bulletin, Topical Review, and "Radio-Liberté" Announcements **3.0,** Dance Music arranged by the Compagnie Nationale de Radiodiffusion ; Programme of Modern Fox-trots, Waltzes, Tangos and Blues.

PARIS (Radio-Paris), Call CFR **(1,750 metres)** ; 6 kW.—**8.0 a.m.,** News Bulletin and Press Review. **12.0 Noon,** Religious Address with Sacred Choral Recital. **12.45,** Albert Locatelli Orchestral in Selections from Madame Butterfly (Puccini). **4.30,** Modern Tangos and Fox-trots by the Grand Vatel Dance Band, News Bulletin. **7.45,** Children's Corner. **8.15,** Agricultural Report and News Bulletin. **8.30,** Concert of Instrumental Music, conducted by M. Eugène Bigot ; News in the Interval.

PITTSBURGH, Call KDKA **(63 and 27 metres)** ; 25 kW.—**4.0,** Divine Service. **7.0,** Roxy's Stroll Programme, relayed from **New York. 9.0,** Dr. Sockman's Question Box, from **New York. 10.0,** Twilight Rêveries from **New York. 11.0,** Telechron Time Signal, followed by Baseball Scores and Instrumental Concert. **11.30,** Dinner-time Orchestral Concert. **12.0 Midnight.** Telechron Time and Baseball Scores, followed by Continuation of Concert. **1.0 a.m.** (Monday), A Dramatic Programme. **1.45 a.m.,** The Whittall Anglo-Persians, from **New York,** followed by Variety and Longine Time. **3.0 a.m.,** Baseball Scores, Telechron Time Signal. **3.30 a.m.** (approx.), Close Down.

POSEN (344.8 metres) ; 1.5 kW.—**10.15 a.m.,** Relay of Morning Service from a Polish Cathedral. **12.0 Noon,** Time Signal. **5.0,** Concert by the Philharmonie de Varsovie, relayed from **Warsaw,** followed by Programme of Talks. **8.15,** Request Concert of the Polish Listeners : Military Orchestra, conducted by M. Sternalski, with Mme. Nadzieja Padlewska (Pianoforte), Irena Felicka (Soprano), Edmund Gizejewski (Violin) and Kajetan Kopczynski (Baritone) ; in the Programme, Pianoforte Solos, (a) Barcarolle (Tchaikovsky), (b) Minuet (Paderewski), (c) Polonaise in A Flat Major (Chopin). **10.0.** Time Signal, News Bulletin, Weather Forecast and Sports Notes. **10.20,** Miscellaneous Items. **10.40,** Programme of Dance Selections, relayed from the Palais Royal Restaurant in Posen. **12.0 Midnight** (approx.), Close Down.

PRAGUE (348.9 metres) ; 5 kW.—**7.0 a.m.,** Promenade Concert, relayed from **Carlsbad,** followed by Agricultural Report. **10.0 a.m.,** Musical Service, relayed from a Church. **11.0 a.m.,** Orchestral Concert, relayed from outside. **12.0 Noon,** Orchestral Selections. **1.5,** Commerce Notes. **1.20,** Miscellaneous Reports. **4.30,** Concert of Popular Selections. **5.30,** Programme for Workers. **6.0,** German Transmission, followed by Evening Musical Programme. **10.0,** Time Signal, News Bulletin and Concert of Instrumental Music.

RABAT, Call PTT **(416 metres)** ; 2 kW.—**1.30,** Concert by the Station Orchestra. **3.0 to 9.0,** No Transmission. **9.0,** Programme of Talks, followed by Le Journal Parlé, News Bulletin and Weather Forecast. **9.30,** Orchestral Concert of Popular Selections. **11.30,** Orchestral Concert, relayed from the Jardin d'Eté Cinema. **12.0 Midnight** (approx.), Close Down.

RIGA (526.3 metres) ; 4 kW.—**10.15 a.m.,** Religious Service from the Mara Church. **1.0,** Children's Corner. **4.0,** Instrumental Concert, conducted by A. Parups. **5.0 to 7.0,** Programme of Talks. **7.0,** Concert of Instrumental Selections and Song Recital ; in the Interval at **9.0,** Weather Forecast ; after the Concert, Last News Bulletin and Selections of Dance Music. **11.0** (approx.), Close Down.

ROME, Call 1RO **(447.8 metres)** ; 3 kW.—**10.15 a.m.,** Opening Signal. **10.20,** Vocal and Instrumental Sacred Music. **1.0 to 2.0,** Selections by the Wireless Trio. **5.0,** Opening Signal. **5.5,** Variety Concert. **6.0 to 6.30,** Dance Music Selections, relayed from the Casinetta. **8.0,** Opening Signal. **8.20,** Talk for Farmers. **8.30,** Sports Notes and News Bulletin. **8.46,** Topical Events Talk. **8.59,** Time Signal. **9.0,** Symphony Concert with Instrumental Solos : Concertstück in C Minor, Op. 79, for Pianoforte and Orchestra (Weber), (a) Larghetto affettuoso, (b) Allegro Appassionato, (c) Tempo di Marcia, (d) Presto gioioso, Soloist Mario Ceccarelli ; in the Intervals, Review of Reviews and Reading. **11.5,** Last News Bulletin. **11.15** (approx.), Close Down.

SAN SEBASTIAN (Union Radio), Call EAJ8 **(335 metres)** ; 0.5 kW.—**10.0 to 12.0 Midnight,** Concert, relayed from the San Sebastian Casino. **12.0 Midnight** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF **(21.96 and 31.4 metres)** ; 30 kW.—**3.30,** Divine Service. **10.30,** Concert by the Ballad Singers, relayed from **New York. 11.0,** Stetson Parade, American Legion Band, from **Boston, Mass. 12.0 Midnight,** Instrumental Selections from **New York. 12.25 a.m.** (Monday), Baseball Scores from **New York. 12.30 a.m.,** Capitol Theatre Programme from **New York. 2.0 a.m.,** Talk on the Government of the United States, from **Washington D.C. 2.15 a.m.,** Atwater Kent Programme, from **New York. 2.45 a.m.,** Time Signal. **2.47 a.m.,** Biblical Drama, from **New York. 3.15 a.m.,** Television Signals, Experimental Transmission. **3.30 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres) ; 5 kW.—**4.30,** Orchestral Selections. **5.30,** Cereal Market Prices. **6.15,** Concert of Turkish Native Music. **8.30,** Weather Report and Time Signal, followed by Instrumental Selections. **10.0,** News Bulletin. **10.30** (approx.), Close Down.

STETTIN (236 metres) ; 0.75 kW. —**6.30 a.m. to 12.30 a.m.** (approx.) (Monday). Programme of Music, Talks and Reports, etc., relayed from **Voxhaus.**

STUTTGART (379.7 metres) ; 4 kW.—**11.0 a.m.** (approx.), Recital of Instrumental and Vocal Sacred Music. **12.0 Noon,** Promenade Concert, followed by Gramophone Record Selections. **2.0,** Funkheinzelmann's Programme for Children, relayed from **Voxhaus. 3.0** (approx.), Vocal and Instrumental Programme, followed by Sports News, Time Signal and Talk. **8.0** (approx.), Musical Programme, followed by News.

TALLINN (408 metres) ; 2.2 kW.—**7.30 a.m.,** Early Morning Concert. **8.30 a.m.,** Church Service Relay. **6.0,** Concert of Orchestral and Vocal Music. **8.0** Agricultural Talk. **8.30,** News Bulletin. **8.45,** (approx.), Close Down.

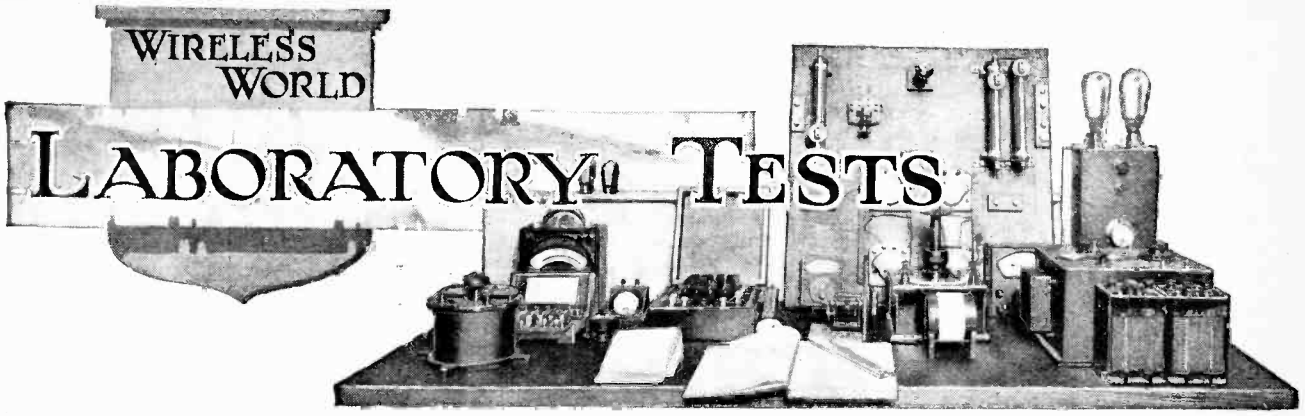
TOULOUSE (Radiophonie du Midi), **(391 metres)** ; 3 kW.—**12.30,** Orchestral Selections. **1.0,** Chimes. **1.45,** Press News. **8.0,** Exchange and News. **8.30,** Concert of Instrumental Music. **9.0,** Festival Concert of Selections from the Works of Delibes : "Lakmé," (a) Prayer and Chorus, (b) O divin mensonge—Fantasia, (c) Pourquoi dans les grands bois, (d) C'est le Dieu de la Jeunesse, (e) Lakmé, ton doux regard se voile, (f) C'est l'amour endormi, (g) Dans la Forêt près de nous, (h) Sous le ciel tout étoilé, (i) O viens dans la forêt profonde, (j) Ballet—Persian, Rektnha. Térana, (k) Entr'acte to Act III, (l) Tu m'as donné le plus doux rêve. **10.15,** North African News. **10.30** (approx.), Close Down.

VIENNA (577 and 517.2 metres) ; 1.5 and 5 kW.—Programme, relayed by **Graz** (357.1 metres), **Innsbrück** (294.1 metres), **Klagenfurt** (272.7 metres), and **Linz** (254.2 metres).—**11.0,** Programme by the Vienna Symphony Orchestra, with Songs in the interval. **4.0** (approx.), Concert of Light Orchestral Music. **7.45,** "The Thief," Drama in Three Acts (Henry Bernstein), followed by Jazz Orchestra Selections—Fox-Trots and Tangos.

VILNA (435 metres) ; 1.5 kW.—**12.0 Noon,** Time Signal, and News Bulletin, relayed from **Warsaw,** followed by Orchestral Concert and Talks. **8.15** (approx.), Concert, Time Signal and News Bulletin, relayed from **Warsaw. 10.30** (approx.), Dance Music Programme, relayed from **Warsaw. 11.30** (approx.), Close Down.

WARSAW (1,111 metres) ; 10 kW.—**10.15 a.m.,** Divine Service, relayed from a Polish Cathedral. **12.0 Noon,** Time Signal, Fanfare from the Tower of Notre Dame Church in **Cracow,** Aviation Report and Weather Forecast. **12.10 to 3.55,** No Transmission. **3.55,** Weather Forecast. **4.0,** Programme of Talks for Farmers. **5.0,** Concert of Orchestral Music by the Philharmonie de Varsovie. **6.30,** Miscellaneous Items. **6.50,** Talk by Professor L. Kulczycki : The History of the Russian Revolutionary Movement. **7.45,** Talk. **8.15,** Concert of Instrumental and Vocal Music by the Philharmonie de Varsovie Orchestra. **10.0,** Time Signal, Aviation Report and Weather Forecast. **10.5,** News and Police Information. **10.20,** Sports Notes. **10.30,** Dance Music, relayed from the Oaza Restaurant. **11.30** (approx.), Close Down.

ZURICH (588 metres) ; 1 kW.—**11.0 a.m.** (approx.), Instrumental Concert. **12.29,** Weather Forecast. **12.30,** Concert of Instrumental Selections. **4.0,** Orchestral Concert, relayed from the Carlton-Elite Hotel. **7.30,** Sermon. **8.0,** Concert of Chamber Music, Orchestral Selections and Ballads sung by Hermann Ernst (Baritone). **10.0,** Weather Forecast, Last News Bulletin and Close Down.



A Review of Manufacturers' Recent Products.

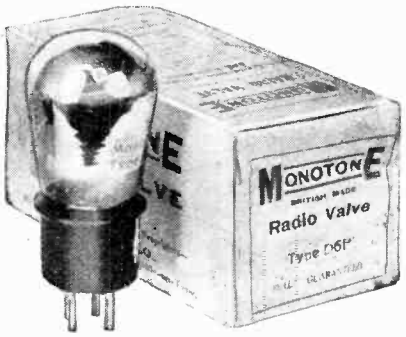
MONOTONE POWER VALVE.

Monotone valves are British made, and are supplied by Messrs. W. A. Davis & Co., 10, Cloth Market, Newcastle-on-Tyne. There are four types—H.F., L.F., R.C.C., and Power—and each type is made with 2-, 4-, or 6-volt filament, making a total of 12 in all. The manufacture is not controlled by a combine, and it has been found possible to produce the H.F., L.F., and R.C.C. valves at 6s. 6d., and the power valves at 8s. 6d.

The valve submitted for test is the power valve in the 6-volt category, and its rated characteristics are as follows :—

A.C. resistance = 4,750 ohms.
Amplification factor = 5.
Mutual conductance = 1.05 mA/volt.

It is designed for a maximum H.T. voltage of 120, and the grid bias required varies between 7½ and 12 volts negative, depending on the H.T. voltage. The valve is therefore capable of supplying sufficient volume for the average room.



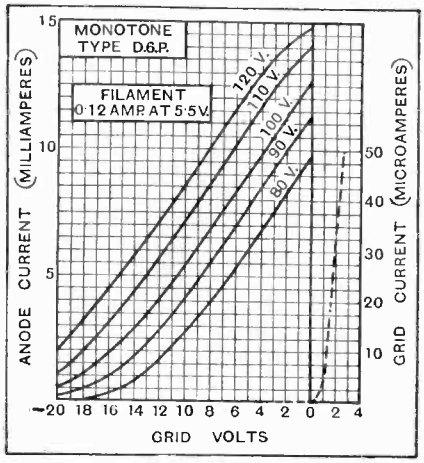
Monotone power valve, type D6P.

The filament of the specimen tested took 0.12 amp. at 5.5 volts, the rated current being 0.1 amp. From the accompanying curves the following average characteristics were calculated :—

A.C. resistance = 6,650 ohms.
Amplification factor = 4.65.
Mutual conductance = 0.7 mA/volt.

These, although not in exact agreement with the rated figures, are at least of the same order. The 120-volt curve shows signs of saturation, but the valve is dead hard.

The valves are guaranteed, and will be



Characteristic curves of Monotone 6-volt power valve.

replaced if faulty, provided they are mechanically intact.

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MAGNUM "VIBRO" HOLDER.

The circular centre moulding carrying the valve sockets is supported on hard rolled brass contact springs which are anchored to the square moulded base.

Magnum "Vibro" valve holder.

The dimensions of the base are 1½in. × 1½in., and slotted hexagonal terminals are fitted at each corner.

The movement of the centre portion is limited by stops, so that it is quite impossible to damage the suspension springs when inserting or withdrawing a valve. Manufactured by Burne Jones & Co., Ltd., 288, Borough High Street, London, S.E.1. Price 2/-.

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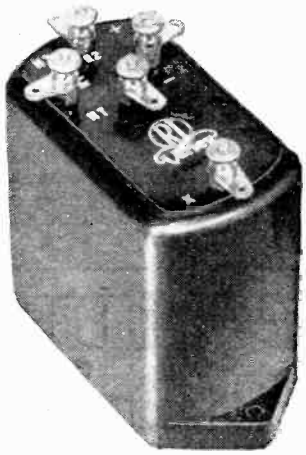
R.I.-VARLEY "ANTI-MOBO."

The "Anti-Mobo" is a unit incorporating a series feed resistance and by-pass condenser for preventing back coupling in L.F. amplifiers and the consequent effect known as "motor boating." The value of resistance required, although not critical, depends upon the valve with which it is to be used and the H.T. volts; it is undoubtedly a convenience to have a series of tappings so that the appropriate value may be found by trial. In the "Anti-Mobo" unit



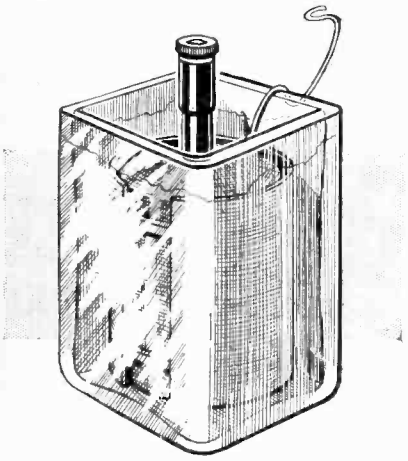
R.I.-Varley "Anti-Mobo" unit for preventing motor boating.

there are three tappings giving resistances of 20,000, 30,000, and 40,000 ohms, and the wire is wound on the bi-duplex system as in other R.I.-Varley products. The unit is of about the same size as an intervalve transformer, and the exact dimensions are as follows : Base, 3½in. × 1⅝in. ; overall height, 3in.

The "Anti-Mobo" is made by Messrs. R.I & Varley, 103, Kingsway, London, W.C.2, and the price is 9s. 6d

L.S.A. WET H.T. CELLS.

The cell tested was of the No. 8100 type in square glass container $2\frac{5}{8}$in. × $1\frac{5}{8}$in. × $1\frac{5}{8}$in., which is recommended for use with multi-valve sets. There is a small type No. 8000 in a cylindrical glass container 1in. in diameter and 2in. high.



L.S.A. Leclanché cell, size No. 8100.

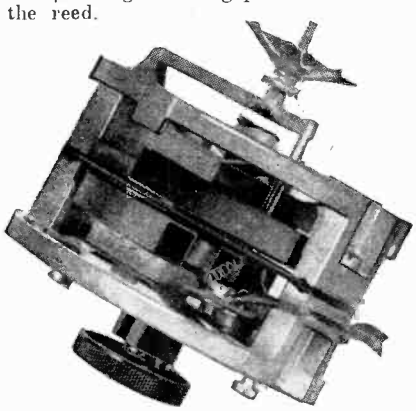
The performance of the No. 8100 cell was extraordinarily good. The initial E.M.F. on load was 1.6 volts, and the "cut off" or sudden falling-off of current did not occur until the cell had been running 850 hours. When the test was stopped at 1,260 hours the cell was still delivering 4.3 mA.

The connection to the zinc electrode is made through a copper wire soldered to the top of the zinc. This is not so good as cutting the connecting strips in one piece with the zinc, and the joints were carefully watched for corrosion. No trouble was, however, experienced, and throughout the exceptionally long test the electrolyte did not succeed in penetrating the coating of black enamel protecting the joint.

L.S.A. cells are obtainable in this country from Messrs. Thompson & Co., 1 and 3, Old Swan Lane, London, E.C.4, and the No. 8100 size costs 8s. 9d. per dozen.

DOUBLE-ACTING REED UNIT.

Messrs. Goodmans, 27, Farringdon Street, London, E.C.4, have now produced a super model of their well-known double-acting reed unit for cone loud speaker construction. Like the PG3 unit, a skeleton reed is used, and is stamped between two die-cast frames. The permanent magnets, pole pieces, and coils are of the type used in iron diaphragm movements, and are mounted symmetrically on opposite sides of the reed. Like poles of the permanent magnets are placed in juxtaposition so that the flux from each magnet traverses the reed in the same direction, and the windings are so connected that the force due to speech currents is additive. One set of magnets and poles is adjustable by means of a knurled screw for the purpose of equalising the air gap on each side of the reed.



Goodmans double-acting reed unit (Super Model).

The price is 32s. 6d., and each unit is supplied with flexible leads and aluminium cones for attachment to the diaphragm.

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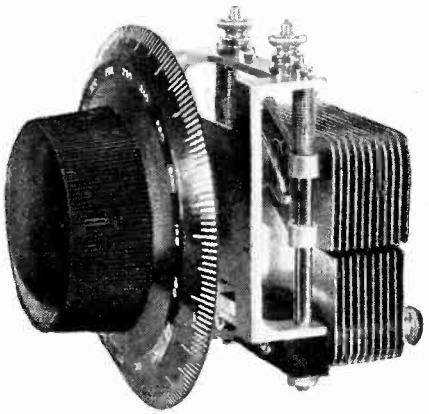
RIPAULT VARIABLE CONDENSER.

The well-known Ripault lateral action condenser has been redesigned from the mechanical point of view and the few remaining drawbacks of the first model have been overcome. The frame is now a brass finished die casting of great rigidity, and a very efficient friction washer is now fitted which adequately resists the action of the return springs on the cam.

The minimum capacity of the 0.0003 mfd. model is 8.5 micro-mfds., and the measured maximum is 0.00029 mfd.



Redesigned Ripault lateral action condenser.

Manufactured by Ripaults, Ltd., King's Road, London, N.W.1. Price 10/6.

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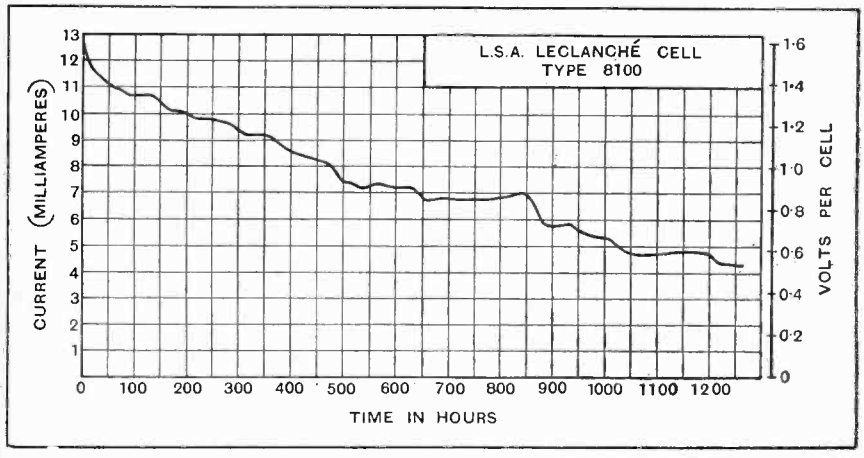
EELEX EARTH.

The Eelex earth is a galvanised iron bowl 9in. in diameter with fluted sides to increase the area of contact. Connection to the bowl is made through a heavy flexible cable soldered to the inside centre of the bowl. The joint is sealed with pitch to prevent electrolytic action between the dissimilar metals at the joint, a precaution which is frequently overlooked by makers of earth plates.

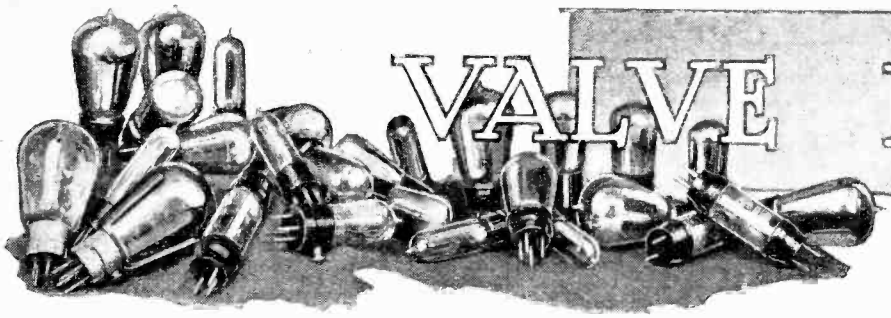
Eelex fluted earth plate

It is claimed that as no part of the earth plate projects above the surface, the heat of the sun is not conducted to the earth immediately surrounding the bowl, and that moisture is consequently retained for a longer period than would otherwise be the case. The cable is 8ft. in length, and is provided with a double-ended connector for joining to the earth wire from the set.

The Eelex earth is made by Messrs. J. J. Eastick & Sons, Eelex House, 118, Bunhill Row, London, E.C.1, and the price is 5s. 6d.



Discharge curve of the L.S.A. No. 8100 Sac Leclanché cell.



VALVE DATA

Revised List including NEXT SEASON'S NEW VALVES.

Readers will welcome what is practically a complete revision of the characteristics of the valves of last season. In general the filaments have been still further improved, so that the figures given for magnification factor are higher, while those for impedance are lower. In interpreting the data given here for use in receiver design it is felt that the column showing permissible grid swing at maximum anode volts is particularly useful. In making comparisons between the various valves one must guard against taking the figure given for grid voltage swing as indicating the power output. Normal grid bias values for maximum anode volts are approximately half the figure given for grid swing.*

Type.	Filament.		Impedance. Ohms.	Magnification Factor.	Conductance.	Permissible Grid Swing.	
	Volts.	Amp.				Swing.	Max. Anode Volts.
B.T.H.—							
RC 210	2.0	0.1	86,000	40	0.45	3	150
HF 210	2.0	0.1	28,000	20	0.7	3	150
GP 210	2.0	0.1	14,000	13	0.9	6	120
LF 215	2.0	0.15	7,000	7	1.0	18	120
P 227	2.0	0.27	2,900	4	1.4	30	120
RC 407	4.0	0.075	100,000	40	0.4	3	150
HF 407	4.0	0.075	21,000	18	0.85	3	150
GP 407	4.0	0.075	14,000	14	1.0	6	120
LF 407	4.0	0.075	5,700	8	1.4	15	120
P 415	4.0	0.15	2,900	5.5	1.9	24	120
RC 607	6.0	0.075	90,000	40	0.45	3	150
HF 607	6.0	0.075	20,000	20	1.0	3	150
GP 607	6.0	0.075	12,500	14	1.1	6	120
LF 607	6.0	0.075	5,300	9	1.7	12	120
P 615	6.0	0.15	2,600	6	2.3	18	120
PX 650	6.0	0.5	1,750	3.5	2.0	80	200
B 12	7.5	1.25	2,900	2.85	0.98	200	425
RHI	7.5	1.25	Half-wave rectifier. D.C. Output 65mA.				R.M.S. 550
Cosmos—							
DE 11	1.1	0.25	16,000	6.5	0.4	18	100
SP16/B.	1.8	0.09	70,000	35	0.5	—	120
SP16/G.	1.8	0.09	17,000	16	0.95	6	150
SP16/R.	1.8	0.09	10,000	9	0.9	20	100
SP18/R.R.	2.0	0.3	4,500	6.5	1.4	20	100
SP60/B.	6.0	0.09	50,000	35	0.7	—	120
DE 50	6.0	0.09	20,000	9	0.45	6	100

*** Compiled from data furnished by the valve manufacturers.**

Type.	Filament.		Impedance. Ohms.	Magnification Factor.	Conductance.	Permissible Grid Swing.	
	Volts.	Amp.				Swing.	Max. Anode Volts.
Cosmos.—*Continued.*							
SP 50/R.	6.0	0.25	4,500	6.5	0.4	25	100
Indirectly heated Cathode Valves:							
AC/G.	4.0	1.0	14,000	35	2.5	6	180
AC/R.	4.0	1.0	2,500	10	4.0	16	180
SP41/U.	4.0	1.0	Half-wave rectifier.		D.C. output	30mA.	R.M.S. 250
SP42/U.	4.0	2.0	Full- ,,	,,	,,	60mA.	R.M.S. 250
SP43/U.	4.0	2.0	Half- ,,	,,	,,	75mA.	R.M.S. 300
Cossor—							
210 H.F.	2.0	0.1	25,000	15	0.65	6	120
210 L.F.	2.0	0.1	12,000	10	0.8	10	120
210 R.C.	2.0	0.1	60,000	40	0.6	3	120
220 P.	2.0	0.2	5,000	5	1.0	16	110
230 P.	2.0	0.3	4,000	4	1.0	20	110
410 H.F.	4.0	0.1	20,000	20	1.0	4	120
410 L.F.	4.0	0.1	10,000	10	1.0	8	120
410 R.C.	4.0	0.1	80,000	40	0.5	2	120
410 P.	4.0	0.1	5,000	5	1.0	16	120
610 H.F.	6.0	0.1	20,000	20	1.0	4	120
610 L.F.	6.0	0.1	8,000	8	1.0	10	120
610 R.C.	6.0	0.1	80,000	50	0.6	2	120
610 F.P.	6.0	0.1	6,500	5.5	0.8	12	120
610 P.	6.0	0.1	3,000	3.5	1.1	40	150
Pentodes:							
230 Quintode ..	2.0	0.30	20,000	40	2.0	20	180
415 ,, ..	4.0	0.15	20,000	40	2.0	20	180
Screened Grid Valves:							
210 S.G.	2.0	0.1	250,000	80	0.3	—	120
220 S.G.	2.0	0.2	200,000	200	1.0	3	120
410 S.G.	4.0	0.1	200,000	200	1.0	3	120
Directly heated A.C. Valves:							
M 41 H.F.	4.0	1.0	20,000	20	1.0	4	120
M 41 L.F.	4.0	1.0	8,000	8	1.0	10	120
M 41 R.C.	4.0	1.0	80,000	50	0.6	2	120
M 41 P.	4.0	1.0	6,500	5.5	0.8	12	120
M 41 S.P.	4.0	1.0	3,000	3.5	1.1	40	150
BU 6	6.0	2.0	Full-wave rectifier.		D.C. output	80mA.	R.M.S 250
SU 6	6.0	1.0	Half- ,,	,,	,,	35mA.	R.M.S. 250
Ediswan—							
RC 2	2.0	0 1	150,000	30	0.2	—	120
RC 210	2.0	0.1	67,000	40	0.6	3	120
HF 210	2.0	0.1	25,000	20	0.8	3	120
LF 210	2.0	0.1	13,000	13	1.0	6	120
PV 215	2.0	0.15	6,600	8	1.2	15	120
PV 225	2.0	0.25	2,700	3	1.1	25	120
RC 410	4.0	0.1	61,000	40	0 65	3	120
HF 410	4 0	0.1	22,000	25	1.1	6	120

Type.	Filament.		Impedance. Ohms.	Magnification Factor.	Conductance.	Permissible Grid Swing.	
	Volts.	Amp.				Swing.	Max. Anode Volts.
Ediswan.—*Continued.*							
LF 410	4.0	0.1	10,500	13	1.2	9	120
LF 410a	4.0	0.1	4,500	9	2.0	18	120
PV 410	4.0	0.1	5,500	5.5	1.0	20	120
PV 425	4.0	0.25	2,000	3	1.5	35	120
RC 610	6.0	0.1	50,000	40	0.85	3	120
HF 610	6.0	0.1	21,000	25	1.2	5	120
LF 610	6.0	0.1	10,000	15	1.5	8	120
PV 610	6.0	0.1	4,200	5	1.2	18	90
PV 625	6.0	0.25	3,000	3	1.0	45	150
Screened Grid Valves :							
SG 215	2.0	0.15	140,000	140	1.0	—	150
SG 410	4.0	0.1	115,000	140	1.2	—	150
SG 610	6.0	0.1	100,000	140	1.4	—	150
Directly heated A.C. Valves :							
MI 41	4.0	1.0	9,000	16	1.75	8	120
MI 41 R.C.	4.0	1.0	50,000	45	0.9	3	140
Marconi—							
DEH 210	2.0	0.1	50,000	35	0.7	3	150
HL 210	2.0	0.1	23,000	20	0.85	7.5	150
DEL 210	2.0	0.1	12,000	11	0.9	13.5	150
DEP 215	2.0	0.15	5,000	7	1.4	21	150
DEP 240	2.0	0.4	2,500	4	1.6	33	150
DEH 410	4.0	0.1	60,000	40	0.65	3	150
DEL 410	4.0	0.1	8,500	15	1.75	10.5	150
DEP 410	4.0	0.1	5,000	7.5	1.5	21	150
P 425	4.0	0.25	2,250	4.5	2.0	36	150
DEH 610	6.0	0.1	60,000	40	0.65	3	150
HL 610	6.0	0.1	30,000	30	1.0	4.5	150
DEL 610	6.0	0.1	7,500	15	2.0	9	150
DEP 610	6.0	0.1	3,500	8	2.3	18	150
P 625	6.0	0.25	2,400	6	2.5	42	250
P 625 A	6.0	0.25	1,600	3.5	2.2	51	180
LS 5	5.25	0.8	6,000	5	0.85	80	400
LS 5 A	5.25	0.8	2,750	2.5	0.9	—	400
LS 5 B	5.25	0.8	25,000	20	0.8	20	400
Directly heated A.C. Valves :							
H Point 8	0.8	0.8	55,000	40	0.75	3	150
HL Point 8	0.8	0.8	17,000	17	1.0	9	150
P Point 8	0.8	0.8	6,000	6	1.0	24	150
S Point 8	0.8	0.8	200,000	160	0.8	—	150
Screened Grid Valves :							
S 215	2.0	0.15	200,000	170	0.85	—	150
S 625	6.0	0.25	175,000	110	0.65	—	180
Indirectly heated Cathode Valves :							
KH 1	3.5	2.0	30,000	40	1.35	3	150
KL 1	3.5	2.0	3,750	7.5	2.0	21	150

Type.	Filament.		Impedance. Ohms.	Magnification Factor.	Conductance.	Permissible Grid Swing.	
	Volts.	Amp.				Swing.	Max. Anode Volts.
Marconi.—*Continued.*							
Pentode :							
PT 235	2.0	0.35	55,000	90	1.65	18	150
U 4	6.0	0.25	1,200	Half-wave rectifier.	D.C. output 15mA.		R.M.S. 220
U 5	5.0	1.6	300	Full-wave rectifier.	D.C. output 60mA.		R.M.S. 400
U 8	7.5	2.4	250	Full-wave rectifier.	D.C. output 120mA.		R.M.S. 500
Mullard—							
PM 1 A	2.0	0.1	72,000	36	0.5	3	150
PM 1 H.F.	2.0	0.1	28,000	13.5	0.5	8	150
PM 1 L.F.	2.0	0.1	18,000	8.9	0.5	12	125
PM 2	2.0	0.15	7,000	6.2	0.9	14	100
PM 252	2.0	0.3	3,800	3.8	1.0	30	125
PM 3 A	4.0	0.075	63,000	35	0.55	3.5	150
PM 3	4.0	0.075	16,000	13.5	0.85	8	125
PM 4 D	4.0	0.1	6,000	12.5	2.1	9	125
PM 4	4.0	0.1	7,000	7	1.0	18	125
PM 254	4.0	0.25	3,500	3.15	0.9	45	150
PM 5 B.	6.0	0.075	74,000	37	0.5	3.5	150
PM 5 X.	6.0	0.075	19,000	17.5	0.95	6	150
PM 6	6.0	0.1	5,700	7.1	1.25	12	100
PM 256	6.0	0.25	3,500	3.15	0.9	45	150
Screened Grid Valves :							
PM 12	2.0	0.15	230,000	200	0.85	at anode volts 100, and screen volts 75.	
PM 14	4.0	0.075	230,000	200	0.85		
Pentodes :							
PM 22 (Pentone)	2.0	0.3	62,500	82	1.3	21	150
PM 24 „	4.0	0.15	28,600	62	2.3	21	150
DFA 6	4.5	0.85	4,500	6.4	1.45	50	400
DFA 7	4.5	0.85	2,850	2.4	0.85	250	400
DFA 8	4.5	0.85	15,000	19.5	1.3	14	400
DFA 9	6.0	0.6	2,000	5	2.5	40	225
DO 20	7.5	1.3	2,000	5	2.5	90	425
DU/2	4.0	1.1	—	Full-wave rectifier		—	R.M.S. 240
DU/10	4.0	1.1	300	Half- „ „		—	R.M.S. 240
Osram—							
DEH 210	2.0	0.1	50,000	35	0.7	3	150
HL 210	2.0	0.1	23,000	20	0.85	7.5	150
DEL 210	2.0	0.1	12,000	11	0.9	13.5	150
DEP 215	2.0	0.15	5,000	7	1.4	21	150
DEP 240	2.0	0.4	2,500	4	1.6	33	150
DEH 410	4.0	0.1	60,000	40	0.65	3	150
DEL 410	4.0	0.1	8,500	15	1.75	10.5	150
DEP 410	4.0	0.1	5,000	7.5	1.5	21	150
P 425	4.0	0.25	2,250	4.5	2.0	36	150
DEH 610	6.0	0.1	60,000	40	0.65	3	150
HL 610	6.0	0.1	30,000	30	1.0	4.5	150

Type.	Filament.		Impedance. Ohms.	Magnification Factor.	Conductance.	Permissible Grid Swing.	
	Volts.	Amp.				Swing.	Max. Anode Volts.
Osram.—*Continued.*							
DEL 610	6.0	0.1	7,500	15	2.0	9	150
DEP 610	6.0	0.1	3,500	8	2.3	18	150
P 625	6.0	0.25	2,400	6	2.5	42	250
P 625 A.	6.0	0.25	1,600	3.5	2.2	51	180
LS 5	5.25	0.8	6,000	5	0.85	80	400
LS 5 A.	5.25	0.8	2,750	2.5	0.9	—	400
LS 5 B.	5.25	0.8	25,000	20	0.8	20	400
Directly heated A.C. Valves :							
H Point 8	0.8	0.8	55,000	40	0.75	3	150
HL Point 8	0.8	0.8	17,000	17	1.0	9	150
P Point 8	0.8	0.8	6,000	6	1.0	24	150
S Point 8	0.8	0.8	200,000	160	0.8	—	150
Screened Grid Valves :							
S 215	2.0	0.15	200,000	170	0.85	—	150
S 625	6.0	0.25	175,000	110	0.65	—	180
Indirectly heated Cathode Valves :							
KH 1	3.5	2.0	30,000	40	1.35	3	150
KL 1	3.5	2.0	3,750	7.5	2.0	21	150
Pentode :							
PT 235	2.0	0.35	55,000	90	1.65	18	150
U 4	6.0	0.25	1,200	Half-wave rectifier. D.C. output 15mA.			220
U 5	5.0	1.6	300	Full-wave rectifier. D.C. output 60mA.			R.M.S. 400
U 8	7.5	2.4	250	Full-wave rectifier. D.C. output 120mA.			R.M.S. 500
Six Sixty—							
SS 210 H.F.	2.0	0.1	27,000	13.1	0.5	4	100
SS 210 L.F.	2.0	0.1	18,000	8.5	0.5	10	100
SS 210 R.C.	2.0	0.1	68,000	35	0.5	3	125
SS 215 P.	2.0	0.15	7,300	6.5	0.9	14	100
SS 4075 H.F.	4.0	0.075	16,500	13	0.8	5	125
SS 4075 R.C.	4.0	0.075	64,000	34	0.5	3.5	150
SS 410 P.	4.0	0.1	8,000	7.3	0.9	12	100
SS 425 S.P.	4.0	0.25	3,600	3.2	0.9	45	150
SS 6075 H.F.	6.0	0.075	20,000	20	1.0	4	125
SS 6075 R.C.	6.0	0.075	74,000	37	0.5	3	150
SS 610 P.	6.0	0.1	6,000	7.1	1.2	12	100
SS 625 S.P.	6.0	0.25	3,600	3.2	0.9	50	150
Screened Grid Valves :							
SS 215 S.G.	2.0	0.15	220,000	190	0.9	—	150
SS 4075 S.G.	4.0	0.075	220,000	190	0.9	—	150
Pentodes :							
SS 230 P.P.	2.0	0.3	64,000	80	1.25	21	150
SS 415 P.P.	4.0	0.15	27,000	60	2.2	21	150

BROADCAST BREVITIES

By Our Special Correspondent.

Relays and the Regional Scheme.—"Kaleidoscope."—The World's Drama.—A Radio Artist's Union?—Reading and Listening.—Booming Broadcasting in France.

New Work for the Relays?

Captain P. P. Eckersley, whose cheery outlook on life never seems to blind him to the stern realities, issues a warning concerning the regional scheme. Even the regional scheme, it appears, may not cover every square inch of this bright little island, and certain communities may go unsatisfied unless steps are taken to cater specially for their needs.

I gather that certain of the present relay stations may be called in to fill the gaps, several of them working together on a common wavelength and transmitting the same programme. No surprise need be occasioned if tests in this direction begin very soon.

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"Prom" Broadcasts Next Week.

The stations relaying the Queen's Hall Promenade Concerts next week are as follows: London and Daventry (5XX), Thursday, September 6th; Daventry (5GB), Friday, September 7th; Manchester and Newcastle, Tuesday, September 4th; Aberdeen, Saturday, September 8th.

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A Master.

Thank you, B.B.C., for Leff Pouishnoff's pianoforte recital last week. Pouishnoff combines technical brilliance with poetic restraint. I listened to the concluding volcanic octave passage of the Chopin A flat ballade without being reminded of scrambled eggs.

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Six Studios and a Hundred Performers!

Judging from a swift glance at the MS. of "Kaleidoscope," I think its performance at 2LO on Tuesday next, September 4th, should not be missed. "Kaleidoscope," the work of Mr. Lance Sieveking, a member of the B.B.C. staff, is something more than a drama in that it exploits the possibilities of broadcasting to secure effects which could hardly be carried off either on the stage or the screen. It attempts a man's life story in terms of vital moments.

Six different studios will be employed for this giant production, and the total number of persons engaged will not be far short of 100. In addition to a cast of about a dozen there are several vocalists, the Gershom Parkington Quintette, the Wireless Orchestra, the Wireless Chorus, and Jack Padbury's Cosmo Club Dance Band. If, with all these artistic resources, we are not entertained, something will be wrong.

FUTURE FEATURES.

London and Daventry (5XX).

SEPTEMBER 2ND.—Service relayed from Whitfield's Tabernacle.

SEPTEMBER 4TH.—"The Kaleidoscope," a Rhythm, representing the life of a man from cradle to grave, invented by Lance Sieveking.

SEPTEMBER 5TH.—Presidential Address by Sir William Bragg at annual meeting of British Association, relayed from St. Andrew's Hall, Glasgow.

SEPTEMBER 7TH.—"Pride," a comedy play (anonymous).

Daventry Experimental (5GB).

SEPTEMBER 2ND.—Service relayed from Birmingham Cathedral.

SEPTEMBER 6TH.—"Managing Margaret," a comedy by Edwin Lewis.

SEPTEMBER 8TH.—"The Sea Hath its Pearls," instrumental and vocal programme.

Cardiff.

SEPTEMBER 5TH.—"Wrong Numbers," a play by Essex Dane.

SEPTEMBER 8TH.—"On the Beat," a Policeman's programme (orchestral, vocal, and two plays).

Manchester.

SEPTEMBER 3RD.—"A Very Musical Fantasy, or A Conductor's Nightmare," by Ernest Longstaffe.

SEPTEMBER 7TH.—Programme in celebration of the bi-centenary of Captain Cook's birth.

Newcastle.

SEPTEMBER 6TH.—Northumberland Historical Pageant—concert relayed from Alnwick Castle, Northumberland.

Glasgow.

SEPTEMBER 5TH.—Presidential Address by Sir William Bragg at the annual meeting of the British Association.

Aberdeen.

SEPTEMBER 2ND.—Organ and Choral Recital.

Belfast.

SEPTEMBER 7TH.—"The Lily of Killarney," opera by Benedict.

The B.B.C.-Side.

I hear that Tommy Handley is busy on a new revue for 2LO and 5XX, to be called "Tommy's Tours or Week-ends at the B.B.C.-side."

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George A. Birmingham.

George A. Birmingham, the popular novelist whose pen-name veils the identity of Canon Hannay, rector of Mells, will broadcast for the first time on September 5th, when he is coming to the London studio at 9.15 p.m.

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A Brave Woman.

The self-abnegation so characteristic of the Savoy Hill staff is being displayed every week-end by a certain lady who takes home a number of listeners' cookery recipes and tests their suitability for broadcasting. This heroine has so far escaped poisoning, and at the time of writing is reported to be still in full possession of her faculties.

The recipes have been received in response to the recent offer of 10s. 6d. for each recipe broadcast. Household hints are also being received, and these are paid for at 5s. each if found suitable for the microphone. The first batch will be broadcast at 6 p.m. on September 24th. The closing date for entries is September 3rd.

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Where Talks are Welcomed.

I wonder what our noble "men in the street" would say if 2LO suddenly adopted the Japanese scheme of programme arrangement. The Tokyo station devotes 25 per cent. of its total time to economics, 40 per cent. to educational subjects, and 35 per cent. to entertainment.

This station serves as a model to the other two stations in Japan, so the seeker after mirth will be no happier if he tunes in to Osaka or Nagoya. As a matter of fact, the average Japanese listener is quite pleased with the *status quo*.

National Drama Series.

Eleven nations are to be represented in the ambitious series of National Dramas which are to be given from the London and Daventry stations during the next twelve months.

Beginning with "King Lear" from 5GB on September 11th and from 2LO and 5XX on the following night, the series will proceed as follows:—

October.—The Betrothal, by Maeterlinck (Belgium).

November.—The Pretenders, by Ibsen (Norwegian).

December.—Life's a Dream, by Calderon (Spanish).

January.—The Fantasticks, by Rostand (French).

February.—Sakuntala, by Khalidasa (Indian).

March.—La Gioconda, by D'Annunzio (Italian).

April.—The Cherry Orchard, by Tchekov (Russian).

May.—There are Crimes and Crimes, by Strindberg (Swedish).

June.—Minna von Barnhelm, by Lessing (German).

June.—Electra, by Euripides (Ancient Greek).

August.—A modern British play, almost certainly by Bernard Shaw.

The plays will be given from 2LO and 5XX on the second Wednesday in each month and from 5GB on the preceding night.

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Explanatory Booklets.

Shortly before the production of each play an explanatory booklet will be published containing articles which will deal in general terms with the drama of the nation represented and will show how the physical features and climate of the country have left their mark on its artistic output. Reference will also be made to the life and work of the author whose play is to be broadcast.

It will be noticed that many of the plays in the list can be classed as modern.

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A Radio Artists' Union?

It might be a bad day for the listener if a *Radio Artists' Union* of the type suggested by an Irish writer ever came into being and waxed strong. So much trash has been talked about the enormity of engaging Continental artists that one trembles at the thought of an autocratic body of broadcast entertainers in this country who could dictate to the broadcasting authorities as to the type of entertainment which must be adhered to. British listeners require the best talent available, and the man who is able to provide it should not be debarred either on the score of his nationality or attachment to a union.

I understand that the idea of a union has been received very coldly by many artists themselves, and this is distinctly to their credit.

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A Perfect Programme!

One would have thought that after five or six years of broadcasting people would have ceased talking about the "perfect" programme, as if such a thing were possible. A programme can only be really perfect to the person or persons who prepare it, but I doubt whether it is in this sense that Mr. Joseph D. R. Freed eulogises the programme which he and his committee are getting ready for September 18th. This is to be "the Perfect Program as known in America," and it will go out from nearly 100 broadcasting stations for all the world to hear. The occasion will be the annual Radio Industries Banquet in New York, and it is expected that "30,000,000 people will be privileged to enjoy the greatest radio entertainment ever given." Besides being broadcast by the National Broadcasting Company and other organisations, it will go out from the short-wave stations at Schenectady and Pittsburgh.

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A Reflection.

The British listener who pays for his licence is freed from the curse of obligation to the broadcaster. Unlike the American listener, he is not being continually reminded that the great privilege he is enjoying is due to the goodwill and generosity of philanthropic merchants.

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Books and Broadcasting.

We shall probably hear no more of that particular brand of gloomy prophecy which maintained that broadcasting would mean the doom of the reading habit. Some time ago, the Edinburgh library authorities made it known that the mention of particular books in the broadcast talks was always followed by a demand for those books at the library counters. And now the Croydon Public Libraries Committee has made the satisfactory announcement, in its annual report, that broadcasting has not brought about a reduction of reading, but has actually proved stimulative.

So much for the Jeremiahs.

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Waking Up the Villages.

A six-valve set and numerous other awards await a number of intelligent Frenchmen who are able to satisfy the demands of l'Unione Françoise de T.S.F. which is now engaged in an effort to extend the popularity of broadcasting in France. Realising that France is far behind other countries in the exploitation of wireless telephony, the Union has determined to open a special enquiry at which suggestions will be considered for extending a love of broadcasting to the small towns and villages. The prizes mentioned are to be presented to the individuals who propound the most sensible ideas with this object in view. May the best men win.

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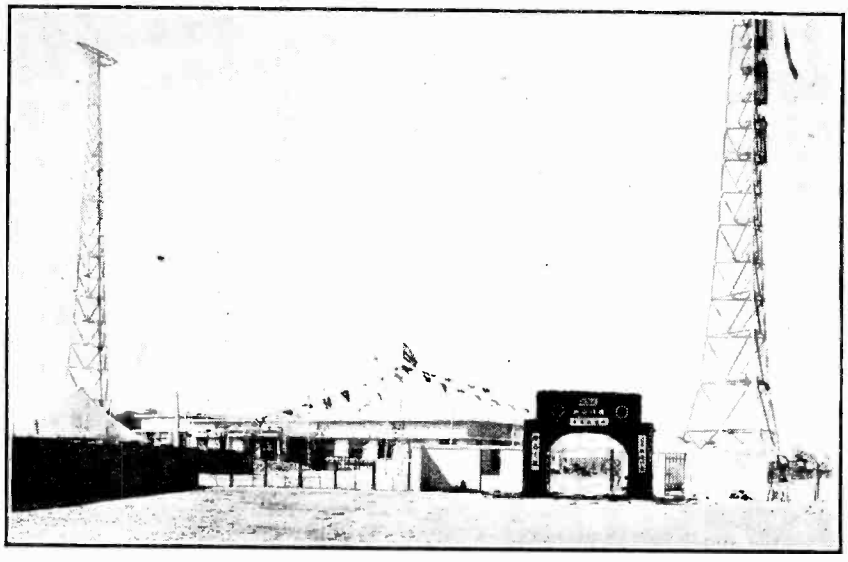
Not Counting the "Pirates."

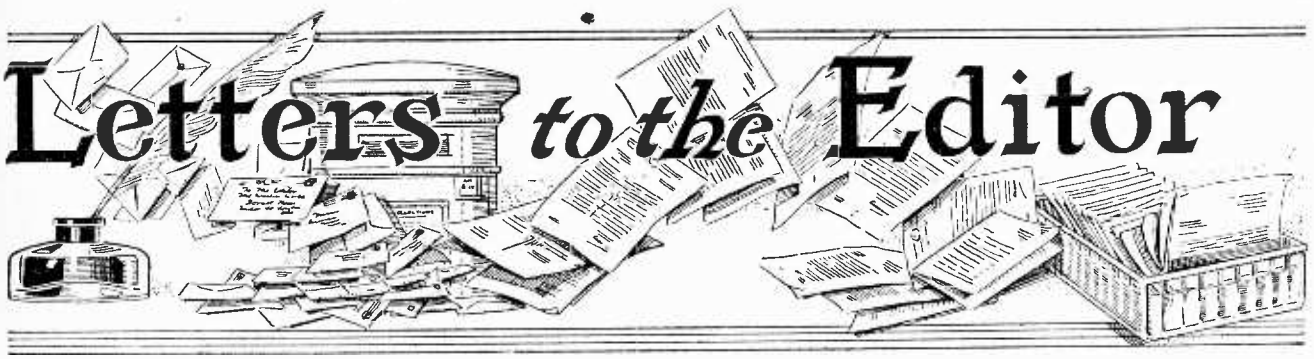
Here are some interesting figures, issued by the Bureau Internationale de Radiophonie at Geneva, showing the approximate number of licensed listeners in some of the countries of Europe.

Austria, 293,408.
Denmark, 214,734.
Hungary, 98,011.
Lithuania, 9,407.
Norway, 64,722.
Switzerland, 66,731.
Sweden, 357,828.
Czecho-Slovakia, 225,501.

This gives a pretty total of less than half the licensed listeners in Great Britain. No account is taken, of course, of the noble army of pirates.



GALA DAY IN JAPAN. The new broadcasting station JOAK at Saitama, a suburb of Tokyo, photographed on the opening day, when speeches were made at the microphone by a number of Japanese politicians and other people of note. A photograph of the new transmitter at Osaka, similar to that at Tokyo, appeared in our last issue.



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.

REALISTIC REPRODUCTION.

Sir,—I think it is only fair both to your readers and to myself to state that my letter of July 18th was prompted by a genuine desire to show how far from the ideal present systems of amplification still are in spite of the wonderful progress that has been made during the last two years. Those who are personally acquainted with the results which I am obtaining from my own outfit and from other outfits designed on the same lines will be able to vouch for the fact that whatever I may say in print is at least backed by actual performance. I feel sure that "S. H." has studied the saturation curves of Professor Doule and is familiar with the formula T=CR. He must know that the quicker the rate of discharge of each signal from the grid, the better the reproduction. He himself refers to the discharge time constant of the grid condenser and leak. Therefore if you abolish the combination you abolish the time factor.

Also, I would point out that the elimination of grid leak and bias means high note loss even when no grid circuit is flowing. That the use of non-inductive grid leaks of sufficiently high resistance to preserve the low notes does produce grid choking on sforzando passages of music is not open to controversy. If "S. H." prefers to go on using non-inductive grid leaks, he must not find fault with those of us who are musical critics as well as wireless enthusiasts. It is not a question of unduly overloading the amplifier, but one of designing the amplifier so as to permit of reasonable handling capacity. The handling capacity of the resistance-transformer combination (not "transformer-resistance") is handicapped by the resistance stage. Elementary faults such as the use of "unsuitable valves and H.T." can be ignored in this discussion.

"A. H. B." says he does not like moving coil speakers, because the bass notes come through devoid of the natural harmonic development of the original instrument, and because speech is too loud. It is a pleasure to know that *some* listeners, at least, possess the critical faculty and can discriminate between the original and the reproduced version. The cause of the loss of overtones in the bass register is mainly attributable to the amplifier and to the forms of coupling usually adopted. With regard to speech items, the trouble is caused by people using a variable resistance volume control in the *grid* circuit (usually the first stage of L.F.). Naturalness of speech can only be obtained by controlling the anode circuit of the detector, which in itself should not be overloaded.

I think "A. H. B." is too hard on the moving coil speaker, and it is obvious that he has been unfortunate in his experience of them.

NOEL BONAVIA-HUNT.

Hampstead, N.W.6.

Sir,—Your correspondent "A. H. B." in his letter in your issue of August 1st *apropos* natural loud speaker reproduction makes mention of "psychological peculiarity" as the reason of his inability to appreciate certain forms of loud speaker reproduction, which statement, I think, is deserving of some consideration.

It is my humble opinion that the "psychological effect" is of considerable importance and is not receiving due attention.

It is possible nowadays to attain such reproduction from a loud speaker as to be almost an exact replica of the original (from an engineering point of view) and yet still leave the feeling that there is something lacking.

One of the principal effects which, in my opinion, robs loud speaker reproduction of "realism" is the artificiality of the "atmosphere" into which the electrically generated sound finds itself liberated.

It must be remembered that when one is listening to a loud speaker, one hears also a large proportion of locally generated sound which constitutes what I refer to as "local atmosphere."

Subconsciously, the mind associates with this "local atmosphere" certain complex acoustic relationships and expects any other familiar sounds (supposed to have been generated in the vicinity) to be modified only in accordance with acoustic conditions prevailing locally.

Actually, the sound from afar carries evidence of acoustic attentuation foreign to local conditions (except, of course, in the very rare case where the acoustics are the same at both ends). Consequently, the human mind, having been trained through years of practice to discern minute differences in acoustic attenuation, refuses to be "hoodwinked," no matter how musically perfect the loud speaker reproduction may be.

It seems that in order to obtain sense of realism one must be conscious of the distant "atmosphere" to such an extent that the local "atmosphere," to all intents and purposes, is non-existent. A step in this direction is made by the "L.S.5 brigade," who endeavour, by means of brute force, to cause the distant "atmosphere" to predominate over the local. What a price to pay for realism! One must, perforce, be nearly deafened by being seated amongst the orchestra.

Again, listening through headphones can give absolutely distortionless reproduction but still not the "real thing."

In this case one or two psychological effects come into play. One is, that "sense of direction" is lost. This peculiarity the human mind simply will not accept.

Another effect is the unusual concentration of sound into the aural organs; a certain proportion of sound being in the habit of passing through the bones, etc.

A combination of headphone and loud speaker reproduction in correct proportions is suggested as a means of obtaining realism. An ordinary crystal set, with headphones, to which is connected a two-stage amplifier and loud speaker, is an ideal arrangement. (Switch off the light and close the eyes as the sense of vision can adversely affect the sense of hearing.

A similar effect can be obtained from a gramophone record by connecting headphones across the pickup.

The headphones, covering the ears, cut off the local "atmosphere." The loud speaker provides the agent for giving sense of direction and external sound to penetrate the body.

This method is never likely to gain popularity owing to the necessity of wearing headphones, nevertheless, it is one way of getting the "real thing."

GEO. E. POHU.

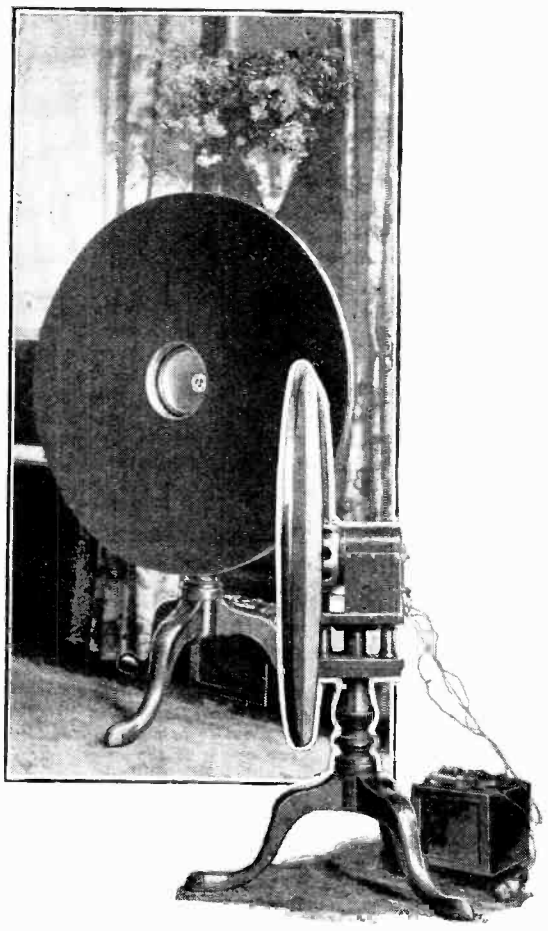
Shepherd's Bush, W.12.

AN IDEA FOR A BAFFLE.

Sir,—The accompanying illustrations show a new baffle and mount for an R.K. loud speaker.

These old mahogany tables can be picked up for a pound or so, and when not in use are quite attractive pieces of furniture with the centre put back in place.

Incidentally ample volume for a fair sized room for the coil speaker is provided from two Met.-Vick Cosmos A.C. valves worked entirely from A.C. mains with a Benjamin eliminator



giving 180 volts. The circuit is anode bend detector (blue spot) resistance coupled to a red spot power valve.

Gramophone reproduction with a Woodroffe pick-up is at full strength using a medium needle.

Bristol. H. G. ROBINSON.

PUSH PULL.

Sir,—I have heard of several people having various kinds of trouble with push-pull amplification, so when I decided to try this method about six weeks ago in an output stage I first obtained a pair of specially matched valves as advised in the article by "W. I. G. P." in your issue of June 6th, and your readers may be interested to know that I personally have got on quite well with push-pull amplification right from the start. It occurs to me that, in view of the troubles I have heard of with this form of amplification, previously mentioned, that my own freedom from trouble may possibly have been due to my having gone to the slight extra trouble of obtaining specially matched valves as you advised.

Messrs. Marconi kindly supplied me with a specially matched pair of D.E.P. 240 super-power valves which operate excellently and give loud, deep bass notes without any roughness and suitable for quite a large room, though I intend to experiment with a pair of specially matched L.S.5A's with the same, and higher, voltages on the plates for purposes of comparison.

We know that there are certain theoretical difficulties in push-pull amplification with regard to "leakage inductance," etc., but the advantage it gives of loud bass notes without any roughness with low plate voltages certainly compensates, especially as I have heard that it is easily possible to overload a pair of L.S. 5A valves with 350 volts on the plates even when connected in push-pull. Also the extensive use of push-pull in America tends to make one think that there is "something in it" in spite of a certain amount of risk of relative high note loss. Perhaps the latter tendency may be obviated to some extent by not having too high an anode resistance following the detector valve in conjunction with a coupling condenser and grid leak of suitable value.

In conclusion, the object of this letter is to suggest that it might be worth while your readers going to the trouble of obtaining specially matched valves as advised in your useful article on the subject. When there are certain other difficulties to be considered, it is surely advisable to do anything possible in order to be on the safe side with regard to one of them when this can so readily be done. Apart from this, there is so much experimenting which can be done in other directions with regard to grid leaks, anode voltages, making sure that the grid bias is exactly right with a milliammeter, etc., that it is a great help to this other work to feel sure that the valves, anyhow, are right. E. PICKWORTH FARROW.

Spalding.

A CURIOUS EFFECT.

Sir,—I believe that the following case of a crystal controlled home-transmitter will be of interest to many readers of your esteemed paper.

Listening with my seven-valve experimental superheterodyne to the transmission of Helsingfors (approximately 45 nautical miles from Reval) I heard in my loud speaker a faint background of piano music. During the intervals of transmission with the carrier wave still on air, the music was pure and adequately loud, but to my great astonishment the tune was the same, which was just played by my neighbours downstairs. I visited my neighbours, and found that they had a crystal set tuned to Helsingfors and placed near the piano. What is the explanation for this phenomenon?

My explanation (hardly credible) is that the aerial of my neighbour was reradiating the carrier wave of Helsingfors, modulated by the change of resistance of the crystal (galena) which was effected by mechanical vibration. E. TUMA.

Tallinn, Esthonia.

A WORD OF CAUTION.

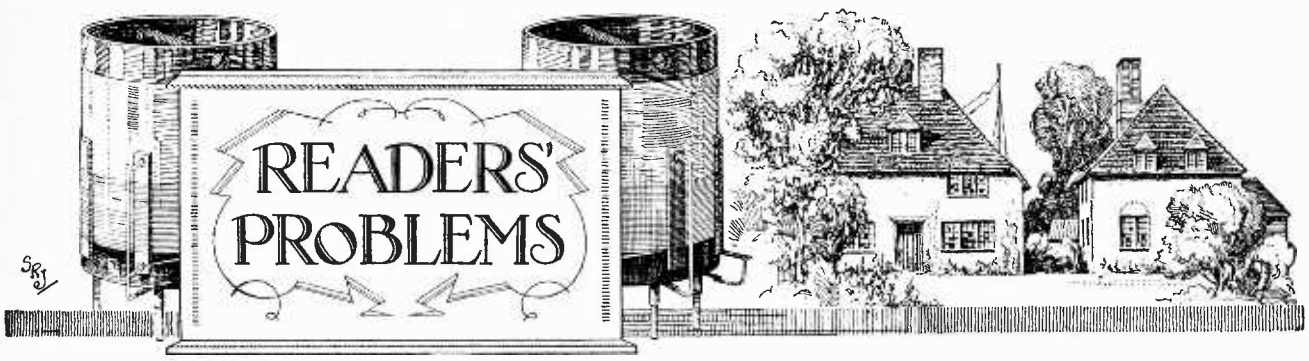
Sir,—With reference to your "Non-Corrosive Flux," on page 212 of your issue of August 15th, will you be good enough also to publish this warning?

Ether is fairly well known to everyone as an anæsthetic, but very few realise that used in fluid form it can be excessively dangerous even in small quantities. *Ether vapour is heavier than air, and lies about the lowest level.* Should this come in contact with a light in any form there is always great danger of a very nasty explosion.

The flux mentioned, while one of the best, should therefore only be mixed in small quantities, well away from flames, and with a free draught of air about. In addition, whilst in use the bulked flux should be kept well away from the work and the iron, and a safe method is to use a small quantity in a dropping bottle.

It may perhaps add weight to this warning if I add that a laboratory training has not lessened but has increased the care with which liquid ether is treated both by myself and by other men who are used to its properties.

C. E. V. WILKINS.



"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.

Back-coupling through Phone Leads.

I have recently come across what is to me an inexplicable effect in my five-valve receiver (two H.F. stages). The set is apparently quite stable when a loud speaker is used, but when I put on phones for tuning in distant transmissions, violent oscillation is produced as the circuits come into tune at the lower part of the tuning scale. Is there any simple explanation of this effect?

V. J. R.

We think it almost certain that a good deal of H.F. energy is getting into the L.F. side of your receiver, and in turn is being transferred back, either through body capacity or the capacity of the phone leads, which may run in proximity to the input (or aerial) end. We suggest that you should fit the usual stopping resistance in series with the first L.F. grid, if you have not already done so.

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Long-wave Reaction.

I have been studying the method of applying reaction to the "Everyman Four" when receiving long waves, which was discussed in the "Readers' Problems" section of "The Wireless World" for August 31st, 1927. Instead of using the single coil method would it be practicable to modify the circuit given and to use capacity-controlled reaction with a fixed coil? If so, will you give me a circuit diagram? A. C.

There is no reason why reaction should not be controlled by means of a variable condenser, particularly if you adopt the arrangement shown in Fig. 1, which, as you will see, provides for short-circuiting both the loading coil and the long wave reaction coil when short waves are being received. For this purpose a double-pole single-throw switch is fitted. The condenser C is the anode by-pass capacity fitted to the original receiver, and marked C5 in the "Everyman Four" booklet; you will observe that the effective capacity of this condenser is reduced when receiving the long waves, and thus detection efficiency may be

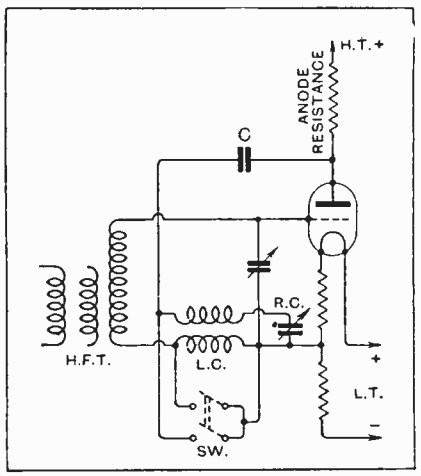

Fig. 1.—Capacity-controlled reaction between anode circuit and long-wave loading coil in an "Everyman Four" receiver.

slightly impaired. However, this will be more than offset by the effect of regeneration, and in any case will not be noticeable if the reaction condenser is of 0.00025 mfd. or larger. Miniature condensers of this capacity are available, and it should be possible to accommodate them, but there would be little real objection to using an even smaller size—say 0.0001 mfd. If you do this, a larger reaction coil would be necessary than when using a condenser of higher capacity.

RULES.

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

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

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

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

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

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

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or photographs.

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Equalising Accumulator Discharge.

There are four separate H.T. positive terminals on my receiver, and each is connected to a different point on the H.T. accumulator battery. I find that the cells at the negative end are discharged much more quickly than the others, and consequently require charging more frequently. Is it possible to ensure that all cells will run down at the same time by fitting a potential divider (as in an eliminator) across the battery? E. H. N.

We do not care for the idea of fitting a potential divider; in effect, you would be introducing the disadvantages of a battery eliminator without obtaining any compensating advantage. The drawback is that the resistance in the potential divider may cause interstage coupling, and if it is really necessary for you to apply separate voltages to the various valves, we suggest the use of the anode feed resistance scheme.

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An All-wave A.C. Receiver.

It is noticed that the A.C. Receiver described in your issues for March 7th and 21st has no provision for the reception of long waves. Is there any real reason why interchangeable coils should not be used? If you endorse this alteration, would you consider it desirable to compensate for any loss of amplification which may be introduced by adding an extra L.F. stage? E. B. D.

This circuit lends itself very well to the alteration you suggest; provided coils of good design are used, the losses should be almost negligible, and we consider it neither necessary nor desirable to add an extra L.F. amplifier.