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REDUCED PRICES.

<table>
<thead>
<tr>
<th>Type</th>
<th>500 ohms</th>
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<td>1,000</td>
<td>710</td>
<td>580</td>
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<table>
<thead>
<tr>
<th>Current (Amps)</th>
<th>Voltage (Volts)</th>
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<tr>
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<td>0-500 millamps</td>
<td>0-100 millivolts</td>
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<tr>
<td>0-1 ampere</td>
<td>0-500 millivolts</td>
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<td></td>
<td>0-250 volts</td>
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Price

Without case and leads, £7 15 0; with case and leads, £9 5 0

Write for leaflet W. 406.

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Grosvenor Batteries give continuous and satisfactory service because they incorporate a new vitalizing element which is unique to Grosvenor.

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The Lewcos Fixed Potentiometer gives perfectly smooth reaction control on all Radio receivers. Price 4/9 without Grid Leak.

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The Battery without CRACKLE

60% longer life

Once use a "Pertrix" H.T. Battery and no other will content you. Being devoid of the ordinary sal-ammoniac electrolyte, "Pertrix" possesses these unique qualities:

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THE NEW Cossor Screened Grid Valve is shock-proof, noise-proof and break-proof. Its Interlocked Construction makes it the strongest and most robust Screened Grid Valve ever produced. Its elements are immovably locked in position—vibration is impossible—all risk of microphonic noise is eliminated. And because of the girder-like rigidity of its elements the NEW Cossor has exceptional strength, even the hardest blow cannot mar its remarkable performance. Use the NEW Cossor Screened Grid in your Receiver—no other make has Interlocked Construction.

The NEW Cossor 220 S.C. (2 volts, 2 amp.) Impedance 200,000. Amplification Factor 200. Anode Volts 120-150. Price 22/6

Cossor 4- and 6-volt Screened Grid Valves are also obtainable from all Wireless Dealers.

A. C. Cossor Ltd., Highbury Grove, London, N.S.

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SHOULD THE DATE OF THE SHOW BE CHANGED?

The New Year always suggests the opportunity for reviewing the events of the old year so as to endeavour to profit by the experience gained in the past and put it to good use during the year that is ahead. In wireless we are continually profiting by experience, for the science is a new one, and broadcasting, in particular, being relatively very new, there are few precedents to go upon to assist in guiding the policy of the broadcasting service and the industry which it has founded.

Delay in Fulfilling Orders.

A reader whose letter is published in this issue comments on the date which has been chosen for the annual Radio Show, and whilst this subject has been discussed previously, our correspondent now puts forward some very good arguments as to why the date of the annual Show should be changed. Our readers and, in fact, all sections of the wireless community are painfully aware that this year, as in previous years, manufacturers in many instances far behind in executing orders which they have received for apparatus which was first exhibited at Olympia in September. Our correspondent points out that it is common knowledge that at the annual Motor Show at Olympia orders for new cars frequently cannot be fulfilled until the spring, but as, luckily, the spring is just the time when most people want to put new cars into commission, there is nothing very much the matter with this arrangement. With the wireless public, however, it is in the autumn that the public demand for wireless apparatus is at its height, and this demand continues throughout the winter months. If the Wireless Exhibition were to be held at a date which gave time for apparatus to be in full production by the autumn, then much would have been accomplished towards overcoming the present difficulties.

When is Interest at its Height?

It has been argued that the Radio Exhibition should be held in the autumn because that is the time when public interest in broadcasting and indoor entertainment has been aroused, but we believe that the public interest is even greater towards the close of the winter months, when the value of wireless is fresh in their minds, than it is at the end of the summer months before their interest has been fully rekindled. We are aware that manufacturers cannot well be expected to make arrangements for a very large production of apparatus until they have some indication of the demand for apparatus, and this is given as the reason why orders for apparatus are still far behind several months. When is Interest at its Height?

We are given to understand that arrangements for the annual Radio Show have to be made a year or two in advance, but if the reason for a change in date is sufficiently good, as we believe it is, then the question should be looked into now in order to see how quickly the change can be introduced. As matters stand at present, with each succeeding season the same complaints occur regarding delay in deliveries of apparatus, and there seems to be no obvious cure for the situation, except by shifting the date of the annual Show.
TODAY the number of short-wave broadcast stations operating a regular schedule is more than sufficient to afford a welcome recreation to listeners in this country. As regards the exile abroad, possibly separated by many thousands of miles from the home country, the only link is through the medium of the special programmes radiated from 5SW, the short-wave experimental station at Chelmsford.

The ubiquitous detector-L.F. arrangement has done yeoman service and for long has been regarded as the accepted standard for a short-wave set. So far there has been a decided reluctance on the part of designers to apply the principles of high-frequency amplification to short-wave reception, and possibly some justification existed in the past, as the general unsuitability of the average receiving valve was a serious obstacle. The question was discussed, however, at some length in an article entitled "High-Frequency Amplification on Short Waves," which was published in The Wireless World as far back as October 12th, 1927. When it is realised that the frequencies dealt with are of the order of 15 million cycles per second, it will be appreciated that the problem is no mean one.

In view of the many improvements made recently in the design of valves—especially those developed particularly for high-frequency amplification—the present would appear opportune again to focus attention on this subject. The screen-grid valve, which has effected such a radical change in the design of H.F. amplifiers for broadcast reception, should prove equally efficacious on the ultra-short wavelengths.

In conformity with modern practice, neutralised circuits will be ruled out, since, on short wavelengths, the complications in the assembly of a suitable receiver would tend to place this beyond the reach of the average home constructor. Consideration will be given, therefore, only to the possible ways and means whereby a worth-while stage gain is possible of attainment by employing a relatively simple unneutralised H.F. amplifier.

This proviso unfortunately limits us in our choice of valve for the H.F. stage, because only those which show a very low internal anode-to-grid capacity will be at all suitable for this purpose. At the outset it might be stated that even with the best valve—regarded from this viewpoint—the amplification afforded on 20 metres could not possibly attain that at 200 metres. For example, the Mazda 215 S.G. valve shows a theoretical stage...
S.G. Short Wave III.—

Gain of about 150, unneutralised, at 200 metres, whereas at 20 metres the calculated stage gain, also unneutralised, is of the order of 60 only. We know that in practice the theoretical amplification is difficult of attainment. On 20 metres the incidental losses pile up in an alarming manner; how they accumulate is far too involved to be dealt with here. But in spite of this some preliminary tests showed that a useful gain is possible, and accordingly the design of the set described in this article was prepared.

As an indication of the importance of choosing a valve with the lowest possible anode-grid capacity, it may be mentioned that with one having an internal capacity of 0.05 µµF—or ten times that of the particular example given above—the calculated stage amplification, unneutralised, would fall to 18. So that it is very doubtful if, under these conditions, any justification would exist for employing an H.F. stage.

Single H.T. Feed.

Ease of construction has been the guiding factor in designing the set and, so far as technical considerations will allow, only those parts readily obtainable have been used. With the exception of winding the coils, it resolves into a straightforward assembly job for which the tools found in the average amateur’s workshop should suffice.

The theoretical circuit is shown in Fig. 1, and from this it will be seen that the receiver consists of a screen-grid H.F. stage followed by a leaky grid detector which is transformer-coupled to a pentode output valve. This choice assures the maximum overall amplification with the minimum number of valves. A single H.T. positive feed is favoured, as this discharges all sections of the H.T. battery at the same rate. Each stage is adequately decoupled to counteract any tendency towards instability, the decoupling resistances acting also as voltage limiting devices where a lower potential than the maximum battery voltage is considered desirable. It should be pointed out that this policy slightly increases the initial cost, but not to any appreciable extent, because decoupling resistances would be required in any case, but their value has been raised in some instances to conform with the requirements of a single H.T. feed.

In designing the tuning coils it was decided to give preference to the parallel feed and tuned grid circuit, as the construction of H.F. transformers suitable for use on
S.G. Short Wave M.——the wavelengths dealt with in this case would be rather involved. Incidentally, it may be mentioned that preliminary tests showed there was little to choose between these two tuning arrangements. From the illustrations it will be seen that the ordinary broadcast type of H.F. choke is incorporated in favour of one of the short-wave variety. This course was adopted after very careful consideration of the merits of both types. Readers will be familiar with the impedance curves of H.F. chokes, as these have been published from time to time in this journal. In Fig. 2 is reproduced a representative curve of a short-wave choke resonating at 170 metres when shunted with the capacity mentioned in the inscription. The difference in impedance at 50 metres and at 170 metres is most marked, and on still shorter wavelengths the broadcast variety shows an impedance very nearly equal to that of the short-wave type. Since there is so little to choose between the two preference was given to the larger choke, as this enables the useful ness of the receiver to be extended to cover the normal broadcast wavelengths with ease.

Extension to Medium Waveband.

To maintain a reasonable degree of selectivity the leaky grid detector should be connected across a portion only of the H.F. coil when using the set on the normal broadcast band, but there is nothing gained by adopting this course on short waves. The connections to the coil base are planned accordingly, the required interconnection between the sockets being made on the coil former. Selectivity can be further improved on the 250-500-metre band by arranging the H.F. coil as an auto-transformer. Ultimately a compromise was made between the best transformer ratio and optimum detector tapping, the H.F. coil being tapped at its centre and connected as shown in Fig. 3. A separate aerial winding was not considered necessary, a tapping, a few turns from the earth end, being brought out for attachment of the aerial lead.

The voltage for the screen-grid in the H.F. valve is obtained from a potentiometer consisting of a fixed resistance of 20,000 ohms, in series with a 30,000-ohm wire-wound potentiometer. Assuming that a 150-volt H.T. battery is used, the screen voltage will be variable from 0 to 90 volts approximately. The fixed resistance sets a limit to the maximum potential available, and assures that the valve will not be overrun. The remainder of the circuit calls for little further comment, as it is perfectly straightforward. Mention might be made, however, of the 5,000 ohms resistance in the auxiliary grid lead of the pentode valve. It has a dual function. It serves to decouple this circuit, counteracting any tendency towards L.F. instability due to battery resistance, and secondly, it limits the voltage on the grid. Without the resistance the potential on the auxiliary grid would be higher than that on the anode, due to the voltage dropped across the primary of the output transformer.

Choosing the Output Transformer Ratio.

The writer has found that pentode valves function just as well with an auxiliary grid potential slightly less than the anode voltage. The A.C. resistance rises slightly, but so does the amplification factor, the mutual conductance remaining sensibly the same. A few milliamps can be saved, so there is a little compensation for adopting this arrangement.

Fig. 3.—Theoretical connections of the aerial grid coil (a) and tuned grid H.F. coil (b) for use on the medium broadcast waveband.

Fig. 4.—Detailed drawing of the coils giving winding data for the 20-34 metre and 32-56 metre wavebands. On the left is the aerial-grid coil, the other being the H.F. coil.

The remainder of

\[
\text{Transformer ratio} = \frac{\sqrt{\text{Valve A.C. resistance}}}{\sqrt{\text{Speaker impedance}}}.
\]

Before passing on it would be advisable to mention that one side of the secondary coil on the output trans-
The former should be tied down to the filament circuit. Unless this connection is made, trouble might be experienced from an occasional L.F. howl. There are other means of curing it, but that suggested is quite satisfactory. Experiment will determine the "live" terminal, and this should be "earthed."

The process of assembly will be found a relatively simple matter, as all parts are readily accessible. The screening box, which is supplied unassembled, can be put together in a few minutes. When putting this box together it will be necessary to use countersunk screws, in place of the round head variety supplied, for fixing the

---

Fig. 5.—Dimensional data of panel and terminal strip. Sizes of holes are as follows: A = 7/16in. dia., B = 3/8in. dia., C = 5/16in. dia.,
D = 5/32in. dia., E = 1/8in. dia., countersunk for No. 4 wood screws.

Fig. 6.—Disposition of the components on the baseboard.
Fig. 7.—Practical wiring plan. Wires passing through the baseboard are lettered to facilitate tracing their path as shown on the under-deck plan.
LIST OF PARTS.

1 Variable resistance, 0-200,000 ohms (Electrad Royalty R.J.
1 Grid leak, 5 megohms (Ediswan).
1 Holder for above (Wearite).
1 On-off switch (Pioneer).
1 Aluminium screening box (Bowyer Lowe).
19 Volt Grid bias battery (Siemens).
1 Pair Geld bias clips for above (Bulgin).
1 Grid cell, 0.9 volts (Siemens).
1 Baseboard, 2½in. long, gin. wide, and 1½in. in thickness, completes the framework on which the set is assembled.

Having marked out and drilled the panel in accordance with the details given, it can be fixed to the base and the position of the hole in the screening box, through which the H.F. condenser bush is passed, may be marked. Before assembling the components, unship the panel and screening box. The parts on the panel can

are not countersunk into the metal they will separate the box just sufficiently from the panel to leave space for fitting the lid. In addition, a small washer — cardboard of suitable thickness will answer—should be slipped over the fixing bush between the box and the panel. A loose interior baseboard is included with the box, thus relieving the constructor of the onus of preparing this. A baseboard, 2½in. long, gin. wide, and 1½in. in thickness, will and a panel 2½in. x 7in. x 1½in., completes the framework on which the set is assembled.

Having marked out and drilled the panel in accordance with the details given, it can be fixed to the base and the position of the hole in the screening box, through which the H.F. condenser bush is passed, may be marked. Before assembling the components, unship the panel and screening box. The parts on the panel can

be required. This may be cut from a piece of hard wood, such as mahogany, or even pitch pine would answer if it can be obtained more readily. In the model illustrated five-ply wood was used. Two battens, each gin. x gin. x 1½in., are now required, one to be screwed on to each end of the baseboard, on the under side. A shallow well is thus formed, in which much of the wiring can be accommodated. A terminal strip, the full length of the base,
S.G. Short Wave III.—

then be assembled with the exception of the H.F. tuning condenser and the reaction condenser. It is advisable to leave the box off until most of the wiring has been done. This applies particularly to the connections on the panel potentiometer and other components in close juxtaposition to the metal container.

The H.F. tuning condenser cannot be fitted until the small sub-base is ready to be dropped into its box. As regards the reaction condenser, and its small screening plate, fitting this too early will interfere with wiring the various small components on the baseboard immediately below it.

Apart from the above-mentioned order of procedure, there is no particular sequence in which the wiring should be done. It is well to check occasionally with the theory diagram and mark off each lead as it is completed.

Particulars of the coils, so far prepared, are given in the diagrams. Two are required for each waveband. It has been found that for the 20- to 34-9-metre range, five turns of No. 18 S.W.G. tinned copper wire, spaced $\frac{3}{4}$ in., are required for the H.F. coil, but to cover the same waveband six turns must be used on the aerial-grid coil. Incidentally, the aerial winding is separate, and consists of one turn of fine gauge wire, wound in the space between the first and second turns from the earth end of the grid coil. In all cases the direction of the windings is the same.

The two other coils shown cover a waveband of from 30-9 metres to 56-3 metres, and 10 turns of No. 18 S.W.G. tinned copper wire are used for the H.F. coil. The aerial-grid coil for this range has 11 turns of the same gauge wire. Each turn is spaced $\frac{3}{16}$ in. from its neighbour. The aerial winding consists of 12 turns in this case. It is hoped that shortly details of the coils required to extend the usefulness of the set to about 150 metres will be available for publication, also the winding data for a set of medium-wave broadcast coils.

Valves.

A calibration curve for each of the H.F. coils described here has been prepared. These may require a slight modification in some cases, as the calibration was made with the receiver just oscillating. Any change in the capacity of the reaction condenser will shift the tuning slightly. The curves will be a useful guide in the beginning, as, provided the same type of valve as mentioned on the chart is used in the H.F. and detector stages, tuning will be sufficiently accurate to identify most of the principal transmissions coming within the range of these coils.

With the exception of the H.F. stage, where unfortunately not much latitude can be given, any well-known make of valve may be used. In the case of the detector, best results will follow the employment of a valve not exceeding about 12,000 ohms A.C. resistance. The Cossor 210 L.F., Mullard P.M. 2 D.X., the Mazda L.210 and the Marconi and Osram L.210 are good examples of the type most suited for use in this position. In the output stage a pentode is required, and since an output transformer with a choice of ratios is fitted, any pentode, provided it has the same filament voltage rating as the other valves chosen, can be used with confidence.

The writer recommends the Mazda 215 S.G. for the H.F. stage by virtue of its exceedingly low anode-grid capacity. But as there is a little delay in obtaining deliveries of this particular make at the present moment, excellent substitutes would be the Mullard P.M. 12, Six-Sixty S.S.215 S.G., and the Marconi or Osram S.215, to mention a few only in the two-volt class.

This receiver is available for inspection by readers at the Editorial Offices, 116-117, Fleet Street, London, E.C.4.

### BOOKS RECEIVED.

*Photograms of the Year.* Edited by F. J. Mortimer, F.R.P.S., the Editor of The Amateur Photographer and Cinematographer. About 100 reproductions of fine pictures made with the camera by the leading photographers in all countries where the camera is used. For the amateur photographer and those who are interested in picture-making, it provides guidance and inspiration that gives it an undoubted educational value. Published by Iliffe and Sons Ltd., London. Price 5s. net in stiff paper covers, or 7s. 6d. net in cloth boards.

TUNING CIRCUIT LOSSES

Sources of Incidental Dielectric Loss.

By A. L. M. Sowerby, M.Sc.

There is no component in the whole of a high-frequency amplifier that has received so much attention as the tuning coil, for it was early recognised that the signal strength given by a receiver could be considerably enhanced by using coils of low high-frequency resistance. The classical researches on the subject by S. Butterworth brought to light the fact that, for the frequencies used in the broadcast waveband, any coil of reasonable dimensions must be wound with stranded wire, or Litzendraht, if the lowest possible resistance, and hence the greatest amplification, was required. This information was promptly acted upon by The Wireless World, and complete receivers in which the tuning coils were wound with "Litz" were described and proved, as might be expected, appreciably in advance of receivers employing coils of less scientific design. The use of coils wound with Litz has now become usual in all sets in which the maximum amplification at high-frequency is desired.

Butterworth's researches into the resistance of coils were carried out on a purely mathematical basis, and had for their object the determination of the resistance due to the copper wire of which the coil is wound, without attempting to make any allowance for the extraneous losses due to the former and the plug or other mount used. Nor were they at any time intended to cover losses originating outside the coil itself in the tuning condenser and the various components which, in a finished set, are connected in parallel with the tuned circuit. It is known, however, that losses arising from such sources as these, and which consist mainly of dielectric losses, form a very considerable proportion indeed of the total losses in a tuned circuit, so that the formula developed by Butterworth, while they are an absolutely indispensable aid in designing a coil, yet give us no reliable estimate of the total resistance of the tuned circuit as it exists in a practical receiver.

The problem that lies before the designer of a receiver, then, is to find some approximation to the resistance of the tuned circuit as a whole, for it is this that he has to take as the basis of his design. The contribution to the total resistance made by the copper wire of the coil can fairly readily be calculated from Butterworth's formula, while at the cost of a little further calculation one can arrive at a coil so designed that it is physically impossible to improve upon it without increasing its dimensions. Unfortunately, that part of the total resistance which arises from the imperfections of the various insulating materials which have inevitably to be connected to the tuned circuit cannot be calculated at all. For any one case, of course, the value of the losses arising in the various dielectrics can be measured, but a systematic treatment does not appear to be possible.

Copper and Dielectric Losses Compared.

The sources of dielectric loss in a finished receiver are many and various. First, there is the insulation on the wire itself, and the former on which the coil is wound. If the coil is made interchangeable with others so that different wave-bands can be covered, there are losses also, and usually very considerable losses, in the plug-fitting of the coil and in the holder into which it fits. Then the tuning condenser contributes its share, for the fixed plates must be carried on a support of some insulating material, so that losses enter here also. Before any use can be made of the tuned circuit it must be connected across grid and filament of a valve, so that the insulating material both of the holder and of the base of the valve itself have an opportunity of absorbing energy.

Each of these sources of loss, if sufficient care is taken, can be made quite small; the sum-total of them all is always far larger than one would like, even when every possible precaution has been taken. As a result, the high-frequency resistance of the tuned circuit must inevitably be very much higher than the figure derived from applying Butterworth's formulæ to the coil itself.
**Tuning Circuit Losses.**

The additional losses have still further depressed the dynamic resistance of the coil, and it will be particularly noticed that with this set of components in parallel with the tuned circuit the dynamic resistance is, for the first time, lower at 200 metres than at 550. The one comforting thought, in face of the heavy loss in amplification that the augmented dielectric losses have brought about, is that the dynamic resistance of the tuned circuit is now practically constant, especially with the Litz coil, over the range 250 to 500 metres, which makes for easier receiver design and uniform amplification.

**A Bad Case.**

The curve of Fig. 4 represents, as has been pointed out, a case in which the dielectric losses have been reduced, by careful choice of components, to a value very considerably below that which obtains in the average receiver, though it is reasonably representative of the receivers described in the pages of this journal. In many sets, and in commercial sets in particular, dielectric losses appear to be relied upon to ensure stability in the high-frequency stages in face of considerable laxity in screening and decoupling. To check the magnitude of the dielectric losses in a case where no attempt has been made to minimise them, a series of measurements was made on a 2-inch diameter coil of the type which is made up, complete with primary, neutralising, and reaction windings, as a single unit.

The coil was a standard type with pin connectors, intended to be plugged into a coil base, and was made by a well-known firm. It bore the inscription "Split-primary H.F. Transformer," and was intended to cover the wave-band from 250 to 550 metres. The winding was 90 turns of 30 D.S.C., giving an inductance of 252 microhenrys.

The copper losses were first calculated; the corresponding dynamic resistances are given in the second column of Table IV. It was noticed that the wrong gauge of wire had been chosen for the coil; for minimum resistance it should have been wound with No. 26 instead of No. 30 gauge.

Measurement of the dynamic resistance of a tuned circuit incorporating, besides the coil, the multi-pin base for which it was designed, and with an H.610 valve in a bakelite holder, and a 3-megohm leak in clips mounted on bakelite connected in parallel, gave the results of the last column of Table IV.

**TABLE IV.**

<table>
<thead>
<tr>
<th>Wavelength (Metres)</th>
<th>Dynamic Resistance (Megohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>0.443</td>
</tr>
<tr>
<td>250</td>
<td>0.461</td>
</tr>
<tr>
<td>300</td>
<td>0.355</td>
</tr>
<tr>
<td>350</td>
<td>0.270</td>
</tr>
<tr>
<td>400</td>
<td>0.228</td>
</tr>
<tr>
<td>500</td>
<td>0.102</td>
</tr>
<tr>
<td>550</td>
<td>0.122</td>
</tr>
</tbody>
</table>

The numerical results of this table are plotted as curves on the same scale as preceding figures in Fig. 5.

![Fig. 5.—Losses in a commercial multi-pin plug-in coil of 2ins. diameter. Curve A shows the dynamic resistance calculated for copper losses only. Curve B gives the dynamic resistance as found in a practical circuit with dielectric losses. At 300 metres the dynamic resistance of this coil and circuit is about five times less than that of a 3M. Wireless World Litz coil.](image)

Curves from which can clearly be seen the appalling effect of unchecked dielectric losses on the efficiency of a tuned circuit. Nor must it be thought that the case chosen for measurement is in any way exceptional; on the contrary, it is typical of a very large class of sets. Dozens of receivers, embodying tuned circuits exactly like that examined, have been designed, and they are used in enormous numbers by those who are sufficiently unversed in technical matters to be unaware of the enormous loss in signal strength that the use of such tuned circuits necessarily involves.

The moral of all these measurements should by now be clear enough; it is that time and energy spent on determining the best winding for a coil are quite wasted unless a good deal of care is also devoted to keeping down the losses due to faulty dielectrics. If this point is overlooked, copper losses may be reduced to an almost negligible fraction of the total losses, being swamped out by the effects of dielectric absorption. In particular, it is interesting to enquire how far the use of Litz is justified in the average receiver.
Tuning Circuit Losses.—
There is, for example, no advantage whatever to be had from the use of stranded wire if the dielectric losses are to be on the scale found for the "multi-pin" coil and its appurtenances, for in such a case the copper losses form so small a proportion of the total losses that even if they are doubled or halved the efficiency of the tuned circuit as a whole would hardly be affected. At the other extreme, where dielectric losses are cut down to the minimum by decapping the valve, the substitution of solid wire for Litz would make a very large difference indeed to the behaviour of a receiver.

In the case where the valve is not decapped, but all components are picked carefully with an eye to reducing dielectric losses as far as convenience permits, we are not far from the borderline between the two extremes. Where there is but one tuned circuit in the receiver the replacement of a Litz coil by a competently designed coil of solid wire would probably not be very noticeable. Since, however, the slight, but appreciable, gain that can be had from using Litz is cumulative from coil to coil, a receiver with two tuned circuits, and, still more, one with three, would show quite a marked falling-off in performance if solid wire were used in its place. Since, in addition, doubling the input to the detector valve results in something like a fourfold increase in rectified signal voltage, even quite small changes in efficiency on the high-frequency side of the receiver are still further magnified by the detector.

But as these points apply equally to dielectric losses, they do but emphasise the need for paying the very closest attention to this insidious thief of signal strength.

PCJ’s BIOGRAPHY.
Short Waves and Long Distances.

THE history of wireless enterprise teems with achievements which really deserve that overworked epithet "remarkable." And no list of such achievements would be complete which did not include the exploits of PCJ, the Philips short-wave station at Eindhoven. The story of how, on a morning in March, 1927, PCJ woke (if it had ever slept) to find itself famous, is told in a handomely prepared booklet now issued by Messrs. Philips Radio. In 28 pages, brightened by numerous illustrations, the author gives not only the story of PCJ’s rise to fame, but many interesting observations on short-wave work in general.

Among the illustrations is a reproduction of a Wireless World cartoon, which appeared in June, 1927, and caused some heart-searching among British wireless authorities. The cartoonist drew a parallel between the victory of the Dutch Admiral Van Tromp over the British Fleet in 1652, and the triumph of the Dutch wireless station in the ether waves. Tied to the masthead of the Dutch ship was Van Tromp’s legendary broom with which he "swept the seas," while a broom of more modern design was shown attached to the aerial at Eindhoven.

That PCJ’s claim of a world-wide audience is not an idle boast is seen by reference to the world map included in the booklet, showing the places from which reports have been received. Only Greenland and Siberia appear to have missed the call. Up to the present time twenty different languages have been spoken before the PCJ microphone. This alone must constitute a record.
Events of the Week in Brief Review.

THE BIG QUESTION.
In the next census of the United States, to be taken this year, householders will be asked whether they possess wireless sets.

WIRELESS AT SCHOOLBOYS’ EXHIBITION.
Electric and wireless displays are among the attractions of the Schoolboys’ Exhibition now in full swing at the Horticultural Hall, Westminster. The Exhibition, which is organised by the Daily Mail, is open daily from 10 a.m. to 9 p.m. The closing date is January 8th.

MORE SHORT WAVES FROM HOLLAND.
The Dutch Government short-wave plant at Kootwijk will soon be augmented by the addition of three new transmitters equipped for C.W. and radio telephony, which are now under construction. These will use the call signs PCO, PCS, and PDM. Their wavelengths will be 15.686, 16.60, and 16.182 metres respectively.

BRITISH RADIO PUBLICITY IN FRANCE.
A number of British firms are now securing broadcast publicity via the French stations. Radio Paris devotes “hours” to Decca, Pathé, and Vocalion records, and also provides programmes sponsored by the Revelation Suitcase Company and other British concerns. Radio Torquay is a mouthpiece for Kolster Brandes, Ltd.

MUSIC AT BREAKFAST.
A correspondent draws attention to the morning broadcasts from Huizen (1,875 metres). These take place on Mondays, Wednesdays, and Thursdays, beginning at 7.55, and consist of over an hour’s recital of H.M.V. records.

SURREY’S LOUD SPEAKERS.
Surrey County Council are seeking the views of local authorities as to whether steps should be taken to reduce public annoyance caused by loud speakers.

VALVE MANUFACTURE DEMONSTRATION.
Working demonstrations of the process of valve manufacture will be a feature of the M.O. Valve Co.’s display at the Exhibition of the Physical and Optical Societies, to be held on January 7th, 8th and 9th at the Imperial College of Science, Imperial Institute Road, South Kensington. The valve demonstrations will include automatic grid making and technical displays designed to show the comparative power outputs of valves.

NEARLY ANOTHER MILLION.
Receiving licences issued up to November 30th last numbered 2,514,521.

WIRELESS AT THE B.I.F.
Over twenty firms have already booked space in the wireless section of the British Industries Fair, to be held in the new and reconstructed Olympia from February 17th to 28th next.

ISSUING A WIRELESS LICENCE.
In reply to a recent question in the House of Commons the Postmaster-General, Mr. Lees-Smith, stated that the average cost of issuing wireless licences during the last financial year was 1s. 1d. per licence. This cost was based upon the time occupied, and it included provision not only for the issuing, recording and renewing of annual licences, but also for headquarters work and for such duties as the detection of unlicensed stations and any subsequent legal proceedings.

THIS ETHERIAL MAGIC.
Alarming remarks are made by a writer in a Chatham newspaper. “Isn’t this wireless craze going too far?” he asks. “With a great many people nowadays it would appear that there is but one thing they live for—wireless. It appeals to
them as a new toy does to a child; they cannot find out too much about it. But uninitiated in the most elementary things of this ethereal magic, they indirectly seek to investigate its intricacies, regardless of the results of their folly. The wireless set owner is legion, and it is not more popular than with the poorer people. . . . A working class man entered a wireless shop and purchased a valve costing half a guinea. He was accompanied by his barefooted child! "Well, what are we going to do about it?"

A GEOGRAPHICAL ERROR.

By an unaccountable error we suggested that the Bucharest broadcasting station, illustrated in our issue of December 4th, exists for the delectation of Roumanian listeners. The Bucharest station is, of course, Roumanian, and is owned and operated by the Societatea de Difuzare Radiotelefonică din România. The power is 12 kW, and the wavelength 354 metres. We apologise for the mistake.

LISTENERS CALL THE TUNE.

Renewal application forms for broadcast licences in Denmark are accompanied by a voting paper on which the Post Office requests listeners to express their views on the programmes. Apparently Danish programme committees in common with those of other countries, a year's voting having shown that listeners are "dissatisfied."

A NEW APPOINTMENT.

Mr. Bernard C. Holding, for the past three years editor of The Electrician, with which journal he has been associated since 1923, has resigned the editorship to take up an appointment with the International Standard Electric Corporation, London, on January 1st.

WIRELESS OPERATORS DISSATISFIED.

General dissatisfaction with the wages and condition of marine wireless operators has led the Association of Wireless and Cable Telegraphists to apply for a conference with employers. The Association states that the 1926 award of the Industrial Court has been given legal and patient trial, but that it is now considered that the award was and is a miscarriage of justice to Association members. Objection is taken to the method of fixing pay according to the tonnage of the ship, and the standard of wages is also condemned.

G.W.R.'S RADIO BEACON.

The construction of a wireless beacon to assist the navigation of the Transatlantic liners and other shipping in Plymouth Sound, and, as owners of the docks at Plymouth, are prepared to bear the cost of building and equipping the station and necessary apparatus. The main difficulty, however, is the question of maintenance, but should they fail the station may not be erected.

that after providing the station they should not be expected to undertake an annual expenditure of £500 to £1,000. Negotiations are in progress which it is hoped will settle the question of maintenance, but should they fail the station may not be erected.

FORTHCOMING EVENTS.

THURSDAY, JANUARY 3rd.

Ifford and District Radio Society—At the Malvern Institute, High Road, Ifford, Lecture by a representative of the Ifford Electric Co., Ltd., "Golding Greens and Ifford Radio Society."

TUESDAY, JANUARY 7th.

Physical and Optical Societies Exhibition (and on January 9th and 10th), at the Imperial College of Science, Imperial Institute Road, South Kensington. The Lecture: "Photographic Problems of Picture Telephony," by Mr. W. S. Newton, B.Sc. (Hons.).

A GERMAN "HAM" STATION.—D4CM, one of the most active amateur stations in Berlin. An input of 28 watts is used. The transmitter, seen on the left, employs the Hartley circuit.

TELEPHONES ON ATLANTIC LINERS.

Interesting technical details are now available regarding the new ship-to-shore telephony service inaugurated on the United States liner Leviathan.

The two parts of a conversation between the Leviathan and a land telephone are, as far as the radio link is concerned, carried by two separate radio waves of different wavelength. The radio wave from land to ship is about 34.8 metres, and that from ship to shore will be about 34.0 metres. The Deal Beach, N.J., experimental station of the Bell Telephone Laboratories transmits on the wave of 34.8 metres. The Leviathan transmitter operates on the wave of 34.0 metres. Telephone circuits from Deal Beach and Forked River, at which latter place the radio receiver is located, lead to a control room of the long-distance headquarters at 21, Walker Street, New York, of the American Telephone and Telegraph Company.

The 34.8 and the 34.0 metre waves are used in the daytime for distances from 250 to 500 miles. For distances in the daytime of less than 250 miles a wave of about 73.0 metres is used to carry the voice from land to sea, and a wave of about 90.5 metres for the voice from sea to land. At night the two waves are effective for all distances up to 600 miles or more.

The land transmitter is quite powerful, about 5,000 watts. The ship transmitter is of 500 watt capacity, but since receiving conditions on land are much more favourable than on shipboard, signals strengths from ship to shore and from shore to ship are about equal.

The British Post Office is not so advanced with its experiments as the American authorities, but it is probable that a similar ship-to-shore service will soon be in operation on this side of the Atlantic. There will shortly take place on the Berengaria.

TRANSMITTERS' NOTES.

Radio Amateur Call-book.

The December issue of the Amateur Call-book is now published and can be obtained from Mr. F. T. Carter, Flat A, Glenaegles Mansions, Streatham, price 4s. 6d. post free.

The lists of amateur transmitters have been revised and brought up to date; that for Great Britain alone occupies over 24 columns of closely printed matter. The supplementary features include the "Q," "R," and "T," and "codes, and a list of the principal commercial short-wave stations, with regard to which the publishers specially ask for reliable information concerning wave-lengths, working regularly on frequencies above 3,000 kc.

We hope there will be a good response to this request, as up to the present time we have not seen anything like a really comprehensive list of short-wave stations, though we receive constant enquiries from readers who ask if a complete list is obtainable.

EXPERIMENTS ON 170 METRES.

Mr. S. J. Styles (GB56), 15, Pickwick Road, Dulwich Village, S.21, is carrying out experiments on the longer amateur wavelengths and wishes to arrange schedules on the 170-metre wave-band for Saturday or Sundays with stations outside London. He will also appreciate any reports on transmissions received on this wavelength.

New Call-signs and Changes of Address.

610 T. Woodhouse-Rayner, 25, The Gardens, East Dulwich, S.22. (Change of address and 2nd issue of transmissions on 1740-1790 and 2700-2750 kc. and will welcome reports.)

6XM North Middlesbrough Radio Society (Portable), Pen. Sec., E. H. Lister, "Windswells," Church Hill, Middlesbrough with N.M. (Change of address.)
An Account of the Short-wave Achievements of the Bell Telephone Laboratories.

By M. RAY.

At a meeting of the Wireless Section of the Institution of Electrical Engineers in March, 1926, a paper was read by Mr. Shaughnessy describing the remarkable achievement of the General Post Office—the thousand-kilowatt Rugby transmitter completely controlled from a small tuning-fork. Many speakers complimented the engineers of the Post Office and affirmed their belief that this was the last word in transmitting station design. Mr. Vyvyan, the chief engineer of the Marconi Co., also remarked that the achievement was the last word in more senses than one, insinuating that, although only completed a few months, the long-wave Rugby station was already out of date.

He was referring to the short-wave beam stations that were in the course of erection by his company under the guidance of that remarkable engineer, C. S. Franklin. Most of those present, though they were not in the position to contradict effectively Mr. Vyvyan’s prophecy, through lack of experimental evidence at their disposal, were well known to be very sceptical regarding the prospects of the employment of short waves for commercial purposes. The last three years have shown that this prophecy, however rash it appeared at the time, was substantially correct for point-to-point transmission.

It is barely two years since the General Post Office took over the pioneer installations of the Marconi Company, and there are now short-wave beam stations almost all over the civilised world, and more are constantly being added to the number already in existence.

One of the latest installations is that designed by the Bell Telephone Laboratories of America for the American Telephone and Telegraph Company. They have been described in a recent number of the Bell Records by the principal engineers in charge of the design.

These stations are of considerable interest and in many ways differ from the original stations built by Franklin. The requirements in these American stations were more stringent, since they were required for telephonic communication, and, in order to obtain reliable service, it was considered that it would be necessary to employ a number of wavelengths, so that when one failed to convey intelligible speech via the Heaviside layer, another wavelength would be used. Each of the transmitters erected by the Bell Laboratories can be used on three different wavelengths of approximately 16, 22, and 33 metres. The transmitters can be readily altered for different wavelengths by changing the coils, but the problem is not so simple for the aerials. These beam aerials can only be designed for a single wavelength, so that each trans-
American Beam Stations.—
mission channel has three separate aerial arrangements and a single transmitter. At Lawrenceville, near New York, there are three channels pointing towards England, making a total of nine aerial arrangements, each of which is 500ft. long.

These had to be arranged in a line in order that they might not interfere with one another. The total area of land covered is 800 acres. The aerials are supported on steel towers 180ft. high. Each of them is considerably smaller than those originally erected by the Marconi Company, which used towers 275ft. high and an aerial spread of 1,300ft., but in most cases only a single wavelength, and never more than two, were used, so that the total system for each channel was smaller, but no doubt did not give as high a degree of reliability. The principle of the aerial design differs somewhat from that of Franklin.

An element of the aerial is shown in Fig. 1, in which the dotted lines show the current distribution. The currents in the vertical portions by this arrangement flow in the same direction, while the currents in the horizontal portions practically cancel one another, so that only the vertical portions are effective in producing radiation. This special form of construction was employed in order to guard against certain dangerous climatic conditions. In the neighbourhood of New York considerable quantities of sleet are liable to condense on wires. To prevent dangerous overloading of the aerials it is proposed to melt the sleet by warming the aerial wires with alternating current at power frequencies. For this purpose it is essential that the aerial should form a complete metallic circuit, a condition which is obtained in the design shown in Fig. 1. A current of 150 amperes at nearly 1,000 volts is used for the purpose. The power generator is connected across a large condenser, which effectively short-circuits the high-frequency current. This condenser is connected at the end of a quarter-wave line. The reason for this is that such a line, when short-circuited at its end, has a very large input impedance. The combination of this line, condenser, and generator connected directly across the high-frequency generator is of such high impedance to the high-frequency that it will barely affect it.

The reflector system is a similar arrangement situated a quarter of a wavelength behind the transmitting aerial, and excited by direct induction from it. The correct phase relation between the current in the reflector and the aerial is obtained by slightly detuning the reflector system.

Quartz Oscillator Control.
The whole aerial system consists of a number of elements such as shown in Fig. 1 situated side by side in a line. A general view of the grounds at Lawrenceville is shown in the title illustration. The long line of aerials are the three channels for European transmission, the shorter one at right angles to it is a channel for transmitting to South America. The photographs give a closer view of the aerial system. It will be noted that in general outward appearance the construction is very similar to that of the original beam aerial designed by Franklin.

While the thousand-kilowatt station of Rugby is controlled from the almost infinitesimal power of a vibrating tuning fork, these high-frequency 15-kilowatt transmitters are controlled by an even smaller source of power, namely, that derived from a piece of quartz vibrating at the rate of 3,300,000 cycles per second. From these the third harmonic is picked out, and then the second of the result, giving finally the highest frequency used, corresponding to approximately 16 metres wavelength. This is modulated by a two-stage speech amplifier and again amplified by large water-cooled valves, of which there are four in parallel in the last stage.

The construction of the oscillator is apparently straightforward, but the designers had to overcome
American Beam Stations.—

considerable difficulties owing to the fact that some of the leads in such large systems are of length comparable to the wavelength and need special coaxing, and also because these high-frequency circuits are liable to break out into various types of oscillations. These may contain extremely high frequencies produced by stray inductances in leads and valve capacities, but they can usually be prevented by the judicious use of resistances.

In construction the power supply and arrangements are along standard lines. One is faced with a bevy of beautifully arranged instruments, switches, knobs, relays, which give the impression like all unfamiliar switchboards of being lost in a large city. An

vertical portions are effective for reception. The reflector is an identical system situated one-quarter of a wavelength behind the aerial, and departs from the usual arrangement in that it is connected to the receiving set in such a way that the E.M.F. induced in it is shifted in phase by 45° before it reaches the receiving set.

The same shift, but in the opposite direction, is given to the signal from the aerial, resulting in a relative phase shift of 90° between the two. This, combined with the distance of separation of a quarter of a wavelength, gives the ideal theoretical condition for a reflector, namely, that it should double the signal received from the required direction, and reduce it to zero if it comes from the opposite direction, the direction of the incoming

explanation is given of the mechanism of the foolproof devices consisting of interlocking switches, lights that go on when something is wrong, lamps that go out when something is right, bells that ring when the operator falls asleep, cages that one cannot enter without making cabalistic signs, and all the remainder of the safety devices.

Minimising Atmospheric Disturbances.

So much for the transmitter. The receiving aerial is of a different design first suggested by Mesny. The construction is shown schematically in Fig. 2, in which the dotted lines show the current distribution. As in the case of the transmitting aerial, it will be seen that the vertical portions carry current flowing in the same direction, while the currents in the horizontal portions are small and largely neutralise each other, so that only the ray being assumed to be horizontal. Actually this phase shift is adjustable, so that minimum reception is in the direction of the most disturbing atmospherics. Each aerial is six wavelengths long: such a system, it is claimed, receives forty times the power (16 decibels) as that received from a simple half-wave aerial. The whole receiving station, comprising four communication channels, each capable of reception on three different wavelengths, covers an area of 400 acres. An aerial view of the station is shown, together with a closer view of the aerial systems.

The receiver proper is built on the superheterodyne, double-detection principle. The signal is first amplified by means of two stages using screen-grid valves, the frequency is then demodulated to one of 400 kilocycles, which is passed through a narrow band-pass filter, and the signal further amplified through six stages
at this intermediate frequency. Between the first and second of these stages is inserted an attenuator, which serves the double purpose of volume control and for carrying out certain measurements. Before the last demodulator, from which the speech frequencies are obtained, another band-pass filter is inserted. A single stage of audio-frequency amplification is employed.

The speech is then transmitted along wires to a central building, where it is further amplified and transmitted over land lines to New York. After this our interest completely disappears, but our imagination may allow us to visualise some impossibly square-chinned business man being disturbed in order to listen over the roar of the electrons and the cracklings of Jupiter to some probably unimportant remarks. (Fortunately, the roar is subdued, and the cracklings not too frequent.)

With the help of the photographs kindly lent by the Bell Telephone Laboratories, the author has been able to describe briefly a great engineering success. The use of short-wave beam stations, with the further improvements in design that are likely to accrue through the research work which is continually going on, will in time bring long-distance telephony within the financial reach of nearly all. In America already he who lives without a telephone lives in Diogenian bliss, but his race is practically extinct.

It is indeed a pity that the transmission of speech over which so much thought, so much work, so much energy has been spent should reach the end of its journey in the common land line and desk telephone, of the reproduction qualities of which even a parrot would be ashamed.


CATALOGUES RECEIVED.

Fuller Accumulator Company (1926), Ltd., Woodland Works, Chadwell Heath, Essex.—12-page illustrated booklet on the care and maintenance of Fuller accumulators.

Carrington Manufacturing Co., Ltd., Camco Works, Sanderstead Road, South Croydon. — Descriptive leaflet of "Camea" "Paxflat" cabinet for the "1930 Cossor Melody Maker."

Part XV.—Properties of Tuned Circuits.

By S. O. Pearson, B.Sc., A.M.I.E.E.

(Continued from page 704 of last week's issue.)

There is still a good deal to be said regarding the series type of tuned circuit discussed in the previous part where the conditions for obtaining the highest voltage step-up effect were mentioned. It was found that for optimum signal strength the resistance of the tuned circuit should be low and the ratio of inductance to capacity as high as possible within practical limits. The product of inductance and capacity is determined by the frequency or wavelength to be received.

Selectivity.

In these days when some valves are capable of giving an actual high-frequency amplification of the order of 200 times or more in a single stage, the voltage step-up effect given by the circuit itself is not nearly so important as it was a few years ago when it was a difficult matter to obtain a high-frequency amplification of only twenty times in a single stage. The most pressing problem at the present time, as every reader knows, is that of obtaining a circuit sufficiently selective to enable him to listen to a desired transmission without interference from other transmissions perhaps more powerful than the desired one and operating at a frequency removed by a few kilocycles per second only from that to which the circuit is tuned.

By more or less elaborate arrangements involving two or more tuned circuits it is possible to obtain a very high degree of selectivity, but as we are studying the general theory of a single tuned circuit at the moment, such refinements must be left for subsequent consideration.

The selectivity of a tuned circuit is not very easily expressed as a numerical quantity on account of the peculiar shape of the resonance curve. There are two ways in which one could judge the selectivity of a circuit, and a definition could be given according to which viewpoint is taken. For instance, in tuning the receiver to a given station the object in view is to cause the signals from this station to build up the maximum possible voltage across the tuned circuit whilst at the same time preventing as far as possible any other station, operating on a neighbouring frequency, from setting up a voltage across the circuit. From this point of view the selectivity of the tuned circuit might be defined as the ratio of the voltage obtained across it at the resonant frequency to that obtained at some other frequency differing by a stated number of cycles per second from the resonant frequency, the voltage induced into the circuit being the same in each case.

Since the present frequency separation of broadcasting stations in Europe is 9 kilocycles per second, a figure of this order suggests itself for use in the above definition. So the selectivity could be defined as the ratio of the voltages set up across the tuned circuit by two stations of equal strength and where frequency separation is 9 kilocycles per second, the receiver being accurately tuned to one of them. But, unfortunately, this definition, although conveying clearly the idea of what is meant by degree of selectivity, does not lend itself very easily to numerical calculation in terms of the constants of the circuit.

In these circumstances it is better to define the selectivity from the point of view of the change in frequency from the resonant value necessary to reduce the voltage across the circuit to a stated fraction of the maximum value. In the October 16th issue of The Wireless World Dr. R. T. Beatty gave a definition on these lines, and explained how a number could be obtained for expressing the selectivity of a tuned circuit as a numerical quantity, and how it could be used for practical calculations. This he called the "selectivity number" of the circuit. It is defined as the ratio of the resonant frequency to the change in frequency necessary to reduce the voltage across the circuit to a value of 10 per cent. of the maximum value. The way in which this selectivity number depends on the constants of the circuit will be explained after we have considered the resonance curves of some actual circuits.

The Effect of Resistance on Selectivity.

The degree of selectivity necessary to ensure reception of any given station free of interference by another station on a neighbouring wavelength or frequency...
Wireless Theory Simplified.—

depends on (a) the difference between the two frequencies, and (b) the relative strengths of the two transmissions as measured in the locality of the receiver. The closer the two wavelengths are together and the more powerful the effects of the unwanted station, the greater will the selectivity have to be.

The resonance curves given in Fig. 3 of the previous part show very clearly that when the resistance of the tuned circuit is reduced, the peak of the resonance curve is increased in height without appreciably changing the width of the hump near the base. This means that, by decreasing the resistance, we are increasing the strength of the wanted "signal" at the resonant frequency without appreciably increasing the strengths of any signals whose frequencies lie outside the band covered by the hump in the curve. In other words, we are increasing the selectivity by reducing the circuit resistance.

The effects of the resistance, however, on the selectivity of the circuit can be made very much clearer if, instead of plotting the resonance curves to actual values of the voltage, each is plotted to values which are a percentage of the respective maximum values, thereby making all the curves coincide at the maximum point. Accordingly this has been done in Fig. 2 for a series-tuned circuit such as that shown in Fig. 1, where the inductance is 2532 microhenrys and the capacity 0.00025 microfarad for resistance values of 70 ohms, 50 ohms, 200 ohms, and 500 ohms respectively, as indicated on the curves.

These resonance curves show very clearly that reducing the resistance of the circuit has the effect of narrowing down the peak of the resonance curve and so increasing the degree of selectivity. Since the curves have been plotted to scale, we can read off directly the frequency at which the voltage across the circuit is 10 per cent. of the maximum value, and from this we can obtain the selectivity number formulated by Dr. Beatty. For instance, from the resonance curve corresponding to a circuit resistance of 50 ohms, the voltage falls to 10 per cent. of the resonant value at a frequency of 184.3 kilocycles per second. The difference between this and the resonant value of 200 kilocycles per second is 15.7, and so the selectivity number of the circuit is

\[ \frac{200}{15.7} = 12.72. \]

When the circuit resistance is increased four-fold to 200 ohms, we find that 10 per cent. of the maximum voltage occurs at a frequency of 237 kilocycles per second. The difference between this and the resonant frequency is 200 - 137 = 63 kilocycles per second. Hence the selectivity number is \[ \frac{200}{63} = 3.18. \] This is just one-quarter of the value obtained for the 50-ohm circuit.

By taking further resistance values and the corresponding resonance curves we find that the selectivity number is inversely proportional to the resistance of the circuit.

Effects of \( L \) and \( C \) on the Selectivity.

It was shown that the voltage step-up or voltage magnification of the tuned circuit is also inversely proportional to the resistance, and so both the signal strength and the selectivity vary inversely as the circuit resistance. We can conclude, then, that the selectivity of a circuit is directly proportional to the voltage magnification obtained at the resonant frequency. Now the voltage across the circuit at this frequency is equal to the current in the closed circuit multiplied by the reactance of the condenser or by the reactance of the coil, because these are equal at the resonant frequency—that is, voltage across the circuit is \( E_r = I \times 2\pi fL \), where \( I = \frac{E}{R} \) at the frequency of resonance, \( E \) being the voltage applied to the circuit. Hence \( E_r = E \times \frac{2\pi fL}{R} \) volts, and so the voltage magnification of the circuit is \( m = \frac{2\pi fL}{R} \) at the frequency of resonance. But we already know that \[ f = \frac{1}{2\pi \sqrt{LC}} \] or \[ 2\pi f = \frac{1}{\sqrt{LC}} \] and therefore the voltage magnification given by the circuit when tuned to resonance is

\[ m = \frac{I}{\sqrt{LC}} \] and the selectivity number is proportional to this quantity, which may be looked upon as a sort of figure of merit of the circuit.

For the circuit considered above, with \( L = 2532 \mu \text{H} \) and \( C = 0.00025 \text{ mfd} \), for a resistance value of 50 ohms the voltage step-up is \( m = \frac{I}{50\sqrt{0.00025}} = 63.6 \) times. The selectivity number for this circuit was found to be 12.72, which is exactly one-fifth of the voltage magnification.

Similarly for the 200-ohm circuit the voltage magnification works out to 15.9 and the selectivity number was 3.18, also exactly one-fifth of the voltage magnification. Hence for a selectivity number calculated on a 10 per cent. basis, as explained above, its value is given for any tuned circuit by \[ \frac{I}{5R\sqrt{C}} \]

Conditions for Maximum Selectivity.

Thus from the point of view of obtaining good selectivity with a single tuned circuit, it is a matter of the first importance to make the effective resistance as low as pos-
Wireless Theory Simplified.—

possible and to choose a ratio of \( \frac{L}{C} \) as large as possible compatible with practical conditions. The effective resistance of the circuit is the equivalent series resistance which, when multiplied by the square of the current, gives the total power absorbed by the circuit; it is made up of the actual high frequency resistance of the coil together with an added resistance accounting for any incidental loss of power associated with the circuit but not actually in the coil or condenser. For instance, if the tuned circuit is followed by a detector valve operating on the leaky grid principle as shown in Fig. 3(a), it is actually shunted by a high resistance “load,” and the simplified circuit is shown at (b) in Fig. 3, where \( r \) is the effective resistance in parallel with the condenser of the tuned circuit and \( R_1 \) is the actual high-frequency resistance of the closed circuit itself. Now since the external resistance \( r \) has a high value, the current in it will be very small compared with the current \( I \) in the coil \( L \), and so we can still take the current as being of equal value all the way round the closed circuit without introducing any appreciable error.

The power loss in the closed circuit is \( P = IR \) watts and that in the external resistance \( r \) is \( \frac{E}{r} \) watts, where \( E \) is the voltage across the circuit at resonance, being equal to \( I \times X_c \), where \( X_c = \frac{1}{2 \pi f C} \). Hence the power expended in the external shunt resistance \( r \) is \( \frac{I^2 X_c}{r} = \frac{I^2 X_c}{r} \) watts; and so a high resistance in parallel with the tuned circuit is equivalent to an extra series resistance of \( \frac{X_c^2}{r} \) ohms within the closed circuit itself.

Thus if \( R_1 \) is the effective resistance of the unshunted tuned circuit, and if this circuit is then shunted by a high resistance \( r \), the effective resistance of the circuit becomes

\[
R = R_1 + \frac{X_c^2}{r} \text{ ohms},
\]

and in consequence both the selectivity and the signal strength are reduced. The equivalent circuit is shown in Fig. 3(c).

Damping Effect with Leaky Grid Rectification.

As a practical example we can consider the same tuned circuit cited previously, namely, where \( L = 2532 \) microhenrys, \( C = 0.00025 \) microfarad, and assume that the effective resistance of the circuit itself with the valve disconnected is 50 ohms. The voltage magnification obtained would be \( m = \frac{1}{R \sqrt{C}} = 63.6 \). Suppose now that the leaky grid detector valve is connected across the circuit and that it introduces an equivalent shunt or parallel resistance of \( 1 \) megohm or \( 10^6 \) ohms. This is equivalent to increasing the series resistance of the circuit by \( \frac{X_c^2}{r} \) ohms. The resonant frequency is 200 kilocycles per second, and therefore the condenser reactance \( X_c \) is 3182 ohms. Hence the extra resistance imparted to the circuit by the valve and its grid leak is

\[
\frac{X_c^2}{r} = \frac{3182^2}{10^6} = 10 \text{ ohms.}
\]

So the total effective resistance of the tuned circuit is increased from 50 ohms to 60 ohms in this case, and the voltage magnification reduced from 63.6 to 53. Obviously the lower the effective resistance of the tuned circuit itself the more pronounced will be the “damping” effect of a leaky grid detector or any other shunting resistance. Thus when a high frequency tuned circuit is designed to have the maximum possible efficiency, it should preferably be followed by an “anode bend” detector if the selectivity is to be unimpaired, because anode bend rectification introduces very little damping.

(To be continued.)

WORLD-TIME INDICATOR.

Messrs. J. H. Willis and Co., Ipswich Road, Norwich, have sent us their new model World-Time Indicator. A description and illustration of this device appeared in our issue of May 8th, 1929. In the new model several more countries have been included, the wording of the instructions slightly amended, and the edge of the dial is now milled. The price is 15. 6d.
To Be or Not to Be?

The New Year finds the B.B.C. Programme Department in a disturbing predicament. The ordinary task of filing programme time for six weeks ahead is sufficiently harassing; add to it the possibility, but not the certainty, that an extra full-blown daily programme will be required in a month or two, and the worries of the representatives of the great naval powers taken by the Prime Minister.

Watch the Educationists.

The outcome of the present twin transmission tests from Brookmans Park will determine whether an additional programme is to be available, and already a number of optional items have been pigeon-holed for use at a moment's notice. I understand that these include a good sprinkling of talks; in fact, it looks as if the alternative regional programme might easily be commandeered by the educational group. Possibly listeners are in favour of such a step, but I very much doubt it. No one denies that broadcast education is hand-picked at present by lack of programme time, but the B.B.C. would do well to ensure that the educationists are not allowed too big a bite from the new cake.

H.M. The King.

The outstanding broadcast event in January is, of course, the relay from the International Disarmament Conference at the House of Lords on the 21st, when H.M. The King will use the microphone again for the first time since his illness. I hear that the B.B.C. will install no less than a thousand microphones for the occasion, which will be operated from a central point just outside the Chamber, linked to the Post Office "PBX" (Private Branch Exchange), and thence to Savoy Hill.

The relay, which will last two hours, will begin at 11 a.m. with the King's opening speech, after which His Majesty will leave the Royal Gallery, his place being taken by the Prime Minister. The broadcast is expected to include speeches by representatives of the great naval powers and delegates of the Dominion Governments.

A Programme Dilemma.—The King at the Microphone.—What Will 1930 Bring?

A Bumper Broadcast Year.

It is doubtful whether any year can eclipse 1929 for the importance and variety of its broadcast events. On the constructional side the year saw the practical completion of the first regional station, the installation of a new listening post at Tatsfield, and the spade work preliminary to the erection of Broadcast House, Portland Place.

In the North work was started on the site for another regional transmitter.

Programme Progress.

On the programme side, the B.B.C. deserve congratulation for several really "star" features during 1929. At the top of the bill came the broadcast of the Schneider Trophy Race, carried out in a masterly fashion by an "O.B." staff who are now masters of the game of bringing outdoor events to the home of the listener. The list of notable speakers who faced the microphone in 1929 is formidable enough. It includes the Prince of Wales, the Duke of York, the Prime Minister, Mr. Philip Snowden, Sir James Barrie and Sir Henry Segrave, to name only a few.

Can Savoy Hill Maintain the Standard?

Radio drama discovered a new technique in "Squirrel's Cage," which fully deserved its repeat performance, while the Talks Department amply justified its existence by the introduction of the "Points of View" series.

Taken all round, it has been a good year for broadcasting, and I am afraid that the B.B.C. may have some difficulty in maintaining the standard. Anyway, here's good luck to them!

Old Bore's Wireless Almanac for 1930.

January.—Old Bore sees a million listeners—resolving not to listen again until the B.B.C. improves programmes.

February.—Unhappy million resume listening to see if programmes have improved.

March.—Still listening.

April.—Coming to a decision.

May.—Dissatisfied; another million switch off.

June.—B.B.C. loses patience and closes down. Public outcry.

July.—A nation starved for entertainment.

August.—Cabinet meeting discusses plans for emergency programmes.

September.—Rugby, Northolt and Wick Radio broadcast Cottenham and Denny. Adult education from Cleethorpes.

October.—B.B.C. behind barred wire at Brookmans Park. Aberdeen station opens subscription list for announcers' families.

November.—Tactful mediation of Postmaster-General brings B.B.C. back to Savoy Hill. Programmes resumed.

December.—Old Bore sees a million listeners resolving not to listen again until programmes are improved.

Things We Want to Know.

Whether a certain artist often visits the Queen's Hall, and, if so, whether he still sees the organ pipes as sausages in mass formation.

TELEVISION IN AMERICA. Regular television programmes are now broadcast by W2XCR, New Jersey, using the Jenkins apparatus. The photograph shows the interior of a Jenkins receiver. Note the rotating drum with its vertical scanning holes and neon lamp.
SUPPLY REGULATION AND MAINS UNIT.

Sir,—May I make the suggestion that users of D.C. units on mains which are expected to be changed over to A.C. should apply to their local electricity works to approve of the unit? The local authority can only refuse to approve the unit on certain obvious grounds (an anticipated change over to A.C. is not a reasonable objection). Having approved the unit, the supply company is, I believe, bound to provide an A.C. unit when they change over to A.C.

ERNEST J. BATY.
Luton, Beds.

ARE AUTUMN SHOWS TOO LATE?

Sir,—It is common knowledge that those who attend the annual Motor Show at Olympia, and order new motor cars, frequently have to wait until the following spring before they obtain delivery. Luckily, the spring is just the time when most people desire to put new cars into commission. With the wireless public the position is less fortunate. The annual Wireless Exhibitions in London and elsewhere are held about October, and those who attend and order new sets or new components naturally expect to be able to use them during the coming winter.

My experience has been unusual, but it has been as follows:
(1) A month or so ago I made enquiries about a new moving-coil loud speaker which received much favourable comment at the recent exhibition at Olympia. I was told that, if I decided to wait so long, I might be able to obtain one next January.
(2) I found the published characteristics of a certain new power valve met my requirements. Upon asking my local dealer about it I was told that he had ordered some of these valves weeks ago, but had not been able to obtain any.
(3) For some unknown reason, the English manufacturers appear content to allow the Americans to hold more or less a monopoly in the sale of variable wire-wound resistances and power potentiometers, though these components are required in practically every home-made wireless set and H.T. unit.

A. H. GREGSON.
Westcliff-on-Sea.

THE SUPERHETERODYNE.

Sir,—The superhet receiver can scarcely be said to have ever enjoyed a popular vogue in Britain, but by serious experimenters it has long been held to be a valuable instrument; nor do those who have had experience of its use consider that its sphere of usefulness is past. It was therefore with some surprise that many read, in two separate articles published by you in November—"Radio in France" (6.xi.29) and "Receiving Sets of To-day" (23.xi.29)—remarks which appeared to convey that the authors of the articles thought the superhet obsolete. So little did the present writer believe that this was the considered opinion of the technical experts of The Wireless World that he confidently expected (following Mr. Cocking's recent article on bandpass filters) that the next Wireless World set would certainly be a superhet with bandpass filters, probably based on the "Record Three," i.e., with a single high-magnification I.F. stage, or the "Kilo-Mag" with two I.F. stages.

Selectivity and high-quality production are the most urgent needs. The selectivity of the superhet has never been questioned; that it can also give the highest quality of reproduction may not be so well known, but one would have thought it to be evident from a study of Mr. Cocking's article on bandpass filters in your issue of October 30th, 1929. Obviously the exact application of the bandpass filter having a constant channel-width is to fit it to the input of the I.F. stages of a superhet.

Since Easter the writer has experimented with superhets in which carefully tuned bandpass filters and I.F. transformers were embodied, and for quality the present hook-up is hard to beat. The eminent organ-builder and master of acoustics, Mr. John Compton, hearing the writer's set, likened it to a big chorus of Schulze diapasons—a term which conveys to those familiar with organ design and technique a tone picture of a quality not to be mistakened, and which may be explained as connoising the presence of solid foundation tone from 16' pitch upwards, accompanied by the fullest harmonic development of which the upper members of the family are present in such power and brilliance as to constitute a perfect blaze of tone.

It may be that the superhet in question differs from the usual type somewhat, but there is neither magic nor secret about it. Anyone could build it without much trouble; possibly, as did the writer, largely out of parts from previous sets. There is not an excessive number of valves, and two of them (the modulator and the detector) have no H.T. on their plates. What perhaps is unusual is the intermediate frequency, which, to obviate repeats and harmonics, is fixed at 478.4 kh. Aerial and oscillator coils, bandpass filters, and I.F. transformers are accurately tuned, the filters and transformers by a fixed component, a semi-variable condenser, and a small variable condenser, all in parallel. The filter and transformers, of course, only require this to be done once for all. There is in all cases a very high ratio of inductance to capacity.

J. T. H. BURRELL.
Millbank, S.W.1.

Sir,—One of your correspondents who signs himself "Super Het" wants three reasons for the unpopularity of the superhet type of receiver in England. As a superhet enthusiast, may I be allowed to state my opinion on the matter? Of the several available reasons, here are what I consider the three more important:

(1) Insularity. The superhet is essentially a long-distance receiver, and the bulk of the listening public in England takes not the slightest interest in events outside her shores.

(2) The mistaken idea, chiefly prevalent in England, that the superhet is incapable of high-quality reproduction.

(3) The absence on the British market of efficient valves of low price and low upkeep cost.

With regard to (2), the superhet is peculiar in that there is no other circuit capable of giving more appalling reproduction if badly designed. If due precautions be taken, however, it would be difficult to equal, let alone surpass, the good quality this circuit is capable of. With regard to (3), British valves
FOREIGN WIRELESS GOODS.

Sir,—For some days I have been trying to purchase various wireless components which are in general demand, and it has been brought home to me very forcibly how the conservatism of British manufacturers is losing for our country the considerable trade in wireless goods.

It is a source of amusement to me how they can sit back and allow foreign articles to outstrip their own from the market. One finds, on asking for British makes, that the shops are invariably out of stock, and can offer no reassurance as to when delivery of the British article can be expected.

I was recently offered a German equivalent of a certain component, and one certainly cannot in most cases follow the maxim “Buy British Goods” in the wireless trade, as the Germans particularly are alive to the possibilities of the British market and appear to be flooding us with their goods to the great detriment, of the wireless trade throughout this country, to say nothing of various other trades.

Can anything be done to remedy this and state of affairs?

Horts.

F. NICHOLS.

PICTURE TRANSMISSIONS.

Sir,—The discontinuance of these transmissions by the B.B.C. must have come as a disappointment to many like myself who had purchased or constructed the necessary apparatus.

The B.B.C. may retort that there are still the Continental transmissions to be received. This is true, and I myself have received some excellent pictures from Vienna in the evenings from Königswinterhausen, but atmospherics and other disturbances are always apt to spoil the picture.

On the other hand, I should imagine that the majority of people constructed their apparatus on the strength of the B.B.C. transmissions, and were hardly influenced at all by the thought that continental stations would also transmit on the same system.

If the B.B.C. are going to treat television enthusiasts in the same way the average man will not bother his head about it, and true television will be further off than ever.

Cheadle, Cheshire

WALTER ADDEY.

TRACKING H.F. RESISTANCE.

Sir,—In studying the subject of H.F. resistance in some of your back numbers recently, I was much impressed by the articles by A. F. M. Boweby, M.Sc., in The Wireless World for December 19th and 26th, 1928.

In these definite measurements were given for commercial apparatus, and comparisons made between different models of the same class of article.

The results are so remarkable that I consider it worth while to use if an improvement could be effected in my "Empire Broadcast Receiver" (Wireless World, June 29th, 1927).

The detector valve holder appeared to correspond with the description of valve holder** A** in the article referred to. The valve sockets were cut out of the bakelite moulded centre-piece, there being still sufficient length to make them serviceable. The H.F. end of the grid-leak was disconnected from its clip and left free.

The improvement in strength and quality was marked, and in consequence it was decided to go a step further and remove the valve cap. After this had been removed there was still a great improvement in performance, but an unlooked for trouble cropped up—that of extreme microphonic resonance, which was bad enough on the telephone, but impossible with the moving coil loud speaker.

In all, three attempts were made to overcome this trouble, as the results achieved justified the expenditure of a little research to see if it were possible to overcome this defect.

In the third attempt the valve connections were sheathed in rubber sheeting (bicycle valve tubing) and the pinch tube packed tightly with cotton wool. The glass was mounted in a light brass cage, for the purpose of holding it, by means of Sorbo sponge pads. The valve and holder were then placed in a cardboard tube with a lid, and packed as tightly as it was possible to do so without damage to the glass, with cotton wool.

All attempts failed to cure the trouble, and whether the aluminium container was open or shut loud speaker reception was practically impossible and telephones little better.

On recapping the valve, a DEL610, its behaviour was normal. So far as this particular sample was concerned, it would appear that the “inferior quality” cap was essential to its success, and that microphonic effects come from other avenues than the glass envelope of the valve, as every precaution was taken to damp this out, and certainly the glass itself could not possibly have been a contributory cause.

Any suggestions from readers will be welcome.

Zaria Province, Northern Nigeria.

WILFRED H. MILES.

TELEVISION.

Sir,—Mr. H. Graham Mallett, your correspondent, whose letter appeared in your issue of November 27th, overlooks the fact that Dr. Lee De Forest has not, evidently, seen the state of television in England. His remarks, presumably, are based upon the American results. The shadowgraphs of Jenkins bear no resemblance to true television such as is now being demonstrated in London. The images in this country are so extremely clear that it is possible, as mentioned in a recent editorial of The Wireless World, to read the time on a watch.

Sir Ambrose Fleming, the inventor of the valve, bears views entirely contradictory to those of Dr. Lee De Forest, and Sir Ambrose Fleming has had the opportunity of thoroughly inspecting British television, and can, therefore, speak with authority.

Without in any way detracting from the pioneer work of Dr. Lee De Forest, surely it is better to take the facts as they stand in this country. Television by the Baird process is being broadcast by the B.B.C. for 2½ hours each week, and the results have been so satisfactory that this time is now to be increased by a further 2½-hour period per week.

Added to this, comes the authentic news that a minimum of a thousand Baird "Television" receivers are now in course of manufacture, and will be available very early in the New Year. Many more can then judge this science for themselves instead of coming to conclusions as a result of hearsay.

As one who has been privileged to witness many demonstrations of television, both by wire and wireless in this country and abroad, and who can pay tribute to the wonderful progress which has been made in the Baird system, I should like to add my humble meed of praise to that of Sir Ambrose Fleming.


H. J. BARTON CHAPPLE.
LABORATORY TESTS.

A Review of Manufacturers' Recent Products.

COUNTERBALANCED PICK-UP ARM.

A gramophone pick-up arm designed to take most of the well-known makes of electric pick-ups has been placed on the market recently by the E.M.G. Hand-Made Gramophones, 11, Grape Street, New Oxford Street, London, W.C.2. Its principal features lie in the number of adjustments that can be made: the length of the arm is variable, the pick-up carrier can be changed to suit the particular model favoured, and the pressure of the needle on the record can be varied by means of an adjustable counter-weight.

Having provided all these adjustments, it is a pity that the designers have not added one more which would permit the pick-up to be set at an angle to the carrier arm, thereby affording an adjustment for track alignment.

The E.M.G. pick-up arm with a multiplicity of adjustments.

The E.M.G. pick-up arm is handsomely finished, the pivot support being nickel-plated. It is marketed at 45s. The makers recommend for use with this arm the Phonovox E.M.G. pick-up, which has been especially designed for fibre needles and is priced at 40s.

"CLIMAX" EARTH TUBE.

The importance of a good earth connection cannot be overstressed, as, in addition to improving reception, it affords a greater factor of safety when the aerial is "earthed" during electrical storms. A direct connection is preferable to a water-pipe earth, but achieving this ideal is less arduous than may at first be thought.

The "Climax" earth tube offers a ready solution, and it costs 5s. only. It is made of hard drawn copper tube, reinforced to prevent buckling, and provided with an iron-shod tip to facilitate driving into hard soil. Holes are drilled at intervals along its length, and during dry spells water can be poured down the hollow centre. Percolation into the surrounding soil takes place and thus a good earth is maintained.

The makers are the Climax Radio Electric Co., Haverstock Works, Parkhill Road, Hampstead, London, N.W.3.

EATON SCREENING CABINETS.

Metal cabinets of standard dimensions, in which the functions of screen and container are combined, are now being produced by Messrs. Samuel Eaton and Sons, 66-72, Barr Street, Birmingham. These are fitted with a wooden base, and are made in conformity with suggestions put forward in the pages of this journal.

Two distinct types are produced: one is a double-compartment container intended primarily for "The Wireless World Kit Set," while the other has four compartments, and its dimensions are suitable for housing the "Kilo-Mag Four," "1930 Everyman Four," or "Receptor III." These are priced, respectively, at 38s. 6d. and 45s. 6d.

Metal channels are fitted round the outer edges of the removable cover, and also to the edges of the crosswise partitions, and as one of the lips of each of these channels is sprung inwards contact is made between the cover and the corresponding edges of the base projections at a number of points. Electrical "sealing" will be adequate for average requirements, but where complete isolation is necessary rolled strips of metal gauze or similar material can be readily inserted in the channels.

External metal-work is finished in crystalline enamel, several colours being available. To compensate for the fact that the plywood sub-base is sunk into the base compartment, the depth of the plinth is somewhat greater than usual; this is all to the good, as the extra space afforded will often be useful, but this must be borne in mind when determining the positions of condenser control dials.

I.D.S. REJECTOR.

Those unfavourably situated with respect to a Regional Station need not despair, as a rejector should help to overcome any difficulty they may have in receiving alternative transmissions. In fact, the I.D.S. "Regional Station Eliminator," has been introduced to cope with such cases. It consists of two coils, wound concentrically on a former:

For unselective sets—the I.D.S. Rejector.

one coil is connected in series with the aerial lead to the set and the other is tuned by a variable condenser. The tuned circuit forms an absorption type rejector.

A practical test was made on a rather unselective receiver, on which 2LO could not be tuned out at any part of the 250-600 metre waveband. With the rejector in use the interference was restricted to a small band of wavelengths between 344 metres and 357 metres only; transmissions above and below these limits being received free from interference from the Regional Station.

The rejector is built into a moulded case 3n. in diameter and 4in. high, with two terminals on the side for attachment of aerial lead and connection to set respectively. The rejector tuning control is mounted on the top.

The price of this useful accessory is 10s. 6d., and the makers are The I.D.S., Ltd., 4, Golden Square, Piccadilly Circus, London, W.I.
Increasing Selectivity and Range.

With regard to the addition of a tuned aerial circuit to the New Kilo-Mag Four, will you please say if this would have any noticeable effect in increasing range?

B. W. R.

Although the conversion in question is primarily intended to increase selectivity, as compared with that of the original "aperiodic" arrangement, it is a fact that, under average working conditions, the use of a two-circuit aerial tuner aids very considerably to the effective range of the set. This is partly because it is generally necessary, in the interests of selectivity, to reduce the coupling of the "untuned" aerial to a value well below that giving maximum signal strength.

Improving the Hartley Circuit.

(Referring to previous correspondence)

Many thanks for your reply to my last letter; the tendency towards insensitivity on the long waves of my "Hartley" det.-I.F. set has been completely cured by connecting a 0.0003 mfd. condenser directly between anode and negative filament terminals of the detector valve, as recommended by you. There has been a considerable improvement in sensitivity, as you suggested would be probable, but your fears that reaction feed-back might be insuffcient to override the whole medium waveband prove to be justified; it is impossible to provide self-oscillation over about one-third of this tuning range unless the extra condenser is removed or disconnected.

Can you suggest a method whereby reaction control may be improved over both wavebands, bearing in mind that, as the set is shortly to be "scrapped" in favour of a more ambitious receiver, I do not wish to spend much time or money on the alterations?

B. C. O.

It is suggested that you should replace the fixed anode by-pass capacity by an inexpensive semi-variable condenser, perhaps of the compression type, with a maximum capacity of 0.0003 mfd. This component should be mounted in a reasonably accessible position, and your aim should be to find a setting for it that is suitable for each waveband. Critical reaction adjustment will be effected by the normal control condenser R.C. (see Fig. 1).

I will be realised that C. and R.C. are interdependent: as the value of the

House-Lighting Systems.

I was interested in your recent reply to "V. W. R." on the subject of using a house-lighting plant for charging an I.T. accumulator, as I myself have been thinking of using the end regulating cells of my own installation for this purpose.

Actually, there are four extra cells that are not normally used, and it is assumed that their voltage would be sufficiently in excess of that of my 6-volt wireless battery for satisfactory charging. What value of resistance should be inserted to reduce current to 3 amps?

G. A.

A 6-volt battery can certainly be charged quite satisfactorily from four of the comparatively large cells used for house lighting, and, as regulating cells are often overcharged through lack of use, it is to the good that they should be worked.

A series resistance of approximately 0.7 ohms will be needed.

A Neutralised "Kit Set."

Will you please tell me how the H.F. section of "The Wireless World" Kit Set (which I am about to build) may be neutralised in order to increase magnification? I presume that a very considerable gain should be possible by making this addition to the published design.

W. R. P.

We should strongly dissuade you from attempting this alteration, as the design does not readily lend itself to modification in this way. In order to make neutralisation worth while, sweeping changes would be necessary; indeed, an adequate discussion of the matter would be rather beyond the scope of the Information Department.

If you must have a "balanced" set, we think you would be well advised to adopt the main features of the "Record III," but we would assure you that the very considerable H.F. amplification of the Kit Set, plus reaction, provides as much sensitivity as is necessary under average conditions.
Back to the Neutralised Triode

Although the screen-grid valve has obvious advantages in a set with a single highly efficient stage of H.F. amplification and in the matter of ease of waveband switching, a careful consideration of recent and receiver designs published in your journal has led me to form the opinion that in a "2 H.F." set for the broadest waveband only neutralised triodes would provide all the amplification necessary (with a good aerial) and would be less costly than the expensive S.G. valves.

Thanks to modern developments such as decoupling and to a fuller use of screening than in the days when neutralised intervalve couplings were popular, it should now be an easy matter to attain nearly the full possible theoretical magnification from each stage, using valves costing less than half the price of those customarily used nowadays.

If you agree that a neutralised triode set is still worth while, will you please give me a circuit diagram of a two-stage amplifier with two-circuit aerial tuner, H.F. transformers, and decoupling devices where necessary, of recent articles, I will screen the valves from the coils and condensers.

There is a good deal of truth in what you say in favour of the neutralised triode, but we think you tend to exaggerate the increased cost of the S.G. valve amplifier, which normally does not require neutralising condensers or the comparatively expensive coil necessary for constructing a superlatively good H.F. amplifier for three-electrode valves.

It is correct enough to assume that two of these valves, used to best advantage, can provide a theoretical amplification quite as great as that of the average set with the same number of screened valves, and that modern stabilizing devices make it much easier to attain something approaching the maximum possible gain from each stage.

The circuit diagram given in Fig. 2 should meet your needs; positions of screening partitions and decoupling devices are indicated. With regard to isolating the valves from the apparatus associated with the H.F. circuits, this procedure cannot do any harm, if carefully carried out, but it is hardly likely to confer very noticeable benefit; it must be remembered that in a neutralised set (as opposed to an S.G. valve amplifier) any stray capacitative couplings can be balanced out.

H.T. Feed.

I have an eliminator with three positive supply terminals, one marked "power," another "120 v.," and a third "0-100 v." The output from the "power" terminal is stated to be 160 volts at 50 m.a., while the voltage of the third supply is varied by an external control knob. Will you please tell me how this should be connected to the "Record III"?

S. B. G. C.

This set is arranged for a single input H.T. voltage, and it will be quite in order to ignore the 120-volt and 0-100-volt terminals of your eliminator. You should join the high-tension leads from the set to the negative and "power" terminals of the eliminator.

We have assumed that the receiver is constructed exactly as described, with a potentiometer for regulating screening grid voltage; it may be pointed out that if this controlling device is included in your eliminator, the set itself may be amplified in an obvious manner by taking this supply direct from the "0-100" terminal of the eliminator. If this modification is introduced, a decoupling resistance must be inserted in the screening grid circuit, in place of the fixed element of the existing potentiometer.

---

The Southern Railway Again.

On several occasions I have tried my "Everyman Portable" receiver in a train, but have found that reception is generally marred by cracklings and other noises. Does this suggest that the set is at fault, or, if the effect is normal, can it be overcome?

H. D.

This form of interference is well known, and is due to the electric lighting installations of the train. It is particularly likely to be troublesome with a receiver having a regenerative detector without H.F. amplification, and we fear that there is no simple cure. You must try to choose a train with gas lighting.

---

FOREIGN BROADCAST GUIDE.

WARSAW
(Poland).

Geographical position: 52° 14' N. 21° 7' E.
Approximate air line from London: 900 miles.

Wavelength: 1.411 m. Kilocycles: 312.5. Power: 8 kW.

Time: Central European (one hour in advance of G.M.T.)

Standard Daily Transmissions.

09.15 Sundays Sacred Service from Posen Cathedral; 10.58 Fanfare from Cracow; 18.58 daily Time signal (q.v.);
18.20 Tuesdays relay of performance from Katowitz or Posen Opera Houses;
19.15 main evening programme; 22.00 Fridays relays of foreign stations; dance music Sundays, Wednesdays and Saturdays.


Announcements are made in the Polish language, but when International concerts are broadcast, also in English, French and German.

Interval signal: the letter W in morse (.-.-).

Time signal: At 6.58 p.m. G.M.T. one long hoot, seven dashes, followed by: ....... the last dot indicating the full hour 7 p.m. G.M.T.

Frequently closes down with the Polish National Anthem (Dombrovsky Mazurkas).

---

Fig. 2.—An amplification of more than 1,000 times can be attained with two neutralised H.F. stages and three-electrode valves.
FOLLOW THE LEAD OF THE SET MANUFACTURER

TELSEN
TRANSFORMERS

TELSEN ELECTRIC CO. Ltd., MILLER STREET, BIRMINGHAM.
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- A complete range of apparatus, including receivers;
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- A complete range of apparatus, includingootplates;
- A complete range of apparatus, including speakers;
- A complete range of apparatus, including buyers;
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INDEX TO ADVERTISEMENTS.

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De Luxe Model
LOUD SPEAKER

Magnificent in Performance & Appearance

Price

50'

A loud speaker of superb tonal quality in a beautiful Cabinet. Scientifically designed to reproduce those overtones by which each instrument attains its individual characteristic tone.

Every note, vocal or instrumental, is produced with faithfulness and charm whilst there is no sign of reverberation when handling "Volume." Fitted with the Four-Pole Adjustable Unit with a convenient adjustment at the rear.

Most Certainly a speaker which will find favour with the most discriminating.

Supplied in handsome Figured Oak or Mahogany Cabinet of most attractive design and superb finish. A loudspeaker unequalled for quality of performance and appearance.
THE WIRELESS WORLD, JANUARY 8TH, 1930.

GRAMOPHONE SPEED TESTER

4D

The Wireless World
AND RADIO REVIEW

The Paper for Every Wireless Amateur

Wednesday, January 8th, 1930.

THE TESTER
L.F. TRANSFORMERS

RADIOGRAND

12/6

TELESOL ELECTRIC CO. LTD.,
Miller Street, Birmingham.

750-WATTS!
THE BEST SWITCH YET.

LYONS "B.A.T." (Best-After-Test; "QMB" SWITCH comfortably breaks 3 Amps, at 250 Volts, yet it is extremely small and very robust and unconditionally guaranteed.
Cordially reviewed by "W.W."—specified in the 1930 EVERYMAN FOUR, etc. Essential in 2-volt sets where switch resistance is fatal. Used by many leading set-makers.

USES:
H.T. Units, A.C. Sets, L.T. Switch, for Portables. Gram-Motor Control, M/C Speaker Field Switch, etc. Supersedes noisy "push-pull" varieties and clearly indicates "ON" or "OFF." Nickel Finish.
Send for FREE 4-pp. Circular.

CLAUDE LYONS Ltd.,
76, OLDHALL STREET, LIVERPOOL.

HYDRA CONDENSERS
THE STRONG POINT IN ANY MAINS UNIT!

Build an eliminator with Hydra Condensers and you are putting between the high voltage of your mains and your set the surest safeguard that science can provide. Hydra Condensers are built to stand up to higher pressures than your mains supply—and every one is tested before it leaves the factory—tested far beyond its stated working voltage. Fit HYDRA for safety.


BurTOn
SELF-LOCATING VALVE HOLDER

1/- each

MANUFACTURED BY
C. F. & H. Burton
PROGRESS WORKS
WALSALL, ENG.

Pentode
Valve Holders 1/6 each

Patent No. 315786
A PERFORMANCE of HIGHEST MERIT

The greatest assurance of "success" possible for an artiste to receive is the public's demand for "more" and "more."

The McMICHAELO SUPER RANGE PORTABLE FOUR

is an assured success and the most popular Portable with discriminating people. Judged on its own merits in regard to quality of design and construction, or judged from a high standard of convenience, portability and performance, this receiver is without doubt supreme. Fitted in a beautifully finished furniture hide suitcase, with patent locking clips, with all accessories ready for immediate use, it possesses the following noteworthy features:—

1. Screened Grid Amplification.
2. Single dial tuning and volume control.
3. High selectivity.
4. Low upkeep cost.

Owing to the high degree of selectivity in this, and our other Screened Grid Portable Receivers, we are able to guarantee complete selectivity between all main B.B.C. Stations under the new scheme of wavelengths.

Ask for a demonstration of this set at any high-class radio store, or call at our London Showrooms.

CASH PRICE 22 GNS.

( Including all Equipment and Royalties).

Or by our special "Deferred Payments on Hire Purchase Terms" system, £5 down and 10 monthly payments of £2: 1: 0

The McMICHAELO SUPER RANGE FOUR

(TABLE MODEL)

A handsome Walnut table model mounted on a turntable and with a self-contained frame aerial and earth. The McMichael Super Range Four (Table Model) offers the same perfection in performance as the Portable model and contains an exactly similar circuit. This model is designed for home use where an outdoor aerial and earth are not convenient or desirable. An additional aerial and earth may be used, however, to add to the normal and truly remarkable range.

CASH PRICE 26 GNS.

( Including all Equipment and Royalties).

L. McMICHAELO LTD

Manufacturers of Wireless and Scientific Apparatus

WEXHAM ROAD: SLOUGH: BUCKS.

Telephone: SLOUGH 445-446
Telegrams: RADIETIER, SLOUGH
London Showrooms: 139, St KAND, W.C.2 (Telephone: Hollow 2496).

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
USEFUL INFORMATION.

A.C. Filament Heating Transformer.  
Output 4 v. 5 amp.

<table>
<thead>
<tr>
<th>Type No.</th>
<th>103</th>
<th>111</th>
<th>210</th>
<th>211</th>
<th>222</th>
<th>240</th>
<th>251</th>
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<tbody>
<tr>
<td>Voltage</td>
<td>100-106</td>
<td>107-114</td>
<td>200-214</td>
<td>215-228</td>
<td>229-245</td>
<td>246-260</td>
<td>260-277</td>
</tr>
</tbody>
</table>

Price 32/6.

Please give voltage and periodicity of A.C. Mains supply or type number when ordering.

H.T. Supply Unit.  
Approximate output when used in conjunction with an average multivale receiver.

<table>
<thead>
<tr>
<th>Tapping</th>
<th>1—Detector Valves 40-60 v.</th>
<th>2—H.F. Valves 60-90 v.</th>
<th>3—L.F. Valves 90-130 v.</th>
<th>4—Last Valves 150 v.</th>
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<td>100-106</td>
<td>107-114</td>
<td>200-214</td>
<td>215-228</td>
</tr>
</tbody>
</table>

Price £5 5 0

Please give voltage and periodicity of A.C. Mains supply or type number when ordering.

RADIO ENERGY

Use them both—the A.C. Filament Transformer and the A.C. High Tension Unit. Mullard has made them for your radio, bringing you instant trouble-free entertainment with no hum. Too long have batteries held back radio from being effortless entertainment, but with the advent of these components you can fetter the steady energy of the mains to give you lasting service.

Mullard MASTER RADIO


Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
ADEVENTMENTS.

THE WIRELESS WORLD

JANUARY 6TH, 1930.

Tudor

HT UNITS FOR MODERN SETS

For modern sets, with power valves, pentodes and moving coil loudspeakers, the Tudor Monobloc High Tension Unit has no superior.

It is a 10-volt Unit sold in three capacities, each more than ample for ordinary requirements, yet not too heavy to make awkward handling—a unit that will stand for months between charges without a drop in voltage, because of its absolutely non-current-leaking construction. It is a unit which has sold in thousands since its introduction, not one single unit having been returned because of unsatisfactory performance. A unit made by a company with 35 years' battery experience— whose huge stationary batteries, weighing hundreds of tons each, are used by the majority of power stations in this country.

ESTABLISHED IN PUBLIC SERVICE

COUPON.

Please send me full particulars of Tudor Wireless Batteries.

Address


LISENIN

POSITIVE GRIP TERMINALS

(Patented)

Scientifically constructed, both electrically and mechanically, they hold the wire, but grip the flex covering. All stresses and strains are removed from the conductors, and once a connection is made it stays put, and without any unsightly frayed ends of leads, the bane of all fans.

Write for FREE copy of our latest descriptive leaflet "W.W." Post free, of course.

POSITIVE GRIP END, a new comer.

2d. each.

POSITIVE GRIP SPADE END. Acid proof contacts at all times.

Price 3d. each.

POSITIVE GRIP CHUBBY WANDER PLUG.

Ideal for portable sets and where space is limited. Various colours.

Price 2d. each.

POSITIVE GRIP PIN END.

2d. each.

POSITIVE GRIP BANANA TYPE PLUG & SOCKET.

A great advance on all other types of plug. A silky, dead smooth contact is NOW attainable. Price 4d. complete.

LISENIN POSITIVE GRIP ALL MAINS PLUG AND SOCKET (Registered Design). The Lisenin Mains Plug and Socket is totally insulated and is equally as valuable on sets working off batteries as those from the electric supply. The leads may be dropped with impunity and there is no chance of a short circuit. Instantly assembled with the aid of a screwdriver. NOTE THE PRICE, 6d. each, complete as illustrated.

WRITE to-day for our new descriptive folder, mentioning this paper.

We have moved to larger premises. Note new address:

THE LISENIN WIRELESS CO.,
5, Central Buildings, HIGH ST., SLOUGH, Bucks.

Phone: Slaugh 652. T. Address: POSGRIP, SLOUGH.

Look for the Lisenin Show Case on your Radio Dealer's Counter.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
The outstanding feature of the FERRANTI A.C. Mains Receiver is the reproduction, which is very nearly true to life. The volume and richness of tone satisfy the critical listener. This quality is attained by the use of the finest audio frequency components available and the close attention to detail which is expected from FERRANTI. Every component has been designed or chosen for the purpose it has to fulfil.

We have considered quality before price. Quality tells in the long run, and the first cost is the last cost when the best is bought. The Set is handsome, too. You have the choice of three woods to tone with any scheme of furnishing.

Available for Alternating Current only, voltages 200 to 250; 50 cycles or over. Any high-class dealer will demonstrate this Set to you and many will supply it on H.P. terms, if desired.

Price, including valves:
In Oak £25; In Mahogany £26; In Walnut £26
Royalty £1 extra.

FERRANTI
A.C. MAINS RECEIVER
FERRANTI LTD.
HOLLINWOOD
LANCASHIRE

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
Go home and listen
Radio Week 12th to 18th January

Easily operated by connecting to any A.C. Mains light socket—no batteries needed—this Lotus All Electric 3-valve S.G.P. Set is highly selective and covers a good range of British and Continental stations. Cash price £21 (Royalties paid, and including valves). The same circuit is used in the Lotus 3-valve S.G.P. Battery Model—Cash price £13·15·0.

For home construction get the Lotus 3-valve S.G.P. Battery Model Kit at £7·12·6. See and hear it at any wireless dealer's or write to-day for the Lotus Sets Catalogue and Hire Purchase terms.

LOTUS
ALL ELECTRIC RECEIVER
Gets the best reception.
Made by the makers of the famous Lotus components in one of the most modern radio factories in Great Britain.

GARNETT WHITELEY & CO., LTD., Dept. W.W.4
Lotus Works, Mill Lane, Liverpool.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
For 1930

VARLEY
ALL-ELECTRIC RECEIVERS


Behind them is the name VARLEY — the name that stands for everything up to date, for QUALITY, for all-round excellent performance, and for perfect finish.

Varley All-Electric
3-Valve Receivers
List Nos. AP3 (A.C.) and AP4 (D.C.).
Marconi Royalty extra, each 20s.

25 Gns.

RADIO GRAMOPHONES

Write to-day for Section A of our new Catalogue, which gives full particulars of Varley All-Electric Receivers and Radio Gramophones.

Varley All-Electric
2-Valve Receivers
List Nos. AP1 (A.C.) and AP2 (D.C.).
Marconi Royalty extra, each 15s.

16 Gns.
ARE YOU PROUD OF YOUR NEW SET?
DO IT JUSTICE
AND FIT THE BEST POSSIBLE BATTERY

Grosvenor Batteries give continuous and satisfactory service because they incorporate a new vitalising element which is unique to Grosvenor.

Grosvenor Batteries
BRITISH MANUFACTURE

GROSVENOR BATTERY CO., LTD., 2-3, White St., MOORGATE, LONDON, E.C.2. Phone: Met. 6966

BAYLISS ROTARY CONVERTER
A.C. from D.C.

Load 400 Watts.
ANY Input.
ANY Output.

PRICE
£12.10.0

Delivery from Stock.

William Bayliss Ltd.
Sheepcote Street
BIRMINGHAM

Telephone: Mid 1499.
Telegrams: "Drumbeck, B’ham."

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
The Sheffield Magnet Co.,
116/126, Broad Lane,
Sheffield.

Gents,

In answer to yours of the 9/12/29, I beg to state that you are at liberty to make any use of the P.C. posted to you on Saturday last. Since writing you this, I have carefully gone over the "Mullard Master Three" set, and the 120 Volt H. Tension "Exide" Batteries, and in conjunction with your "KUKOO" Unit, I now get results that are really surprising and pleasing. I do get Moving Coil results and far sweeter than most M. Coils on the market. There is absolutely no trouble in fixing your Unit to a 36" Baffle Board as I use. With a Vellum (pure) Cone--surrounded with a Chamois leather edging (Cone made shallow) I get wonderful reception. I intend making 2 more Loud Speakers.

Yours etc.,

TOM PRENDERGAST
24, UPPER BROOK ST.,
MANCHESTER.
FEATURES THAT MATTER

IT'S when you begin to look into J.B. Condensers that you appreciate the skill, the accuracy, the endless patience with which they are designed and made.

This is the Universal Log—one of the new models. It is the Condenser of the season, and has already featured in many of the Star Circuits. The frame construction is such that complete rigidity is assured.

PRICES:

.0005 - 9/6 - .0004 - 9/-
.00025 - 8/9 - .00015 - 8/9

Radio Week, Jan. 12-18
J.B. Precision Condensers will ensure sharp, easy, accurate tuning.

This bush is removable, enabling the Condenser to be fixed to Panel either end, left or right hand.

Steel Centre Spindle, adjustable for length and particularly useful for ganging and attaching to Thumb or Drum Control.

Showing the well-known J.B. adjustable tension to Centre Spindle.

STORE YOUR WIRELESS GOODS WHERE YOU CAN FIND THEM

"TILTRACK" (Senior)
The ideal stores for the Retailer and Factory.

"TILTRACK" (Junior)
Ideal for the Experimenter and the Household for storing Nuts, Bolts, Screws, Washers, Condensers and Small Components.

THE "BENCHRACK."
(Tiltrack Principle.)

Made to stand on the work bench; thus all small parts needed for the job in progress are immediately to hand. The trays are provided with patent hinging partitions, and the front face of each tray is curved to facilitate quick removal of the goods in the tray. This rack is a tremendous time saver.

Price 30/- Carriage Extra

"TILTACCESSORIES"
ACCESSORIES to "TILT RACK", for the "JUNIOR" and "SENIOR."
These are special boxes for fitting into the "Junior" and "Senior" Trays. Especially useful for small details as screws, washers, etc. The illustrations below show the boxes as fitted to the "Senior" Trays.

FOR the "SENIOR"

Particulars from Manufacturer & Patentee—
BERTRAM THOMAS,
Worsley Street, Hulme,
MANCHESTER.

London Office & Showroom—28, Victoria Street, S.W.1.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
WISE WIRELESS USERS PREFER BATTERIES

BECAUSE -

pure H.T. current comes only from a dry battery, for it contains steady, direct current and does not depend upon humming generators for its source of supply.

Batteries are handy, portable and safe, too; and cheaper in the long run—no expensive valves or windings to burn out.

Buy a battery and get the best in EVER READY, the battery that has stood the test for 25 years.

During Radio Week ensure perfect reception of the special programmes by fitting an EVER READY BATTERY to your set.

Use an EVER READY refill battery for your Electric Hand Lamp.

The Popular Batteries for Portable Sets.

PORTABLE 1. 63 volts, 6x 3 x 3. 8/6
PORTABLE 2. 90 volts, 9 x 3 x 3. 13/6
PORTABLE 3. 108 volts, 10 x 3 x 3. 18/6

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
Useful throughout the 12 months ahead

"The Wireless World Diary" contains 80 pages of useful facts and figures for wireless users, together with ample space for memoranda and personal notes on radio matters.

Get Your Copy!

PRINCIPAL CONTENTS:

- Summary of Regulations Relating to Amateur Transmitter and Receiving Licences.
- Conversion Tables, English measures to metric and vice versa.
- Decimal and metrical equivalents of fractions of an inch.
- Broadcasting Stations of Europe with their Call-Signs and Wavelengths.
- Principal Short-Wave Broadcasting and Commercial Stations of the World.
- Nationality Prefixes used by Amateurs.
- Typical Wireless Receiver and Eliminators—Fourteen Different Circuits with Diagrams.
- Valve Data, giving the characteristic features of standard valves.

Published jointly by

"THE WIRELESS WORLD," LONDON, E.C.4, and CHARLES LETTS & CO.

PHOTOGRAFS
OF THE YEAR

THE ANNUAL REVIEW FOR 1930 OF THE WORLD'S PICTORIAL PHOTOGRAPHIC WORK

Edited by F. J. MORTIMER, F.R.P.S.

Editor of "The Amateur Photographer and Cinematographer."

This year's edition of "PHOTOGRAFS OF THE YEAR" is now on sale, and lovers of pictures made by the camera will give it a warm welcome.

"PHOTOGRAFS" contains reproductions of the most striking and representative pictures from the principal photographic exhibitions of the year, selected from the work of the leading pictorial photographers of the world.

A literary section provides reports of photographic progress at home and overseas, and a useful Directory of British Photographic Societies is included.

For keen photographers the annual volume of "PHOTOGRAFS" is an inspiration; for those to whom camera pictures appeal it is a book which gives lasting pleasure.

From all leading booksellers or direct from the Publishers:

£20 New Year's Gift Competition

Open to All
Readers of "The Wireless World"

HIDDEN ADVERTISEMENTS

Below will be found six reproductions of fragments taken from the Advertisement pages of this issue of "The Wireless World." Each fragment is a clue. Can you from these clues identify the Advertisements? Eight prizes will be awarded to the first eight readers who send us correct solutions. No technical skill is required, merely observation. There are no restrictions or entry fees and the conditions are simple.

First Prize
An order entitling the winner to purchase goods as advertised in this number of "The Wireless World" to the value of £7.10s. for the first correct solution opened.

Second Prize
An order entitling the winner to purchase goods to the value of £5 for the second correct solution opened.

Third Prize
An order entitling the winner to purchase goods to the value of £2.10s. for the third correct solution opened.

Consolation Prizes
of goods to the value of £1 each for the next five correct solutions opened.

CONDITIONS

1. All solutions must be written on the special coupon appearing on an advertisement page in this issue and addressed to The Wireless World, Dorket House, Tudor Street, London, E.C.4, and marked "Hidden Adverts." in bottom left corner.

2. Clues will not, of necessity, appear in the same way as in the advertisement page, but may be inverted or placed in some other position.

3. In order that town and country readers may compete on equal terms, solutions will not be dealt with until 10 a.m. on Monday, January 13th. All solutions received before that date will be retained until Monday morning. Competitors may submit any number of entries. Erasures or alterations on a coupon will disqualify the entry.

4. The first prize of £7.10s. will be awarded for the first correct solution opened; the second prize of £5 for the next correct solution; the third prize of £2.10s. for the third, and five consolation prizes of £1 each for the next five correct answers. In the event of no readers sending correct solutions the prizes will be awarded to the competitors whose solutions are most nearly correct.

5. The decision of the Advertisement Manager of The Wireless World is final, and no correspondence can be entered into. Competitors enter on this distinct understanding. No member of the staff of the paper is permitted to compete.

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
- and no crackle

Every sal-ammoniac battery begins to "crackle" far too soon. "Pertrix" simply cannot "crackle," for its electrolyte produces no corrosion. Nor can "Pertrix" lose power when not in use. These two points alone place "Pertrix" in a peerless position.

Use no battery but that with "pep."

**PERTRIX**

SUPER LIFE

H.T. BATTERIES

PERTRIX LIMITED, Britannia House,
Shaftesbury Avenue, London, W.C.2.
Factory: Britannia Works, Redditch, Worcs.

LONGER LIFE!

---

The Wireless World COUPON for

"HIDDEN ADVT." COMPETITION

The latest time for receiving this Coupon is 10 a.m., Monday, January 13th, 1930.

<table>
<thead>
<tr>
<th>Clue No.</th>
<th>Name of Advertiser</th>
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I enter the above solution subject to the published rules.

Name
(please write clearly)

Address

When constructing your new set, ask for a Trolitax panel. Your dealer can supply Trolitax cut to the size you require in whatever finish you choose. Its insulating properties are excellent and it is easily workable and reliable under all conditions. You cannot do better than a Trolitax panel. Ask to see the range of finishes.

F. A. HUGHES & CO., LIMITED

204-6, Great Portland Street, London, W.1

Phone: Museum 8630 (4 lines).

Distributors for Northern England, Scotland and North Wales:
H. C. Rowton (Sheffield and London), Ltd., 100, London Road, Sheffield. Phone: Sheffield 26006. 27, St. Mary's Parsonage, Manchester. Phone: Manchester City 3329.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
NATIONAL RADIO WEEK
JANUARY 12th to 18th, 1930.

We regret that some of our customers were disappointed over delivery at Xmas. With the New Year we are extending our factory to meet the demand.

Get the Experts to Advise You:
The R.G.D. Radiogramophone

For the highest possible quality and tone for both radio and record, with ample volume, incorporating the latest developments in moving coil speaker; operates entirely from electric mains, A.C. any voltage, or D.C. 200 volts or over.

Mahogany £80

A Pick-Up of Distinction.

The R.G.D. Magnetic Pick-up is designed after years of experiments, and we believe it to be as perfect as possible. No record wear, perfect tracking, a scientific instrument, specially developed for moving coil speaker reproduction. Price £3 in bronze, £3.3.0 in oxidised silver.

The Radiogramophone Development Co.,
St. Peter's Place, Broad Street, Birmingham.

STANDARDS

The IMPERIAL PINT and T.C.C.

The Imperial Pint is the Standard pint—the pattern for all pints. Many pint pots are etched with the Imperial Pint mark—such a pot, filled, contains true measure. There is also a standard among condensers—and that is T.C.C. Every condenser marked "T.C.C." is an assurance that it is up to standard. T.C.C. Condensers, because of their accuracy, dependability and good service are to-day the recognised standard of all condensers—that's the opinion of experimenter, scientist and amateur alike. Remember this when next you want a condenser.

The illustration above is of the 2 mfd. Paper Condenser (Licensed under Design Reg. No. 723,771) Price 3s. 10d.—Other capacities from .005 to 10 mfd. Prices 1s. 8d. to 18s. 6d.

The Radiogramophone Development Co., Ltd., Walsall, W.3. T.C.C. 1120

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
Centralab
Control is everything

Your radio or electrical gramophone must carry on every time you snap on the switch. Your volume control must function smoothly, easily—consistently if you wish to be rewarded with perfect reproduction. No radio is perfect unless it is Centralab equipped. Centralab Modulators and Potentiometers are used as standard by all the leading manufacturers—this is an insurance of supreme quality.

Our 1930 4th Edition of the "Great Voice" booklet tells you all about Centralab Volume Controls and their uses. This 68-page booklet contains numerous diagrams and information of paramount importance to all constructors of radio sets, gramophones, etc. Send 6d. in stamps for postage.

THE ROTHERMEL CORPORATION LTD.,
24, Maddox Street, London, W.1.
Phone: MAYFAIR 0578/9.

Use the CAMERON

"MAJOR" Cabinet
FOR YOUR
RADIO-GRAM
Especially suitable for
MULLARD ORGOLA,
OSRAM MUSIC MAGNET,
and for panels up to 15" x 8". Loud Speaker compartment is 13" x 13½" x 16½".

OAK - £7.10.0
MAHOGANY £7.15.0

Call and see full range of "Cameron" cabinets at new London showroom.

CARRINGTON MANUFACTURING CO., Ltd.
Telephone: Holborn 8202.

Get improved reception with this long-life BATTERY

66 Volts

SUPERIOR (Single Capacity)
9 volts... 7/6 1/2
12 volts... 7/6 1/2
18 volts... 7/9

SUPREME (Treble Capacity)
60 volts... 7/9
100 volts... 10/6
150 volts... 14/3
200 volts... 17/6

Get Dubilier's Booklet—"A Bit about a Battery"—from your Radio dealer.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
An aid to accurate tuning

The use of the Polar Differential Condenser in your reaction circuit eliminates the necessity for retuning when reaction is adjusted; it also gives much greater control over oscillation. By aiding the accuracy of your tuning it gives you stronger and clearer reception, especially on distant transmissions. Excellent in all circuits, but particularly suitable for screened-grid valve circuits.

POLAR
DIFFERENTIAL CONDENSER
For Reaction or Volume Control
Strongly built of brass on a moulded frame and fitted with bakelite di-electric to prevent risk of shorting.

- .0001 each side 6/6
- .00015 each side 7/6
- .0002 each side 7/6
- .0003 each side 8/6

Send for the Polar Catalogue (W).

WINGROVE & ROGERS LTD.
188-189 STRAND, LONDON, W.C.2
Polar Works: Mill Lane, Old Swan, Liverpool.

SMALL COMPONENTS OF BIG IMPORTANCE

IGRANIC-PACENT JACK
Of German silver, with silver contacts and nickel-plated non-magnetic brass frames. Insulated and adjustable fixing bush with lugs tinned and fan-tailed to facilitate soldering. From 2/-

IGRANIC-PACENT UNIVERSAL PLUG
Nickel-plated with black or mahogany finish shell. Merely insert phone tags in connector springs, clamp shells together and obtain a biting grip with thorough electrical contact 1/6

IGRANIC FIXED CONDENSER
Moisture-proof. Highest performance under all conditions. Constant capacity, and di-electric losses practically nonexistent. The plates are of highest quality brass, and only the finest selected Ruby Mica is used. .001 mfd. to .01 mfd. 1/3

IGRANIC INDIGRAPH INSULATED TERMINAL
Made of best quality bakelite with non-rotating engraved title base and socket for extra connections by means of a wander plug. Twenty-nine titles and in plain red, green and black. 6d.

IGRANIC SPRINGMORE PLUG
Self-adjustable, therefore indispensable for varying diameter of H.T. and grid bias battery sockets. Combines function of socket so that one plug may be fitted on top of another. Ensures positive electrical connection and cleans socket into which it is plugged. 3d.

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
BECAUSE of its Interlocked Construction the NEW Cossor Screened Grid has a degree of strength never before attained in any valve. Unit by unit its elements are assembled — each joint electrically welded — each unit reinforcing and locking the previous one until the whole structure assumes a gird-like rigidity. Even the hardest blow cannot disturb its perfect alignment. For strength, for power and for long life use the NEW Cossor Screened Valve in your Receiver, no other make has Interlocked Construction.

2-volt type now available.

Cossor 220 S.G. (2 volts, 2 amp.) Anode volts 120-150, Impedance 200,000, Amplification Factor 22/6.

Price —

Cossor 4 and 6 volt Screened Grid Valves are also available with similar characteristics at the same price.

The NEW Cossor Screened Grid Valve

There are so many objections to the scheme that there shall be some link between the revenue of the manufacturers and the public. In order to remedy this state of affairs the manufacturers of receiving sets who, since they are in a position with the manufacturers in order to ascertain how far the public as users of receivers will be affected by the change. Should Manufacturers Contribute Towards Programmes?

The suggestion has recently been made that the B.B.C. does not keep closely in touch with the manufacturers of receiving sets who, since they are catering for the requirements of the public, really represent the listening public as far as the practical side of reception is concerned. It has been proposed that in order to remedy this state of affairs the manufacturer should contribute a royalty on the receiving sets which he sells, to go towards the cost of the programmes, in order that there shall be some link between the revenue of the B.B.C. available for broadcasting and the sale of receivers, and also to give the manufacturer a claim to a more positive influence on the programme policy than he has at present.

There are, of course, arguments which can be brought forward to support such a proposal but, on the other hand, there are so many objections to the scheme that we sincerely hope that it will never be proceeded with. Before the Broadcasting Corporation was formed broadcasting in this country, it may be remembered, was conducted by a company composed, or rather guaranteed, by the principal radio set manufacturers who also largely controlled the policy of the company. In those days a substantial contribution was made by manufacturers towards the cost of programmes, the contribution taking the form of a charge on sets sold, but fortunately this arrangement came to an end, and the revenue for programmes has since been derived from a proportion of the licence fees paid by the public through the Post Office.

To reinstate the old arrangement would, in the first place, mean an increase in the cost of receivers to the public and would be equivalent to charging a higher rate for the annual licence. No scheme whereby the public is called upon to contribute a larger sum towards broadcasting is to be recommended so long as it is possible to avoid it. Further, it does not seem to be desirable that the responsibility for the programme matter and general policy of the B.B.C. should be divided, and we certainly do not think that the manufacturers themselves would desire to accept part responsibility, although we believe that they would welcome a rather closer co-operation than has existed in the past. This position is, however, improving and the B.B.C. is no longer inclined to make rash decisions with regard to rearrangement of stations, or changes in wavelength, without first discussing the position with the manufacturers in order to ascertain how far the public as users of receivers will be affected by the change.

RADIO WEEK, JANUARY 12th—18th.

"O Home and Listen" is the slogan for Radio Week 1930, which is arranged for the week beginning January 12th.

During Radio Week, as in previous years, the B.B.C. will put out programmes of special attraction, and the object of Radio Week is to widen the circle of listeners so as to bring us nearer to the position when every home will be linked together through the medium of the broadcasting service.

We hope that our readers will co-operate during Radio Week in recruiting new listeners from amongst their friends who have up to the present failed to interest themselves in broadcasting. The fact that special programmes have been planned will help to emphasise the advantages which are to be found in the ownership of a broadcast receiver.
Constructing a Band-pass Filter.

By W. T. Cocking.

Good Quality with a Square-Top Resonance Curve.

At the present time with the regional scheme in force there is an ever-growing quest for high selectivity without distortion. There is a fund of information in the accompanying article on the design of filters which are a good compromise between selectivity, quality and magnification. It is shown that several stages can be ganged, thus considerably facilitating the control of a receiver.

THERE is little doubt that the band-pass filter offers the best solution to the problem of obtaining adequate selectivity and high quality at short distances from the Brookmans Park transmitter. While the circuit is simple to set up and operate, the results with it are principally dependent upon the degree of coupling between the primary and secondary circuits; for, if this is incorrect, poor signal strength and bad quality may be obtained.

In Fig. 1 is given the circuit diagram of a filter, coupled by mutual inductance between the coils, which is used as the sole means of tuning before a grid rectifier. Fig. 2 shows the effect on magnification (curve A), on the side-band variation (curve B), and on the selectivity (curve C) of varying the value of the mutual inductance. These curves are for a wavelength of 500 metres and for coils having an inductance of 240 microhenries and an H.F. resistance of 5 ohms. This last condition will not be true when a filter is used before a grid detector, owing to the heavy damping imposed by this method of rectification; but when reaction is used there will be a certain setting of the reaction condenser at which the curves are exactly true.

It will be seen that there is an optimum value of coupling for both magnification and side-band variation, and that the optimum is not the same for both. The selectivity, on the other hand, always increases with a decrease in the coupling. The greatest efficiency is obtained when the mutual inductance is 1.5 microhenries, for then the magnification is 90, a figure which is exactly half that for one identical tuning coil used in the orthodox manner. The selectivity with this degree of coupling is quite high, being 240 at 40 kc. from resonance; the unfortunate part, however, is that the side-band variation is 75 per cent., which is altogether excessive. With a mutual inductance of 3 microhenries, the best value for quality, the side-band variation is only 5 per cent., but the selectivity has fallen to 85, and the magnification to 66. In practice, therefore, it is usually necessary to make a compromise between the three conflicting requirements, selectivity, quality, and magnification.

Opinions differ as to which is the best compromise, but it is suggested that a maximum high note loss of 40 per cent. at a frequency of 5 kc. either side of the resonance frequency will usually meet the case. It is probable that a side-band variation of this order would be quite undetectable by the average person, as the ear is very insensitive to changes in strength; particularly is this so when the changes occur at different frequencies. Taking this figure, then, as the maximum allowable, the best value for the mutual inductance is 2.5 microhenries, with which the magnification is 75 and the selectivity is 120.

Fig. 3 gives the results with the same filter at a wavelength of 250 metres, at which the coil resistance is 10 ohms. It is interesting to note that, for mag-
High Selectivity.—

nification, the best value for the mutual inductance is unchanged at this lower wavelength, but that the best value for quality is now 2 microhenries instead of 3 microhenries. Incidentally, the best value of mutual inductance for magnification can be found very easily for the case when each coil has the same H.F. resistance; it is only necessary to choose a value of mutual inductance such that its reactance is equal to the H.F. resistance of one coil at the same frequency. This may be expressed in the following simple manner:—

\[ M = \frac{R}{\omega} \]

where \( M \) = mutual inductance in henries.

\[ R = \text{H.F. resistance of one coil in ohms}. \]

The greatest difference between the curves for 250 metres and those for 500 metres is in the selectivity, which is much less at the lower wavelength. A value of mutual inductance (2.5 microhenries) which gives a 40 per cent. high note loss at 500 metres and a selectivity of 120 will give at 250 metres a side-band variation of 18 per cent. and a selectivity of 27; not only this, the side-band variation is no longer in the form of a high-note loss, but is what is perhaps best called a high-note accentuation. A selectivity of 27 at 250 metres, however, is still high in comparison with that of a single-tuned circuit at this wavelength. The falling-off in selectivity is normal and unavoidable with the usual method of tuning by variable condensers. It is due partly to the higher ratio of inductance to capacity, but principally to the increased coil resistance at the lower wavelengths.

Selectivity Under New Exacting Conditions.

For a receiver of the type of Fig. 1 these figures for selectivity are unusually high, and also the high-note loss is less than with a single-tuned circuit. In practice, the signal strength is less than that with normal tuning arrangements, the aerial winding in each case being chosen for maximum strength. When, however, the turns on the aerial winding are reduced for selectivity, as is commonly done, the filter with a full aerial winding is far superior as regards strength, quality, and selectivity. Brookmans Park, at a distance of nine miles, causes far less jamming with an o-v-a filter-tuned set than did the old 2LO on the same set and at the same distance, but with an ordinary single coil. Thus not only the Daventry Experimental station but Continental stations intermediate in wavelength can be received without a trace of Brookmans Park. It should be noted that the operation is not complicated, for the two tuning condensers are gauged.

Curves A and B of Fig. 4 and curve A of Fig. 5 show the selectivity, amplification, and side-band variation respectively with an H.F. amplifier consisting of a filter-tuned aerial circuit and a Mazda AC/SG valve coupled to the detector by another identical filter circuit—four tuned circuits in all. These curves show that for high quality the mutual inductance must be a little greater than when one filter only is used. This results in a somewhat higher loss of both amplification and selectivity. With a mutual inductance of 2.75 microhenries for each filter the side-band variation is 40 per cent., the amplification 6,400, and the selectivity 10,000! Lest it should be thought that selectivity of this order is unnecessary, it may be as well to quote figures for an amplifier satisfactory under the old broadcasting conditions and to show the increase in selectivity now essential if the apparent selectivity of the set is to remain the same.

Relative Signal Strengths of Old and New 2LO.

A set consisting of a tuned grid circuit with a tuned anode and a P.M.12 valve with a 5-ohm coil for the grid circuit and a 10-ohm coil for the anode has, at 500 metres, an amplification of 8,750, a selectivity of 273, and a side-band variation of 79 per cent. These figures are typical of well-designed H.F. stages of receivers of a year or so ago. Generally speaking, the amplification is quite sufficient for first-class reception of foreign stations on a good aerial. At distances of ten miles or more from the old London station the selectivity was great enough to allow the reception of stations working with about a 60 kc. separation from 2LO, but the quality was usually poor due to side-band cutting. Now the power of the new station is about fifteen times that of the old, so that if the receiver is used at the same distance from it the selectivity must be increased fifteen times; that is, it must now be 3,195. If, in adi-
High Selectivity.

In addition, the new station is not so far away, a still further increase will be necessary. In the case when it is only one-third as far away, a further increase of three times is needed; that is, the total selectivity needed to get the same apparent selectivity as before is 9,585. It will be seen that a selectivity of 10,000 is not excessive for those living close to Brookmans Park.

If, therefore, an old set is rebuilt to include two band-pass filters the apparent selectivity on the new station will be about the same when it is one-third the distance away; the quality will be much better, but the amplification will suffer a slight decrease, for it will be about 25 per cent. less. This is, of course, provided that in both cases the optimum number of turns for the aerial winding is used.

When one comes to consider practical details, however, one finds that it is almost impossible to use coils having an H.F. resistance as low as 5 ohms when connected in circuit. The standard *Wireless World* type of Litz wound coil has this value of resistance when in circuit. But since the dimensions of this coil are about 3 in. x 3/8 in., under ordinary circumstances it is obviously impossible to use four coils of this size. Not only is it difficult to find sufficient space for large coils, but it is not easy to obtain sufficiently loose coupling between the primary and secondary coils of the filter. It can be shown that the lower the coil resistance the looser is the coupling required, and this accentuates the difficulty. In addition, the use of large coils greatly increases the risk of instability owing to their large external field. In practice, the only satisfactory way of using this type of coil in a filter circuit is to use either inductance or capacity coupling and to screen each coil completely.

While considering large coils, which have a low H.F. resistance and therefore give greater amplification, it is as well to point out that the amount of amplification affecting stability is greater than the stage amplification. The stage amplification is the overall amplification from the grid of the H.F. valve to the grid of the detector. The actual amplification affecting stability is the ratio of the voltage developed across the primary coil of the anode filter to the voltage on the grid of the H.F. valve. This may be nearly double the stage amplification, and with low resistance coils may cause trouble due to feedback through the grid-anode capacity. The coils to be described later in this article can be relied upon to give no trouble in this respect; they have a calculated H.F. resistance at 500 metres of 5 ohms, but when connected in circuit the figure will be higher. The exact figure is rather uncertain, but it is probably in the neighbourhood of 7 or 8 ohms; in any case, it is not greater than 10 ohms. The actual results with these coils, therefore, will be between those with 5-ohm coils and those with 10-ohm coils.

**Using Four Tuned Circuits.**

Curves C and D of Fig. 4 and curve B of Fig. 5 give the selectivity, amplification, and side-band variation respectively for a one H.F. set using two filter circuits with coils having an H.F. resistance of 10 ohms at 500 metres. An inspection of these curves reveals an interesting point; for a high-note loss of 40 per cent, a mutual inductance of 3 microhenries is required, and this is also the optimum value for amplification. With coils of 10 ohms resistance, therefore, the operation of adjusting the coupling is simple as it is only necessary to adjust for maximum strength. On the other hand, the best value of mutual inductance for quality is 4 microhenries, with which value the side-band variation...
High Selectivity.—
is only 5 per cent., a truly remarkable figure for a set having four tuned circuits! Furthermore, the loss in amplification with this increase in coupling is only 14 per cent., an amount which is only just detectable by ear. The loss in selectivity with this tighter coupling, however, is rather more; it falls from 3,800 to 1,720, that is, a loss of 55 per cent. In some cases it may be worth while loss, for the selectivity is still high in comparison with that of an ordinary set. It is not high enough, however, to give the best results near a high-power transmitter.

Earlier in this article it was said that a selectivity of 3,195 was necessary for good results at ten miles or more from Brookmans Park; if a 40 per cent. high-note loss is considered allowable, this degree of selectivity can easily be obtained by using two filter circuits with 10-ohm coils, each filter being coupled by a mutual inductance of 3 microhenries. The selectivity with this arrangement is slightly greater than is essential; and this is borne out in practice, for two filter circuits with the recommended coils give distinctly greater apparent selectivity with the new station than did the two tuned circuits when the old 2LO was working.

(To be concluded.)

**LOUD SPEAKER DEVELOPMENTS.**

According to patent No. 312,756, a more even distribution of the energy applied to the diaphragm is ensured by using four moving coils instead of one. The coils A...A are wound on cardboard rings spaced equally apart on the pole-pieces of the four-pole magnet, as shown in Fig. 1. They cooperate with gaps formed in the pole-pieces of the four-pole magnet, and are provided near the narrow end of the cone, and form a square suspension system.

In the arrangement shown in Fig. 2, the diaphragm is supported around the edges by thin leather strips S, S, and is centred by a rod R.

In the ordinary way the primary windings of the output transformer of a valve amplifier carries a direct-current component, as well as a fluctuating low-frequency current. The presence of the former may give rise to various undesired effects. For instance, if there is any residual "ripple" in the H.T. supply, the ripple will be transferred to the secondary winding and so pass on to the loud-speaker. Again, the steady-current component may cause the transformer to operate on an unfavourable point of its magnetisation curve.

The arrangement shown in the figure (patent 313,229) is designed to prevent these drawbacks. The output primary consists of two oppositely wound halves P, P. The portion P, is connected in series with a high resistance R across the terminals of the H.T. supply, R being of such a value that the current flowing through the lower half of the windings exactly neutralises the effect of that flowing in the upper half. If any "ripple" is present in the H.T. source, this will also be balanced out as far as its effect on the secondary is concerned.

**RECENT INVENTIONS OF WIRELESS INTEREST.**

**L.F. TRANSFORMERS.**

In the arrangement shown in Fig. 1, mounting two pot-magnets P, P, the windings of the coil being divided into two sections, so that the electrodynamic effect is additive. The diaphragm D is connected to the moving coil by arms F extending radially outwards through the space between the adjacent magnets.

**Output transformer with primary having two oppositely wound sections.** (No. 313,229.)

**SUSPENSION SYSTEM FOR LOUD SPEAKER DIAPHRAGMS.**

An interesting method of suspending a loud speaker diaphragm is described in patent No. 313,646. The suspension is designed to allow the diaphragm to move freely to and fro in the direction of the applied forces, i.e., in the so-called plunger fashion, whilst at the same time the diaphragm can "flex" or vibrate internally under the action of the stresses and strains set up in the material of which it is composed. The diaphragm is prevented, however, from moving as a whole in a plane at right-angles to the direction of the applied driving-forces.

In one arrangement, Fig (a), tangential cords C are attached to the outer end of the cone, and form a square suspension, the corners of which are secured to a fixed support by auxiliary strings C. A second similar string support K may be provided near the narrow end of the cone. In another arrangement, Fig. (b), the string suspension C is in the form of an octagon, each corner of which is connected by other strings C, to a supporting ring R.
Events of the Week in Brief Review.

**THE JOYS OF OLD AGE.**
Exemption from payment of licence fees is now granted to German listeners who are too old to visit a theatre.

**24-HOUR SHORT-WAVE SERVICE.**
Kenya Colony, which has already won laurels with its broadcasting station at Nairobi, has now started a 24-hour continuous service from Mombasa. The Mombasa station works on 36.74 and 21.59 metres (C.W.) as well as on higher wavelengths for ordinary ship traffic.

**FREE DINNERS FOR LISTENERS.**
A new inducement to listening in Denmark is afforded by a guessing competition instituted by several broadcasting stations which transmit orchestral selections. Listeners who can guess the titles of a given number of orchestral selections win a free dinner ticket.

**KIT SET FOR BROADCAST RELAY.**
Oil prospecting by wireless and acoustic devices has engaged the attention of several petroleum companies in the United States. The Federal Radio Commission has just allocated five frequencies for "geophysical exploration," these being 1,600, 1,650, 1,660, 1,700, and 1,704 kilocycles.

**FREE IMPLEMENTS FOR BROADCAST RELAY.**
In the combined radio and acoustic devices, the clues were taken from the time lag between radio and sound waves transmitted simultaneously from a given spot. Geological and other considerations affect the speed of the sound waves, which often reveal the presence of oil.

**HIDDEN ADVERTISEMENTS COMPETITION.**
Since we announced the results of the recent Hidden Advertisements competition, a number of readers have enquired as to the correct solution of the mystery. The clues were taken from the following advertisements: (1) Ferranti, Ltd.; (2) Westinghouse Brake Co.; (3) Forino Co.; (4) C. A. Vandervell and Co.; (5) C. F. and H. Burton, Ltd.; (6) Wm. Bayliss, Ltd.

**NATIONAL WIRELESS WEEK PROGRAMMES.**
At the moment we are going to press we learn of a change in the B.B.C. programme for Monday, January 13th. In place of the announced recital by Madame Suggis, referred to in last week's "Broadcast Briefs," Lionel-Tertis will give a viola recital accompanied at the piano by Berkeley Mason.
THE original sounds recorded on a gramophone disc can only be reproduced correctly when the turntable of the gramophone rotates at a uniform speed, and, moreover, only when its speed is exactly the same as that at which the record was originally cut. Uniformity of speed is essential, and can only be ensured by the use of a good motor, properly adjusted, whilst the rate of revolution is set by means of the governor of the motor.

A record which runs too slow or too fast will produce sounds which differ from the original in several ways. In the first place, it is obvious that the tempo of music will be altered, though a slight deviation in this respect would generally, in the absence of other effects, pass unnoticed. There also occurs, however, a change in the pitch, music being transposed into a higher or a lower key, according to whether the record is running too fast or too slow. These two effects are well known to every gramophone user, and are not infrequently employed with deliberate intention—as in the case of dance music, to suit the speed to individual requirements, and for purposes of study, to “tune” the gramophone to the same pitch as a piano or other instrument.

Effects of Pitch Variations.

The divergence in pitch from that of the original performance may, however, produce decidedly undesirable effects. The pitch, or frequency, of every simple tone will be altered in the same ratio, and therefore a compound note, consisting of harmonic tones, i.e., frequencies which are exact multiples of a fundamental, will be unaltered in quality. The simplest instance of this is the octave. An interval of an octave will remain an octave, whatever the speed of rotation of the record. All music, however, and especially that from some instruments, involves intervals which are inharmonic, and when these are modified by the speed of the gramophone, the musical quality of the sound will be altered. The reaction of the ear to sounds is known to depend to a large extent upon the sensation due to subjective beat tones, and these will be altered when the notes combining to form them are changed in the same ratio, because the numerical difference, upon which a beat frequency depends, will no longer be the same. Transients in particular will be found to suffer to a marked degree.

This change in the quality of reproduced sounds occurs not only in music, but also in speech, and can...
Gramophone Speed Tester.—

be demonstrated in a convincing manner even to an ear which is musically untrained by using a record of the speech of some well-known voice, such, for instance, as that of Sir Oliver Lodge. With the disc running a little too fast or too slow, the familiar tone of the voice becomes quite unrecognisable, altogether apart from the change in the speed of the discourse. That vowel sounds are modified can be shown by slowing down the record and listening for the ce sounds, which become 50 quite distinctly.

All this serves to emphasise the point that the quality of sounds, as well as their pitch, may be affected adversely unless the motor speed is right. Most records bear the correct playing speed printed on the label, and this is usually either 78, 79, or 80 revolutions per minute. Except in the most expensive gramophones the speed indicator cannot be relied upon for great accuracy. Counting the revolutions of the turntable with the aid of a stop-watch is a simple but rather tedious process, but where alternating current lighting is available, there is an extremely convenient method, which depends upon the well-known principle of the stroboscope, of verifying the turntable speed.

If the accompanying illustration is pasted on to a piece of cardboard, and cut into a circular disc, with a hole punched in the centre having a diameter equal to that of the turntable spindle, it can be used as a quick and accurate speed tester wherever there is A.C. lighting at 50 cycles frequency. Placing the disc on the turntable, and viewing it by the electric light as it rotates, the speed regulator of the gramophone is adjusted until one or other of the divided rings appears to be quite stationary, according to the speed requirements of the record to be played. If, for instance, 79 revolutions per minute is the desired rate, the middle one of the three divided circles is brought to rest by careful manipulation of the regulator. Under these conditions it is interesting to notice that the outer and inner rings appear to be slowly travelling round in opposite directions. The disc can also be used to detect any wavering in the speed of the turntable, and, since it is only four inches in diameter, it can be put on the top of a record whilst it is being played, to ascertain whether the load imposed by the pick-up is too great for the motor to handle satisfactorily.

The diagram illustrated is divided to suit a supply frequency of 50, which is rapidly becoming standard practice; any other frequency would require a different division of the circles. In cases where a pilot light is used in the instrument, just above the turntable for convenience in needle-changing, the substitution of a lamp of the Osglim neon-filled type shows up the stroboscopic effect very vividly, although it is sufficiently distinct enough for practical purposes with lamps of either the vacuum or half-watt variety.

(The disc shown on the previous page has been reprinted in more durable form on white opaque paper. Applications for copies should be accompanied by a stamp for postage.)

B.T.H. ELECTRIC GRAMOPHONE MOTOR.

A Universal Machine Embodying Sound Engineering Practice.

This unit is of unusually massive construction and embodies the best engineering practice. Liberal use is made of aluminum alloy castings, and all bearings are of generous proportions. The main frame casting is mounted on rubber washers to absorb vibration.

The motor is of the universal type and can be used on either D.C. or A.C. mains. An adjustable resistance is provided so that the motor can be run off A.C. from 100 to 250 volts at 25 to 60 cycles, or D.C. from 50 to 250 volts—a range which covers most if not all the supply voltages available in this country. Measurements showed that the current consumption under load is of the order of 0.3 amp.

The drive is transmitted through a flat belt giving a reduction gear of approximately 4:1. The whole of the motor is mounted on swivel bearings and spring loaded to take up belt slack; the spring tension being adjustable.

Speed regulation is obtained by means of a conventional friction governor driven through a skew gear of composition material mounted on the turntable spindle. The speed of the turntable is therefore unaffected by belt slip, provided the power transmitted by the belt is in excess of the power absorbed in the record. Correct adjustment of the spring tension will ensure the attainment of this.

Tests showed that the reserve of power is in excess of all normal requirements, while the speed of rotation is constant and maintains its setting over long periods. A comparison between a standard tuning fork and the constant frequency records is a searching test of this quality.

The accessories include a neat trip switch actuated by the tone arm, which automatically cuts off the motor current at the end of the record. The price of the complete equipment is £6 6s.
MR. R. P. G. DENMAN’S article in your issue of July 31st on the performance of logarithmic horns of adequate length was indeed refreshing.

At the risk of being shot at dawn, I must confess being guilty of lèse-majesté to King Cone and Co.—that is, to the reed-driven and the moving-coil-driven Monarchs of the Wireless World (by which I do not refer to your excellent publication). King Moving-Coil has, of course, been the worse tyrant of the two, for he has been the more powerful and dogmatic. During the last few years he has slowly and ponderously thudded his way into our presence (both in the streets and at home) until the life of the more gentle listener-in has become a veritable nightmare of noise.

It is no longer enough to own a loud speaker which fills an ordinary room with crisp and soothing music and speech; the thing now is: Can it deliver the LOW NOTES? Can it deliver them at full volume? Can you feel the thud-thud of the 32-cycle organ note hit you in the solar plexus? Do you get notes—real, deep, he-man sort of notes—which not only move you to ecstasy but even move heavy articles of furniture, make the floor vibrate, and disturb the plaster on the ceiling? When some coloured jazz musician smites the big drum at Savoy Hill, does it hit you at Tooting, Balham, Bedlam, or wherever you happen to be listening-in? Does it make the grandfather clock wobble? Is the jazz orchestra going full blast in your own house? If all of these hectic things do not happen, then you do not know what modern reproduction is.

Should you have—in your humble and obscure way—a reed-driven cone, you are a man to be pitied—one who lives in darkness, or, rather, in comparative silence. Should you have a moving coil without a baffle board as big as the side of the room, you are living in a fool’s paradise devoid of those cherished depths to which only a M.C. can descend. Even if you erect that terrific baffle board, or embed your loud speaker in the door or the wall of your private concert hall, you still cannot expect faithful results from your inadequate set. What? You have only one power valve in the last stage? No, even a super-power is insufficient. You want a carefully balanced crew of at least four—two push-pulling and two working in parallel.

Seeking to be modern, you pile valve upon valve, accumulators become useless, you resort to the mains, "juice" is poured through your set as though it were a miniature, electrically driven factory. And thus you become another lost soul who has been called to salvation. You thud. Your neighbour, hearing you, also thuds in due course. His neighbour, hearing him, becomes another convert to the band of thudders. And so the pounding and pounding of low notes goes on. It is literally contagious. The 32-cycle punch hits you—physically—and you fall for it.

If, like me, you have no cone, and you have no moving coil, you are anathema. What have you? What else can you have? You dare to whisper, simply and modestly, "Just a little horn affair..." The look of horror which sweeps over your interrogator’s face is enough to make the strongest quiver.

And yet, Mr. Editor, here am I, hanging conservatively on to the old, old horn with which I be-
In Search of Quality.—

I began imbibing sound waves when Edison’s phonograph arrived, and told me nasally that this was an “Edison Bell Record.” When I say the old, old horn, I am, of course, guilty of poetic licence. Ordinary commercial horns are useless, except as examples of graceful curves and contortions, or as super ash-super for cigar and cigarette ends. Long, long ago—back in the dark pre-cone ages—I decided that the only thing was to build one’s own horn.

Sound Likes the Straight Path.

With the aid of endless penknives, safety-razor blades, oceans of glue, strips of all sorts and thicknesses of wood, and an extensive vocabulary of “cuss” words, I have built some dozen or so horns, varying from six to eleven feet in length. They have, however, all been straight and all have conformed—as really dutiful horns should do—to the logarithmic principle on which their lives are founded. It was clear from the first, even to my untutored mind, that sound hates to go round curves or curves. Any modern gramophone will tell you this, and those whose horns fold beautifully and fearfully in and out of themselves will tell you it best of all. However good their intentions are as regards space, they are “boxey.” The deep baritone who sings to you of one moonlit night in Venice is incarcerated in a tub, a barrel, or some sort of resonating chamber from which he cannot escape. He is badly hampered by not getting a straight run for his money.

Solidity is naturally another very important factor. Any energy wasted in vibrating the sides of the horn is nearly that much less energy available for disturbing the peace. I have never placed my present ten-foot loud speaker on one of those penny-in-the-slot weight machines, but it would certainly register loud speaker on one of those penny-in-the-slot weight machines, but it would certainly register a telling weight.

Any modern gramophone seems to be 50 per cent. more efficient than the best stalloxy diaphragm unit. I use a modified Everyman Four receiver, with push-pull at the business end, and (in a room eighteen feet by twenty-one) I am able to get everything I want from a whisper, for restfulness, to a full-blooded orchestra, for those wilder moments when one must dance—or burst. But I cannot deliver thuds. I get all the low notes I want, and, above all, a crispness and brilliance—which I also want. No one who has heard the loud speaker has yet told me that he knows of a better one—which may be due either to politeness (for which wireless fiends are not noted) or to love of truth.

Thus do I remain faithful to my old love. I am, however, still awaiting the advent of a well-designed unit (which does not clamour for too much “juice”). When it arrives on the jaded market my ten-foot horn, realising its own worth, will give the newcomer a cordial welcome and will look down on the moving coil with even greater scorn than it does to-day. I now resignedly wait for a party of moving-coil patriots to convey me to some quiet spot in Richmond Park—there to shoot me in the cold dawn (which I hate even more than I do the dawn of my loud speaker). For restfulness, I get all the low notes I want, and, above all, a crispness and brilliance—which I also want. No one who has heard the loud speaker has yet told me that he knows of a better one—which may be due either to politeness (for which wireless fiends are not noted) or to love of truth.

Thus do I remain faithful to my old love. I am, however, still awaiting the advent of a well-designed unit (which does not clamour for too much “juice”). When it arrives on the jaded market my ten-foot horn, realising its own worth, will give the newcomer a cordial welcome and will look down on the moving coil with even greater scorn than it does to-day. I now resignedly wait for a party of moving-coil patriots to convey me to some quiet spot in Richmond Park—there to shoot me in the cold grey light of the dawn (which I hate even more than I do the moving coil).

Ralph Stranger’s Wireless Library for the “man in the street.”

No. 1.—MATTER AND ENERGY. The Chemical Elements. Structure of the Atom, Heat, Cold, Energy, etc.

No. 2.—ELECTRICITY. Matter, Atoms, Distribution of Charges, Electric Fields, Discharges, etc.

No. 3.—ELECTRONIC CURRENTS. E.M.F., Ohm’s Law, Alternating Currents, etc.

No. 4.—MAGNETISM AND ELECTRICITY. Permanent Magnets, Electro-magnets, Induction, Dynamos, Motors, etc.

No. 5.—THE MATHEMATICS OF WIRELESS. Charging, etc.

No. 6.—BATTERIES AND ACCUMULATORS.

Written in simple language for the instruction of ordinary non-technical man. Each part comprises sixty-four pages with numerous illustrations and diagrams. Published by George Newnes, Ltd., London. Price 1s. each part.

Further parts in preparation.


Photometric Cells, Their Properties, Use and Applications, by N. R. Campbell. Revised and rewritten for the assistance of secretaries of limited companies in view of the additional obligations imposed by the Companies Act, 1929, which came into operation on November 1st. Pp. 64+xxxii. Published by John and Sons, Ltd., London. Price 2s. 6d.

BOOKS RECEIVED.

Reminders for Company Secretaries (Fifteenth Edition), by H. W. Jordan.—Revised and rewritten for the assistance of secretaries of limited companies in view of the additional obligations imposed by the Companies Act, 1929, which came into operation on November 1st. Pp. 64+xxxii. Published by John and Sons, Ltd., London. Price 2s. 6d.

LABORATORY TESTS.

A Review of Manufacturers' Recent Products.

WATES THREE-RANGE PANEL METER.

This measuring instrument provides a ready means of checking the H.T. and L.T. voltages, also the total a.c. current taken by the set. The three ranges read respectively 0-150 volts, 0-6 volts, and 0-30 mA. It is intended that the meter should be mounted on the panel together with an eight-socket range selector board supplied with each meter. By suitably interconnecting the sockets on this board the various ranges are brought into use. Two-pin plugs are supplied for this purpose. An illustrated leaflet explains clearly the correct method of wiring.

Two specimen meters were sent in for test, and measurements were made with these, using standard laboratory instruments to check their accuracy. The results are tabulated below.

Specimen I showed a maximum error of 5 per cent., and specimen II, 9 per cent. On the 150-volt range the first-mentioned sample showed a maximum error of 4.4 per cent., and the second 6 per cent. This error appeared at the 50-volt mark, the meters showing greatest accuracy between 100 volts and 150 volts.

The first specimen had a resistance of 32.5 ohms per volt on the 6-volt range and 32.8 ohms per volt on the 150-volt range. In the case of the other sample the resistance was 32.5 and 33.6 ohms per volt respectively. These values are moderately low, particularly for an H.T. voltmeter, and the instrument should be used only for making check readings, and not left permanently in circuit.

The makers are the Standard Wet Battery Co., 184-3, Shaftesbury Avenue, London, W.C.2, and the price, complete with accessories, is 13s. 9d.

"SHAKEPROOF" LOCK WASHERS.

Special washers provided with teeth which grip firmly the locking nut and the assembled parts have been in use in the U.S.A. for some time past, and are now to be introduced into this country. Messrs. Barber and Colman, Ltd., Brooklands, Manchester, have acquired the sole manufacturing and selling rights for Great Britain. Some early samples of these devices have been sent to us for review. These consist of lock-washers used as special terminal tags. It is claimed that they will withstand shock and vibration and will not loosen. Those who have had much experience with nut and washer connections will appreciate the advantages of a sure and certain contact of this nature.

The locking washers have twisted teeth set at equal intervals around the internal edge. When the nut is tightened these teeth bite into both surfaces between which it is placed and form a positive locking arrangement which is shake-proof.

Locking teeth similar to those on the washers are provided on the inside edges of the holes in soldering tags. The samples sent in are for use on 2- and 4-B.A. stems, but, no doubt, other sizes are available.

So far we have not been notified of the prices for these, and interested readers are referred to the manufacturers for this information.

"CLIMAX" RESISTANCES.

The "Climax" potential divider, which readers may recall was hitherto wound on a grooved wooden former, thus dividing the whole into sections of equal resistance, has recently been re-designed. Sectionalised winding is retained but the sections are of unequal resistance value, having been chosen to give more convenient voltages at each tap. A grooved paxolin former is used now in place of the earlier arrangement. The nominal value is 20,000 ohms; its measured resistance was found to be 19,400 ohms. The largest section was 22 per cent. of the total resistance, the other sections varying from 7 per cent. to 10 per cent. of the whole. The price remains at 5s.

An addition to their range of components takes the form of some wire-wound decoupling resistances. The wire is wound in a groove on a former the size of a halfpenny in diameter and equal to three in thickness. So far these are supplied in values of 600, 10,000 and 25,000 ohms. A 600-ohm sample was measured and found to have a resistance of 646 ohms. The price is 2s. in each case. The makers are the Climax Radio Electric, Ltd., Haverstock Works, Parkhill Road, Hampstead, London, N.W.3.
CONSIDERATION must now be given to another kind of tuned circuit, differing in several ways from the ordinary series or tuned grid circuit considered in the two preceding instalments. This is the parallel type of tuned circuit where the condenser and coil are connected in parallel with respect to the E.M.F. applied to the circuit. The condenser is connected across the coil and the alternating E.M.F. is applied to the ends of the circuit, that is, across it, and not introduced into the closed circuit.

The commonest example of the parallel type of circuit is afforded by the ordinary tuned anode high-frequency amplifier valve, as indicated in Fig. 1 (a), where L R C is the tuned circuit. When an alternating voltage is applied between the grid and filament of the valve, a corresponding voltage, several times greater than that applied to the grid, is set up in the anode or plate circuit, and this drives an alternating current between the A B terminal and the filament of the valve, the circuit being completed through the high-tension battery. The part of the circuit between the anode and filament has a high resistance, being the internal resistance (so-called impedance) of the valve itself. Hence the complete anode circuit is electrically equivalent to the simplified circuit of Fig. 1 (b) where R represents the valve resistance and E the voltage "generated" in the anode circuit by the action of the valve. The D.C. voltage and current due to the H.T. battery play no direct part and do not affect the properties of the tuned circuit.

From Fig. 1 (b) it is quite clear that no E.M.F. is induced into the closed circuit, but that a voltage is applied between the ends A B. Under these conditions the behaviour is entirely different from that of the series circuit or tuned grid circuit, and so before we can deal intelligently with a tuned anode circuit and see what factors make for the highest efficiency, it will be necessary to investigate the general properties of the parallel circuit.

Simple Parallel Circuit Without Resistance.

Consider a circuit such as that shown in Fig. 2 (a) where a condenser of capacity C farads is connected across a coil whose inductance is L henrys. An alternating voltage whose R.M.S. value is E is applied to the ends A B of the circuit and thus drives a current through each branch.

It will simplify matters greatly to assume in the first place that the coil has no resistance whatever, find the conditions obtaining at resonance, and then consider the effects of resistance afterwards. It should be noted that for a parallel circuit the applied voltage is common to all branches and a separate current flows through each branch and can be calculated, if the voltage is known.

So in our imaginary perfect circuit of Fig. 2 (a) the current through the coil will be 

\[ I_1 = \frac{E}{2\pi f L} \text{ amperes} \]

where \( 2\pi f L \) is the reactance of the coil in ohms, \( f \) being the frequency. This current \( I_1 \) lags behind the voltage by a quarter of a cycle. In the same way the current through the condenser branch will be 

\[ I_2 = 2\pi f C E \]
Wireless Theory Simplified.

Imagine now that the frequency of the voltage applied to the circuit is varied from a very low value to a very high value. The current $I_1$ taken by the coil is inversely proportional to the frequency, whereas the current in the condenser branch is directly proportional to the frequency. Hence as the frequency is raised the current taken by the coil will start from a high value and fall, whilst that taken by the condenser will build up from a very low value to a high value. This means that at low frequencies $I_1$ is greater than $I_2$ and at high frequencies $I_2$ is greater than $I_1$. Hence there must be one particular frequency for which the currents in the branches will be equal, and this is the resonant frequency of the circuit. For complete resonance, then, we have $I_1 = I_2$, or $E = E \times \frac{2\pi f}{C}$, whence $(2\pi f)^2 = \frac{1}{LC}$ or $f = \frac{1}{2\pi \sqrt{LC}}$ cycles per second, being exactly the same as for the series circuit considered previously.

The Oscillating Current.

Now, since the current $I_1$ in the external circuit, drawn from the source of supply, is equal to the numerical difference between the currents $I_1$ and $I_2$ in the branches, and since these two are equal at the resonant frequency, it follows that when a circuit like this, having no resistance, is tuned to complete resonance, it takes no current whatever from the source of supply, because $I_1 - I_2 = 0$. Yet at the same time a considerable current, whose value is $I_1 = I_2$, will be flowing backwards and forwards round the closed loop $LC$ of Fig. 2 (a). It constitutes a true oscillating current.

This might at first sight appear impossible. In practice the condition cannot be fully realised, because we cannot get a circuit without some resistance, but, as will be seen later, it is actually possible to arrange a circuit so that the current supplied to it is only a small percentage of that oscillating round the closed loop. If we could get a resistanceless circuit, however, a heavy oscillating current would be produced as explained, without any current flowing in or out at the ends of the circuit. It might appear at first sight that we are getting energy from nowhere! But, of course, this is not the case, and the explanation of the behaviour of the circuit is fairly simple. It will be remembered that the average power taken by a pure inductance and by a condenser was zero, and therefore once the oscillating current has been started, no further energy will be required to maintain it. This principle can be very clearly illustrated by a simple mechanical analogy: Suppose a heavy pendulum is suspended in a perfect vacuum on a suspension spring absolutely free from losses. When once such a pendulum has been set in motion it would go on swinging for ever without being driven. There is nothing to stop it. (In practice the small losses in the suspension would cause it to come to rest after several hours.) The same conditions exist in our imaginary perfect circuit; there are assumed to be no losses whatever.

Oscillation of Energy.

Before considering a more practical circuit where resistance, and hence energy loss, is present, we must consider what is actually happening within the closed circuit itself; it is necessary to have a sort of mental picture of what is going on. Although no energy is coming in from the outside source it must be obvious that energy is stored within the fields of the coil and condenser at any instant, and that because nothing is coming in or going out the sum of the energy stored in the magnetic field of the coil and in the electrostatic field of the condenser must be a constant quantity.

Now the current round the closed loop is exactly a quarter of a cycle out of step with respect to the voltage across the circuit, and therefore when the current through the coil is a maximum the voltage across the condenser...
is zero. Hence at this instant the magnetic field linked with the coil will have its greatest intensity, and there will be no lines of electrostatic force in the dielectric between the plates of the condenser. This means that the whole of the stored energy in the circuit is in the magnetic field of the coil at the particular instant considered, and the condenser carries no energy at all. If \( I_n \) is the maximum value of the current, the energy stored in the magnetic field is \( \frac{1}{2} LI_n^2 \) joules at an instant when that in the condenser is zero.

Just a quarter of a cycle later the current will have fallen to zero, and the voltage across the condenser will be a maximum, and we find now that the whole of the energy is contained in the electrostatic field of the condenser, the magnetic field having fallen to zero. If \( E_n \) is the maximum value of the voltage, the energy stored in the condenser is \( \frac{1}{2} CE_n^2 \) joules, as explained in a previous section.

Now as we have seen that no energy is coming into the closed circuit, and neither is any being lost as heat (heat can only be generated in a resistance), it follows that during the quarter of a cycle considered the whole of the energy originally possessed by the magnetic field of the coil has been transferred to the condenser, there being no loss and no gain. During the next quarter cycle, when the voltage again falls to zero and the current builds up to a maximum in the opposite direction, the energy is transferred back again to the field of the coil. So every quarter-cycle there is a complete interchange of energy between the coil and condenser. The whole principle of action of a tuned circuit pivots on the fact that the condenser is always giving up its energy when the magnetic field is being established and is therefore calling for energy, and vice versa. In a circuit tuned to resonance, then, energy is being oscillated backwards and forwards between the coil and the condenser.

**Comparison with Mechanical Oscillations.**

It is here that a mechanical illustration will assist materially in obtaining a clear conception of what is occurring in the resonating circuit. It will be remembered that inductance was likened to the inertia or mass of a material body, and that the reciprocal of capacity was compared with the stiffness or elasticity of a spring (see page 600, November 27th issue). Now if a weight \( W \) is suspended on the end of a vertical spiral spring rigidly fixed at the upper end, as shown in Fig. 4, and if the weight is then pulled downwards a short distance and released, it will continue to oscillate up and down. If the whole contrivance were enclosed in a perfect vacuum to eliminate air resistance, and if there were no energy losses in the spring itself, the oscillations would continue indefinitely without any further supply of energy from an external source. In a similar way the electrical oscillations in the resistanceless tuned circuit maintain themselves, once they have been started, without drawing any further energy from the source.

When the weight \( W \) is pulled down initially, energy is imparted to the spring in extending it. When the weight is released it is accelerated upwards by the pull of the spring and energy is transferred to it from the spring, being converted into energy of motion, or kinetic energy. At the instant the weight has reached its original position it has acquired considerable velocity, the whole of the energy having been given up by the spring. Owing to its momentum the weight continues to move upwards and compresses the spring, which now retards the weight until it brings it to rest once more, and then accelerates it downwards again. When the weight is at its highest or its lowest point the whole of the energy is contained in the spring, whereas in the mid position, where the velocity is greatest, the energy is all kinetic and within the weight.

It will thus be seen that the energy is oscillating backwards and forwards between the weight and the spring in exactly the same way that the energy in the tuned circuit oscillates between the condenser and the coil.

The formula for the frequency of oscillation of the spring and weight is also of exactly the same form as that for the resonant frequency of the tuned circuit.

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**Transmitters' Notes.**

Barcelona station, as printed in our list of short-wave broadcasting stations on page 585 of our issue for November 27th, This should read: EAR 25 instead of EAJ 25; the latter was the call-sign of the Malaga Broadcasting Station which is now closed down. EAR 25 is controlled by the Radio Club of Cataluña.

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**New Call-Signs and Changes of Addresses.**

<table>
<thead>
<tr>
<th>Callsign</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBPS</td>
<td>L. K. Winn, 375, Heasle Rd., Hull.</td>
</tr>
<tr>
<td>G6KSN</td>
<td>B. M'Callum, 194a, Divis St., Belfast.</td>
</tr>
<tr>
<td>G5CB</td>
<td>Capt. K. Harridge, 2, Washtune Crescent, London, W.2. (Change of Address.)</td>
</tr>
<tr>
<td>G5DK</td>
<td>J. S. Dykes, Thornhill, Shadnodsie, Ayrshire.</td>
</tr>
<tr>
<td>G5VA</td>
<td>J. Wright, 13, New St., Bell Green, Stoke-on-Trent.</td>
</tr>
<tr>
<td>G5SN</td>
<td>F. Nicol, 107, Tomorion Rd., Burnley, Lancs. (Transmits on 7,146 kC. and 14,000-14,340 kC. and will welcome reports.)</td>
</tr>
<tr>
<td>G6TEZ</td>
<td>W. R. Bottomley, Providence Electrical Works, Louis Lane, Marsh, Hudnersfield. (Change of address)</td>
</tr>
</tbody>
</table>

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**Swiss Amateurs.**

The Radio Club of Zurich is transmitting telephony tests on 42 metres from its station HB9D at Spyristr., on the first and third Saturdays of each month between 13.00 and 15.00 G.M.T. and will welcome reports from Great Britain. Our Zurich correspondent, who sends this information, states that British amateur stations as a rule are received there very clearly, and he especially mentions G5JO, an amateur station at Cambridge.

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**Notes.**

Erratum: The 9th line of column 2 on page 600 should read: "... that \( \frac{1}{2} \) in the one case corresponds to \( S \) in the other".

**To be continued.**
New Method of Detection using A.C. Valves

Tests of the Marconi and Osram MHL4 and ML4 Valves.

The MHL4 as a Grid Detector.

In The Wireless World for January 26th, 1927, there appeared a review of the Marconi and Osram K.L.1 valve, which was the first indirectly heated mains valve that was introduced in this country. It was nearly a year before the only valve suitable for heating from alternating-current mains. We were therefore particularly interested in being able to examine the latest indirectly heated valves of the Marconi and Osram Companies.

The new series consists of four valves in all, one of which is a screen-grid valve, the other three being triodes of varying amplification factors. The two that we have had under examination are the low- and medium-impedance triodes, known as the ML4 and the HL4 respectively. The description of the valve is not arbitrary, but expresses its functions; M stands for "mains." L and HL indicate low and medium impedance, while 4 is the voltage required for the heater, at which voltage the current drawn is one ampere, the modern standard consumption for valves of this general type. Since the ampere in question comes from the mains, there is no need to attempt economy in consumption, with the result that the valves have a higher efficiency than is usual with battery-heated valves—a desirable feature which is accentuated by the fact that, as the emitting surface does not carry current, it is at the same potential throughout its length. The whole of it—and not, as in battery-heated valves, a part only—is therefore effective in providing electrons for the plate circuit.

Construction.

Perhaps the most noticeable feature about the valves of this series, as compared with other mains valves, is their small size. Most A.C. valves are very decidedly larger than those intended for battery operation; the Marconi and Osram M valves are larger than the HL 6io of the same make, but smaller than the DE5A. A second unusual feature is the material of which the plate is made; this is not the sheet metal that we have become accustomed to expect, but a piece of metal gauze instead. We suspect that this is meant to keep the grid of the valve cool, and so to help, towards preventing grid emission, which is always difficult to avoid in mains valves. If this is the purpose of the gauze plate, it has achieved its object; no one of the four separate valves examined showed any reverse grid current, though half a microampere would have been easily detected with the instrument used. The absence of reverse grid current also shows the valves to be absolutely hard.

The ML4.

The ML4 valve is modestly described as a "general-purpose" valve, but as it has an impedance of no more than 3,000 ohms, and will run quite happily with a plate-current of 39 milliamperes, at 200 volts, we feel that this description errs on the side of understatement. In a battery-heated series, such a valve would probably be called a "super-power" valve; it is adequate to run a moving-coil loud speaker at quite respectable strength. If greater power is needed, the ML4 may be followed by a valve of the LS5 class, for which it will easily provide the very large grid swing required.

The maker's rating of the valve is as follows:

<table>
<thead>
<tr>
<th>A.C. resistance</th>
<th>3,000 ohms.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplification factor</td>
<td>6</td>
</tr>
<tr>
<td>Mutual conductance</td>
<td>2.0 mA. per volt</td>
</tr>
</tbody>
</table>

(Measured about anode volts 100, grid volts 6.)

Both the samples we tested, which were practically identical, had the stated mutual conductance, but were a shade lower both in A.C. resistance and in amplification factor than the rated figures. The deviation is too small to signify, and low impedance is a virtue in a valve rather than a vice. Curves, on a large scale, are given for one of the valves, and the best working conditions, as determined from these, is very close to the suggestions made by the makers on their instruction sheet. Taking their advice, and adjusting the grid-bias to provide the current they mention as desirable for each value of plate voltage, we should
New Method of Detection Using A.C. Valves.

suggest the following working conditions:

At the full 200 volts, the maximum anode voltage permitted, the valve will provide about three-quarters of a watt of undistorted power for the loud speaker. In watts this does not sound much, but it makes noise enough, when a reasonably sensitive speaker is used, to make conversation difficult in an ordinary room.

In addition to its possibilities in the output stage, the ML4 may be used as a detector or as a low-frequency amplifier. Supplied with very strong signals (about 15 to 20 volts R.M.S.) it would make a first-rate anode-bend detector for a "quality" receiver. If followed by a transformer it would give very adequate reproduction of low notes, though it would be necessary to arrange a resistance- or choke-feed to prevent the heavy plate current from passing through the primary. The same precaution would be required if the valve were in use as a low-frequency amplifier.

The MHL4.

The maker's rating of this valve is as follows:

- A.C. resistance: 6,250 ohms
- Amplification factor: 15
- Mutual conductance: 2.0 mA per volt

Both the valves tested had a higher mutual conductance than the nominal value, the amplification factor being a shade lower, and the A.C. resistance a good deal lower than stated. Curves are reproduced herewith to enable the anode current at different voltages to be estimated.

This valve is a very welcome addition indeed to the range of mains valves, for it fills a gap that has long been in existence between the high-impedance and the low-impedance mains valves. It is particularly suited for use as a rectifier, whether on the anode-bend or leaky-grid principle, and is equally serviceable either with resistance or transformer coupling in the low-frequency amplifier. Once again, a transformer should be resistance-fed unless its primary is capable of retaining a high inductance with some eight or ten milliamperes passing through it. In a resistance amplifier the MHL4 should combine good amplification with very perfect reproduction, especially of the high notes. A resistance of some 20,000 ohms is suggested as suitable for this purpose.
A Successful Application of the Superheterodyne Principle to Short-wave Reception.

THERE is nothing essentially novel in the idea of applying the superheterodyne principle to short-wave reception: In the days when direct H.F. amplification below 600 metres was attended with considerable difficulties, the superheterodyne was employed to convert the incoming frequency to a value which would be successfully amplified with known methods. Although we have solved the problem as far as the 300-500-metre band is concerned, H.F. amplification on wavelengths below 100 metres stands much in the same position as did the 300-500-metre band, say, five years ago. It is therefore only logical to apply the superheterodyne principle until such time as we can obtain stable H.F. amplifications of 100 per stage or more below 100 metres.

It is one thing, however, to decide that this principle is desirable in theory, and another to put it into practice. Those who have had practical experience of reception below 100 metres will appreciate that it is extremely difficult to control the very high frequencies involved. The smallest stray capacities afford an excellent path for currents of the order of 10,000,000 cycles, and it is exceedingly difficult to prevent these wandering into the intermediate amplifier and other places where they are unwanted, particularly when a part of the receiver is itself oscillating at a frequency close to that of the input. In the Igranic set all these various frequencies would appear to be well under control, for the set functions rationally down to 15 metres, and is as easy to control as a broadcast receiver. There is a notable absence of hand capacity and "threshold howl" near the oscillation point occurs only in the last few degrees of the lowest wave-range.

Advantages of Aperiodic Aerial Circuit.

The circuit employs six valves in all with 4-volt filaments. The first, a P.M.14 screen-grid valve, performs the dual function of H.F. amplifier and aerial coupler. It will be seen from the schematic circuit of Fig. 1 that the input voltage from the aerial is developed across a high-frequency choke H.F.C.1 between grid and filament of the H.F. valve. The resonant frequency of this choke is well above the longest wavelength the set is designed to receive, and the aerial circuit is therefore aperiodic throughout the whole range of the set (12.5 to 70 metres). Obviously, the voltage developed across the choke is much less than would be obtained with a tuned circuit, but this is compensated for by the amplification of the screen-grid valve. The input to the first detector is therefore about the same as would be obtained with a good tuned circuit, but the choke-valve coupling has three distinct advantages over the more convenient method.

It is well known that harmonics in the aerial system are a frequent source of trouble in short-wave reception. In the conventional reacting detector - L.F. set these harmonics are one of the causes of blind spots where an abnormal degree of reaction is required to produce oscillation. The consequences in the case
Broadcast Receivers.— Of a superheterodyne would be even more serious, as the aerial load would damp out the local oscillator, and if the power of the latter were increased to overcome this difficulty, the oscillations would be too strong for efficient reception at other parts of the wave-range. In the Igranic set the screen-grid valve, with its low residual capacity, acts as an effective screen between the aerial and the oscillating detector, which is thus independent of variations in the aerial load. This arrangement confers the further advantage that the length of the aerial can be increased almost indefinitely without loading the set in any way. In addition, radiation due to the local oscillator is reduced to a minimum, and, finally, a tuning control is eliminated, thus producing a one-knob set.

The single Indigraph dial and three-vane condenser tunes the anode circuit of the screen-grid valve, which is virtually the grid circuit of the combined first detector and oscillator. To this coil is coupled the reaction coil in the plate circuit of the detector. Both coils, which are of the standard Igranic plug-in type, are mounted in a two-way coil holder, the reaction coil being fixed and the anode coil variable through a slow-motion control on the front panel. Little change in the coupling between the two coils is necessary, however, and the setting is maintained over the greater part of each waveband. Four changes of coil are necessary to cover the full range of the set (12.5 to 70 metres) and there is considerable overlap between the wavebands associated with each pair of coils.

The oscillator and first detector (PM3) is followed by two intermediate-frequency amplifiers (PM3A) associated with a standard Igranic I.F. unit as used in Neutrosonic sets designed for ordinary broadcast reception. In the set submitted for test the measured wavelength of the I.F. amplifier turned out to be 6,250 metres. At first sight this would appear to be an unnecessarily high figure, having regard to the low wavelengths received. It has one advantage, however, in that two reception channels for any given station are not more than two or three degrees apart on the tuning dial and there is much less confusion in tuning than would otherwise be the case. The cost of the set would also have to be increased if a special amplifier of lower wave-length were introduced.

Reaction is introduced in the I.F. amplifier by means of a small variable condenser on the front panel. The advantage of applying reaction in the fixed frequency amplifier is obvious; it is practically unaffected by alterations in tuning and the reaction setting need not be disturbed over wide sections of the tuning dial. There is also a volume control associated with the I.F. amplifier which takes the form of a high-resistance potentiometer in the grid circuit of the first I.F. valve.

Hints on Operation.

The second detector (PM3) is followed by a type "J" Igranic L.F. transformer feeding into a PM254 power output valve. The loud speaker is connected directly in the plate circuit and the volume is such that phones are unnecessary even when receiving the most distant stations.

The tuning is delightfully simple when compared with the usual reacting detector—L.F. short wave set. Having set the reaction control it is possible to go practically all round the dial, either with the receiver just oscillating for C.W. signals or just off the oscillation point for telephony. American stations have been picked up in this way without heterodyning the carrier wave at all. Right at the bot-
Broadcast Receivers.
was discovered in testing, however, that long-wave C.W. stations, due to direct pick-up in the I.F. amplifier, could be heard in the loud speaker when the first detector stopped oscillating. Normally these stations are inaudible, so that this effect is a useful reminder that the oscillator coupling must be increased. One soon learns the best average coupling for each pair of coils, however, and the "oscillator" knob needs adjustment only when coils are changed.

It would be impossible to give a complete list of stations received. On the two middle ranges there is a station—either C.W. or telephony—every two or three degrees on the dial and on each of the remaining two ranges there is enough material for several evening's work. The American end of the transatlantic telephone comes in well at all times of the day and night on one or other of its alternative wavebands and the Eindhoven and German transmitters are always reliable. An evening was devoted to American broadcasting and six stations were logged at good loud speaker strength, including 2XAF, 2XBA, 3XAL and 8XK, the last two at full bore. The modulation from any of these stations could be easily found without once allowing the I.F. amplifier to go into oscillation.

As a result of more than a week's experience with this set we are of the opinion that it is definitely superior to any short-wave receiver having the conventional reacting detector circuit so far tested both on the score of range and ease of control. The price in oak, including valves, coils and royalties, but excluding batteries and loud speaker, is £28 and the makers are The Igranic Electric Co., Ltd., Bedford, and 147, Queen Victoria Street, London, E.C.4.

Picture Reception in the Air.

German Tests with the Fultograph.

Of what value are wireless pictures to the aeroplane traveller? This is the question that the Lufthansa Company, of Berlin, recently set itself to answer, and the success of the experiments conducted is indicated by the announcement that it is intended to equip the company's machines with picture receivers for the reception of weather maps and aerodrome plans.

The aeroplanes are already furnished with up-to-date wireless apparatus—both for telegraphy and telephony—but there are grave limits to the amount of information which can be conveyed in a hurried Morse message or telephone conversation, especially in emergencies, and the new opportunities presented by the transmission of a picture or map capable of telling a long story at a glance are not to be neglected. It often happens that when a pilot encounters a storm belt he is quite ignorant of its extent and shape, and a blind attempt to fly round it may end in disaster. Here is a case in which a chart transmitted from the nearest meteorological station can be vitally useful. Again, during wet weather aerodromes may be flooded, or marshy patches may develop on which it would be unsafe to land. A picture transmission will at once indicate to the pilot what parts of the ground are still available.

The recent experiments were carried out on a Lufthansa aeroplane in co-operation with the German branch of the Fultograph Company. The apparatus on the experimental plane consisted of a Fultograph with built-in rectifier, a type which has been on the market since the Berlin Wireless Exhibition. Use was made of the Telefunken receiver already installed in the aeroplane, but it is intended later to fit a special picture receiver designed for aerial service.

It is interesting to note that the operator finds it necessary to adjust the receiver from time to time to suit the direction of movement of the aeroplane with...
Picture Reception in the Air.

respect to the transmitter. The Lufthansa aeroplanes are nearly all fitted with aerials consisting of a single wire let down from the machine, so that the aerial is inclined in a direction opposite to that of flight, and its direction with regard to the transmitter is always varying. This fact will have to be taken into considera-

tion in designing the new picture receiver for aeroplanes.

Another field of research is being explored by the Lufthansa Co., viz., the use of short waves for aerial telegraphy and telephony. In this work the company is being aided by the combined firms of Telefunken and C. Lorenz, with the assistance of Professor Esau, of Jena, and the German Air Traffic Research Institute.

A sketch map transmitted to an aeroplane to indicate that a portion of the aerodrome was flooded and unsuitable for landing purposes. The original is shown on the left and the map as received on the right.

The experiments are primarily concerned with the ultra-

short waves, which the Lufthansa Company are especial-

ly anxious to introduce into their service on account of the very light weight of the apparatus involved. The tests have already been carried out on the Berlin-Königsberg air route, but unfortunately they have not yet pointed to the possibility of establishing a twenty-

four-hour service. More recently attention has been turned to the Lübeck-Travemünde route, and a short-wave wireless equipment has been built into a Roman aeroplane. The results of these tests have not yet been published, but it is understood that the ultra-short waves are likely to prove of real value for aircraft navigation.

F. N.

NEWS FROM THE CLUBS.

Meetings Twice a Week.

The Kentish Town and District Radio Society commenced its new session on January 7th. New members are heartily welcomed. Meetings are held at 8 p.m. on every Tuesday and Friday at the Carlton Road Schools, Kentish Town, N.W. On Tuesday, January 14th, a lecture with lantern slides on the "Screened Grid Valve," prepared by the Marconiophone Co., Ltd., will be delivered. This will be the first of a series of three lectures. The Society caters both for novices and advanced amateurs. The keenness of its members can be gauged from the fact that bi-weekly meetings were held throughout the summer months. All enquiries should be addressed to the Hon. Secretary, Mr. A. H. Barlow, 46, Harrington St., Regents Park, N.W.

All About Mains Sets.

Mains units and their use with wireless receivers was the subject of a lantern lecture given by the Marconiophone Co. at a recent meeting of the Tottenham Wireless Society. Early difficulties met with in the design and satisfactory operation of mains sets, particularly in respect of the filament heating, were dealt with, and interesting details were given regarding the latest types of all-electric receivers. The lecturer gave valuable hints on the most suitable voltages and adjustment of grid bias.

Hon. Secretary, Mr. W. E. Rodenmead, 10, Bruce Grove, Tottenham, N.

Mains Operation.

"Operation from A.C. Mains" was the title of a lecture given by Mr. Youle, B.Sc., A.U.G.I., of the Marconiophone Co., at a recent meeting of Slade Radio (Birmingham). Concerning the question of R.T., the lecturer gave useful information regarding rectification, valves, chokes, and smoothing circuits. The question of L.T. was next explained, and details were given of A.C. mains, valves, etc. A convincing demonstration was given of a Marconi four-valve set and moving-coil speaker, together with a new gramophone pick-up.

The Society offers exceptional facilities to those interested in wireless, and full information may be obtained from the Hon. Secretary, 110, Hillaries Road, Gravelly Hill, Birmingham.

Pick-ups on Trial.

A fascinating demonstration of various types of electrical pick-ups took place at the recent annual general meeting of the Croydon Radio and Physical Society. Members formed the "jury" for the evening, and the results were interesting and instructive.

The next meeting will be held on the 20th January, when Mr. A. J. Webs will give a lecture on selectivity. Visitors are heartily welcomed to the meetings. Particulars regarding membership may be obtained from the Hon. Secretary, Mr. E. T. F. Gill, Staple House, S-28, Clancy LAKE, W.3.

The Siemens Film.

A combined meeting of the Whitgift Middle School Wireless Society, the Thornton Heath Radio Society, and the South Croydon Radio Society will be held in St. Paul's Hall, Thornton Heath, on January 30th, when a cinematograph film dealing with Messrs. Siemens' products will be the chief feature. All wireless enthusiasts will be welcome.

Society Offers to Help.

That highly controversial question, the separation of 2LO's two wavelengths, was the subject of an open discussion at a recent meeting of the South Croydon and District Radio Society. Views on the subject were not lacking, for many members had them to air, and it soon appeared that the two transmitters were quite capable of being separated, but with precisely what type of set was debatable.

It was realised that the ever present "man-in-the-street" might be in difficulties if he did not possess a stage of high-frequency amplification. The majority of speakers agreed, however, that without a high-frequency valve it was still quite easy to perform the divorce of the two wavelengths, but there attention must be paid to the coils and tuning arrangements if reasonable results were to be expected. Some speakers insisted that at least two stages of high-frequency would be necessary.

The Hon. Secretary, Mr. L. Cumbers, 4, Campden Road, South Croydon, said that the Society was only too eager to get in touch with Croydon's wireless set owners who were troubled by the problem of selectivity, and he felt certain that as a result the Society could help them not a little. Indeed, he concluded, it was for matters such as this that the Society existed, and it was essentially its duty to do all it could to ensure that the "man-in-the-street" received his alternative programme without trouble.
The Dominions and Empire Broadcasting.—"Go Home and Listen."—Something for Everybody.

New Stimulus to Empire Broadcasting.
How much longer is 5SW to be known as the "experimental short-wave transmitter"? Possibly the project for a permanent Empire broadcasting station will receive a fresh impetus on January 21st, when the speech of His Majesty the King at the International Naval Disarmament Conference will be sent out from Chelmsford primarily for reception throughout the Empire.

Cash from the Colonies?
The B.B.C. can, I think, be spared any further criticism in the matter of Empire broadcasting, as the question is now in the hands of the Colonial Office. I understand that the Dominions and Colonies are now being canvassed for contributions towards defraying the expenses of a permanent service. His Majesty's speech will thus come at an appropriate juncture; the Dominions are sure to make a determined effort to hear it (as well as the speeches of the Dominion representatives on the Conference), and the degree to which 5SW can make itself heard on this occasion may directly affect the financial enthusiasm of its audience.

Pre-breakfast Enthusiasm.
American keenness over the transmission illustrated by the news that the National Broadcasting Company of America is arranging to relay the speeches through its chain of stations despite the fact that New York will hear the event at 6 o'clock in the morning!

Regional Developments in 1930.
Several promising developments on the technical side should occur before we sing dirges for 1930. Everybody knows that twin programmes are to be expected from Brookmans Park, but nobody (no, not even the Chief Engineer himself) knows when.

After London Regional the next regional station to be officially constituted as such will be Daventry, the Midland Regional. The Northern Regional at Shildon will begin testing by the autumn, but before then constructional work will have begun on the Scottish station at Falkirk and a site will have been chosen for the Western Regional in the Cardiff district.

"Go Home and Listen."
I have already referred to the embarrassment of the Savoy Hill Programme Department when faced with an appeal for specially brilliant programmes in National Wireless Week, which begins on Sunday next, January 12th. The programmes felt it necessary to explain that all programmes nowadays are brilliant, so why gild the lily, etc. However, prodigious tearing of hair and burning of midnight oil have produced a bill of fare which is admittedly above the ordinary standard, and I would recommend everybody to follow the slogan of the week, viz., "Go Home and Listen."

An Appetising Menu.
Among the coruscating items must be mentioned the appearance of Madame Suggia in a 'cello recital from 2LO, 5XX on Wednesday, a work in which Robert Louis Stevenson and his stepson, Lloyd Osborne, collaborated. And on Thursday we are to have "The Immortal Memory of Sir Walter Scott," toasted by the Rt. Hon. Stanley Baldwin at the dinner of the Sir Walter Scott Club in Edinburgh.

Something for Everybody.
A first-class symphony concert from the Queen's Hall, with Szegi as solo violinst, the veteran Sir George Henschel singing to his own accompaniment, and two microphone appearances of Gracie Fields are among the additional attractions. So why stay out-of-doors?

That New Year Broadcast.
Once again the B.B.C. "went all out" in its New Year celebrations. The idea of touring European cities was a good one, and was well carried out in spite of atmospherics. True, we had only a cough or two from Bratislava, but a cough from Eastern Europe is better than a jeryssyn in the B.B.C. talks studio. I listened to the "Grand Good Night," or rather, part of it, via Hilversum. Eventually our Dutch friends gave up struggling with an alien tongue and broadcast orchestral music on their own account.

Where Opportunity Counts.
America's latest record is that of a woman who listened to broadcasting continuously for "more than five days." If the B.B.C. could be persuaded to broadcast continuously, the American record would probably be broken by the licence-holders of Aberdeen.

Things we Want to Know.
Whether Big Ben is developing a bigger crack, or whether a new microphone is needed.

"Burns Night."
This year Mauchline will again be the stage for the broadcast celebration of the poet's birthday on January 25th. Instead of in Poosie Nansie's Inn, the microphone will be installed at Mausgel Farmhouse, outside the town, in which Burns wrote some of his best works. The celebrations will be broadcast from all stations except SB2.

FEATURES FOR NATIONAL WIRELESS WEEK.

London and Daventry (5XX).
JANUARY 11TH.— "The Wrecker," play adapted from "R.L.S." by Hults, 1100.
JANUARY 11TH.— Symphony Concert relayed from Queen's Hall.

Daventry Experimental (5GB).
JANUARY 11TH.— "Oratorio Programme." 5GB.
JANUARY 11TH.— "Helmet and Haversack," a Peace of Military History. 5GB.

Cardiff.
JANUARY 11TH.— "Ludds of Selkirk," a story of the Men of the West, by Dorothy Champion and David Thomson.

Manchester.
JANUARY 11TH.— "Conrad's Quilt," adapted from Robert Louis Stevenson. 5GB.

Glasgow.
JANUARY 11TH.— "Vocal Music of Colonies, Ireland and Scottish Country Dances." 5GB.

Belfast.
JANUARY 11TH.— "Concert of First Prize Winners, North of Ireland Bands Association."

and other stations on Monday at 10.15 p.m. Those to whom radio drama appeals should not miss "The Wrecker."
A New Rectifying Valve

A Gas-filled Full-wave Valve with Remarkable Regulation Curve.

By E. R. Dietze.

One of the features of the Berlin Wireless Exhibition was the very great number of mains-operated receivers and power-amplifiers as compared with those operated from batteries. The latter have practically disappeared altogether from the German market. One of the reasons for the great popularity of the mains-operated set is, of course, the fact that throughout Germany the mains are standardised to a far greater extent than in England, where any number of different A.C. and D.C. voltages exist, where even the cycles of the A.C. mains are not standardised, but vary between 25 and 100 cycles. Also, there are still large stretches of country without any electric power supply whatever, such stretches, however, being comparatively rarer in Germany. On the other hand, the development of efficient and inexpensive battery eliminators for the mains operation of receivers, power-amplifiers, and radio-gramophones, has been greatly facilitated by the fact that a certain type of full-wave rectifying valve of the gas-filled variety possessing most remarkable characteristics has been available for some length of time.

The Rectron valve, under which name it is known in Germany, is filled with a mixture of rare gases and mercury vapour at low pressure. The effect of the mercury vapour is to keep the internal resistance of the valve as low as possible. It is this negligible internal resistance which is the outstanding feature of this valve, so that the rectified D.C. potential is to all practical purposes the same even when the load on the valve changes by as much as 100 per cent. Naturally, this property is of great value in the design of battery eliminators; for instance, the pot winding of a moving-coil loud speaker may be energised from the rectifier supplying the high tension to the receiver if thought fit, without the potential dropping to any serious extent, or, in the case of the pot winding being disconnected, rising to a value liable to harm the valves in the receiver. Another great advantage is the negligible loss of energy across the internal resistance of the rectifier valve, which is quite a considerable percentage of the D.C. wattage delivered in the case of the more usual rectifier of higher internal resistance. Incidentally, of course, the valve is capable of handling very large power without undue development of heat, even although the electrodes are very small.

A full-wave rectifying valve of this design yielding 120 watts D.C. is no larger than an ordinary receiving valve of the super-power type. The most remarkable property of all, however, is that the same valve may be used for both low-tension work up to more than one ampere and high-tension work up to 500 volts, according to the A.C. potential applied to the plates. This makes it possible to combine an L.T. charger with an H.T. battery eliminator by simply changing over the plates of the valve to a low-tension winding on the mains transformer and applying the rectified potential to the L.T. accumulator on switching off the set. All these properties, of course, are the natural result of the negligible internal resistance of the valve due to the mercury vapour present.

Low Internal Resistance Due to Mercury.

Considering this, it is remarkable that this valve is as suitable and as reliable for high-tension work as it has proved itself to be, the largest of these valves at present available handling 1,200 volts and 300 mA of D.C. output with ease and safety. A complete range for all low- and high-tension requirements is available, including heavy-duty types yielding 280 watts at 220 volts. A special type is manufactured with three or six plates to rectify three- or six-phase A.C. without the use of a transformer, yielding 280 or 560 watts of D.C. at 220 volts. The price of these valves compares favourably with those of other valves, and thus they have become very popular in Germany, especially for medium- and high-power work in large receivers, power-amplifiers, and radio-gramophones, where their use is a standard practice.

The conventional full-wave rectifying circuit is used for this valve. It possesses a filament heated at about 1.8 volt and taking about 2.5 amperes. The filament...
A New Rectifying Valve.—

The valve filament glows at a very dull red, and is extremely substantial, as its low resistance indicates, and therefore has a very long life. In fact, the life of these valves is only terminated by their vacuum reaching a degree of 'hardness' at which the glow-discharge can no longer be effected and maintained in the usual way. The glow of the filament has the effect of evaporating the mercury, which is present for the greater part in liquid form when the valve is cold, due to the comparatively low vacuum and high gas pressure in the valve. The mercury then evaporated reduces the internal resistance and assists the glow-discharge taking place.

It would, therefore, seem advantageous to apply A.C. potential to the plates and heat the filament for several seconds before applying the load to the rectified potential, and this is borne out in practice. The life of the valves is considerably prolonged if this precaution be taken, especially if the load is near the maximum capacity of the valve. The average life of the valve under such conditions is in excess of a thousand hours, which is a very good figure for a gas-filled valve of this design. Momentary peaks of load up to three to four times the normal maximum, such as would be brought about by accidental short-circuits, etc., can be sustained without "backlashings," which is the inevitable result of continuous overloading and applying maximum loads without first heating up the filament, especially in a valve of such low internal resistance working at potentials of several hundred volts.

Fig. 1 shows a series of curves taken of the D.C. output potential in relation to the load for different reservoir condensers. Especially the curve taken of the valve alone without any reservoir condenser shows scarcely any potential drop whatever with the rising load, the result of the extremely low internal resistance.

The development of this valve, largely due to Dr. W. B. Spender, has been of the greatest importance for the mains-operation of sets in a simple and economic way, and has supplied mains-operated apparatus with a source of H.T. of such "elasticity" as to compare quite favourably even with an H.T. accumulator.

IN designing this instrument the makers kept in mind two salient points: (1) the attainment of a high standard of quality in the reproduction of both radio and gramophone records, (2) the maintenance of engineering standards of robustness and reliability in manufacture and testing.

The accompanying photograph of the interior of the set shows that there is no suggestion of the delicate scientific try about the amplifying equipment. The layout and massive quality of the components are reminiscent rather of transmitting practice.

The amplifier, which is common to both radio and gramophone pick-up circuits, is assembled on the base platform, which is metal covered. There are two transformer-coupled stages, the output valve being an A.C./P.I. capable of an undistorted output of 1,000 milliwatts, which is sufficient to drive the moving coil loudspeaker at full volume.

Indirectly heated valves are used in both the A.C. and D.C. models. In the A.C. model illustrated H.T. is derived through a Mazda S.P.42/11 (U76/360) full-wave rectifier, while the loudspeaker field is energised from a Philips P.306 full-wave rectifier.

The moving coil loudspeaker is also mounted on the base platform in a position coinciding with the aperture in the cabinet. The diaphragm is of the corrugated type which automatically adjusts its effective diameter to the frequency applied.

The radio unit and control panel, which is wired as a separate unit, is mounted immediately above the loudspeaker, and is linked to the amplifier through cleated leads running down the side supports. A leaky grid detector in conjunction with a dual range reacting tuner unit provides local station reception with the possibility of alternative programmes. An external aerial varying in length according to circumstances is necessary. The volume control takes the form of a Centralab which controls both radio and gramophone volume.

We have had an opportunity of testing one of the receivers and found the reproduction full and round with excellent volume. A noticeable feature of the reproduction from gramophone records is the entire absence of surface scratch.

THE CLARITH RADIO-GRAMOPHONE.

General view of the Clarith radio-gramophone, showing simplified control panel and moving coil loud speaker grille.

Amplifier-receiver unit for A.C. mains. The receiver unit and control panel are mounted above the loud speaker, while the power amplifier and rectifier units occupy the base platform.

A rigorous system of testing has been evolved for each component and for the various stages of assembly, and taking into account the rugged appearance of the finished product it is safe to predict that this reproducer is destined to set new standards in reliability and long service.

The makers are Messrs. Clarith Reproducers, Ltd., East Street Mills, Leeds.
EMPIRE BROADCASTING.

Sir,—The many letters published in your paper convince me that G5SW is a washout east of Suez. One correspondent thinks we are rather rubbing it in when we say that nearly everything but British is on the SW. In vain do I tune in to 25.55, and for days, and even weeks, I could not get the carrier till last week at 7 p.m. I.S.T. (7.30 p.m., G.M.T.) I heard the announcer say, "G5SW at Chelmsford, England, closing down till 7 p.m. G.M.T."

Also that G5SW sometimes worked on 11.55 metres —that is, if I heard correctly the wavelength, and note, please, the "sometimes." Why not send the wireless Press a short paragraph giving times and days? Why so casual? Within a few minutes of this (if G5SW on R2 or 3 strength) Stockholm came roaring in up to 9.30 p.m.

These are the hours we want, i.e., between 2 to 7 p.m. G.M.T., and if Holland, Germany, Manila, and now Sweden can do it, what is wrong with G5SW? I have before mentioned there are 50,000 British lads in the Army out East who would be glad to get some home news, etc. Most of the present Army had their crystal sets in England, and by clubbing together could get a 3-valver to while away the often too long evenings between sunset and bedtime. Is the British manufacturer unconcerned, and is he going to allow the opportunity to slip by? If Britain is on the "air," then people will buy British sets to hear her. Geographically, Huizen, Hilversum, Leesen, and Stockholm are not so situated as to make things different for G5SW, and so far as Pakistan, India, and the F.M. States are concerned, G5SW is included in the fairness direction, and "what one fool can do, etc."—RADIOX.

December 11th, 1929.

THE PROGRAMME DIFFICULTY.

Sir,—Referring to the article mentioned in your December 25th, you were good enough to publish a letter from me in which I suggested a scheme of broadcasting on four wavelengths from the same site without mutual interference, especially as the frequency separation of low power stations would be fed either by land line or wireless. The scheme I suggested called for a large number of stations, each relaying simultaneously a number of programmes without appreciable distortion. This is because the rectifier does not act on each input component separately, but on their sum.

There is a fallacy which has appeared in different forms so much in the literature on this subject that I think it is worth pointing out here. It is said that when a rectifier is insensitive to weak signals the strong components of the input are relatively enhanced. This is not a mathematical consequence; in some cases it is true, in others it is not. This is because the rectifier does not act on each input component separately, but on their sum.

"When the rectifier has the simple 'square law' characteristic \( i = a + b v \) (where \( i = \) current, \( v = \) applied voltage, \( a \) and \( b \) are constants) if the input is a strong signal \( V \sin pt \) and a weak \( v \sin gt \) we have:

\[
i = a(V \sin pt +v \sin gt) + b(V \sin pt -v \sin gt) + V \cos 2pt -v \cos gt + 2V \cos (p-q)t -2V \cos (p+q)t
\]

In this case the output is \( \frac{b}{2}(V^2 + v^2) \), so that the strong component \( V \) is relatively enhanced. We may call this the "selectivity-quality problem."—G. B. BENNETT.

Sir,—Major MacCallum's suggested synchronised transmission scheme is either five years too late or at least five years too soon. In the old days of bad receivers and horn speakers it mattered little that land lines added adenosine to artists. But wireless can no longer amuse by its novelty. The possibilities of reception have reached a very high standard, far higher than that of present land-line transmission. S.B. is no longer tolerable. Possibly in the uncertain future, when line transmission has been enormously increased in quality, it may become acceptable. For the present, however, any extension of the use of land lines is a step in the wrong direction. Admittedly the Regional Scheme is not ideal, but it is the best solution of the problem yet advanced. Buxley Heath.

A. G. WARREN.

"KILOHMS."

Sir,—May I suggest that much time, ink, paper and breath would be saved by the introduction of a term for thousands of ohms? I have had this in mind for some time, and the need is emphasised by a perusal of the "Valve Data Supplement" (The Wireless World, December 4th, 1929) with its armies of noughts in the A.C. resistance column.

The obvious suggestion for such a term is "kiloohmagas." Your assistance in securing the general adoption of this would, I have no doubt, be greatly appreciated.

E. H. LATER.

Hon. Sec., North Middlesex Radio Society.

THE SELECTIVITY-QUALITY PROBLEM.

Sir,—I expected to see in The Wireless World at least one letter commenting on Mr. Bertram Hopey's article in the November 27th issue, for there must be several of your readers who were not deceived by his explanation of the great selectivity obtained as he describes. The following extract from a paper on the detector read before the Cambridge University Wireless Society last October bears on the point.

"There is a fallacy which has appeared in different forms so much in the literature on this subject that I think it is worth pointing out here. It is said that when a rectifier is insensitive to weak signals the strong components of the input are relatively enhanced. This is not a mathematical consequence; in some cases it is true, in others it is not. This is because the rectifier does not act on each input component separately, but on their sum.

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In this case the direct current in the output is \( \frac{b}{2}(V^2 + v^2) \), so that the strong component \( V \) is relatively enhanced. We may call this the "selectivity-quality problem."—G. B. BENNETT.
also note the term $kV_v e^{\pm \omega t}$, the heterodyne beat note, which is proportional to $v$. If the two input signals are carrier and sideband, this is the required audiofrequency note, and is DIRECTLY PROPORTIONAL to the amplitude of the sideband.

RECEPTION OF CONTINENTAL STATIONS.

Sir,—It is possible to receive foreign transmissions without all the interference of which Mr. A. W. Scott complains. It just depends on the receiver and one's ability to use the best advantage. With two efficient stages of screened grid high-frequency amplification and anode-bend rectification it is possible with carefule control of input and output to claim correct interference. My receiver is a "Kilo-mag Four" with a resistance-capacity coupled low frequency stage, and I can receive Budapest, Vienna, Prague, Milan, Rome, Bucharest, Radio-Toulouse, Barcelona, and all the powerful German stations at good strength on a moving-coil speaker. I listen regularly to opera from Vienna, Milan, and Rome. The long-wave stations are there, too; one has only to select a suitable programme.

I suggest that as Mr. Scott is disappointed with foreign station reception he should build a "Kilo-mag Four." I am certain that he will not be disappointed with the results.

Grimshy.

J. H. BORRILL.

Sir,—It is not the set usually that causes the trouble but the quality in which it is used.

My own house is dreadful for reception, which is much upset by local static, Sunday evenings excepted. The set used is a Superhet.

I have a set exactly similar at a relative's near where the Trent and Ouse meet to form the Humber, apparently miles from anywhere. Here the foreign stations come in with a clarity unbelievable, on a background of silence.

I pay a weekly visit to a friend two miles outside Rotherham; he also uses a Superhet, and his reception is perfect, with just a slight trace of interference from trackless transits now and again. The quality and strength of foreign stations are quite equal to that of our own British stations.

ALFRED FRANCE. Rotherham.

Sir,—I was interested to read Mr. Lewis's letter commenting on my recent article, "The Selectivity-Quality Problem." The article refers to a publication after I had sent it in.

It shows mathematically the ratio of the two components $V_4+4V_2v^2$ in the output to be $V_4+4V_2v^2$, so that unless $V$ to begin with is $>2$ no gain is obtained; in fact the weaker signal is enhanced. Where the device works as described is with a considerable difference between $V$ and $v$. With $V=v_{10}$ the ratio given above comes out to 26, and is greater for larger values of $V$.

Since it was only on stations having a large difference of initial intensity that the scheme was attempted, no cases of its failure were noted.

I am glad of this opportunity of thanking Mr. Lewis for his criticism, which gives readers more accurate outlook on the phenomenon.

The references given in his letter should prove useful to readers wishing to follow up the mathematics of the case.

Mr. H. Royle. BERTRAM HOYLE.

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Mr. H. Royle. BERTRAM HOYLE.

RECEPTION OF CONTINENTAL STATIONS.

Sir,—I have read with awe and veneration the descriptions of various achievements in the way of reception of distant programmes which certain of your correspondents have related in letters which you have published. Since it was only on stations having a large difference of initial intensity that the scheme was attempted, no cases of its failure were noted.

I am glad of this opportunity of thanking Mr. Lewis for his criticism, which gives readers more accurate outlook on the phenomenon.

The references given in his letter should prove useful to readers wishing to follow up the mathematics of the case.

Mr. H. Royle. BERTRAM HOYLE.

Sir,—I was interested to read Mr. Lewis's letter commenting on my recent article, "The Selectivity-Quality Problem." The article refers to a publication after I had sent it in.

It shows mathematically the ratio of the two components $V_4+4V_2v^2$ in the output to be $V_4+4V_2v^2$, so that unless $V$ to begin with is $>2$ no gain is obtained; in fact the weaker signal is enhanced. Where the device works as described is with a considerable difference between $V$ and $v$. With $V=v_{10}$ the ratio given above comes out to 26, and is greater for larger values of $V$.

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choke-capacity filter circuit. The detector anode circuit includes H.F. choke, H.F. by-pass condenser, and stopping resistance between coupling condenser and grid of L.F. valve. The H.T. is supplied by a mains unit, and the L.T. is kept "up to scratch" by a trickle charger. My ear is fairly sensitive, but my only complaint as to errors in reception is an over-lead effect with high soprano solo notes or heavy choral work, manifesting itself as a horrible "hard breathing" effect below the musical note. I cannot fairly blame the transmission on the engineering side for this effect. Again, one piano only in one of the London studios broadcasts with horrible "dithers" almost through its entire compass. On the same evening, without any adjustments to my set, other pianos either from Savoy Hill, or outside, have broadcast with perfectly pleasing results.

Now, to what conclusions do these details point? I suggest that the trouble is not so much in the engineering output or modulation, but my only complaint as to errors in reception is an over-lead effect with high soprano solo notes or heavy choral work, manifesting itself as a horrible "hard breathing" effect below the musical note. I cannot fairly blame the transmission on the engineering side for this effect. Again, one piano only in one of the London studios broadcasts with horrible "dithers" almost through its entire compass. On the same evening, without any adjustments to my set, other pianos either from Savoy Hill, or outside, have broadcast with perfectly pleasing results.

Sir,—The differences in land-line qualities noted by your correspondent, Mr. E. C. Richardson, obviously point to that much-maligned B.B.C. department, the Control Room, and as the B.B.C. in their own interest, and not being bigger fools than their critics, must have done their level best to maintain the highest possible quality of control throughout their long transmissions (most days 10.15 a.m. till midnight), no fair-minded person can believe that this department has yet succeeded in perfecting this matter, although it must be generally admitted that its transmissions taken as a whole are the best in Europe. Incidentally, I have yet to read any constructive criticisms in this connection.

HERBERT S. COPPOCK.

Didsbury, Manchester.

Sir,—I have spent a considerable amount of unnecessary time "looking to my set," when the fault has proved to be the "other end."

Some weeks ago the quality of the service relayed from Boulogne was so bad that I dismantled the M.C. speaker, as the coil is wound with a copper strip, and I had decided that this was causing the chatter. To my great annoyance, on substituting a spare coil, I found the trouble persisted, only to become perfect on reverting to London for the "news."

Crawley, Sussex.

ERIC J. PEARCE.

Sir,—There is one point which has so far not been clearly brought out, viz., the general poor quality of the transmissions from 5GB. The higher and lower frequencies seem both sadly lacking, and improving the L.F. amplifier, increasing the H.T. voltage, and improving loud speaker response on the receiving side only seem to bring this fact into greater prominence.

It is, however, a matter of common experience that programmes performed in London and transmitted from 5GB can be, and usually are, of excellent quality, with a brilliant upper register and thumping bass. And yet, presumably, the same broad casts rotten.

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It is, however, a matter of common experience that programmes performed in London and transmitted from 5GB can be, and usually are, of excellent quality, with a brilliant upper register and thumping bass. And yet, presumably, the same length of land line exists in each case.

A. M. ROACH.

Kingston Hill.

Sir,—With reference to your correspondence regarding land-line transmissions, it may interest your readers to hear that from here (Geneva) the difference in quality and volume between direct and relayed broadcasts from British stations is always noticeable, and often marked. At a distance of roughly 500 miles one has, of course, to be content with comparatively imperfect reception, and the good old days of five years ago, when one could pick up all the main British stations (even relays), are past, and the only British station now left unswamped by the Germans is 5GB. Nevertheless, there is always a sharp difference between the woody obscurity of the first news bulletin, for instance (replied from 2LO), and the second (broadcast from the Birmingham studio), and the light music following the first bulletin seems suddenly to jump out of the loud speaker after one has been straining one's ears and nerves to hear how Lindrum and Smith are progressing. Moreover, it is sheer nonsense to say that imperfect reception is invariably the fault of the receiving set. One has only to turn the dial over from a British station at its best or from the German stations (which also give excellent quality, though rather hard tone) to stations like Lyons, Toulouse, or Seville, which seem to suffer from perpetual erratic throat, due to rack bad modulation. After all, if one can get good and bad quality signals on the same set within a few minutes of each other, the fault for the bad signals obviously lies at the transmitting end.

G. D. MILLAR.
Modernising an Eliminator.

I have a rather out-of-date eliminator giving a main output rated at 120 volts 25 milliamps, and another terminal intended for feeding a detector valve, which is supposed to give up to 100 volts, variable in five steps by a rotary switch. I was located that this output should be suitable for supplying the screening grid of a "S.G. Regional" receiver, but a test shows that this is not so. As a temporary measure I am feeding the three anode circuits from the main output terminal, and have connected a battery of small dry cells for the screening grid. These cells now show signs of decline, and, if possible, I should like to devise a more satisfactory and permanent arrangement. Can you help me?

M. M. R.

We advise you to try the arrangement suggested diagrammatically in Fig. 1; this requires the addition of a wire-wound potentiometer of between 50,000 and 50,000 ohms, which is connected externally between eliminator and set in the manner shown.

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 details 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.

Parallel-fed L.F. Amplification.

Will you please tell me if the parallel feed method of L.F. amplification is applicable only with modern inter-\n
Transformers having high/hp  permeability cores, or whether it can be used with ordinary transformers.

W. H. R.

Generally speaking, this system confers greater advantages when dealing with the modern "Munmetal" transformers, but it is a mistake to assume that it cannot be successfully applied to the larger transformers with ordinary cores.

H.F. Transformer Primaries.

I am using " The Wireless World" Kit Set coils in constructing a four-valve A.C. mains receiver having a single H.F. stage with a Mazda A.C./S.G. valve. Will you please tell me how many turns should be added to the primary windings of the H.F. transformer?

D. C. B.

In order to attain maximum amplification a considerable increase should be made in the number of primary turns, but actually the windings specified make a good compromise between the requirements of range and selectivity, even though the valve in question has a considerably higher impedance than that for which they were originally designed.

We recommend that you should try the H.F. transformer as it stands, and then, if sensitivity and stability are both in excess—the latter quality will, of course, depend to some extent on circuit details and screening—add another primary section to both long and medium wave transformers.

---

Long Wave Troubles.

My "H.F. set," built in accordance with suggestions made in recent articles is working exceptionally well on the medium broadcast waveband, but is totally incipient in stability on the long waves. This puzzles me, as I have always thought that the small residual capacity of a screen-grid valve has little effect at comparatively low radio frequencies, and that, having achieved stability with regard to high frequencies, the rest should automatically follow.

J. W. W.

It is correct to assume that there should be less tendency towards H.F. instability on the long waveband in an amplifier such as you describe. When a set of this kind fails to operate satisfactorily on this band, although it puts up a good performance on medium waves, the first thing to suspect is imperfect separation of H.F. and L.F. components in the anode circuit of the detector valve; failure in this respect often gives rise to an effect not quite the same as ordinary self-oscillation due to interaction, but very similar to it.

To assure yourself if this is at the root of the trouble it is a good plan temporarily to connect a much larger condenser—say 0.002 mfd., or even more—than can be generally tolerated from the L.F. point of view between detector anode and earth. If this produces a cure for instability, it can safely be assumed that the normal filtering devices are inadequate.

It should be added that trouble of this kind is sometimes traced to the use of decoupling condensers of excessively low value.

---

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Wireless World

Unsuspected Current Leakage.

Will you please examine my circuit diagram (on which resistance values and details of type symbols, etc., are marked), and say whether I am correct in assuming that the total anode current consumed will amount to approximately 25 milliamperes with a common input of 15 volts. My problem is to know whether it is safe to take this figure in calculating the value of resistance necessary to absorb the surplus voltage delivered by my eliminator.

J. B. V.

With regard to the valve anodes, your estimate as to total current consumed is as correct as need be, but you have ignored the fact that unless the screening grid potentiometer is also a load on the eliminator. This potentiometer, according to your diagram, consists of a fixed and variable limb, with values, respectively, of 10,000 and 20,000 ohms. This gives a total of 30,000 ohms, which will pass 5 milliamperes when 150 volts are applied. This extra current must be added to that consumed by the anode circuit, so you should allow for a total of 35 milliamperes.

Alternative Programme Reception.

Will you please give me a circuit diagram of a throttle-controlled regenerative detector valve arranged for alternative programme reception?

I should like to arrange matters so that it is possible to change programmes by switching over from one tuned circuit to the other. I am, of course, prepared to use separate pairs of tuning coils and condensers.

T. S. S.

Fig. 2.—A regenerative detector circuit arranged for easy switching-over to alternative transmissions. Standard components may be used.

Frame Aerials and Quality.

The majority of frame aerial sets to which I have listened seem to be deficient in the matter of quality, or at any rate they do not give such good reception as receivers with outside aerials. Do you consider that this is inherent in the design of a self-contained set?

S. D. H.

There is no basic reason why a frame aerial set should not give quite as good results as one with an outside aerial, although it is admitted that risk of trouble is somewhat increased in the case of the self-contained receiver. In the first place, there is generally greater tendency towards H.F. instability, and some sets are found to be on the verge of self-oscillation on a considerable part of the tuning scale; this incidental reaction will naturally impair quality. Again, many sets must of necessity be fitted with small-capacity H.T. batteries in view of the space available, and this in turn leads to the use of an output valve with strictly limited power-handling capacities.

Further, it is possible that you may have formed your opinion after listening to frame aerial sets working at the extreme limit of their range where a good deal of reaction is necessary.

Increasing Wavelength Range.

I find that my det-L.F. set will not tune down to the new Regional station working on 261 metres; a reduction in aerial length does not have any appreciable effect in extending the lower limit of its wavelength range. Should this be so? Will you please suggest a way of altering the set so that the alternative transmissions may be received?

E. C.

From the fact that alterations in aerial length (and consequently in aerial capacity) do not have any appreciable effect in changing the tuning range of the grid circuit, it is fair to assume that your set includes either an "aperiodic" aerial grid transformer, or that the aerial is coupled to the grid through a very small fixed condenser. In either case the remedy is the same; you must make a reduction in the inductance of the tuned circuit, and if provision is not made for doing this it is only a matter of removing a few turns from the winding. We suggest that you should take off a few turns at a time until the desired wavelengths are received.

A Composite Receiver.

Can you see any disadvantage in combining the high-frequency amplifier of the original Evernay Four with the detector and L.F. amplifier of the new (1930) set? The aerial tuning arrangement of the latter receiver would be embodied, and interchangeable coils would be used for the two wavebands.

D. W. B.

Up to a point, this circuit arrangement should be highly satisfactory, but it must not be expected that it will provide as much H.F. amplification as that afforded by the "1930" Evernay Four with the best type of modern screen-grid H.F. valve. Selectivity will be of a very high order if proper use is made of the aerial coupling adjustment.

FOREIGN BROADCAST GUIDE.

TUNIS-KASBAH
(North Africa).

Approximate Geographical Position: 36°48' N. 10°18' E.
Approximate air line from London: 1,360 miles.
Wavelength 1,350 m. Frequency 222.2 kc.
Power 0.6 kW.
Time: Central European (one hour in advance of G.M.T.).
Transmits daily from 8.15 p.m. G.M.T. (10.15 p.m. E.T.)
Male Announcer: "Call: Allo Allo. Ici le Poste Radiodiffuse de Tuni s-Kasbah. Announcements are made in French and Arabic."

Under the heading "Foreign Broadcast Guide," we are arranging to publish a series of panels in this form, giving details regarding foreign radiobroadcast transmissions.

B 49
MISCHA LEVITSKI

hears 'the impossible'!

"I have heard what I thought impossible," says Mischa Levitski, the brilliant pianist—"the true authentic notes of a piano coming from a radio loud speaker. The radio was a Marconiphone, and so was the speaker."

Choose your programme—orchestra, dance music, a speech. On a Marconiphone loud speaker it will come through clear-cut, flawless. Sir Edward Elgar, Theodor Chaliapine, Albert Coates, many other famous musicians, have found in the Marconiphone tone and volume unrivalled today.

Marconiphone engineers make these speakers. All the skill of thirty years' leadership in wireless is in their construction. Ask any dealer for a demonstration. If there is no dealer near you, write to the Marconiphone Company Limited, 210-212 Tottenham Court Road, London, W.1.

MODEL 60 CABINET CONE

Obtainable at the very moderate price of £5, the Model 60 is an extremely efficient "all-purpose" speaker. Embodying the Marconiphone reed system, it is outstandingly clear in tone.

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The highly accurate centring of the Moving Coil and the one-piece fibrous diaphragm ensure absolutely accurate reproduction. Units from £4.10.0. Cabinet models: for 6-volt accumulator, £7; for D.C. mains, £7.10.0; for A.C. mains, £12.12.0.

ONLY 30/-

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A very useful manual giving the maximum information on the subject. Following a simple explanation of the principles of tuning circuits, the author discusses the many methods of tuning circuits, with explanations of spade, condenser and variometer tuning. Other chapters treat in detail of the choice, construction and design of coils, and give particulars as to size of coil required, the best shape, size of wire, type of insulation, and special uses of the various coils.

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Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
WATTs AN OHM
WILL NOT MEET A
DIX-ONEMETER
50 Electrical Instruments in 1
AMPS
VOLTS
OHMS
Only Six Terminations, as What Ranges
The DIX-ONEMETER is portable size to go in the
pocket, but big enough to cover the whole range of D.C.
electrical measurements. You can have multipliers to
work on 50 micro-amps to 150 amps and 20 milli-amps
to 2,000 volts. All other instruments in this Electro-
Standard Scope, Standard of Accuracy for First Grade
meters is available at the price? None. A novice can
use it as accurately as an expert. No switch to be
accidentally turned with disastrous results, as each range
has its independent multiplier and a safety button
controls the moving coil.

PRICE REDUCTION
OF THE MULTI-RANGE
DIX-ONEMETER
Dix-onemeter 50/-
Range Multipliers: 6/6 each

Electrical and Radio Test Booklet Free
The extensive sale and increased use has
enabled a reduced price to be offered below
the already exceptionally low price.

DIX-ONEMETERS are now
90/-, 150/-, 250/- each
Reasons:
Latest Model. To 1st Grade B.I.C.,. Standard
Mirror Double Scale. Moulded Base. The finest
Precision Multi-measuring instrument is the
DIX-ONEMETER, the acknowledged Radio
standard beloved by Expert and Amateur.

ELECTRAX RADIos
Apparatus Depot
218, Upper Thames Street, E.C.4.
City 6181.

BERCLIF COILS
1930 EVERYMAN 57/- the Set
NEW KILDAM 50/-
RECORD 111 60/-

CABINETS AND DIALS
SIMMONDS BROS.,
SHIRELAND ROAD SMETHWICK

“It may interest you
to know
that my advertisement in ‘The Wireless World’
brought over 70 replies in three days, which is, I think,
a wonderful testimony to the advertising efficiency of your
paper.”

J. MITCHELL
10, Hilton Avenue, Frizington,
Bradford, Yorks.

Full particulars of advertising
in the Classified Columns
of ‘The Wireless World’
are given on the first page
of Miscellaneous
Advertisements.

W. W. 76.

Components, Etc., for Sale.—Contd.

WESTON Moving Coil Relay: 30/-, or offer; unused,
exchange for Brown microphone amplifier.—Forster,
APC 20/-; A.F.S. 20/-; 0.100 Weston milliam-

er; 3 PESDA valve; 21/-; Phillips pick-

up, 5/-; in the new. — Seeley, Coldham.
L.F. Transformers, Léon, 5/-; Success; 7/-; Léonard
unit, 6/-; mains wiring for scoring coil speaker.

1:01, 111 Northu, W.2 (7779).
FURBANLY A.P.E. Transformer, Hotel Vio A.C.
S.B. valve, indirectly heated, for use with adapter,
Brown’s a.F.5C, 20/-; or offer; limited number.—
C. O. Patterson, 58/4, Shields Rd., New-
castle-on-Tyne (7780).

COMPONENTS for 3-valve Set, dual wave, choke output,
and 3 valves: £1.10s.—4 oz. 4561, c/o The
Wireless World (7782).

METER Bearing: 3, 12, 120 mA; 1.2, 6 amm.
6, 24, 120, 450 volts, 50/-; also 6 volt moving coil
mout, 2/-;—111, Burdage Rd., Home Ill, 8.E
(7814).

RI 2 Hypermic Transformer, 12/-; Colmation Wood
pick-up, 2/-; — all guaranteed.—New 4560, c/o The
Wireless World (7804).

PRIVET No. 5, 4560, c/o Times
L.E. (7783).
PRIVATE Sale Like New Goods.—Sets, no cabinet,
3-valve, 25/-; 2-valve, 20/-; pick-ups, Blue Spot.
J.E.C. 17/-; J.T.B. 22/-; Brown’s unit,
classic case, 27/-; double microphone amplifier,
5/-; F.P. A.C. meters, coils, transformers, H.P. choices,
condensers, leak, resistances, switches, etc.; send
requirements; call evenings.—7/-, Lavender Square,
W.11 (7811).

30/12/29.—Dear Sirs, I must say how pleased I
am with your prompt attention to my order and
the satisfaction of the part exchange: I had tried
twenty other firms before writing to you to see what
would give me for my surplus parts, but every
time was disgusted with their offers; I shall be
pleased to accept your offer and further radio components
from you when next required.

The above is genuine and uncorrected; we receive many of a similar nature.

Why?—Hobstock & Son Ltd., 1 Westbourne Terrace,
Park Rd., London, S.E. 23 (7799).

E.C.O. C.D. All mains Units, hardly used: 25/-, A.F.S.
£2; F.M. 1, 9/-, near Orgaa coils; new; 11/-, Fos.
D.C. eliminating, 15/-; Cosmos A.G.L. 18/-; large
assortments of high class condensers, coils, valves,
transformers, chokes, resistances, etc., both used
and new; to be cleared: for lines.—Reston
Green Lane, Thornton Heath, Surrey (7799).

MILLARD H T. Unit, new 24/-, O.P. 3C. 10/-;
Utility Spools, 4/6; Milliard 100,000 resistance
9/-; head-phones, 5/-; Brown's reporter; 8/-; D.P.P
10/6; R.S. 20/6; £/-: 220 P, 7/-; Lodge, Crookhill
Hall, Courtenaud, Aberdare (7794).

CONTROL Your Receiver from that Other Room by
Means of the Foolproof and Inexpensive Vary
Relay, no maintenance or attention; model
for battery operated sets, £3/6 post free; mines models
7/6; 25/6: £/-; stamp particular.—Varr, 1, Eccles
Old Rd., Manchester (7795).

BANKFIELD Stock, guaranteed—Dohler B.C.
2 units, 5/6; transformers, Taked Radioform
y.—Norman, Nicoll 11, 7/-; R.I.
transformer, 15/-; Ready Radio selectivity units, 15/-;
B.T.H. 'phones, 2/-; — both; order or c.o.d.;
satisfaction or money returned.—Simpson, 36
Northampton (7776).

BLUE Spot 88A Unit, as new, 17/6; Blue Spot
Chassis 8/6; B.S.A. Knees, 5/6;—Edison Bell
pick-up, 19/-; Mullard’s new P.M. 24, £2.6;—
15, Hawkeswood Mill Lane, Northfield, Birmingham
(7791).

APPLEVI’s Bargains.
END of Year Clearing.—The following slightly used
material is offered subject to price; every article will
be severely tested before despatch, and guaranteed in
workable condition; the following items quoted are
for sale at reduced prices:—

END of Year Clearing.—L.F. transformers: Ferranti
8/6 each, second grade 2/-; limited number: Ferranti
A.F.S. as new, 15/-; second grade 15/-, limited number:
Ferranti A.P.E. 12/6 each; Marconi Ideal, 2/6 to 1, 17/-;
each; Universal, 1/-; limited number; small A.F.
Marconi, 9/- each; R.I. straight-line transformers,
£3, cost £20; meters, coils, transformers, H.F. chokes,
condensers, leak, resistances, switches, etc.; send
requirements; call evenings.—7/-, Lavender Square,
W.11 (7804).

END of Year Clearing.—Variable condensers: Grundon No. 4, 5/-; F and Log, 0.005 and 0.0065, 9/- each; as new; second grade, 5/-
each; brick, contact motor, 5/- each; in lots of
two or more post paid; singles, postage 6d. extra;
next week.

APPLEVI’s, Number Forty-four, Chapel St., Mary-
lebone, N.W.1 (four minutes from Oxford Circus)
(0216).

How to sell a Portable!
For the sale or purchase of Portable or other Receivers use the Miscellaneous Columns of
‘The Wireless World.’ A recent advertiser writes as follows:

“I am very satisfied with the results obtained. The Portable set
was sold the same day, and I had over twenty other replies,
including prepaid Telegrams. I also had a large number of callers,
and altogether am very pleased with the pulling powers of your
valuable paper.”

M. A. Frost,
54, Clerkenwell Road,

W.W. 83.

Response!
A recent adverstisement in ‘The Wireless World’ series —

“I should like to inform you of the wonderful response to
my advertisement in ‘The Wireless World.’ I have
received no less than 20 applications for the
Ferranti and Marconi Transformers and many
of the other goods have been sold.”

W. H. Trevely,
60, High Street,
Erlith, Kent.
ALEXANDER BLACK.

To date, gramophone pick-ups, eliminators, and Webson

PLEASE Note New Address.

EASY Payments.-We

by Radio Society of Great Britain and Wireless League;

world-wide organisation waiting to help you, whether you

truth.-Full particulars free from Ernest H. Robin-

and advice which will have it. If you are

Full particulars free from Ernest H. Robin-

with your or our components, guaranteed Short

eering.

exams., and outlines home study courses


details

No Pay-

of

we have satisfied customers

all Continents;

Butter job you owe

£400, £500 per year and more.

ENGINEERS.-Can't we

three Continents,

remember,

three Continents;

in

CABINET. 2d.

21d.

3.11P

REPAIRS Returned Post Free,

REPAIRS Returned Post Free,

hires, or loud-speaker repaired and despatched within

4 or 5 days, short diode if best estate terms to trade.-Transformer Repair Co., (Dept. W.),

LONDON, E.C.4.-Free advice and handbook on

AGENCY, Ltd., 146a, Queen Vic-

454, Vauxhall S.W.1 Bridge

Marconiphone Moving Coil Cabinet, oak or

by Appointment Without obliga-

to date, gramophone pick-ups, eliminators, and Webson

WIRELESS Notes.—A monthly service of informa-

tion for all those who want the very best in

WIRELESS Notes.—A monthly service of informa-

and advice in all difficulties; something new and

efficiency. you will find it.

EASY Payments.-We

of our components, guaranteed Short

in

must work, find what it.

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of our components, guaranteed Short

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AGENCY, Ltd., 146a, Queen Vic-

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Marconiphone Moving Coil Cabinet, oak or

by Appointment Without obliga-

of

we have satisfied customers

all Continents;

Butter job you owe

£400, £500 per year and more.

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in

CABINET. 2d.

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Butter job you owe

£400, £500 per year and more.

ENGINEERS.-Can't we

three Continents;

remember,

three Continents;

in

CABINET. 2d.

21d.

3.11P

REPAIRS Returned Post Free,

REPAIRS Returned Post Free,
You cannot afford to use any but the best Condenser in an eliminator circuit.

HELSBY CONDENSERS
are made and guaranteed by a firm with 30 years' experience in condenser making, from small telephone and radio condensers to Power Condensers weighing upwards of 2 tons. Guaranteed working voltages:

- **Type M**: 150 volts D.C.
- **Type 2A**: 350 volts D.C.
- **Type 3A**: 450 volts D.C.
- **Type 4A**: 600 volts D.C.

All Helsby Condensers are vacuum dried and impregnated with a special non-hygroscopic material which renders them moisture proof.

It unobtainable from your dealer, write to us giving his name and address.

BRITISH INSULATED CABLES LTD
PRESfoot - LANCs.
Makers of PREScot and HELSBY cables

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
Radio Week

Go home and listen with Osram valves

One of the famous Osram Super Power Valves will make the programmes louder, clearer and more life-like.

"TENACIOUS COATING"

Made in England
Sold by all Wireless Dealers


Colonial and Foreign Agents:


AUSTRALIA—Gordon & Gotch, Ltd., Melbourne (Victoria), Sydney (N.S.W.), Brisbane (Queensland), Adelaide (S.A.), Perth (W.A.), and Launceston (Tasmania).


NEW ZEALAND—Gordon & Gotch, Ltd., Wellington, Auckland, Christchurch and Dunedin.
Supreme precision in construction allied with outstanding genius makes McMichael Receivers without equal for results achieved.

Such perfection results in ideal selectivity, enabling the maximum number of stations to be obtained without interference, and with greater volume than usual.

The McMICHAEL
SUPER RANGE PORTABLE FOUR


CASH PRICE
22 GNS.

(Including all Equipment and Royalties), or by our special "Deferred Payments on Hire Purchase Terms" system, £5 down and 10 monthly payments of £2119.

Owing to the high degree of selectivity in this, and our other Screened Grid Portable Receivers, we are able to guarantee complete selectivity between all main B.B.C. stations under the new scheme of wavelengths.

The ideal combination of the latest valves and the most advanced circuit for portable and self-contained receivers—hear the McMichael Super Range Four (either model) demonstrated at any high-class radio store, or call at our London Showrooms.

The McMICHAEL
SUPER RANGE FOUR (Table Model)

Containing a circuit of exactly similar design to that of the Portable Model, but fitted in a handsome Walnut Cabinet, mounted on a turntable. Designed with a self-contained frame aerial, this receiver is intended for use in the home where an outdoor aerial and earth are not necessary or desirable. An additional aerial and earth can be used to add to the normal and very remarkable range.

CASH PRICE
26 GNS.

(Including all Equipment and Royalties.)
THE TRANSFORMER THAT PUT A1 IN RADIO

Telsen Transformers have set a standard of performance second to none in the history of Radio Component manufacture. They give equal rendering of the Treble and Bass notes and have been accepted as standard by many of the leading Set Manufacturers. Fit one in your set—notice the perfect rendering of all notes throughout the entire musical range; you will then appreciate Wireless in all its glory.

Radiogram 12/6  Ace 8/6
Ratios 3-1 & 5-1.  Ratios 3-1 & 5-1.

TELSEN ELECTRIC CO. LTD.
Miller Street, Birmingham.
THE NEW CELESTION LOUD SPEAKER
MODEL Z.20

PERCY HARRIS, a foremost radio expert, writes in the "Wireless Constructor"—"Z20, renowned for brilliancy and quality... speech and music particularly good... a handsome instrument."

Gloriously realistic in tone... holding undisputed rank as the finest of all loud speakers.

Model Z.20 is designed specifically to give the finest possible results with any set from a Two-Valve to a Power Amplifier. Crowned with the Celestion hallmark—a beautifully designed and hand-polished cabinet.

In Oak £7.15.0.
Mahogany £8.5.0.
Walnut (to order) £9.0.0.
Other Celestion models from £3.15.0.

CELESTION
The Very Soul of Music

WRITE FOR AN ABSORBING FREE BOOK ON "SOUND RE-CREATION"

London Showrooms:
106, Victoria Street, S.W.1
Write to: Celestion Ltd., Dept. C
Kingston-on-Thames

CERTAINLY EXPERIMENT WITH YOUR SET

BUT NOT WITH THE COMPONENTS

Always use the best—

BENZAMIN

VALVEHOLDERS.

Clearer Tone 2/-
Vibrolder 1/6
5-Pin Holder 1/9
Pentode 2/3

SWITCHES.

Push-Pull 1/3
Rotary 1/9

TURNTABLE.

Ball-bearing and equipped with hinged and folding legs 7/6

Send P.C. for fully illustrated leaflet No. 2003.

THE BENJAMIN ELECTRIC LTD.
BRANTWOOD WORKS, LONDON, N.17
An "all-mains" receiver constructed in **15 MINUTES**!

**WITH THE LEWCOS 3 VALVE KIT**

Eliminating troublesome complications, the Lewcos 3 Valve Kit, designed for use with either D.C. or A.C. valves, enables a safe and satisfactory all-mains receiver to be built in fifteen minutes. Highly satisfactory results of quality and strength, combined with selectivity and sensitivity, are provided by this receiver.

**SEND TO-DAY FOR BOOKLET R.58.**

This free booklet fully describes the construction, assembly, working and performance of one of the most efficient circuits ever conceived.

**LEWCOS REGD.**

**3 VALVE KIT**

THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LIMITED
Church Road
Leyton
London, E.10

Trade Counter: 7 Playhouse Yard, Golden Lane, London, E.C.1

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
Use a **NON-SPILLABLE battery** in your home ~

It is so fatally easy for a few drops of acid to spill when changing over ordinary low tension accumulators. You may already have experienced the vexation of discovering damage to carpet or furniture on which acid has dropped.

The C.A.V. Non-spillable accumulator contains acid—but in a jellied form. You cannot spill it, and it does not flow, so you can use it in any position. Because of its advantages over the free-acid type of non-spillable accumulator, its compactness, its safeness, it is the ideal battery for portable receivers. It is also the battery to relieve you of all anxiety. Why not use one with your home receiver?

Our latest Radio Battery catalogue No. T3 will gladly be forwarded upon application.

We have recently introduced an entirely new range of rechargeable high tension accumulators—built like car batteries. May we send you details?

---

**NEW ELECTRAD SUPER-TONATROLS**

These new Electrad variable non-inductive high resistances will safely operate a week at any position of the contact, and the contact remains in the same position even if the resistance elements are shorted. The all-metal construction with the graphite resistance element fused into an aluminium base obviates the necessity of using either a non-current paper element or flat wire.

The action is amazingly smooth, long lived and both mechanically and electrically perfect.

The Super-Tonatrols embody new ideas of proved merit with generous factors of safety which more than fulfil all expectations.

These resistors are made in seven resistance ranges, taking care of all possible requirements.

<table>
<thead>
<tr>
<th>Resistance Range</th>
<th>List Price</th>
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</thead>
<tbody>
<tr>
<td>3 A, 25,000-ohm potentiometer</td>
<td>1/2 each</td>
</tr>
<tr>
<td>2 A, 10,000-ohm potentiometer</td>
<td>1/2 each</td>
</tr>
<tr>
<td>2 A, 5,000-ohm rheostat</td>
<td>1/2 each</td>
</tr>
<tr>
<td>4 A, 10,000-ohm rheostat</td>
<td>1/2 each</td>
</tr>
<tr>
<td>4 A, 100,000-ohm potentiometer</td>
<td>1/2 each</td>
</tr>
<tr>
<td>3 A, 25,000-ohm pick-up volume control</td>
<td>1/2 each</td>
</tr>
<tr>
<td>2 A, 50,000-ohm fourth terminal pick-up fader volume control</td>
<td>1/2 each</td>
</tr>
</tbody>
</table>

Write for full particulars to

**ROTHERMEL CORPORATION Ltd.**

24, MADDOX ST., LONDON, W.1.

Phone: Mayfair 0578-9.

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**MINIMUM LOSS**

Hard and tough, almost unbreakable, “Atlas” Pirtoid Tubing is a unique and far superior material for High Frequency Transformers, Aerial Coils, etc.

Drills and taps like hard wood or bone. “Atlas” Pirtoid Tubing can be obtained in any usual diameter, thickness of wall and length.

---

**ATLAS PIRTOID TUBING**

Write for full particulars to the Sate Makers:

H. CLARKE & Co. (MCR) Ltd.,

ATLAS WORKS,

OLD TRAFFORD, MANCHESTER.

---

**PIRTOID TUBING**

Write for full particulars to

H. CLARKE & Co. (MCR) Ltd.,

ATLAS WORKS,

OLD TRAFFORD, MANCHESTER.

---

**All Position-Non Spillable Batteries**

---

**NEW ELECTRAD SUPER-TONATROLS**

The Original Jelly Acid Battery Perfect for Portables

---

**MINIMUM LOSS**

Hard and tough, almost unbreakable, “Atlas” Pirtoid Tubing is a unique and far superior material for High Frequency Transformers, Aerial Coils, etc.

Drills and taps like hard wood or bone. “Atlas” Pirtoid Tubing can be obtained in any usual diameter, thickness of wall and length.

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ATLAS WORKS,

OLD TRAFFORD, MANCHESTER.

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**PIRTOID TUBING**

Write for full particulars to

H. CLARKE & Co. (MCR) Ltd.,

ATLAS WORKS,

OLD TRAFFORD, MANCHESTER.

---

**All Position-Non Spillable Batteries**
Go home and listen to the MADRIGAL

Here at last is a musical instrument so near to perfection that reproduction, whether of a full orchestra or individual soloist, is so faithful that it is difficult to realise that the invisible ether alone is the sole medium between the "Madrigal" and the source of transmission. Eminent musicians and scientists agree that the "Madrigal" will be standard radio for many years, and they are safe in their decision.

The moving coil loud speaker within the pedestal has been selected for its perfect fidelity in reproduction of all sounds within the frequency range of Broadcast transmission. The absence of any aerial or earth, or even a frame aerial for the local station and Daventry, makes the instrument non-directional. The rubber-tyred castors enable it to be wheeled into any room at will, and a single connection to any lamp-holder or power point provides all the power. There are no batteries dry or wet.

The consumption of current is ridiculously low: less than a 50-watt lamp for both speaker and set. The cabinet work is a delight to the eye.

It is impossible here to give more than a brief survey of the many points which are of interest to every Radio Listener, but you can learn all about the instrument by asking your dealer for one of the artistic coloured folder of the "Madrigal," in which are included the latest test reports from the Press. That you will ask for a demonstration after reading it, is inevitable.

The MADRIGAL The Instrument with the Golden Voice

The "Madrigal" Receiver only, in walnut or mahogany, handsomely figured and polished. Price, including all valves and royalties, for A.C. or D.C. Mains - £30 : 0 : 0
Pedestal only, with moving coil loud speaker for D.C. - £15 : 15 : 0
Pedestal only, with moving coil loud speaker and rectifying equipment for A.C. - £18 : 18 : 0

Advertiements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
**FOR ELIMINATOR CIRCUITS**

You cannot afford to use any but the best Condenser in an eliminator circuit.

**HELSBY CONDENSERS**

are made and guaranteed by a firm with 30 years' experience in condenser making, from small telephone and radio condensers to Power Condensers weighing upwards of 2 tons.

Guaranteed working voltages:

- **Type M**: 150 volts D.C.
- **Type 2A**: 350 volts D.C.
- **Type 3A**: 450 volts D.C.
- **Type 4A**: 600 volts D.C.

All Helsby Condensers are vacuum dried and impregnated with a special non-hygroscopic material which renders them moisture proof.

If unobtainable from your dealer, write to us giving his name and address.

---

**BRITISH INSULATED CABLES LTD**

**PRESCOT - LANCs.**

Makers of PRESCOT and HELSBY cables

---

**FIT THE DUBILIER BATTERY**

Fitted with the long-life Dubilier Battery, your Set will give better quality performance over a longer period. And it costs less! **7/9** Other Voltages Available.

Ask your dealer for a copy of the Dubilier Booklet—"A Bit about a Battery."

**DUBILIER CONDENSER CO. (1925), LTD.,**


---

**DONOTONE**

**THE BEST LOUD SPEAKER**

From 5 Gns.

The wonderful Loud Speaker with the tuned gongs which impart crispness and brilliance together with real purity and increased volume.

**DEMONSTRATIONS DAILY.**

**THE DONOTONE (Regd.) LOUD SPEAKER,**


Phone: HOLBORN 9293.

---

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
REPLACE IT WITH A BURTON!

Every Burton component embodies every latest improvement! It is at Burton’s Progress Works where these improvements are first discovered, first experimented with and first utilized —others follow. Examine your set! Replace any defective part with a Burton!

BURTON REACTION
CONDENSER.
Base-board mounting type. Price 4/-

BURTON DIFFERENTIAL
CONDENSER.
A new addition to the famous range of Burton Condensers. Scientifically designed, brass vane, interleaved with Bakelite leaves, this condenser makes shorting an impossibility. It means easier tuning, better selectivity and better detection. The price is only 5/-

BURTON BATTERY
SWITCH.
Super finish, with Ebonite knob and Nickel Plate. Price 1/- With metal knob Price 9d.

BUY BURTON
COMPONENTS

BURTON RESISTER
CONTROLS.
Supplied in 3, 6, 10, 15, 30 and 60 ohm resistances. Price 2/9

The FERRANTI
A.C. Mains Receiver

PRICE, including Valves:
In Oak £25. In Mahogany £26. In Walnut £26
Royalty £1 extra.

Handsome both in appearance and in the sense that ‘handsome is as handsome does’; for the reproduction is very nearly true to life, and manipulation is of the simplest.

Available for Alternating Current only.
Voltages: 200/250, 40 cycles or over.

FERRANTI LTD. HOLLINWOOD LANCASHIRE

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
IF YOUR SUPPLY MAINS ARE D.C.
You can use an A.C. All Electric Receiver
By Employing The M.L.—D.C. to A.C.

ROTARY TRANSFORMER

Can be supplied to run from any Voltage
12-250 V. D. C.

Recommended and used by
Philips Radio,
Marconiphone,
Burndect,
Kolster-Brandes,
M.P.A., Etc., Etc.

40 WATT Model
£13.0.0
85 WATT Model
£19.0.0

M-L MAGNETO SYND. Ltd., Radio Dept., COVENTRY.
Telephone: 5001.

DURING RADIO WEEK

Will Day Ltd., as always, are co-operating with British Radio manufacturers, and all wireless receivers, component parts and accessories can be obtained immediately. Deal with a firm that has a real British reputation second to none.

ALL MAINS RECEIVERS

- Dubilier - (3-valve) £25
- 39. Marconi - (3-valve) £21
- Lotus - (3-valve) £21

ALL TYPES OF LOUD SPEAKERS SETS PORTABLE RADIO-GRAMS

supplied on easy payments. Details and catalogue on request.

WILL DAY LTD.
19, LISLE ST., LONDON, W.C.2.

*Phone: Regent 0921-22.


Mention of "The Wireless World" when writing to advertisers, will ensure prompt attention.
All who prefer Quality in Cigarettes

Say Player's Please

5 for 3d. 10 for 6d.
20 for 11d.

Pertrix once —

Pertrix always

The Battery without CRACKLE

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A WIRELESS LICENCE SCANDAL.

A wireless receiving licence costs but 10s. a year, and this is not a large sum when we consider the hours of programmes to which it entitles us. The Wireless World has always supported the authorities in their insistence that the licence be regularly paid, and we have approved of the attitude of the Post Office in bringing to book those who deliberately neglect to pay the annual fee. We have gone to considerable trouble to explain to readers who have written to us, and we have also published an interpretation of the regulations concerning the use of more than one wireless set in the same building.

Our Statement Officially Approved.

The Post Office has officially approved of the wording of the paragraph in which we have expressed the position as follows: "A single receiving licence will cover the installation of more than one set, provided that the sets are all in the same house, flat, etc., that is to say, tenants of separate flats or sub-let premises in the same building are not entitled to share the benefits of one licence, nor may extensions be made from a licensed set whereby the occupants of other houses, flats, etc., may listen without taking out separate licences."

In view of this statement of the position officially approved by the Post Office, we were astonished to read in the daily Press recently that the Post Office had agreed that a single 10s. licence was sufficient to cover a wireless receiving installation which supplied 200 separate luxury flats apparently for the reason that they happened to be all within one building.

An Irregular Decision.

We cannot believe that this is a proper interpretation of the licensing position, and we draw special attention to this case because we feel that it should at once be looked into by the Post Office, and, even if fresh regulations are necessary to meet the situation, they should be made in order that individual tenants of the flats may be called upon to pay separate licences for broadcast listening.

We believe that legally the Post Office would find it difficult to enforce the payment of a licence fee on apparatus capable of receiving wireless broadcasting but which, in fact, was not being used by the owner for that purpose. This seems to point to the monopoly of the Post Office covering the use of apparatus for the purpose of listening rather than the ownership of the apparatus, so that we contend that in a building where one receiving set is installed it is even more important that the licence be paid by those residents in the building who have separate loud speakers or telephones which they use for the purpose of listening than that the receiving installation itself should be licensed. Furthermore, it might be argued that under the Telegraphy Act, 1869 (Sections 4 and 5), the Post Office is entitled to a rental in respect of the extension lines to the individual flats.

If the Post Office attempts to justify their action in accepting one annual payment of 10s. for a licence for the installation in question which supplies 200 luxury flats, then we regard the position as little short of a scandal. The cottager and even the family living in one room is, under the present regulations, required to pay the 10s. licence, however difficult it may have been to raise the necessary money for the wireless set and to pay the annual licence, and, this being so, why should residents in luxury flats enjoy the advantages of broadcast reception with first-class quality from an ideal and expensive receiving set without being called upon to contribute in any way towards the cost of programmes, whilst the poorer members of the community enjoy no such privilege?
W HILE it is now nearly three years ago since this journal first introduced moving-coil loud speaker designs little attention has been drawn to the possibility of dispensing with the field-energising current by the adoption of permanent magnets. In consequence the moving-coil loud speaker is restricted in its use to where electric supply mains are available, as the current demanded by the electro-magnetic field cannot be maintained by a portable accumulator. Attempts to use permanent magnets have proved unsatisfactory inasmuch as the flux density produced has invariably been inadequate. There is little point in using a weak field and hoping to make up for the loss of signal strength by the use of a generous winding on the moving coil, fed with the output from several parallel-connected power valves. In so doing the behaviour of the loud speaker may become less linear over the frequency range due to an increase in the mass, inductance and capacity of the winding, the current consumed by the output stage can only be provided by the use of supply mains, while the smallness of the gap and the largeness of the coil impose a limit beyond which one cannot go.

A minimum flux density of 10,000 lines to the square centimetre has been assessed in respect of the electro-magnetic type of field, and to produce this value in a gap of sufficient width and area requires a field winding dissipating up to some 30 watts. In this case the gap has a width of \(\frac{1}{8}\) in. and an area of about 20 sq. cms. To halve the width of the gap about one quarter of the field wattage is needed to produce the required field strength. Similarly with permanent magnets, to halve the area of the gap will nearly double the amount of available magnetic flux, while to halve its width will, in a well-designed magnet, increase the flux nearly four times. A compound permanent magnet that is intended to produce a high flux density across a small gap is by no means easy to design. Special forms of cobalt steel must be utilised to create the necessary high flux within a magnetic circuit of reasonable size and cross-section. Precautions must be taken to ensure that the flux can be carried by the iron where the cross-section narrows towards the gap, while the magnetic leakage is governed by the shape, and saturation is kept to a minimum so that the field is concentrated within the space to be occupied by the moving coil. Many instances have come to the writer's notice of attempts to construct a compound permanent magnet in which it was hoped that the total flux when added would produce the required density at the gap. Measurement has shown, however, that the flux density is much lower than was anticipated, while the performance of the finished loud speaker was inferior in quality to an electro-magnetic type working from a given output stage.

It was not until the Exhibition of last September that attention could hopefully be turned to the possibilities of a reasonably compact permanent magnet. Many readers must have examined with interest the moving-coil loud speaker magnets, then just produced, and shown at the stand of Swift Levick. These magnets

![Permanent magnet with 1.5 mm. gap and fitted with soft iron pole pieces. Flux density 8,000 lines to the sq. cm.](image)

Permanent Magnet Moving Coil Loud Speaker.

were of only moderate size, of unique shape as regards casting and machining, and were stated to possess flux densities of the order of 5,000 lines to the square centimetre. Subsequent development by way of a small increase in size and cross-section, minor modifications in shape and the insetting of mild-steel poles to convey the concentrated flux to the gap, has now resulted in the production of magnets of assured flux density of 8,000 lines to the square centimetre when the gap width is 1.5 mm. and the area 7 sq. cms. This area permits of a pole diameter of 11/4 in. with a gap length of 1/4 in. We now have a permanent magnet which promises to satisfactorily replace the electro-magnet. As width of gap has so great an effect on flux density the dimensions decided upon must be no larger than is required to just accommodate the coil. On the other hand the reduction of diameter reduces the area of the gap, with consequent increase of flux, but the number of turns on the moving coil must be increased in proportion to the reduction of their diameter.

Coils for Small Gaps.

Our problem is now that of filling the gap to the utmost with the moving-coil winding, for if there is any space to spare this should obviously be taken up by decreasing the width or area of the gap. There is no question that the best method is that of building the moving coil as a single layer of edge-wound strip, as has long been done by the Gramophone and Western Electric Companies. Somewhat special tools are required to effect this, but the resulting coil is exceedingly stiff, requires little support, and can be relied upon to maintain its shape. For lightness the strip used may be aluminium, carrying a single covering of silk or enamel, wound so that it stands edgewise on its former. Another winding that suggests itself is three layers of No. 36 enamelled wire, operated like the strip-wound coil, through an output transformer. For the home constructor there is another possibility in that with reasonable care he can wind a high-resistance coil, thus obviating the dangers of distortion incurred by the output transformer. A high-resistance coil designed to handle a given value of signal watts occupies a slightly greater volume than the corresponding low-resistance winding actuated...
Permanent Magnet Moving Coil Loud Speaker.—

through a transformer owing to the increased ratio of insulation and space to conductor. Nevertheless, there is just sufficient room for a high-resistance winding possessing the maximum number of turns for the undistorted power output specified for a valve that will give ample volume for home conditions.

Test reveals that a 1,300-turn coil of No. 48 enameled wire gives practically faultless results when fed from a P.625 valve. It is owing to the fact that No. 48 enameled wire is the finest that can be conveniently handled that it has been adopted, though its signal-carrying capacity is considerably in excess of that produced in the anode circuit of the P.625 valve. Incidentally, the output from a valve such as the L.S.6A can be carried by the winding. It might be noted here that the vast improvements that have taken place in the past year in the power output of L.F. valves makes it possible to produce adequate signal strength with less distortion, coupled with a more compact moving-coil winding.

A thin paper ("detail paper," thickness 0.004in.) former is constructed to carry the winding. It is made exact to size by wrapping round a smooth brass cylinder. Dimensions for cutting out the paper, which should be of a thin, smooth, non-shiny variety, are given in the diagrams. Two layers are wrapped round the brass cylinder, a thin coating of seccotine completely covering the faces which adhere together. Seccotine must be kept away from the interior and outside surfaces to obviate the sticking of the former to the cylinder and to permit of a subsequent treatment with shellac varnish before winding on the wire. As the turns are to be put on in a bank-wound fashion across the former, and not layer by layer, the cross-over lead of No. 42 or 44 wire is taken through under the end of the paper before sticking on the end strips which form a support to the winding.

A spindle and crank handle such as can easily be made up is used to rotate the cylinder, and care must be taken to see that the former and end pieces run true on the cylinder or otherwise the wire may ride over the edges when winding is
Permanent Magnet Moving Coil Loud Speaker.—

The reel carrying the No. 48 wire is lightly mounted in line with the former and away from the operator. By the use of fine "blue-back" emery the enamel covering of the wire is removed and is lightly soldered, without need for twisting, to the lead out wire already provided. Allowing the wire to lightly pass through the fingers of the left hand and turning the crank with the other 200 turns are run on into one-sixth of the winding space. With care there is little danger of breakage, and a magnifying lens is useful for examining the condition of the winding. Owing to the careful attention required in handling the wire it is helpful to note down each 100 turns as completed in order to guard against an error in counting. If on completing the winding space there is room for another 100 turns, or if the former is filled with 100 turns short of the required number, there is no need to leave a space or, alternatively, to cramp the turns, but to aim at filling the former with an approximate winding. Test the former frequently to make sure that it can be released from the smooth brass centre-piece. Test the winding, also, for continuity, on completion, with a milliammeter and 1.5-volt cell. The current will be 0.75 mA. It is worth while making a pair of coils while the winder is set up.

Right Angle Cones for 1.5 mm. and 2 mm. Gaps.

Impregnate the winding with good shellac varnish, leaving it on the cylinder to dry and frequently sliding it to ensure freedom, taking care not to burr up the ends of the former or to crush it while forcing it free. When thoroughly dried out in front of a fire cover the winding, end-pieces with a single layer of shellac impregnated absorbent tissue paper. What is known as "two sheet" (thickness 0.010in.)

Details for cutting out the diaphragm. The centre hole has a larger radius when used with the magnet having a 2 mm. gap.

"Bristol" board still proves to be one of the best materials for the construction of the diaphragm. The edges to be secured together are bevelled and roughened with a smooth file. A stick of wood with a saw-cut end is used to turn over the front for attaching to the surround. With a pair of sharp side-cutting pliers the points are made on the end of the former at intervals of about 1 μ, taking care not to injure the leading out wires. While held on the brass cylinder shellac is removed from the outer face of the points, and these are then roughened with the file. A tight fit should result when the former is brought up to the diaphragm, and, assuming the end ring has been carefully mounted,
**Permanent Magnet Moving Coil Loud Speaker.**—
the axes of coil and diaphragm will coincide. While still holding the coil with the aid of the brass cylinder the joints are turned back on to the seccotine-coated rim of the diaphragm, and after, perhaps, a quarter of an hour they will be found to hold in position. The blade of a penknife can be used to press them down, following round from point to point until the seccotine has hardened. One loose or split point will give rise to rattle.

A pair of cardboard rings are cut and secured with seccotine, coinciding on the two sides of the surround material. While leather is still regarded as one of the most satisfactory materials for constructing the surround thin rubberised cloth ("Britcam") is used in this instance as it is convenient to work and can be made to lie flat without tensioning. With the card rings securely fixed the diaphragm is attached concentrically, the edge being "ironed" down. When dry, cut a rough hole in the centre of the rubberised cloth and then follow round carefully with the sloping edge of a razor where diaphragm and surround meet, being careful that the grain in the cloth does not cause the edge of the razor to wander from the circle. In planning the diaphragm and its aluminium flange allowance has been made to permit of the insertion of spacing washers so that the coil winding can be brought centrally within the gap.

The provision of centring is, of course, essential in so small a gap. Any form of attachment by paper spider effectively ties down the movement of the coil, and if loosely mounted is of little use. The centring adopted consists of a brass ring and baize pad so that the coil actually rides on the edge of the baize which fits into the centre of the coil former. This form of centring does not produce an increasing restriction on the movement with increase of amplitude. At the same time it allows the coil to take up a position in the gap as determined by the surround apart from the centring device. Leading-out wires are seccotined down to the sides of the diaphragm under strips of tissue paper some $\frac{1}{4}$ in. in length and then taken on to terminals carried in insulating bushes on the aluminium frame.

To ensure good results attention must be given to the circuit of the receiver, and experience shows that a single H.F. stage with either neutralised triode or screen-grid valve, transformer-coupled to an anode-bend detector and followed by a resistance-coupled L.F. stage, is about the best when using a good outside aerial. This circuit, with suitable values, is given. Such a set is a local-station receiver, and it will quickly be realised that good-quality reception cannot be obtained from distant stations if only for the reason that a sensitive set introduces background noises. Owing to the impedance of the loud speaker being somewhat low in value, the use of a pair of parallel-connected output...
Permanent Magnet Moving Coil Loud Speaker.—

valves gives an appreciable increase in volume. Two
P.625 valves produce a sensitive output stage in view
of the comparatively high amplification factor and the
relatively low impedance. If the grids are fully loaded
the power output of the pair of valves is nearly two
watts when combined with the moving coil described,
while with a single valve this output is more than

halved.

To those accustomed to the use of a moving-coil loud
speaker where the field excitation is derived from a
rectifier this loud speaker is to be specially commended.
Although the background ripple coming from a rectifier
used to energise a field magnet may be practically
inaudible, its removal makes a vast difference to the
quality of reception, particularly as quite large 50-cycle
amplitudes may be built up without an appreciable
sound resulting. Moving-coil loud speakers are, more-
over, particularly responsive to these low frequencies,
whereas a reed-driven cone invariably gives no response
below 100 cycles. Tested over the frequency range
with audio-oscillator and calibrated microphone using
valve voltmeter as a means of measuring the ampli-
tudes transmitted and received, the finished speaker
reveals a characteristic as good as any other model,
possessing, at the same time, the well-defined brilliancy
only to be found in speakers of the moving coil type.
The base response is as good at 40 cycles as at 200,
while a falling off does not occur until a frequency of
6,000 is reached, which is a condition with all types
of loud speakers and, incidentally, of the associated
amplifier as well.

AN OPTICAL PICK-UP.

The drawing illustrates an ingenious method of converting the mechanical
movements of a gramophone stylus into a fluctuating electrical current, corre-
sponding to the movements of the stylus S as it follows the track of
the gramophone record. The movements of the light reflected back on to the cells
G from the "spot" mirror, thus

of the light reflected back on to the cells
G from the "spot" mirror, thus giving rise to corresponding current
changes in the circuit of those cells. The component parts shown are all mounted
on the tone arm.

INDIRECTLY HEATED VALVES.

The sensitised cathode of a valve is
energised by heat generated when the current from A.C. mains is applied to a
condenser of which the cathode forms
one plate (Patent No. 307,225). A highly
refractory dielectric is used, such as zir-
conia, thoria, or silica. The sensitised
cathode is in the form of a tube contain-
ing the dielectric, which contacts in
turn with two semi-cylindrical metal
plates to which the alternating mains
voltage is applied. The arrangement in
effect forms two condensers arranged in
series, the external cathode being the
common or central plate, so that it re-
mains at a constant potential.

In another arrangement (Patent No.
307,326) the sensitised cathode is heated

RECENT INVENTIONS
OF WIRELESS INTEREST.

by ionic bombardment set up across the
gap between its inner surface and a cen-
tral auxiliary electrode, the A.C. mains
being directly connected across the two.

The tubular cathode forms an electro-
static screen for the other electrodes.

SAFEGUARDING POWER
OSCILLATORS.

During normal operation the passage
of grid current automatically maintains
the grid of a transmitting valve at a
safe negative bias. Should the valve
cease to function, the negative grid
charge tends to disappear, and if no pre-
cautions were taken this would in most
cases cause the transmitter to burn out.
In order to prevent such a contingency,
the arrangement shown in the figure has
recently been protected (Patent No.
308,085).

The ordinary grid condenser C and
grid leak G L are supplemented by a
choke L, and by one or more discharge
tubes D, D', designed to flash over
at a voltage corresponding to the mini-

num "safe" grid potential of the
oscillator valve O. So long as the trans-
mitter is in operation the correct working
grid bias is maintained, any excess volt-
age escaping via the tubes D-D'. Should
the valve cease working, so that the
grid current stops, a rectifier valve R comes
into action and provides sufficient
negative grid bias to prevent any damage
to the power valve.

A CONSTANT-COUPLING CIRCUIT.

It is well known that in the ordinary
type of back-coupled receiver the coupling
factor tends automatically to increase for
the shorter wavelengths, and to fall off
for the longer waves, even if the spacing
between the two coupling coils is main-
tained constant. A simple method of
ensuring a constant degree of reaction in
this type of receiver, even over a wide
variation in tuning, is illustrated in the
accompanying diagram (Patent No.
283,121).

The plate or reaction coil L, is shunted
by a resistance R in series with a con-
denser C,. When the input circuit LC
is tuned to a short-wave station, the
shunt circuit R C, tends to bypass a
larger proportion of the plate current
than when the set is tuned to a long-
wave station. The effective current
flowing through the reaction coil L is
accordingly regulated so as to offset
automatically any fluctuation in the de-

gree of reaction as the tuning of the
input circuit is altered.

A 21
Hints on the Operation of Ganged Filter Circuits.

By W. T. COCKING.

(Concluded from page 35 of previous issue.)

In Fig 6 are given full details of the medium-wave coils which have been used in experiments with the band-pass filter. While it is not claimed that they are the best which can be made, in practice they give extremely good results, and they have the merits of being both compact—an important point—and inexpensive. The inductance of each coil is 240 microhenrys, and the calculated H.F. resistance at 500 metres is 5 ohms; the tuning condenser should have a capacity of 0.00035 mfd.

The Use of Trimming Condensers.

Each coil consists of 76 turns of No. 26 enamelled wire on a 2 in. diameter ebonite former. The formers are placed side by side in the position indicated, and as close as possible without the wire of one coil touching the former of the other; and in a position such that the distance between the end turn of one coil and the end turn of the other is exactly one inch. The value of coupling given by this arrangement has been found to be very satisfactory under all conditions; in some cases, however, a different value may give better results, and the effect of varying the coupling should certainly be tried. The two ends of the coils which come together in this method of mounting should, of course, be the low-potential (earthed) ends in order to reduce the possibility of capacity coupling.

In order to obtain the best results from the filter circuit it is essential that the two condensers in each filter be ganged; and, if this is done, there is no difficulty in ganging all the tuning condensers and making a single-control set. Ganging filter circuits is quite a different proposition from ganging the condensers of the usual cascade tuning circuits; the difficulties encountered are the same, but they are present in a very much smaller degree. Slight imperfections in the ganging do not make very much difference to the signal strength; instead, they make the tuning curve asymmetrical.

The greatest difficulty with ordinary tuning circuits lies in the aerial circuit, owing to the extra capacity thrown on to it by the aerial. Since the inductances of all the coils can very easily be made almost identical, the chief point in ganging the condensers of any set is to make the stray capacities across each tuned circuit the same. In the ordinary tuning arrangement this is difficult; each circuit usually has a very different minimum capacity. With filter circuits, on the other hand, the capacities are more evenly divided; indeed, sometimes the circuits are so nearly alike that almost perfect ganging can be achieved without the least trouble.

In certain cases, when volume control is carried out by means of a high-resistance potentiometer shunted across the secondary coil of the aerial filter, it is found that this circuit has the highest minimum capacity of any. Therefore, the capacity across every other coil must be increased; and this is best done by connecting in parallel with each tuning condenser a small adjustable condenser with a maximum capacity of about 50 mfd. In any circuit this method of matching the minimum capacities may be adopted with good results. While it is easiest to connect an adjustable condenser in parallel with each tuning condenser, it is wasteful, for in every case there is at least one circuit in which an extra condenser is unnecessary. By adopting the following procedure it is quite a simple matter to find out which circuits have low minimum capacities, and these are the only ones which need additional condensers: Tune in a station on about 500 metres by adjusting each section of the gang condenser separately. Tighten the couplings between them, and tune in a station on as short a wavelength as possible. Loosen the couplings, and, having noted the positions of the rotors, tune in the station to its best on each condenser separately. That circuit which requires the vanes of its tuning condenser to be enmeshed the least has the highest minimum capacity. Therefore, unless capacity can be
High Selectivity.
removal from this circuit, all the other circuits must have a small condenser connected across them.

The operation of adjusting the capacities of these equalising condensers is quite simple. Set them all at minimum, and tune-in a station on the higher wavelengths (500 metres or so) by altering the positions of the rotors of the ganged condensers. Tighten up the couplings, and tune-in another station at the other end of the scale. This time do not loosen the coupling, but tune it in to its best by the small adjustable condensers. Now return to the longer wavelengths, and

aerial lead a series condenser for adjusting the minimum capacity of this circuit, and to include a different condenser for each waveband.

Tuning Appears Flat with Band Pass Filter.
All these equalising condensers are shown in the circuit of Fig. 7, and also the recommended method of switching for waveband changing. Reaction is shown, but can, of course, be omitted if desired. The reaction winding should consist of a few turns of thin wire, wound at the earthed end of the secondary coil of the anode filter. Care should be taken to ensure that

again tune-in a station by altering the positions of the rotors. Tighten up the couplings and go back to the short wavelengths; tune-in a station on the adjustable condensers. Repeat this until no adjustments are necessary at any part of the scale. Usually it need only be done two or three times, but the oftener it is carried out the more perfect will the ganging be.

The Series Aerial Condenser.
The operation of ganging, if carried out on these lines, is by no means difficult, and, fortunately, once the condensers are properly ganged on the medium waveband, the ganging still holds good when the long wave coils are switched in. This is provided that the long-wave coils all have the same inductance and self-capacity, which is usually the case. The only circuit likely to give trouble in this respect is the primary coil of the aerial filter. There will be no trouble if the aerial winding is suitable, but, unfortunately, this is different for every aerial; the best remedy is to include in the

it has a very low capacity to the tuned winding, otherwise either howling will result on the long waveband or the ganging of the last tuning condenser will be affected. This is not peculiar to the filter circuit, for it will occur with any circuit in which the reaction winding has a large capacity to the tuned grid circuit. On first operating a set employing band-pass filters the results may at first seem a little peculiar. As the single tuning control of a properly designed set is rotated a station will suddenly be heard, it will remain at constant strength over a condenser movement of several degrees, and then, as the control is further rotated, it will suddenly disappear. At first the tuning seems very flat, for when listening to a station quite a large movement of the dial produces little or no change in strength; but on each side of this band the station is suddenly cut out. The effect is due, of course, to the relatively flat-topped tuning curve obtained with these circuits. When trying out a new set it may be said that, after all the condensers are properly ganged, if a station can be tuned-in sharply
High Selectivity.

at one distinct setting of the dial, the coupling between the coils is too loose. On the other hand, if a station can be tuned-in sharply at two distinct settings of the dial the coupling is too tight. The coupling is correct when every station is audible over a small range of dial settings, but cuts off sharply outside that range. If it is noticed that the selectivity is less on one side of a station than it is on the other, it is a sign that the ganging is imperfect; the remedy is obvious.

The most satisfactory layout for a set using filters is undoubtedly one which is more or less symmetrical. The aerial circuit filter can be enclosed in a metal box, and the anode circuit filter in another box of the same dimensions. The layout of components in each box should be the same, in order to keep the stray capacities as far as possible alike in each circuit. The H.F. valve can very well be placed between the screening boxes. With a layout of this kind there is very little danger of instability, due to the anode circuit coils coupling with those of the grid circuit, but it is, of course, necessary to insert the usual decoupling devices in the battery leads.

Remarkable Selectivity and Good Quality.

The writer has found that a set built to the diagram of Fig. 7, with a layout on the lines indicated, gives very good results when followed by a two-stage L.F. amplifier (one R.C., one transformer). The coils used in the experiments were made to the specification given earlier in this article, and all four tuning condensers were ganged. As an indication of the selectivity obtainable, it may be said that with a P.M.12 valve for the H.F. and a slight amount of reaction to counteract the detector damping, Toulouse can be received at full loud speaker strength without any jamming from Brookmans Park, although it is only about nine miles away. This could not be done with the same H.F. valve and two tuned circuits, at the same distance from the old London station. The separation of 2LO from Toulouse is only 58 kc., so this indicates a very high order of selectivity, and the valve used has both a low A.C. resistance and a lower amplification factor than the A.C./S.G., for which the calculations were carried out.

On the long waveband it is not possible to receive Koenigswusterhausen without jamming from both sXX and Radio-Paris. This is hardly surprising, since the separation is only 9 kc., Radio-Paris, however, is quite clear of Daventry. The most noticeable improvement on the long waveband is the exceptionally good quality. On both wavebands the amplification is noticeably less than with the same valve used with only two tuned circuits; this is inevitable, and represents the price which has to be paid for the high selectivity and good quality. The loss in amplification, however, is not serious, since by the use of the indirectly heated cathode screen-grid valve the amplification can be made the same as, or nearly equal to, that with a battery type valve with two tuned circuits. It may be said, therefore, that the filter circuit offers real advantages, not only for the improvement in quality but also in providing the high selectivity necessary under modern broadcasting conditions. In addition, a not inconsiderable advantage which it offers is the greater ease with which a really single-control receiver can be made.

International Amateur Telephony.

The Federal Radio Commission of U.S.A. has recently granted permission for the use of amateur telephony on 14,100 to 14,300 kc. (21.28 to 20.98 metres) by those holding extra first-class operators' licences or otherwise able to show special technical qualifications. The privilege, however, is in every case subject to the endorsement of the licence by the A.R.R.L., as the waveband is so restricted that the Superintendents of the League wish to limit the right to amateurs of demonstrated technical ability.

The Editor of our esteemed contemporary, QST, fears that the language barrier may prove a difficulty in transatlantic conversations, but he is, undoubtedly pessimistic when he writes: “Even when we talk to our cousins in the far-flung lands of the British Empire we cannot be too sure that our harsh American accent will convey much intelligence to the carefully attuned British tympanum. We may need a new international abbreviation to mean: ‘I hear you perfectly, but I haven’t the slightest idea what you are talking about.’” We suspect that Mr. Warner is trying to “pull our legs” but hasten to assure him that, provided his followers do not indulge in too high flights of ultra-Americanism, we do not anticipate any great difficulty in understanding them.

### TRANSMITTERS' NOTES.

**International Amateur Radio Union.**

It may be of use to our readers if we give a list of the various branches of the I.A.R.U. and the addresses to which communications may be sent. The Headquarters are the offices of the American Amateur Relay League, Hartford, Connecticut, where the business of the Canadian Section is also conducted. The affiliated societies are:

- **Australia.**—Wireless Institute of Australia, 53, Castlereagh Street, Sydney, N.S.W.
- **Belgium.**—Reseau Belge, 11, rue du Congres, Brussels.
- **Denmark.**—Experimentalværne Danske Radioamatører, 5, Holmens Kanal, Copenhagen K.
- **France.**—Reseau Emetteurs Francais (R.E.F.), P.O. Box 11, Boulogne-Billancourt (Seine).
- **Germany.**—Deutschen Amateur Sendeb. und Empfang Dienste (D.A.S.D.), Blumenthalstrasse 19, Berlin, W.S.
- **Holland.**—Nederlandse Vereeniging voor Internationale Radioamateurise (N.V.I.R.), P.O. Box 430, Rotterdam.

**American Time Signals.**

A slight alteration in the code of signals from stations in U.S.A. will be made as soon as the transmitting clocks have been altered. The new code will consist, as before, of the transmission of a dot for each second of the five minutes preceding the actual time signal, omitting the last four dots (at the 56th, 57th, 58th, and 59th second) of the 55th to 58th minute, and the nine dots immediately before the dash which indicates the hour; the 29th dot in each minute is also omitted. The new feature will consist of the omission of the dots at the 51st second of the first minute of the signal, at the 52nd second of the second, the 53rd second of the third, and the 54th second of the fourth minute. The dots following these gaps indicate the number of minutes to go before the final dash.

**Italy, S.D.R.T.**—Associazione Radiotecnica Italiana (A.R.I.), Viale Bianca Maria 24, Milan.

**New Zealand.**—New Zealand Assocn. of Radio Transmitters, P.O. Box 779, Auckland.

**Norway.**—Norwegian Radio Relay League, Vokselia, Oslo.

**South Africa.**—South African Radio Relay League, P.O. Box 7023, Johannesburg.

**Spain.**—Asociacion E.A.R., Mejia Lequerica 4, Madrid.

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Wireless World

JANUARY 15th, 1930.
CURRENT TOPICS

Events of the Week in Brief Review.

LONG WAVES FROM ICELAND.
"Utvarpsstoed !" will be the password of Iceland's first broadcasting station, to be opened at Reykjavik in the early summer. The aerial power will be 16 k.w. and the wavelength 1,200 metres.

A USE FOR "JUNK."
Most amateurs find it necessary to start a junk box within a few weeks of beginning their wireless career. Many of the components which make up these museums to contribute to this most practical effort are cordially invited to send their surplus apparatus, be it ever so old, to the Hon. Secretary, Manchester Station Wireless for the Blind Fund, Town Hall, Manchester, or to the Stretford and District Radio Society, 6, Derbyshire Lane, Stretford, Manchester.

I.E.E. ANNUAL DINNER.
The annual dinner of the Institution of Electrical Engineers will be held at the Hotel Cecil, Strand, W.C.2, on Thursday, February 6th, 1930, under the Presidency of Col. Sir Thomas F. Parves, O.B.E.

INDEX AND BINDING CASES.
The index for Volume XXV of The Wireless World is now ready, and copies are obtainable, price 3d. (post free 4d.), from the publishers, Dorset House, Tudor Street, London, E.C.4. Binding cases for the volume can also be supplied, together with the index, price 2s. 1d., post free.

RADIO TRAIN CONTROL.
The London and North-Eastern Railway has recently conducted experiments in the use of wireless for handling goods trains in shunting yards, the object being to provide a means of communication between the engine-driver and the operator in charge of the control tower from which shunting operations are directed.

The results, which are not yet published, are being considered by the Ministry of Transport, and are expected to be dealt with in an official report on various methods of automatic train control.

WAR IN THE ETHER.
In defiance of the cheerful theory that broadcasting makes for international amity comes a disturbing report from a Stockholm correspondent indicating a radio feud between Sweden and an unnamed "Central European country."

The message tells of the establishment of a special control station in the little town of Eskiltna, in Central Sweden, with the object of overcoming interference to Swedish listeners from outside sources. "It has been found," says the report, "that a wireless transmitting station in a certain capital of a Central European country has not respected the International Radio Convention, which it had signed, but arbitrarily changed its wavelength, with the result that it conflicted...

CHELSEA PENSIONERS' WIRELESS.
Through the enterprise of the Daily News a Marconiphone receiver with 576 telephone points has been installed at Chelsea Hospital. A unit system amplifier with eight valves is used. The photograph shows how the service is "laid on" to each cubicle.

1 IN 2: Cambridge is believed to be the most "wireless" town in Britain, according to the local Post Office authorities. The number of wireless licences exceeds 15,000, representing one licence for about two-and-a-half inhabited houses.

SHORT-WAVE BED-TIME STORIES.
Even the tiny tots are discovering the value of short waves, to judge from an innovation at the Radio Experimental Station, Paris. This station now transmits a Children's Hour on 31.65 metres.

WIRELESS FOR WAR VETERANS.
The Daily News, which was instrumental in securing wireless for the principal London hospitals, completed another happy enterprise on Wednesday last, when Viscount Cowdray presented a wireless installation to the Chelsea Pensioners' Hospital, the cost having been borne by readers of the newspaper. The installation, on which nearly £700 has been spent, includes 576 points for headphones.

HAVE YOU TRIED IT?
"Sonorous perspective effects" are claimed by M. P. Hemardinquer, a French wireless amateur, in experiments he has conducted with two pick-ups and two identical gramophone records played simultaneously. By slightly retarding one record and carefully adjusting its volume, M. Hemardinquer states that a genuine stereoscopic effect is obtained, especially when two loud speakers are employed.

SHORT WAVES AND A SOLAR ECLIPSE.
General Ferrié, the chief of the French military wireless service, has just communicated to the Academy of Sciences the results of radio observations which he conducted in Indo-China in May last during the total eclipse of the sun.

During the period of totality there was a considerable diminution of signal strength on the short waves and 30 seconds elapsed between the direct signal and the receipt of the characteristic "echo." The General made no attempt to explain the delay, writes our Paris correspondent.

1 2 5
with that of Sweden. The country in question has been officially requested to change its wavelength to conform with the wavelength allotted to it."

A similar situation recently arose between Great Britain and Spain, but the question was amicably settled through the mediation of the British Post Office. It seems a pity that Sweden cannot adopt the same peaceful tactics.

JAPANESE PROGRAMME DILEMMA.

Japan's broadcasting system, which was inaugurated in 1926, has considerably developed during the past three years. Today (writes a correspondent) it is run by four separate organisations, which together control over ten transmitters. The principal stations are installed at Hirosh-}

NAME OF MANUFACTURER: A. C. Cossor, Ltd.

ADDRESS: 112-122 Brixton Hill, London, S.W.2

GENERAL INFORMATION: Manufacturers of Wireless and Gramophone Equipment.

LE T.S.F.M., 1930, by L. G. Veyssière. Published by "La T.S.F.

WARNING TO WIVES.

Discomfort for the "accused wife" when the Scottish Regional broadcasting station opens is predicted by a Northern newspaper, which says that wives may expect a "shocking revelation" of electrical energy in the other. They may find it difficult to pick up metal kitchen utensils without getting mysterious electric shocks," explains the writer. However, he concludes with the comforting assurance that these shocks are not sufficiently strong to do any harm and are only received in certain circumstances. He might have added that the necessary circumstances include living under the aerial and fairly near to the transformers.

FIRK.

We are asked to state that there is no truth in recent reports that the factory of Messrs. A. C. Cossor, Ltd. (manufacturers of Cossor valves and wireless apparatus), had been burnt out. The fire in question took place at the works of Messrs. A. C. Cossor and Son, scientific instrument makers. There is no connection between the two firms.

BOOKS RECEIVED.


Wireless and Gramophone Trader Year Book and Diary, 1930.—The sixth edition of this most useful book of reference includes all the features which have proved so valuable in the past carefully revised, enlarged, and brought up to date. The Directory Section contains a full alphabetical list of Manufacturers, Agents, Associations, and Publications connected with the wireless and gramophone trades in Great Britain; Wireless and Gramophone Factors; a Classified List of the Manufacturers of Wireless and Gramophone Sets and Accessories, and a list of Proprietary Names of various apparatus. The General Information, Trade Information, Technical Data, and Gramophone Sections have also been considerably enlarged. Manufacturers and traders will especially welcome the abstract of the new provisions of the Marconi Licence. Published by the Trader Publishing Co., Ltd., Salisbury Square, E.C.4. Price 5s. 6d. post free, or at a reduced rate to subscribers to the "Trader" journals.
The Construction of an Electrostatic Earpiece.

DESPITE the fact that many deaf people suffer agonies from being shouted at, practically all the existing electrical devices for the deaf are based on the principle of amplifying the sound to an extent unbearable to the normal ear.

To find a better means of influencing the inner organs of the ear, Dr. Gustav Eichhorn, of Zurich, has experimented for a number of years with a system which now appears in commercial form under the name of the "Radiophone." From the results obtained with this interesting instrument the inventor concludes that the flesh surrounding the ear is forced, by an electrostatic effect, to set up oscillations, which are not transferred to the skin of the ear drum, but direct to the organs of hearing.

The distinguishing feature of the "Radiophone" is the inclusion of the listener himself in the plate-circuit of the L.F. valve of the wireless receiver. This is done by connecting the user through the hand holding the device (a) to the positive output terminal of the receiver, while the negative terminal is connected with stranded flex to a thin metallic plate (b) in a special sound-box placed against the ear. The sound-box is provided with a movable cover of cardboard, thin wood or similar non-conducting material, upon which the metallic plate is fastened on the inner side. The individual wires (c) of the flex lead are splayed over the surface of the metal sheet, and upon this connection a second sheet of metal foil is pressed tight.

It is common knowledge that in the telephone-circuit of a wireless receiver we have to deal with the direct current in the plate-circuit and the modulated alternating currents superimposed thereon. Dr. Eichhorn's experiments have shown that the sensitivity of his set, the "Radiophone" gives signals which are nearly as powerful as those with the usual headphones. If the hand is removed from the metallic surface on the handle no signals can be heard; this is also the case when the polarity is reversed by connecting the sound-box to the positive terminal of the receiver. From this the inventor deduces that the small tin-foil sheet is set in oscillation by the low-frequency currents, the speech and music being amplified to some extent by the sound-box.

In the lower recess in the handle a metal strip making contact with the hand is connected to the positive lead to the receiver. The negative lead is taken through to the metal disc in the sound-box, while across the two leads in the lower recess is a resistance, of about 100,000 ohms (d). This resistance has been found to eliminate fluctuations in sound intensity due to the fact that the polarising potential derived from the valve circuit is not constant. The optimum plate potential depends upon the type of valve used, one working with an anode voltage of between 70 and 100 being recommended.

Curves showing the relation between sound intensity and superimposed D.C. voltage for various A.C. potentials.
Part XVII.—Parallel Tuned or Rejector Circuits.

By S. O. Pearson, B.Sc., A.M.I.E.E.

(Continued from page 44 of previous issue.)

In last week's issue a tuned circuit was considered where the inductance and capacity portions were connected truly in parallel so that the alternating voltage applied between the ends of the circuit was common to each branch. Under these conditions it was found that when the circuit was tuned to resonance with the frequency of the applied voltage and that once the oscillating current flowing round the closed loop had been built up to a steady R.M.S. value or constant amplitude, no current whatever was drawn from the source of supply.

The system was likened to a pendulum or weight-loaded spring in vacuo where all sources of energy loss had been eliminated. Once the mechanical oscillations are started they will continue indefinitely without diminution under conditions like this where there is no loss of energy. Similarly in the imaginary perfect tuned circuit the oscillations of current round the closed loop would theoretically persist with undiminished amplitude even after the closed circuit has been disconnected from the source of E.M.F. This obviously must be so as there is no means of escape for the stored energy. Oscillations of any kind, electrical or mechanical, which continue with undiminished amplitude are called undamped oscillations. If the oscillations are self-maintained, as explained above, they are called free oscillations and their frequency is called the natural frequency of the circuit (or mechanical system). In the case of undamped free oscillations the natural frequency is the same as the resonant frequency of the circuit, being given by $f = \frac{1}{2\pi\sqrt{LC}}$ cycles per second.

The Effect of Resistance.

Now in practice it is impossible to obtain any vibrating system, whether it be mechanical or electrical, which is absolutely free from energy loss. For instance, in the case of a pendulum, even if it is suspended in a vacuum, there are some small losses in the suspension spring when the pendulum is in motion. The result is that as soon as the driving impulses are withdrawn the oscillations will begin to die away at a rate depending on the magnitude of the energy losses. If the pendulum is suspended in air at ordinary atmospheric pressure instead of in a vacuum the air resistance to the motion of the bob would have a considerable damping effect and the decay of oscillations would be very much more rapid. Where it is required to maintain the oscillations at a constant amplitude in spite of incidental losses, it is necessary to give the pendulum a small impulse once every swing to make good for the energy lost per swing. This is what is done by the driving mechanism of an ordinary clock.

Turning now to the electrical circuit, we find that the same conditions have to be fulfilled. The inductance coil $L$ is bound to have some resistance and this is always far greater than that possessed by the condenser and connecting leads. For this reason we are justified in assuming that the whole of the resistance in the circuit is concentrated in the inductive branch. The actual circuit under consideration is shown in Fig. 1 (a), where $L$ is the inductance of the coil in henrys and $R$ is its resistance in ohms; $C$ is the capacity of the condenser in farads.

Suppose that an alternating voltage whose R.M.S. value is $E$ is applied to the ends of the circuit and that the circuit is tuned to resonance. As before, an oscillating current will traverse the closed loop, but heat will now be generated in the coil, due to its resistance. This means that the circuit is absorbing energy from the source of supply, and should this supply be cut off the oscillations would die away in the same manner that a clock pendulum will come to rest when the clock spring runs down. At the present time we are not concerned with the decay of oscillations but with the conditions obtaining when the oscillations are being maintained by the source of E.M.F. We require to know the general behaviour of the circuit when it is tuned to resonance with the frequency of an applied E.M.F. of constant amplitude.
Wireless Theory Simplified.—

We have already seen that a coil of inductance \( L \) and resistance \( R \) is electrically equivalent to a pure inductance \( L \) connected in series with a resistance \( R \), and therefore the parallel circuit of Fig. 1 (a) is equivalent to the circuit of Fig. 1 (b), where the coil \( L \) has no resistance and the resistance \( R \) is non-inductive. Each branch then consists of a simple circuit whose principles have already been dealt with in this series. By combining the known laws of each in the proper manner we can determine the resonant frequency of the circuit and find the impedance at any frequency or when tuned to resonance.

**Currents in the Branch Circuits.**

The current \( I_1 \) taken by the coil is given by

\[
I_1 = \frac{E}{Z} \text{ amperes} \tag{1}
\]

where \( Z = \sqrt{R^2 + (2\pi f L)^2} \) ohms is the impedance of the coil. This current lags behind the applied voltage \( E \) by an angle \( \phi \) where \( \cos \phi = \frac{R}{Z} \) as explained on page 523 (November 26th issue) and the simple vector diagram showing the phase difference between the current and voltage for the upper branch of the circuit is given in Fig. 2 (a).

The current \( I_2 \) in the inductive coil can be considered as being the resultant of two component currents, \( I'_1 \) in phase with the voltage, and \( I''_1 \), lagging behind the voltage by \( 90^\circ \). This idea is clearly shown by Fig. 2 (b), from which it is easy to see that

\[
I_2 = I'_1 \cos \phi \quad \text{and} \quad I''_1 = I'_1 \sin \phi,
\]

and from the impedance triangle of the inductive coil, shown in Fig. 3, we see that \( \cos \phi = \frac{R}{Z} \) and \( \sin \phi = \frac{X}{Z} \).

Referring now to the condenser branch, the current in it is given by

\[
I_3 = \frac{E}{X} \text{ amperes} \tag{2}
\]

where \( X = \frac{1}{2\pi f C} \) is the reactance of the condenser. This current \( I_3 \) leads the voltage \( E \) by \( 90^\circ \) as shown in Fig. 2 (c).

To find the current taken by the combined circuit, i.e., the current drawn from the supply, we must add by the vector method the two currents \( I_1 \) and \( I_3 \) in the respective branches. This is done by drawing the two current vectors \( OI_1 \) and \( OI_3 \) from a common origin \( O \) in their correct phase positions as shown in Fig. 2 (d). We see at once that the two currents \( I_1 \) and \( I_3 \) are not opposite in phase as they were in the case of the circuit without resistance, and the resultant therefore cannot be found by simple subtraction. The resultant current is given by \( OI \), the diagonal of the parallelogram formed with \( OI_1 \) and \( OI_3 \) as adjacent sides. The impedance of the complete circuit is simply equal to the ratio of voltage to current. The formula giving the current at any frequency is rather complicated, but fortunately we can deal with the circuit from a graphical aspect to get a clear conception of its general behaviour.

**Minimum Current at Resonance.**

As the frequency is raised the current \( I_2 \) in the coil decreases, whilst the current \( I_3 \) in the condenser branch increases; but if on the other hand the frequency is kept constant and the capacity of the condenser is varied, only the current \( I_3 \) will change. This simplifies matters a great deal and accordingly let us suppose that the capacity \( C \) is varied over a wide range, everything else being fixed. The current \( I_3 \) is directly proportional to the capacity and therefore the resultant current \( I_I \) will vary both in phase and magnitude as the capacity is changed. Let \( OA, OB, OC, OD \) and \( OF \) be several values of condenser current represented as vectors in Fig. 4 (a) corresponding to different values of the capacity, \( OC \) being the fixed current in the inductive coil. The broken line vectors \( 1, 2, 3, 4 \) and \( 5 \) in the diagram show the resultant currents for the respective capacity values. Of these, No. 3 is in phase with the voltage and is obviously the shortest.

It is thus clear that there is one particular value of capacity which will make the total current a minimum, and this minimum current is exactly in phase with the voltage. When this happens the circuit is tuned to complete resonance with the applied frequency, because all components of current at right angles to the voltage balance out and the circuit as a whole behaves as though it were a pure resistance. The vector diagram showing the conditions for complete resonance is given in Fig. 4 (b).

**Maximum Impedance at Resonance.**

Since the current is smallest at the frequency of resonance it follows that the impedance of the circuit must be a maximum when tuned to resonance. These conditions are exactly the reverse of those obtaining in a series circuit, where the impedance was found to be a minimum at the resonant frequency. And so the parallel circuit has the property of partially rejecting or refusing to pass currents whose frequencies lie within a band near the resonant frequency whilst allowing currents at frequencies outside this band to pass comparatively freely. For this reason the parallel tuned circuit is very often called a "rejector circuit," especially when used in a filter circuit designed to cut out a powerful local station.
Wireless Theory Simplified.

A parallel circuit is used for tuning purposes where it forms part of a circuit which normally has a very high resistance, as, for instance, in the anode circuit of a valve. The details of such a circuit will be discussed later, but it can be mentioned here that the conditions for maximum selectivity are practically the same as those relating to the series tuned circuit, namely, low coil resistance and high ratio of inductance to capacity.

The vector diagram of Fig. 4 (b) enables us to find the impedance of the circuit at the resonant frequency and the value of the resonant frequency itself. The resultant current $I$ is in phase with the voltage, showing that $I_1$ and $I_1'$ balance out. Hence $I_2 = I_1'$, from which the exact resonant frequency can be found. But in practice the resistance of the coil is so low compared with its reactance at the high frequencies used that the angle of lag, $\phi$, is nearly equal to $90^\circ$ and therefore $\omega \phi$, is almost equal to $I_1'$ and a negligibly small error will be introduced if we assume $I_2 = I_1$. When this assumption is made, the conditions are the same as those for the circuit without resistance, and therefore the resonant frequency is

$$f = \frac{1}{2\pi \sqrt{LC}}$$

cycles per second approximately (see appendix).

At the resonant frequency the circuit behaves like a pure resistance, and the impedance under these conditions is called the "the dynamic resistance" of the circuit. It is the actual resistance offered to currents at the resonant frequency, being thus an extremely important quantity.

Finding the Dynamic Resistance.

The value of the dynamic resistance is given by the ratio of voltage to current when the circuit is tuned to resonance. Denoting the dynamic resistance by $R_D$ we have $R_D = \frac{E}{I}$ ohms, where $I$ is the current taken by the complete circuit when tuned to resonance. But from the vector diagram of Fig. 4 (b) we see that

$$I = I_1 \cos \phi = \frac{E}{Z} \times \frac{Z}{Z} = \frac{E}{Z} \times \frac{R}{Z}$$

Hence dividing the voltage $E$ by this current we get for the dynamic resistance $R_D = \frac{Z^2}{R}$ ohms, where $Z$ is the impedance of the coil.

Now, since in practice the resistance $R$ of the coil is small compared with its reactance $2\pi f L$, the impedance of the coil is very nearly equal to its reactance and we may therefore write $2\pi f L$ in place of $Z$ to give an approximate result. Hence $R_D = \frac{L}{CR}$ ohms approximately. But at resonance the frequency is very nearly

$$f = \frac{1}{2\pi \sqrt{LC}}$$

and substituting this value of $f$ in the last equation we get dynamic resistance $R_D = \frac{L}{CR}$ ohms. This is an expression of fundamental importance and is not an approximation but an exact formula (see appendix) in spite of our having made two approximations in arriving at the result. It happens that the two slight errors introduced are of opposite sign and balance out.

The conclusion is that the dynamic resistance or maximum impedance is actually inversely proportional to the ohmic resistance of the coil, and proportional to the ratio of inductance to capacity. If the resistance of the coil were zero the dynamic resistance of the circuit would be infinitely great and no current would enter or leave it, as we have already discovered.

**Appendix.**

1. Resonant frequency of Parallel Circuit.

From Fig. 4 (b) $I_1 = I_1 \sin \phi$, $\omega CE = \frac{E}{Z} \times \frac{\omega L}{R}$, where $\omega = 2\pi f$,

$$C = \frac{Z}{Z^2}$$

Whence

$$\omega \frac{\omega L}{R} = \frac{Z^2}{L} \times \frac{R}{Z}$$

or

$$\omega = \sqrt{\frac{1}{LC} \cdot \frac{R^2}{L^3}}$$

\(\therefore\) Resonant frequency $f = \frac{1}{2\pi} \sqrt{\frac{1}{LC} \cdot \frac{R^2}{L^3}}$

II. Dynamic Resistance.

$$R_D = \frac{E}{I} = \frac{E}{I} \cos \phi = \frac{E}{Z} \times \frac{Z}{Z} = E \times \frac{R}{Z}$$

But from (1) above

$$Z^2 = \frac{L}{C}$$

\(\therefore\) $R_D = \frac{L}{CR}$ ohms.

*(To be continued.)*

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**RADIO WEEK.**

In a few days' time the jury, i.e. the non-listeners, will retire to consider their verdict on the question, "Is Broadcasting Worth While?" Listeners can help to secure a favourable answer by letting their non-wireless friends listen to good reproduction of the B.B.C.'s special programmes, remembering that a bigger listening public means a better broadcasting service.
LABORATORY TESTS.
A Review of Manufacturers' Recent Products.

MARCONIPHONE MOVING COIL LOUD SPEAKER UNITS.
These units are now being supplied unboxed to provide the home constructor with a model suitable for building into a piece of furniture, or for incorporating in radio-gramophone cabinets.

Two types are available: one with a 10-ohm field winding for use with 6-10 volt accumulators, and the other with a 3,000-ohm field coil intended for mains excitation. The last mentioned would be used on D.C. mains direct, but in conjunction with a rectifier unit for A.C. supplies. Both models are sensibly the same, the only difference being in the method of exciting the field coil. The chassis submitted for test was of the low-voltage type.

BELEX INSULATED H.T. CONNECTORS.
The new range of insulated plugs and sockets introduced by Messrs. J. J. Eastick and Sons, 116, Bunhill Row, London, E.C.I, have been designed especially for use in connection with battery eliminators and mains-operated receivers.

Greater care is required in handling the H.T. leads, and consequently the insulation on the plugs and sockets has been very carefully thought out. All metal parts hitherto exposed are fully protected, and the risk of shock due to accidental contact with live leads has been reduced to a minimum. Provision is made also to grip the braided covering on "flex" leads, thereby giving a tidy appearance to the connecting leads.

These "All Shrouded" plugs and sockets are offered at 6d. per pair.

LOTUS JACKS AND JACK SWITCHES.
The body of these jacks consists of a bakelite moulding on which is mounted genuine nickel silver springs each tipped with a pure silver contact. A faulty connection should be very rare indeed. Hitherto contact with the springs was made by soldering the leads on to tags, but in the latest version the soldering tags have given way to small terminals carried on fanteil extension lugs. A single-hole fixing bush is provided.

Five types are available, ranging from a single-circuit open jack to a single-circuit open double-filament control type. The price is according to type, the cheapest being 2a. and the last mentioned 3a.

These jacks demand a jack plug with a longer stem than is usually fitted so that it is necessary to employ the "Lotus" version. This costs 2a. Loud speaker tags or "flex" can be gripped firmly by the aid of the special cam-lock fitted. The "stem" and the "ball" connections are clearly marked on the bakelite cover.

A range of five jack type push-pull switches from a single-pole make-and-break to a double-pole double-throw is now available, the general design following...
Southend Wireless Show

Society’s Record
Success.

A WIRELESS festival, to the fitting accompaniment of open-air and indoor loud speaker reproduction, was held at Southend on Saturday, January 4th, when the Southend and District Radio Society attracted thousands of visitors to their Sixth Annual Radio Exhibition, held at the Boys’ High School, Victoria Circus. The occasion was a triumph for amateurs and professionals alike, and their joint efforts resulted in a contribution of at least £70 to the Victoria Hospital, Wireless Maintenance Fund.

Several magnetic influences were at work. In the first place, many enthusiasts were drawn to the competition stands, on which were displayed some excellent examples of amateur craftsmanship. The casual passer-by was also attracted by the compelling invitation of a battery of loud speakers facing Victoria Circus, these being erected and operated by Messrs. S. H. Davis and Son, of Westcliff. And in the Exhibition Hall itself Mr. F. H. Haynes, Assistant Editor of The Wireless World, provided a continuous demonstration of quality reproduction, with loud speaker “points” on each stand. The set employed consisted of the Schools Demonstration Receiver, followed by six independent output stages each fitted with choke condensers and two P 625 valves.

An admirable feature of the competitions was the introduction of a new method of classification enabling entrants every chance to succeed having regard to their opportunities and qualifications. Three classes of competition were instituted—A, B, and C—the first for bona fide amateur members of the Society, the second for other members, and the third for bona fide amateurs who were non-members. The scheme worked well.

Through the generosity of the trade, prizes were offered for a variety of home-made apparatus, and this formed the basis of the amateur side of the Exhibition. The apparatus submitted included portables, short-wave receivers, one- to three-valve and multi-valve receivers, loud speakers, battery eliminators, wavemeters and wavetraps, receiving set cabinets, and various mechanical and non-mechanical units. Much careful and painstaking work was indicated, and the standard of craftsmanship increased the difficulties of the judges, Mr. F. H. Haynes, Mr. H. B. Dent, and Mr. H. L. Lobb.

The list of prize-winners is as follows:

<table>
<thead>
<tr>
<th>Class</th>
<th>Prize</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Complete Set by High School Boy — 1st Mr. C. Stockell. 2nd Mr. R. Kramer. Cons. Mr. J. Hill.</td>
</tr>
<tr>
<td>B</td>
<td>No Entries.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>Portable Sets — 1st Mr. W. A. Webb. 2nd Mr. H. R. Ireland. Cons. Mr. E. W. Lockhart.</td>
</tr>
<tr>
<td>B</td>
<td>No Entries.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>Short Wave Receivers — 1st Mr. E. W. Lockhart. 2nd Mr. E. T. Wiseman. Cons. Mr. J. Hill.</td>
</tr>
<tr>
<td>B</td>
<td>No Award.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>1 to 3 Valve Receivers — 1st Mr. H. A. Clinton. 2nd Mr. W. J. Fletcher. Cons. Mr. J. Hill.</td>
</tr>
<tr>
<td>B</td>
<td>No Award.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>4 or more Valve Receivers — 1st Mr. W. J. Fletcher. 2nd Mr. H. R. Ireland. Cons. Mr. E. W. Lockhart.</td>
</tr>
<tr>
<td>B</td>
<td>No Award.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>Loud Speakers — Special Mr. H. R. Ireland. 1st Mr. W. J. Fletcher. 2nd Mr. E. W. Lockhart. Cons. Mr. J. Hill.</td>
</tr>
<tr>
<td>B</td>
<td>No Entries.</td>
</tr>
<tr>
<td>C</td>
<td>Special Mr. D. J. Lewis.</td>
</tr>
<tr>
<td>A</td>
<td>Battery Eliminators — 1st Mr. P. Green. 2nd Mr. A. E. Atwood. Cons. Mr. E. W. Lockhart.</td>
</tr>
<tr>
<td>B</td>
<td>No Award.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>Wavemeters and Wavetraps — 1st Mr. E. W. Lockhart. 2nd Mr. W. J. Fletcher. Cons. Mr. J. Hill.</td>
</tr>
<tr>
<td>B</td>
<td>No Award.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>Receiving-set Cabinets — 1st Mr. H. R. Ireland. 2nd Mr. A. E. Atwood. Cons. Mr. E. W. Lockhart.</td>
</tr>
<tr>
<td>B</td>
<td>No Award.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>Various Mechanical Units — 1st Mr. A. R. Knipe. 2nd Mr. A. E. Atwood. Cons. Mr. J. Hill.</td>
</tr>
<tr>
<td>B</td>
<td>No Award.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>Various Non-mechanical Units — 1st Mr. T. Holbeche. 2nd Mr. A. E. Atwood. Cons. Mr. J. Hill.</td>
</tr>
<tr>
<td>B</td>
<td>No Award.</td>
</tr>
<tr>
<td>C</td>
<td>No Entries.</td>
</tr>
<tr>
<td>A</td>
<td>Special Mr. D. J. Lewis.</td>
</tr>
<tr>
<td>B</td>
<td>Special Mr. E. W. Lockhart.</td>
</tr>
<tr>
<td>C</td>
<td>Special Mr. J. Hill.</td>
</tr>
</tbody>
</table>

A 32
Southend Wireless Show.—

Three sets, not for competition, were exhibited by the chairman, Mr. H. H. Burrows. One of these was an imposing six-valve instrument having two screen-grid H.F. stages, detector, and two stages of L.F., the last consisting of two power valves in parallel. The total value of the components alone was estimated at £25. The set was given in connection with a shilling competition in aid of the Hospital Wireless Fund.

Interest in amateur television was demonstrated by the curiosity aroused in Mr. A. Knipe's experimental television receivers, in which considerable ingenuity was displayed both in the synchronising gear and the method of marking out and constructing the disc. For his collective exhibit of television gear and a carbon microphone with control units, Mr. Knipe was awarded the Pocock Silver Championship Cup, presented by the Editor of The Wireless World for annual award for the entry of most outstanding constructive merit.

The total number of entries in the amateur section was fifty-four, and the value of the prizes distributed was £45.

The trade exhibitors included Messrs. S. H. Davis and Son (organisers of the outdoor loud speaker demonstrator), J. Bridge and Son, T. Davis, F. Jeffery, E. K. Cole, Ltd., and H. C. Revell.

The Exhibition was open for eleven hours—from 11 a.m. to 10 p.m.—and during this time there were no fewer than 4,684 visitors. Is this a record for a wireless society show?

CORRESPONDENCE.

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

B.B.C. TRANSMISSIONS.

Sir,—Much has been written recently about the effect of land lines on the quality of B.B.C. transmissions, and the following figures relative to the London-Bournemouth land line may be of interest. The attenuation factor per 50 miles of land line is approximately 1 ounce of sweet pudding in the mouth of the silvery-voiced announcer. It is regretted that no figures relative to orchestral transmissions can be given as none have been definitely identified as such.

C. E. WOOD.

Parkstone, Dorset.

Sir,—Whatever the faults of land-line transmissions may be, surely Mr. Jas. Hudson, of Manchester, does not mean that the output from 2ZY's aerial is a good sample of perfection, even from the fine new studio, or otherwise. A more "tin-canny" output is not to be heard from any station in Europe.

Bolton.

A. GREGSON.

THE PROGRAMME DIFFICULTY.

Sir,—The article concerning a Low-power Synchronised Transmission Scheme, by Major Humphry MacCallum, in your issue of December 25th, provided food for much thought. The outcome is that the views expressed are certainly worthy of more than passing attention. Eight out of ten people with whom I came into contact appear to be dissatisfied with the general run of programmes, whilst agreeing that the whole business of programme "building" is something of a problem. The eight, including myself, have not been clever enough to formulate a really practicable scheme. The one suggested has great possibilities and appears to be quite practicable from a technical point of view as far as wireless is concerned. I am not so sure, however, as regards the land-line system involved. Judging by last night's (December 30th) transmission over the lines from Manchester, there remains much to be done in this direction. The cut-off in the lower register was very pronounced. This on a receiver which normally gives most faithful reproduction. With this difficulty overcome, the scheme presented would be welcomed by the great majority of, and probably all, listeners, whilst, in addition, one can visualise a boom in the radio industry. Given a scheme on the above lines, and the Robinson Radiocast, we shall be wondering what to do with all our spare ether channels! —H. A. HANKEY.

Sir,—I have read with considerable interest the article under the above heading in your current issue, but I cannot help thinking that the suggested scheme is "too good to be true." If not, how is it that someone has not thought of it before? There must be a snag somewhere, though the writer states his case very convincingly. If there is no "nigger in the wood pile," it would seem that the MacCallum Scheme provides a complete solution of the programme difficulties, and its adoption should bring real prosperity to the radio industry and satisfaction alike to the listener and the B.B.C.

W. E. WARRILOW.

SOUTHEND WIRELESS SHOW.

Back and front views of a home-made television receiver exhibited by Mr. A. Knipe. It is fitted with the standard arrangement of toothed wheel synchronisation. The cathode of the neon lamp glows on both sides, a concave mirror being provided to bring the light emitted from the reverse of the electrode to the scanning disc.

Sir,—Major MacCallum's article in your issue of December 25th was most interesting. He refers to the probable objection of the absence of "local colour" in his scheme, but I cannot see why there should be. What does it matter where the programme comes from as long as it is good? Schubert's "Unfinished Symphony," for example, will be just the same whether it is played at John o' Groats or Tim.
Sir,—I venture to put forward the following four propositions as raising questions of some interest and importance to provincial listeners:—

1. It is not possible in practice for a number of transmitters, even though using low power and radiating one programme, to operate within a restricted area on the same wavelength without mutual interference.

2. There is mutual interference between B.B.C. common wave transmitters.

3. All B.B.C. transmissions on the common wavelength are therefore of bad quality.

4. In the matter of oscillation interference, the B.B.C. are themselves the chief offenders.

It will be borne in mind that as many as eleven transmitters in Great Britain, from Dundee in the north to Plymouth in the south, share at present the common wavelength of 266.5 metres. If the national scheme in its present shape is brought to completion, subsidiary stations, for which there will be no independent wavelength available, will be needed at Aberdeen and Newcastle.

There are two essential elements in a good wireless programme—good quality transmission and good quality programme matter. The two are complementary, one being as necessary as the other. In the case of the indifferent programme, good quality transmission may make poor programme matter tolerable, but bad quality transmission can reduce the best programme matter to the level of the worst. It may be said, therefore, that a symphony concert relayed from the London Queen’s Hall is a good programme only for those within the service area of the London transmitter. For listeners elsewhere, the quality of transmission is impaired or destroyed by the use of land-lines and the inherent defects of common wave transmission.

These clear and simple considerations indicate the terms in which the provinces should formulate any demand for a better service. The demand should be for—

(a) Direct transmissions of (b) good programme matter on (c) an independent wavelength.

It is certain, however, that any such demand would have a chance of success only if it were pressed with energy and determination. Present signs—among them in particular the salving of the London Promenade Concerts, the formation of the National Orchestra in London, the scheduled expenditure of some half a million pounds on the erection in London of Broadcasting House—all clearly foreshadow the permanent centralisation of the service in London and a continuation of the evil system of land-line transmission to the provinces.

Newcastle-on-Tyne.       K. MCCORMACK.

Oscillation.

Sir,—It seems to me that the only way out of the trouble (oscillation) is for the Post Office or British Broadcasting Corporation authorities to make a standard test of the impending programme matter by chronic land-line distortion.

However, the article was, as stated, not without interest, and I hope to see more of this kind of reading.

London, N.I.       F. H. HEINEMAN.

I speak from experience when I say that one of the greatest difficulties experienced is that of obtaining a supply of parts for the construction and maintenance of sets.

Moreover, you would be able to test parts before despatch, thus reducing the possibility of failure and disappointment to a minimum.

The purchase of wireless material through friends at home is not always a success, and it is exceptional to have a friend in the position to purchase and test apparatus before despatch, to say nothing of the trouble entailed by the latter.

Northern Nigeria.       WILFRED H. MILES.

THE BRITISH MANUFACTURER.

Sir,—Two letters in your January 1st issue do, I think, need a little backing up or amplifying. I refer to those over the signatures of A. H. Gregson and F. Nichols. The reason why the Germans and Americans hold their market in this country is that they deliver the goods within a reasonable period of their being ordered. There are only about two British firms that ever do this. I have proved this by buying costly receivers and do general repairing and modernising of any set. Needless to say, I need a large variety of different valves and components, and in order to do the best work I care to follow the advertisements and technical articles in The Wireless World. In all cases I try out new components and circuits before recommending them to customers.

Now when some new component is advertised or recommended I have to decide where to get it. I naturally consider the factor, as it saves time to order from him along with other stuff; but it would appear that this gentleman does not keep himself up to date by reading, and does not order new goods for stock until there has been a continual large demand for them for several months.

I then fall back upon the manufacturer, and the following is an actual case that has happened to me recently, and is typical of what happens in very many cases.

Ordered article September 27th; no acknowledgment of order. Ordered a second one November 15th, and asked that they should be expedited. Received letter November 27th stating could not deliver until early in December. Sent postcard December 12th; no reply. Telephoned double long distance call December 30th, and spoke to sales manager.

Goods arrived December 31st.

Now, if they could post them off at once like that, why not have done it before? This latter is a very favourite trick—to send goods when telephoned for—and reduces my profit by the price of a double trunk call. I literally cannot afford to deal with firms who treat my orders in this manner.

Mr. Gregson’s remark that the makers have to see what the demand is likely to be before producing in quantity does not point to much confidence in the goods on the part of the maker, and, anyhow, this does not apply in the case of such things as valves of proved superior qualities, as there is sure to be a demand for such at once and in large quantities, if they really are good.

One firm wrote me that their orders had been so large that their packing staff could not deal with them!! What about increasing the packing staff for the busy season?

I am not sure that the Exhibition should be held any earlier, as any suggestion that the dummy goods exhibited then will not be available for another three months or more will simply cause the public and provincial traders to treat the show as a joke, and the three months will be a general slack season.

My orders are going to those who deliver promptly,—of any nationality.

GUY S. M. ASHBY.
PICTURE RECEPTION.

Sir,—May I endorse the statements of Mr. Walter Addey in your issue of January 1st, 1930, on the subject of Picture Transmission and the authorship of a picture machine following the pattern of The Wireless World design, and it is now just finished, only to find the transmission of pictures has been discontinued.

It is somewhat heavy reading for the student and is an indispensable work of reference, has now passed through several editions and is the basis for many courses in university and college curricula.

As Mr. Addey says, "Pictures are to be received from Vienna," but until we have adjusted our instruments and tested them on a reliable transmission we cannot hope to overcome fading effects, etc. I shall be pleased to hear from any other readers in a similar plight, should you publish this letter.

Many thanks for your valuable paper—still splendid value at its increased price.

H. W. HOWLETT.

THE ROBINSON "STENODE RADIOSTAT."

Sir,—I read with considerable interest the article, under the above heading, which was published in The Wireless World of December 1st, 1929, but perhaps you will permit me to comment on the last part of the article, in which the writer states he is puzzled by the fact that true reproduction can accompany perfect selectivity in a radio receiver. In recent years considerable misconception has arisen regarding the theory of the transmission and reception of radio frequencies modulated by audio frequencies, and it is probable that it was this misconception which was responsible for the writer being puzzled.

In modern wireless literature it is repeatedly stated that, as the modulation of constant frequency carriers produces "side bands" or subsidiary frequencies equal to the sum or difference of the modulation and carrier frequencies, this, however, is a statement which I believe to be neither borne out in fact, nor technically accurate. To take an example: If a carrier of 1,000kc., is modulated by 1kc., there will be only one frequency radiated, namely, 1,000kc., the amplitude of which, however, will fluctuate one thousand times each second. The production of beat frequencies, of course, cannot take place, as there is too great a difference between the primary frequencies. The study of an oscillograph record should make the matter quite clear: the modulation of 1,000 cycles per second by one cycle will produce a graph with the peaks of the waves having a figure 8 formation, but in no case will frequencies of 1,001 or 999 be traced. When two transmitters are heterodyning, a whistle of varying amplitude, but constant pitch, is produced, but if side bands existed the pitch would vary with the modulation.

This misconception has received considerable support in view of the fact that highly selective receivers have hitherto been unable to reproduce all the audio frequencies in correct proportion. This fault, however, is not because the receiver is selective and so "cuts the side bands," but because of the method whereby selectivity is attained. Such a receiver has employed one or more high-frequency resonant circuits and, from the nature of these circuits, it follows that the less resistance or damping employed the longer time will it take the current to change from one amplitude to another. In the case of high audio frequencies the amplitude changes have to be very rapid, with the result that the persistence of the current in the circuit tends to smooth them out. The matter can be reasoned from another angle. If side bands are produced, it is unquestionable that the amplitude of a carrier varies as it is modulated.

Present-day receivers are affected by the heterodyning of two transmissions because both the frequencies are received, whereas, if the receiver responded to one only of the frequencies, however closely it approached the other, the heterodyne note would not be heard.

From the foregoing remarks it will appear that there is no theoretical reason as to why a receiver designed to be highly selective should not be entirely successful, providing that selectivity is not achieved wholly by the aid of undamped resonant circuits. Dr. Robinson is to be congratulated if he has succeeded in producing such an instrument.


F. STUBBINGS.

THE SUPERHETERODYNE.

Sir,—The reasons for the unpopularity of the superhet in England are these:

1st.—The necessity for extreme selectivity is not so urgent. Transmitting stations are not so broadly tuned as they are in France.

2nd.—The British public have been accustomed to very simple tuning devices and seem afraid to buy a set that requires a little more attention to tuning in.

3rd.—A superhet requires more valves and consequently increases the price of the set. The price of a general-purpose receiver in France is 37 frs. 50 (about £s. 5d.), whereas in England it is 10s. 6d.

As a representative of British firms in France, I am up against the selectivity problem every day. The first question one is asked at the dealers is, "Is it a changeur de fréquence?" One has to stay no, and then many firms will not even trouble to listen.

It is quite impossible in Paris with the usual circuits used in England to eliminate Radio Paris and Eiffel Tower and obtain Daventry, which every Frenchman wants.

The screened grid is an improvement, but not as selective as the superhet, which in experienced hands is quite as good and pure as any straight circuit.

Why have British manufacturers neglected this market? What they have missed I am in a position to know.

I recently represented a large British portable set manufac-
turer who eventually started a factory in France. I tried to convince them that the superhet was the only circuit that would sell here, but they decided that the set was doing well in England and must be made to go well in France.

The result was that Daventry could never be received without interference from Radio Paris and Eiffel Tower. What hopes has a British firm of doing satisfactory business on these lines? Whatever British firms do to-day, if only they would build a superhet for the French market they would do ten times the business.

A. J. HILL.

PARIS.

BOOK REVIEW.

Elements of Radio Communication, by J. H. Morecroft (Chapman and Hall, 1929, 15s. net. Pp. 250). Professor Morecroft's well-known standard work, "Principles of Radio Communication," has now passed through several editions and is an indispensable work of reference to the professional wireless designer, but is somewhat heavy reading for the student and the amateur. The present work is of a simpler character, and may be considered as an introductory volume to the larger book.

Though the treatment is elementary in that no mathematical equipment beyond a knowledge of algebra is required, yet the subject is dealt with in a more solid fashion than in the average popular exposition. The principle is to give first an account of the theory of alternating currents, with special reference to the requirements of telegraphy and telephony and to follow this with the applications involved in modern practice. The numerical information given is usually complete. Thus, we are given figures as to the absorption of waves by steel buildings, the relative ranges and ship distances of transmissions on various wavelengths, and the comparative rectifying powers of crystals and valves using anode-bend or cumulative detection.

The chapter on receiving sets gives a most readable account of the good and bad points of modern sets. It begins with crystal circuits and treats of loud speakers, impedance units, superhet, various types of H.F. and L.F. amplifiers, and ends with mains-fed sets and filter systems.

R. T. B.
Broadcast Brevities

The World's Biggest Broadcast.

If the International Disarmament Conference were being held in a studio at Savoy Hill, the powers that be could show no greater deference to the peculiar requirements of broadcasting than they will on January 21st. For the special benefit of the world's listeners, H.M. the King and ten representatives of the Great Powers will observe a rigid time-table which will bring all their speeches within the compass of two hours.

Order of Speeches.

Immediately after the King's speech, which begins at 11 a.m., His Majesty will leave the Chamber, the chair then being taken by the Rt. Hon. Ramsay MacDonald.

I learn from an authoritative source that the subsequent speeches will be given in this order: (1) Mr. Ramsay MacDonald, (2) Mr. Henry Stimson (U.S.A.), (3) M. André Tardieu (France), (4) Signor Dino Grandi (Italy), (5) Mr. Kanami Wakasugi (Japan), (6) Col. the Hon. J. L. Ralston (Canada), (7) Mr. J. E. Fenton (Australia), (8) Hon. T. M. Willis (New Zealand), (9) Mr. C. T. ter Water (South Africa), and (10) Sir Atul Chandra Chatterjee (India).

B.B.C.'s Responsibility.

The delegates will be seated round a horseshoe table and each will be provided with a microphone extension. The B.B.C. control engineer will be discreetly inconspicuous just outside the door.

There can be little doubt, I think, that this broadcast will be the biggest of its kind ever staged. Ten nations have a direct interest in the proceedings of the Conference, while nearly every other country will hold a watching brief. Europe will be listening to Daventry, or via special landlines to Continental transmitters, and the rest of the world will be doing its best to hear 5SW. The B.B.C. has a big responsibility.

Dreary News Bulletins.

'Brighter news!' was the question that leapt to everyone's lips at the announcement of a staff change in the Savoy Hill news department. I doubt whether the change will have any effect whatever, but the B.B.C. is scarcely to be blamed on that account.

Unlike a newspaper, the broadcasting machine, given time even for a 'proof' sub-editing is reduced to a minimum, as many items of news come in while the announcer is actually reading the bulletin. I believe a scheme of broadcast "headlines" was once considered with the idea of making the items more attractive, but it was not found practicable. Some means should be found, however, to brighten up one of the duller features of the broadcast service.

Special Radio Week Feature.

I see that one of the organs of the B.B.C. prints a sonnet "to be broadcast, with other poems, by Elizabeth Barrett Browning, on January 14th." Seeing that this is National Radio Week, the B.B.C. might have gone a step further by giving us a sonnet from the lips of Will Shakespeare himself.

New Tests from Brookmans Park.

Only seven thousand letters have been received at Savoy Hill regarding the Brookmans Park tests. This is a negligible figure compared with the vast numbers who are known to be within the service area, and the inference might be that the twins are giving satisfaction. The real truth, of course, is that the really serious tests have yet to come. So far few people have been inconvenienced by the simultaneous transmissions, but I hear that the tests will be much more drastic in a week or two, with music from both transmitters. Up to the present this has been attempted only at unimportant times: in the afternoon, for instance.

Not until the final test period begins will it be possible to say when the twin transmitters will begin their permanent service of simultaneous transmissions. The final tests will probably last three or four weeks.

Present Schedule.

Until further notice, the arrangement of the alternative programme test transmissions from Brookmans Park is as follows:

The published programme is transmitted by the national programme transmitter working on a wavelength of 261 metres and by Daventry 5XX, from 12 noon to 1 p.m. on Monday to Fridays, and from 1 p.m. to 2 p.m. on Saturdays.

The whole of the late dance music which follows the studio programme each evening is transmitted also by the national programme transmitter on a wavelength of 261 metres and by Daventry 5XX.

During the whole of these periods the 356 metre Regional programme transmitter radiates a contrasted programme. On Sundays there will be no test transmissions in the evenings, but the alternative programme test transmissions will take place as usual between 2 and 2.50 p.m.

THE NORWEGIAN GIANT. The new 60-kilowatt broadcasting station at Oslo, just completed by the German Telefunken Company. Operating on 493 metres, Oslo can be heard at most times of the day in Great Britain.
The Wireless World Supplies a Free Service of Technical Information

'THE WIRELESS WORLD' SUPPLIES A FREE SERVICE OF TECHNICAL INFORMATION

Juggling with Grid Bias Cells.
I am using, as an anode bend detector, a high-impedance valve which apparently requires a bias of some 11½ volts to 5 volts (the voltages of one or two dry cells). To avoid the need for fitting a potentiometer, I recently obtained one of the new 0.9-volt cells, and have connected it in series with an ordinary dry cell; although signals are louder, I think that the valve would work much better with slightly less negative on its grid. Is it safe to try the expedient of reversing the polarity of the low-voltage cell connection? D. D. L.

A self-addressed stamped envelope must be concisely worded and headed "Information Department." Only one question (which must deal with a single specific point) can be answered. A double question or to standard manufacturers' receivers.

No harm can be done by trying this experiment, and we suggest that you should connect two ordinary dry cells in series and then join up the 0.9-volt cell in opposition. This would give an effective voltage of 2.1, which should be about right.

New Arrangements for Grid Bias Cells.

An Extra Tuned Circuit.
I understand that the addition of a separately tuned and loosely coupled aerial circuit will increase the selectivity of my Eko-Megg receiver. It is possible to assume that this addition will also bring about an appreciable increase in its sensitivity. H. T. L.

Under average working conditions, it is safe to assume that a separate tuned aerial circuit will add to the range of a receiver equipped with the "aperiodic" arrangement which it usually displaces. At any rate, it is quite safe to make this assumption if the comparison is to be made on a basis of equal selectivity; a two-circuit aerial tuner with coupling adjusted for lowest signals gives better results than an "aperiodic" arrangement similarly adjusted.

When Valves Fail.
My present valves have been in use for well over two years, and as the signals given by my receiver are not as good as formerly, I have come to the conclusion that this falling off is due to a partial failure of valve emission; a careful point-to-point and stage-by-stage test with the apparatus at my disposal fails to reveal any fault. Will you tell me if there is any simple and easy way of checking the emission of the valves without the need for any elaborate equipment? M. K.

A milliammeter with a range depending on the characteristics of the valves to be tested is sufficient equipment to enable you to form an idea as to whether your valves are in order in the matter of their emission. First connect the milliammeter in the anode circuit of the valve under test, taking care to short circuit any transformer primary or other resistance of appreciable value that may be in series. Next, having set grid bias and anode voltages at convenient values, observe if the anode current indicated is due to a partial failure of valve activity; if so, this falling off is necessarily that say within 25 per cent.) to that indicated by the manufacturer's published curve.

Even without any apparatus at all it is possible in some cases to form a very fair opinion as to the state of the valves, provided one can assume that the various batteries are in order. When it is found that an L.F. amplifying valve cannot be used with the full value of negative grid bias recommended by its makers without introducing obvious distortion, it can generally be assumed that emission has fallen off considerably.

A Double-purpose Resistance.
Will you please criticise the circuit diagram of my proposed four-valve receiver? Valve types and resistance and capacity values are marked. Please say if these are suitable. S. P. S.

Your diagram shows a fairly conventional H.F.-det-2 L.F. receiver; in general, it should give satisfactory results, but I expect you will find it necessary to alter the ratio of the H.F. transformer (shown as 1:1) or to add another tuned circuit. The set as it stands will lack selectivity for use in your locality.

The decoupling resistance in the detector anode circuit should be increased from 600 ohms (as shown) to about 20,000 ohms. It must not be forgotten that in this circuit we are dealing both with H.F. and L.F. currents; it is probably true to say that the latter are most likely to give rise to trouble, and they must be taken into account when determining the values of decoupling components. The associated by-pass condenser should be increased in capacity from 0.1 mfd. to 2 mfd.
Detector Anode Milliammeter.

My receiver is a 1-w.2 combination, with anode bend detector coupled by a high-inductance choke to the first L.F. amplifier, which is coupled to the output valve by a transformer. A post-detection volume control is fitted, in the form of a quarter-maghm variable resistance shunted across the L.F. choke.

The set works well, but I have been puzzling since fitting a detector anode milliammeter as an indicator, by the fact that quite good and very loud signals are obtained from many stations without any observable change taking place in anode current reading. So far as several near and more powerful transmissions are concerned, it is quite easy to get a maximum deflection of between one and two milliamperes; of course, in these conditions it becomes necessary to use the volume control to prevent overloading.

Even after dark, it is unusual to find any great number of stations whose signals bring about an increase of more than a small fraction of a milliamper. Does the above suggest that anything is wrong? Grid bias has been brought about an increase of about one milliamppere, assuming normal working conditions.

Although you give no particulars of your milliammeter, we are inclined to think that your apparent difficulty in taking fractional readings is a proof that the instrument is less sensitive than is desirable for this sort of work. Generally speaking, a scale reading of 0.15 or 0.2 milliamperes is to be recommended.

A "Tune-stand-by" Switch.

I am planning a new receiver, which is to include a separately tuned aerial coupled to the grid circuit through a small variable condenser connected between the centre points of the two coils. Is it possible, without introducing any serious losses, to fit a switch for cutting out the tuned aerial circuit at will? My object is to simplify operation of the set when searching for transmissions of which the corresponding condenser adjustments are not known.

In the design of commercial and "Service" apparatus it has always been quite usual to include a so-called "Tune-stand-by" switch for this purpose, and, now that two-circuit aerial tuners are coming into more general use for broadcast reception, this is a practice that might well be imitated. It is very likely to be helpful in your own particular case, as we see that you live at a considerable distance from a transmitting station, and consequently you will not always need the higher selectivity conferred by the separately tuned aerial circuit.

For the arrangement you describe the form of connection shown in Fig. 2 (a) is suitable, an "aperiodic" coupling is provided when the switch is "down."

It may be pointed out that matters may be simplified if you change your circuit slightly, and adopt the arrangement suggested in Fig. 2 (b). Provided the coupling condenser (C.C.) has a suitably low minimum value, this is practically as effective, and requires nothing more than a single-pole on-off switch for its execution.

Wireless World

JANUARY 15th, 1930.

Transformer Primary Condensers.

With reference to your recent article on the subject of parallel-fed L.F. amplification, will you please tell me if there is any reason why an L.F. transformer with a built-in condenser in shunt with the primary winding should not be used in circuits of this sort? If not, would it be satisfactory to remove the condenser? W. L. S.

The effect of this condenser--from the "L.F." point of view--is allowed for by the manufacturers, and these transformers can most certainly be used with entirely satisfactory results. The condenser should not be removed.

Porcelain Connectors.

I recently saw some small porcelain blocks fitted with brass insets carrying nipping screws; these were used for securing some of the connections of an experimental receiver. Having had some experience of burning out valves through short-circuits between temporary leads, these little "gadgets" attracted my attention. Can you tell me what they are called and where they may be obtained?

These are known as porcelain connectors, and we are rather surprised that you should have any difficulty in obtaining them. They are usually stocked by dealers in small electrical fittings, and are made with one, two or three insets for similar numbers of conductors. We agree that they are very useful for making safe semi-permanent connections.

FOREIGN BROADCAST GUIDE.

KHARKOV

(Russia).

Geographical Position : 50° N. 36° 14' E.

Approximate air line from London: 1,580 miles.


Time: Eastern European (two hours in advance of G.M.T.).

Standard Daily Transmissions.

Time signal at 17.00 G.M.T. a long buzz followed by chimes on a gong to indicate 19.00 Eastern European Time. 06.00 and 09.00 morning concert; 18.00 and 20.00 evening programmes; 21.00 dance music (Saturdays only). Frequently relays programmes from Moscow Komintern and Leningrad.


Interval Signal: gong.

These transmissions are also broadcast by a 4 kilowatt station on 242 m. (7042 kc).
SOUTH POLE speaks to LONDON!

In far Antarctic wastes... Sir Douglas Mawson charts unknown continent. Sights new island. Wireleses to London —through Marconi Valves. "Discovery" uses them—to keep touch with civilization, with supply ship, with accompanying airplane. Cable Service to Australia... Empiradio Beam Wireless... all British Broadcasting Stations... use Marconi Valves. For their wide range. For their long life. For their reliability.

In cases like these, when unfailing efficiency is essential—a matter of life and death even—men insist on Marconi Valves

FIT MARCONI VALVES TO YOUR RADIO SET

Give you clearer tone, greater volume, longer range. Cost not a penny more. Fit any set. The first and greatest name in wireless

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
NOTICES.

The CHARGE FOR ADVERTISEMENTS in these columns is
3 words or less, 2/-, and 5d., for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh business, the entire "copy" is repeated from the previous issue : 4 consecutive insertions 10%; 16 consecutive insertions 15%; 32 consecutive insertions 20%.

ADVERTISEMENTS for these columns are accepted up to FIRST POST on THURSDAY MORNING (previous to date on which advertisement appears) and must be properly addressed to THE WIRELESS WORLD, Dorse House, Tudor Street, London, E.C.4, or on WEDNESDAY MORNING at the Branch Offices 11, Herford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 200, Manchester Road, Manchester; 191, St. Vincent Street, Glasgow, C.1.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section will be strictly compiled.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and cheques sent in payment for advertisements should be made payable to BELL & SOES Limited and crossed ___. Notes marked "Deposit" are not acceptable unless accompanied by instructions to the contrary.

NUMERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World." Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover possible replies from advertisers is included in the advertisement charge, which must include the words Box No., c/o "The Wireless World." Why the number will appear in the advertisement. All replies should be addressed No., c/o "The Wireless World." Dorse House, Tudor Street, London, E.C.4. Readers also reply to Box No. advertisements through "The Wireless World," Office, Ashton-under-Lyne, Lancashire, and must be clearly marked "Deposit Department.

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. Instructions are received by the "Wireless World," both parties are advised of the payment.

The times are charged as follows : on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh business, the entire "copy" is repeated from the previous issue : 4 consecutive insertions 10%; 16 consecutive insertions 15%; 32 consecutive insertions 20%.

The proprietors reserve the right to refuse or withdraw advertisements at their discretion.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

The MISCELLANEOUS COLUMNS THIS MONTH.

Readers who reply to advertisements are warned against sending remittances. All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared. The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

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Receivers for Sale.—Contd.

FOR SALE.—G.C.C. 3-valve set, superhet, indoor aerial. Elko batteries for H.T.; last order accepted. Apply.—G.C.C., 106, Torriano Ave., N.W.2. (Sofar). 5 VALVE, Eulas Neodynmos (switch on 4 valved). 5 Mullard valves, H.T. battery, accumulator, and loud-speaker. 5s. 6d. for C.D.E.S. Aerial, gsmaphone and small biland table complete.—F. G. Harding, 45, North St., Hampstead, N.W. 3.

EUROPA Portable, with cabinet, bass wiring, H.F. transformers, speakers and valves.—Inquiries to W. H. Sadler, Ottery St. Mary.

SYMONDS BROS.—Receivers constructed to your specification and published design; all valves new, 12 months guarantee; applications at moderate charges. Best materials and workmanship guaranteed; quotation on application.—Shireland Rd., Bootle.

Testimonials; quotations free.—Address, Shireland Ltd., Bootle.

Our Latest Triumph!—Epoch Super-Cinema Model.

The most powerful speaker ever put on the market, and the most sensitive too! Many times as sensitive as an ordinary moving coil speaker. Such supper quality has never before been heard before. Delivers enormous volume and wonderful quality from the most modest of sets. The speaker for the home, public entertainments or Taxis! The finest Loudspeakers in the world in their class.

Models 99 and 66 are the standard of comparison in many of the famous Laboratories of the world. The speakers that have made Epoch so popular. 14 different models for all requirements, £2.3 to 90 upwards.

Write for booklet W.S. giving full particulars and the 7 days free trial offer.

Epoch Moving Coil Models

BATTERIES.

NEW.—Replacements.—Sets (tapped or un-tapped). Highest grade.—Large set, No. 1, 1/2p per doz.—Small sets, No. 1, 1/2p per doz. Drag. 10 sets, 1 ½p per doz. (See below)

Z.—No. 1, 9d. per doz.; No. 2, 9d. per doz.; No. 1, 1½d. per doz.—Large sets, 10 sets, 1 ½p per doz.—Small sets, 10 sets, 1p per doz. (See below)

Z.—No. 1, 9d. per doz.; No. 2, 9d. per doz.; No. 1, 1½d. per doz.—Large sets, 10 sets, 1 ½p per doz.—Small sets, 10 sets, 1p per doz. (See below)

CHARGERS and ELIMINATORS.

VORTEXION Transformers, chokes, etc., wound to any specification; write or phone for list. Good working order; small set, 15/-; medium, 25/-; large, 40/-.


WELD.—H.T. Batteries—Parts per dozen, Box, No. 1, 1½d.; No. 2, 1½d.; No. 3, 1½d.; No. 2, 1½d.; total list £10. Batteries complete with plugs and electrolyte, No. 1, 4/3d.; No. 2, 5/-; No. 3, 5/-; additional plug, 6d.; self charging, quick small, send £1; for sample unit, illustrated catalogue giving data, post free under 10/-; write for list wireless parts, trade supplied.—W. Taylor, 57, Studley Rd., Stebleton, London.

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KUSHETTE PICK-UP ARM

A new Arm for Radio-Graphophones; fast, easy, perfect, and more efficient than a cheap arm ever made. Suitable for use with existing Tone Arms to avoid removal of Sound Box.

Price 5/9

Weight-relieving adjustment. Lifts out from base: correctly angled for best alignment; bushed bearing: no vibration; well finished in aluminium.

Through G.R.C., all best Factors, or direct from


Phone: Law. Wm. 1176.

THE WANDER PLUG WITH THE POWERFUL GRIP

Look at its price of special metal that goes into the most fashionable radio-sets and turntables—its design makes it ready for use as it is delivered—natural finish. Simple, elegant, durable, effective, radio-gain, electric turntable, etc., etc., illustrated lists free—E. R. H. Glasscoe & Co., Mount Pleasant Rd., London, N.17. Phone: Westhampton 1462.

R.CRAFT Radio Cabinets are Britain's Best Value

DIGNITY Cabinets—Table models in solid oak and mahogany; from 11/- to 7/11.-

DIGNITY Cabinets—Fitted with Radio or Record Discs; extra discount if required.

DIGNITY Cabinets—Pedestal model, with separate battery compartment; from 5/- to 25/- which includes accessories.

DIGNITY Cabinets Made to Customer's Own Design.

DIGNITY Cabinets.—Write for new 16-page art cards. Specify which of our 4000 models is best for you.

Phone: Bishopsgate 6435.

ARTCRAFT Radio Cabinets; ARTCRAFT DIGBY'S Cabinets.—Table models in solid oak and mahogany, polished rich dark oak, unless otherwise ordered, 8/- 9 x 5 1/2in., with double curves.

GREAT Bargains.

R.CRAFT.—Engish model A new moving coil speaker kit (or complete unit), brand new; a large number of these famous instruments made for a special order for use in radio-sets, but not executed, for credit reasons only; regular prices, £2 11/-; 8/11 1/2/-; and £17 11/6, to sell at 6/- for a very long order, £1 15/-; 4/- for A.C. mains; kits comprising copper placed super magnets, use of 23 1/2 x 8in. x 15in. x 23in., fitted for moving coil, any impedence, paper, leather and horn, 8/-; also for complete, if desired, 8/- extra.

GREAT Bargains.

R.CRAFT.—In face, the greatest bargain ever offered! A number of Epoch model A new moving coil speaker kits at given away prices, guaranteed in perfect working order; early 1928 model, 35/-; latest model, 42/6; for credit reasons only; regular prices, £3 15/-; £5 15/-; £12 15/-.

GREAT Bargains.

R.CRAFT.—A modern marvel! Epoch REP-0101.-R.C. Epoch Reproduction at Ridiculous Cost; don't wait until they are all gone, but secure one immediately by writing, telephoning, or hurrying to Epoch, 3, Farringdon Av., E.C.4.

Send to-day for our FREE 36-PAGE EPOCH BOOKLET.

ENJOY the Music of your own voice—your own speaking voice—infinitely better than ever before—at your own choice! Epoch speakers by Deferred Payments. EPOCH Famous Moving Coil Speakers, best quality, 9/- each, post free; models at given away prices, guaranteed in perfect working order; early 1928 model, 35/-; latest model, 42/6; for credit reasons only; regular prices, £3 15/-; £5 15/-; £12 15/-.

GREAT Bargains.
Only Brownie's huge production enables them to offer this really splendid dial for 2/6. The special non-backlash design makes hair-breadth tuning a matter of delightful ease, while its handsome appearance (black or beautifully grained mahogany bakelite) will add to the good looks of that new set you are building.

BROWNIE WIRELESS COMPANY (G.B.) LIMITED, NELSON STREET WORKS, LONDON, N.W.1.

BROWNIE! - a tone-perfect production - a friend of good Records!

Scientifically designed, beautifully made, The MELTROPE Sound Box gives perfect tone and wonderful service, and will bring the oldest gramophone up to date!

Price 12/6.

Made by AMPLIFIERS LTD., BILLET ROAD, LONDON, E.17.

Suitable for all types of tone arm.

NEW LIFE TO SETS... OLD OR NEW

from £3 19s 6d.

ULTRA ELECTRIC LIMITED

661-663, Harrow Road, London, N.W.10

ULTRA AIR CHROME SPEAKER

Baldry Ad. No. 197.

The "Layerbilt" is un-beatable for smooth reception. It is crammed full of electricity and lasts half as long again as any other battery of the same size and weight in the world. This is assured by the Columbia patented process of building layer upon layer of flat cells. The "Layerbilt" Heavy Duty Battery is the best and most economical battery in the world. Use it always.

25/-.

Columbia RADIO BATTERIES


Scotland: J. T. Cartwright, 3 Cadogan St., Glasgow.

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
APPLICATIONS invited for POSITIONS AS REPRESENTATIVES by TESLEN ELECTRIC CO. LTD.

The positions are for whole time, and salary, commission and expenses will be paid.

Applications must state full detailed experience during the last seven years, age, number of years experience in car driving and remuneration required, also the particular area or district preferred, or, where best known.

Only first-class men with good references need apply.

All applications will be treated with strict confidence.

TESLEN ELECTRIC CO. LTD.
Miller Street, BIRMINGHAM.

RADIO-GRAMOPHONE CABINETS

Beautifully finished in highly polished OAK. We take sets.

18" x 7" x 16" or 21" x 7" x 16".

Spacious compartment for speaker and batteries. Overall size 39" x 24" x 15". 5-ply motor board.

£4 - 19 - 6

(Mahogany Finish, £5-15-0).

Delivered free in England and Wales. Scotland 2/6 extra.

Send for our List Catalogue.

Fitted complete with D.S. Motor, B.T.H. Pick-Up and Arm, Osmund Unit and Chassis...

£21-17-6

This is all you need to turn your RADIO-GRAMOPHONE.

PREMIER SUPPLY STORES

Radio & Gramophone Specialists,

Phone: Central 2033

Large selection of Gramo. Motors and Pick-ups always in stock.

"B.A.T." 750 Watt "Q.M.B." SWITCH.

This miniature switch comfortably breaks 3 Amps at 220 Volts. For P.P., P.T., H.T., H.T. Grids. For A.C. sets, Receiver, Gramophone, Motors, and as Loud Speaker Field Switch, etc.

"WIRELESS WORLD" and 22-013. "Thunder and lightning" sets can be shut off and do not give any corona effect. Ideal for public speaking. "B.A.T." and "Q.M.B." can be used on all types of mains equipment.

"B.A.T." and "Q.M.B." POWER SWITCH only 2/6 Each.

CLAUDE LYONS LTD.,
76, OLDHALL STREET, LIVERPOOL.

ALEXANDER BLACK.

PLEASE Note New Address.

THE Original Wireless Doctor, will call (London and Home Counties) and cure your sets.

CONSULTATIONS by Appointment Without Obligation. Sets installed, maintained, and brought up to date, gramophone pick-ups, eliminators, and Webson moving coil speakers demonstrated; purity reproduction specialist.

55, Bury St., Victoria, S.W.I. 

LONDON Wireless Society.

EASY Payments—We supply, by easy payments, all components, accessories, and sets, any make; 10/- down, balance payable over 10 months. Send list of requirements to London Radio Supply Co., 31, the Lanes, London, E.C.2.

WIRELESS Notes—A monthly service of information for all those who want the very best in wireless or gramophone reproduction; frank criticism of receivers and components; immediate postal help and advice in all difficulties; something new and unusual; you must have it if you want to know the truth—Full particulars from Ernest H. Robinson, Longwood, Friargate, Woburn, Surrey.

SCOTT SESSIONS and Co., Great Britain's radio doctors, officially approved on wireless repairers by Radio Society of Great Britain and Wireless League; sets of every type repaired, rebuilt, modernised; send for immediate quotation.

SCOTT SESSIONS and Co.—New sets constructed to your order, or any of our components, guaranteed first class; we specialise in Wireless World sets; remember, we are satisfied customers throughout the British Isles and in three Continents; if you so desire, we will design and construct strong cabinets to suit your special circumstances for quality, shape and selectivity. 28, Twelve 5328, Maxwell Hill, London, N.10.

HAVE Your Set Brought Up To Date; able to separate Brookmans transmissions, cost 25/-; all mains sets installed from 15/-10/-; whatever your requirements drop a card, all work guaranteed by expert.


PATENT AGENTS.


PHONE: Holborn 1525.

REPAIRS.

TWELVE Month's Guarantee Accompanies all our sets. Repairs; any make of I.F. transformers, loud- phone, headphones, etc. We repair and despatch within 48 hours; 4/- per item, don't discard old units; send in your requirements drop a card, all work guaranteed by experts. Gee and Co. (H. T. Gee, Member A.S.G.B. and Member A.M.I.R.E.), 221, Cavendish Rd., Hallam.

GUARANTEED Repairs by Experts. Loud speakers, headphones, cone units, transformers, or, where best, new units. Do not discard old units; send in your requirements drop a card, all work guaranteed by experts. Gee and Co. (H. T. Gee, Member A.S.G.B. and Member A.M.I.R.E.), 221, Cavendish Rd., Hallam.

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THREE Marconiophone Intermediate Transformers, tuned 5-500 metres. Glenville, 113, Loes Lane, Mitcham.

WANTED, "The Wireless World," issues October 24th, 1928, elmen and intact; will give 2/-

Yorkshire Radio Society, 14, St. James's Arv, Hulme, Manchester.


WANTED, Philips 4-valve all mains set. —Polly, Pipton, Kentish Town.


WANTED, "Wireless World." Please Note New Address.

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THE Original Wireless Doctor, will call (London and Home Counties) and cure your sets.

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WANTED, Philips 4-valve all mains set. —Polly, Pipton, Kentish Town.

Convert your present Set into a Short Wave Receiver.

Magnum Short Wave Converter.

This Converter is adaptable to any valve set by simply removing the detector valve from set and inserting it in the valveholder of converter, the plug of converter taking the place of the detector valve. Its lightweight metal cabinet, with 2 Coils 2040 and 4080 metres, Plug and Adaptor £11.5.0 inclusive.

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500 or 600 ohms . . . . 1s.6d.
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**The Wireless World**

The Paper for Every Wireless Amateur

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Have acquired a world-wide reputation for Quality and Value. Built by Specialists in Transformer construction, they have set a Quality of Performance above reproach. Your Set will work better with a Telsen Transformer - - - - - - Fit one now!

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Portable Receiver

22 Gns.

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THE WIRELESS WORLD

JANUARY 22ND, 1930.

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- **EVER READY POPULAR PORTABLE THREE**
  - 1.3 THORIUM NUCLEI
  - 3 JAM
  - 13 VOLS.

- **EVER READY POPULAR PORTABLE THREE**
  - 108 VOLTS

THE BATTERY FOR YOUR PORTABLE SET
— with a great name behind it!

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The three essentials of radio reception—
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Volume, and
Selectivity—are well and truly balanced.

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In the field of good batteries Tudor, with its long life and reliability, always leads the way. The Tudor Monolyt Unit is the ideal accumulator for your set. Every part has been carefully designed, and is the result of thirty years battery experience. With this accumulator you will obtain a definite refinement in reception, combined with a much longer life. Among its many characteristics are the charge indicators, which show you when the cells are running down. It has all the usual Tudor features, including non-corrosive terminals and 5 m/m positive plates. Despite these advantages, Tudor costs little more than ordinary accumulators, and in comparison with the excellent results obtained the slight extra cost is well worth while.

ESTABLISHED IN PUBLIC SERVICE.

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Name

Address

Tudor Accumulator Co., Ltd., 2, Norfolk St., Strand, London, W.C. 2

**SUPERIOR A.C. POWER TRANSFORMERS and CHOKES for the MAINS**

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35'- for all Inputs and Outputs

Special Audio-Frequency Chokes and Transformers, and Smoothing Chokes for all purposes.

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2,000 to 12 METRES. A redesigned model with an effective range of 2,000 to 12 metres. Specially suitable for screened grid H.F. circuit where the choke is of vital importance, and in all other positions. Used solely in "EDDYSTONES" short wave receivers. Takes up very little room and has an exceptionally small outside field.

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Sole Manufacturers:

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Gerrard 1542.
A BAD Filament
WITHOUT
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Reproduction from an untouched microphotograph showing part of the filament of a badly coated valve before use, showing a serious gap in the coating. A gap such as this starts the valve off in its life with a poor performance. The valve then prematurely fails.

A GOOD Filament
WITH
"TENACIOUS COATING"
This reproduction shows the coating typical of all OSRAM VALVES. Notice the absolute evenness of the coating. There are no gaps, the coating clings, so that the full benefit of the coating is maintained. The secret is the startling discovery of the scientific process of "TENACIOUS COATING."

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Hold for horizontal type 1/-. Vertical or horizontal 1/-.

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Use no battery but that with "pep."

PERTRIX
SUPER LIFE
H.T. BATTERIES
PERTRIX LIMITED, Britannia House, Shaftesbury Avenue, London, W.C.2.
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LONGER LIFE!

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POLAR "IDEAL" .0005 12/6. POLAR "No.3" .0005 5/9.
.0003 12/-. .0003 5/6.

POLAR CONDENSERS
Obtainable from all Dealers. Write for Free copy of "Polar" Catalogue (W).

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This new Regentone Model is specially designed for Portables. Three separate positive output sockets—one variable—on a separate circuit principle are provided to ensure those exact critical values of voltage so necessary in Portables for maximum efficiency. Special precautions have been taken entirely to prevent the possibility of any external field.

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For A.C. or D.C. Mains.
A.C. Model £4 5 0
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THE FINEST VERNIER DIAL OBTAINABLE

MECHANICALLY PERFECT, POSITIVE BRASS CONTACT drive on SOLID BRASS SCALE ensuring smooth movement, with absolutely NO BACK-LASH, ROBUST in Construction and Trouble Free. SMALL, EXTREMELY ELEGANT, EFFICIENT.

TUNING WITHOUT IRRITATING UNCOMFORTABLE CROUCH OR STOOP.

As pictorially shown, the scale and aperture are inclined at an angle of 30° from perpendicular, thereby permitting convenient unobstructed view of scale without need to crouch or stoop.

WESTON sets the world's standard

Model 528, Pocket Size A.C. Tester
A small and reliable instrument essential to maintain accuracy and efficiency in Voltage control. The sensitivity is remarkably high, 0.1 m.a. for 600 volts with self-contained resistance. The scale is very legible and the damping excellent. This instrument is capable of continuous service at full load.

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THE FORMO CO., CROWN WORKS, CRICKLEWOOD LANE, LONDON, N.W.2

WIRELESS WORLD
JANUARY 22ND, 1930.
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are made and guaranteed by a firm with 30 years' experience in condenser making, from small telephone and radio condensers to Power Condensers weighing upwards of 2 tons.

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All Helsby Condensers are vacuum dried and impregnated with a special non-hygroscopic material which renders them moisture proof.

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**FOR ELIMINATOR CIRCUITS**

**BLUE SPOT CHASSIS**

When getting your 66K Unit, ask your wireless dealer to demonstrate the Blue Spot Chassis.

You will then hear what the 66K Unit really can do—for it is working under ideal conditions, driving a chassis specially made for it.

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The World of Wireless needs these helps!

They save endless worry, wasted time, and money.

**THE "BENCHRACK."**

(Tiltrack Principle.)

No builder of Wireless Sets, no Dealer should be without this splendid help. It stands on the workbench and all parts needed for the job in progress are thus on the spot. It is a tremendous time-saver. All the trays are tilted so that the parts stored can be seen at a glance; and, furthermore, to facilitate rapid removal of the parts the face of the trays are rounded. Each tray is provided with patent hinging partitions which can be rapidly moved to make larger or smaller compartments. All parts needed for the job in progress are thus on the spot. It is a tremendous time-saver. All the trays are tilted so that the parts stored can be seen at a glance; and, furthermore, to facilitate rapid removal of the parts the face of the trays are rounded. Each tray is provided with patent hinging partitions which can be rapidly moved to make larger or smaller compartments. They are all steel and a really sound job. They are stronger, neater, cleaner, and much more efficient in every way than wooden shelves, and they cannot catch fire. Being so accessible they save tremendous time when stocktaking. The Experimenter will do his jobs much quicker and with greater pleasure; and the Factory, Factor, and Retailer will save many pounds per year by installing this Benchrack.

**Price 30/- Car. extra.**

Particulars from Manufacturer & Patentee:

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The outstanding feature of a good mains unit. Look at any good mains unit! See how often Hydra Condensers are incorporated! The best manufacturers and the wisest amateur constructors know that Hydra Condensers provide the greatest margin of safety because Hydra are built to stand up to overloads and have never been known to break down under normal conditions.

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**ELECTRADIX RADIOS,**


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50 ranges on one meter.

The Rolls-Royce of Radio Testers. Highest grade at a low price. METER ONLY 50/-

RADIO SET £4 10s.

Half the price of old-fashioned designs. Order one for 1930. SAVES RADIO USERS POUNDS.

The World of Wireless needs these helps!

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JANUARY 22ND, 1930.

ARE YOU PROUD OF YOUR NEW SET?
DO IT JUSTICE AND FIT THE BEST POSSIBLE BATTERY

Grosvenor Batteries give continuous and satisfactory service because they incorporate a new vitalising element which is unique to Grosvenor.

66 v. from 7/6
99 v. 11/6
199 v. 32/6


ALL ELECTRIC - 2 -
A SET WORTH LISTENING TO

£13

The Igranic All Mains 2 operates entirely from A.C. Mains. Compact design. One knob control. Dual wave switch to eliminate coil changing. Perfect reproduction.

£13

Supplied in attractively designed oak or mahogany table cabinet. Price £13.0.0 complete with valves and royalties.

Please state exact mains voltage when ordering.
Write to Dept. U 305 for details.

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THE Telegraph Condenser Co., Ltd.—the Makers of the world-famous T.C.C. Condensers—have pleasure in announcing that they have acquired sole selling rights in "Microfu," product of Microfuses, Ltd.

The "Microfu" is made in various ratings, from 5 milliamperes to 1000 milliamperes, and is suitable for the protection of valves, wireless sets, eliminators and all instruments taking small currents. It remains constant and will carry a load within 80% of its blowing point. It blows to within 10% of its rated value and operates with the extreme rapidity of 1/1000 second.

The "Microfu" will now have behind it the backing of the whole T.C.C. organization, with its unrivalled and world-wide reputation.

**Cartridge:** 2/-
Complete with Holder : 2/9.

The "Microfu" is made in a wide range of types to blow at from 5 m/a to 1000 m/a. Obtainable from all dealers.

**POLICY**
The T.C.C. will continue as heretofore their policy of manufacturing Condensers only.

**TELEGRAPH CONDENSER**
Co., Ltd., Wales Farm Road, NORTH ACTON, W.3.
CURRENT FOR YOUR MOVING COIL SPEAKER.

THE COMPARATIVELY HEAVY SUPPLY DEMANDED BY THE POT MAGNETS CAN BE VERY EASILY OBTAINED FROM YOUR A.C. HOUSE MAINS WITH THE AID OF A WESTINGHOUSE METAL RECTIFIER.

Full particulars, and circuits, showing how to use all types of Westinghouse Metal Rectifiers, are given in our 32-page book "The All-Metal Way, 1930." It includes a chapter of useful information on the running of moving coil speakers from the mains.

Send 2d. stamp for a copy.

IF YOUR SUPPLY MAINS ARE D.C.
You can use an A.C. All Electric Receiver
By Employing The M.L.—D.C. to A.C. ROTARY TRANSFORMER

Recommended and used by
Philips Radio,
Marconiphone,
Burndent,
Kolster-Brandes,
M.P.A., Etc., Etc.

Can be supplied to run from any Voltage 12-250 V.D.C.

40 WATT Model £13-0-0
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M-L MAGNETO SYND. Ltd., Radio Dept., COVENTRY.
Telephone: 5001.

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When you buy a screened Grid Valve insist on the one which will give you the longest service—the NEW Cossor. The Interlocked Construction system, used exclusively in the NEW Cossor Screened Grid Valve has proved itself, in actual service, to be the most reliable, the most robust and the most dependable method of valve construction yet devised. For power, for reliability and for long life, use the NEW Cossor Screened Grid Valve in your Receiver. Every Dealer sells it.

The NEW Cossor Screened Grid Valve

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INDISCRIMINATE LISTENING.

WHAT is indiscriminate listening? Sir John Reith has recently described it as one of three great prejudices against broadcasting.

In an article in the Daily Express last week, referring to indiscriminate listening, Sir John wrote: "When wireless is first installed it is a novelty and people probably listen too much. The novelty wears off, interest flags, and boredom results. There are those who think they should be entertained or edified or instructed according to the particular desire of the moment.

"They are annoyed if, on switching on, they hear something they do not like. They may switch on haphazard a dozen times a week, and on each occasion hear nothing which pleases them. They sometimes forget that there is wireless apparatus in almost every second home in the land, and that there are millions of others whose tastes are certainly not identical with their own.

"Programmes cannot be modelled on individual desire. They should be studied in advance, a selection made of the items which will be of interest, and these listened to seriously."

We are entirely in agreement with the view that listeners ought not to expect that at any moment when they switch on the wireless they are going to be entertained or amused with a programme item exactly to their taste. No sane person would contract the habit of buying theatre or concert tickets without first knowing at least something about the character of the performance to be given.

Indiscriminate Programmes.

So far, then, we are in sympathy with the views expressed by Sir John Reith, but, in calling attention to indiscriminate listening on the part of the public, has not Sir John also turned the spotlight on what, in the opinion of many, is the weakest part of the programme organisation of to-day? We refer to what can suitably be described as "indiscriminate programmes." Suppose the listener follows the advice of the B.B.C. and picks out the programme items to which he wants to listen, what does he find? Too often, we are afraid, as a result of the indiscriminate compilation of the programmes the listener finds that on very few evenings is there a programme which is mainly to his liking, and the odd bits of programme matter throughout the week which appeal to him are so short in duration as to compel him to hesitate between other engagements and remaining at home without commitments for those particular items alone.

What is needed in programme compilation is that the programmes should be less "scrappy" in character and that as much as possible should be done to avoid the devastating contrasts inflicted on us at present, where we get short snatches of high-brow educational matter, low-brow musical entertainment, modern music, jazz, and classical music all pounded into our ears in a single evening. Again, unless we are listeners with few engagements, we have to make our arrangements for listening-in some time in advance and can only do so by studying the Radio Times for the week. We know that only a proportion of the listening public reads the Radio Times and probably that proportion is made up entirely of regular users of wireless.

If the B.B.C. were to adopt the suggestion which we put forward some time ago of advertising particular programmes well in advance, we believe that much would be done to counteract the influence of indiscriminate listening, whilst it would also serve to attract many more to the ranks of the listening public.
Mains Transformer Construction

Design No. 1.—Constructional Details of a Mains Transformer for an H.T. Eliminator.

The purpose of this article is to give some helpful information of a practical nature on the subject of constructing small power transformers of the type used in battery eliminators. As a consequence the theoretical design will not be dealt with, but the general principles are those discussed in articles which have appeared from time to time in this journal. The design prepared for this particular purpose is one which, it is hoped, will meet the requirement of those who, having a battery-operated receiver, desire to put together an H.T. eliminator, and as a further convenience, operate the output valve entirely from the A.C. mains. Since any one model will have a limited application only, especially when dealing with the diverse requirements of mains-operated sets, it was felt that readers would welcome a number of designs which will be described in these pages as facilities are afforded. By a slight modification to the design chosen to introduce this series it is possible to extend the usefulness of the component to all-mains operated sets using the indirectly heated type of valves. This point will be discussed later.

For the purpose of the present article it will be assumed that a popular type of four-valve receiver is in use, in which case the normal H.T. current is probably of the order of 15 mA. Now since the mains are harnessed the opportunity might be taken to improve the power-handling qualities of the output stage, using a valve not hitherto possible in view of its heavy demands on the H.T., and possibly the L.T., battery. When designing the transformer this possibility was borne in mind and a six-volt winding included to supply the filament current for the last valve.

The high-tension secondary coils have been chosen to give a generous anode voltage and at the same time allow a sufficient excess to provide grid bias for the power valve. The adoption of these recommendations will demand a slight alteration to the receiver, but only the output stage is affected; the H.F. detector and first L.F. stages remaining much as hitherto.

In all there are four separate windings on the transformer, a primary, an H.T. secondary designed to give 250+250 volts at 60 mA; a 5-volt coil for supplying the filament of a Marconi or Osram U5 rectifying valve and, as mentioned above, a winding to give 6 volts at one amp. maximum.

If alternating current was supplied at a standard voltage and frequency throughout the country designing transformers would be relatively easy. Unfortunately it is impracticable to make a transformer which will function efficiently on all A.C. supply mains and certain limitation must, reluctantly, be...
Mains Transformer Construction.—

imposed. The voltage question is easily surmountable, but this cannot be said of the widely different frequencies. Fortunately the majority favour a 50 cycle supply. The transformer described in this article is suitable for use on supply mains of from 40 to 60 cycles. Having acquainted ourselves with the nature of the component it is proposed to build, attention can be given to the choice of the material. The stampings used for the core, and the two special bobbins, were obtained from W. Bryan Savage, 146, Bishopsgate, London, E.C.2. In all 100 pairs of "Electra." Size No. 4 stampings, are wanted. The bobbins to fit these are listed as No. 4H, and since they cost only 9d. each it is not worth while bothering to make them up. Particulars of the wire and other small items are given in the full list of parts. It will be seen that the cost of the material is very low having regard to the fact that the component may be classified as a high-grade article.

The process of winding the coils will be greatly facilitated if a lathe, with a back gear attachment, is available. As an alternative a simple winder, something on a 6-Volt winding to the centre of the bobbin, No. 28 enamelled wire, could be made up. Winding without the aid of some simple mechanism to hold the bobbins will be found rather tedious. The first coil to tackle is the primary. This is wound in two equal parts, half being put on each former. First drill a small hole in each of the end cheeks, one for the beginning and the other for the finish of the coils. These holes must be drilled through the shorter sides of the rectangular former. If the leads come through a long side they would be obscured by the iron when the core is assembled. One hole is on a level with the inside surface while the other, or exit hole, is ½ in. up. The primary is wound as tight as possible, with turns touching and in layer form. A good example is to be found in the manner cotton is wound on its reel. Between each layer of wire place a layer of thin paper which can conveniently be cut into strips a fraction over an inch in width. As the former is one inch wide this will allow the paper to curl up slightly against the inside of the end cheeks and assure good separation between the layers of wire.

Insulation Between Primary and Secondary.

Having wound on the correct number of turns to suit the particular supply voltage on which the transformer will be used, this former can be laid aside and the other treated in like fashion. The following windings will be required for various supply voltages: 200 volts, 600 turns each bobbin; 220 volts, 600 turns; and 240 volts, 720 turns each bobbin, No. 28 enamelled wire being used for this purpose. In cases where the supply is of the order of 100 volts, two courses are open. The primary winding may be chosen for twice the supply voltage and the two bobbins later connected in parallel, or, a larger gauge of wire can be used and the correct number of turns for the series-connected arrangement wound on each former. Assuming the adoption of the latter course, as this lightens the labour, No. 24 S.W.G. enamelled wire will be required for 100-110- and 120-volt mains. The turns on each bobbin will be 300, 330 and 360 respectively. As the area occupied will be somewhat less than in the case of the higher voltage windings the exit holes for the finishing ends of the coils should be drilled slightly lower.

The next point to consider is the insulation between the primary and the high voltage secondary, which is wound next. Three layers of "empire cloth" or similar insulating material, a fraction of an inch wider than the inside of the former, will suffice. It is essential that particular attention should be given to this operation, as it would be courting trouble if any cracks or crevices were left down which the fine wire of the secondary could fall and contact with the primary. Possibly it would be well to give the covering a coat of shellac varnish, thereby ensuring a perfect seal between the cheeks of the bobbin and the covering.

The secondary is divided also into two equal parts, each former carrying 1,530 turns of No. 36 enamelled wire. To wind this in absolute layer form, with each

![Sectioned drawings of the two bobbins showing the disposition of the various windings.](image-url)
Mains Transformer Construction.—

turn touching its neighbours, is expecting too much from any hand-operated winding mechanism, but it will be perfectly satisfactory if the turns are run on as evenly as possible with the apparatus available. The writer adopted this course, and found that a good coil could be made up by winding 160 turns in this manner and then putting on a layer of thin paper. This is followed by a further section of 160 turns, then more paper, and so on until the full number of turns has been wound on.

When assembling the core reverse the order of each pair of stampings. If (a) depicts the first pair then the second pair should be as in (b).

Before commencing to wind this coil the exit hole for the finish of the winding could be drilled through the side cheek 1⁄4 in. above the surface of the insulation over the primary. Incidentally, the direction of winding should be kept the same throughout, and as a guide for future reference it would be well to engrave an arrow on the outside of the bobbins showing this. Thin wire is very fragile and inclined to break at the least provocation. As a precautionary measure the beginning, and the finish of the winding should consist of much stouter wire. This will prevent any likelihood of the wire breaking off where it passes through the holes on the side cheeks. A few turns of No. 28—the primary wire—might be used and the No. 36 gauge soldered to it.

Testing for Continuity.

When the two secondaries have been completed the windings should be covered with insulating material and finished in the manner described above. Similar precautions should be observed in these cases, although there will be little likelihood of the following winding settling down between the cheeks and the covering; a much thicker wire will be employed. Insulation of a high order is essential, however, as the coil which follows the secondary is the filament supply for the rectifying valve. Readers who are familiar with valve rectifier circuits will appreciate this point, but for the benefit of those not so well versed on these matters it is well to bear in mind that the filament of the rectifying valve becomes the H.T. positive, while the centre point of the high voltage secondary coil is the H.T. negative. Thus there is a considerable difference in potential between the two coils.

Before proceeding further it would be well to test the coils for continuity, using a 1½-volt cell and telephones, or a galvanometer. It is highly improbable that any thing will be found amiss, as one advantage of employing enameled wire is that a break would have been spotted during the process of winding. However, it is a safety measure well worth adopting.

For the next coil we require 16 turns of No. 20 D.C.C. wire on each bobbin. This is wound as a single layer with turns touching. The beginning of the wire may be passed through a hole in the cheek through which the starting ends of the other coils pass. This applies to one bobbin only. For explanatory reasons we will call this bobbin A. Reference to the small sketch, showing the disposition of the coils on the bobbins, will explain the reason. The overall width of the two formers does not permit any appreciable separation between them when assembled on the core; and if the ends which we will call OP, and IP, were brought out through the cheeks, which lie adjacent; the core stampings would not fit snugly together. An air gap in the magnetic circuit is highly undesirable, as it tends to lower the efficiency of the transformer. Therefore, when finishing the winding on bobbin A, bring the end out on the inside of the cheek. It is not difficult to arrange, as the wire can be anchored in position by binding with stout cotton. Likewise the beginning of the coil on bobbin B should come out on the inside of the cheek, but its end can pass through a hole in the other face. A coating of shellac may be applied if desired, but it must be allowed to set hard before commencing to wind the next coil.

The final winding supplies current to the output valve, and as a consequence there will be a difference in potential between this and the preceding coil equal to the high tension supply to the anodes of the valves. Particular care is required, therefore, in insulating these two coils. In addition to the layers of "empire cloth," place a strip of mica across the coil so that it completely isolates the end of the coil which is brought out on the inside face of the end cheek. Its function is to form an artificial cheek and assure good insulation between the two coils at the point where the wire is not fixed so securely.

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As would be the case if it had been convenient to pass the end through a hole in the side of the former.

Now for the final winding. This consists of 18 turns of No. 20 D.C.C. wire—on each former. The method of commencing and finishing this coil is the same as that described for the preceding one. The windings are now completed to conform with the specification outlined at the beginning of this article. If particularly
Mains Transformer Construction.—

desired the six-volt winding can be replaced by one suitable for the supply of current to three indirectly heated valves. In this case 12 turns of No. 18 D.C.C. wire should be substituted for the 18 turns of No. 20 D.C.C. on each bobbin. A thin coat of shellac, and finally a few turns of insulating cloth, to impart a pleasing finish, complete the winding, and attention can be given to the assembly of the core.

This is built up with thin stampings cut from specially prepared steel, on one side of which is a thin layer of insulating material. They consist of "T" and "U" shaped pieces, one of each forming a pair, and giving the distinctive shape to the core. The two bobbins should be placed side by side, with the long side of the rectangular core spaces at right angles to the bench. If the winding has been carried out in accordance with the details given here the arrows showing the direction of winding will both point in the same direction with all leads coming out from the top. If there is any difficulty in identifying the various leads, test through with a battery and telephones. Now cut two strips of mica \( \frac{3}{2} \) in. long and \( \frac{3}{4} \) in. wide and drill a small hole in each. One hole, through which should be threaded the OP lead, will be \( \frac{3}{8} \) in. up from the lower edge, and the other will be about \( \frac{1}{8} \) in. up to accommodate the IP lead. Cut these leads, leaving about \( \frac{1}{8} \) in. of wire, remove the enamel carefully, using a piece of emery cloth, and solder together. When the two bobbins are butted together the primary join will be protected by the two mica strips.

The core can now be built up by inserting the tongue of a "T" piece into the core opening and following by a "U" piece from the opposite side. The order of assembly must be reversed in each layer. For example, if the first "T" piece is inserted from the right-hand side the second "T" piece goes in from the left. This is explained diagrammatically in the sketch of the core stampings. If (a) is the first pair, then the second pair should be arranged as in (b) and so on until as many pairs as the space will hold have been assembled. If the core is built up correctly it should be possible to accommodate 100 pairs. To clamp the iron, pieces of \( \frac{1}{6} \) in. angle brass, 4 in. long, can be used. Holes to pass 2BA screwed rod should be drilled 3 in. apart. This will allow sufficient clearance for the rods. The brass rods must not touch the edge of the laminations, otherwise all the advantages of using insulated stampings will be lost. Incidentally, when assembling the core keep the insulated sides of the stamping the same way up throughout, the object being to maintain a layer of insulation between each. Terminal strips, cut from paxolin, or \( \frac{3}{4} \) in. thick ebonite, can be clamped on to the extension of the holding bolts and small terminals, or \( \frac{3}{4} \) in. No. 4BA screws and nuts, used to finish off the transformer. The method of assembling these is shown clearly in the illustration of the finished model.

Voltage Regulation Curve.

Some practical tests were made with the experimental model and curves taken of the output voltages on load. These are shown in the graph reproduced here. At the time of test the mains voltage was down to 230, whereas its nominal value is 240 volts. All output voltages are thus reduced in the same proportion.

It was a pleasant surprise to find that this particular model was absolutely silent when connected up; generally a slight hum is present, which is brought into being by looseness in the core. The stout walls of the bobbins
Mains Transformer Construction.

enable the iron to be packed much tighter without damage to the coils than appears possible with any other method of assembly.

The voltage regulation of the H.T. secondary may be regarded as satisfactory, since the variation between no-load and full-load—in this case 60 mA—is of the order of 7% only. No change in conditions in the H.T. circuits could be discerned when current was drawn from the 6-volt winding. On voltmeter load only, the voltage was 6, at 0.5 amp. it dropped to 5.85 volts, and at 1 amp. to 5.7 volts. This is equivalent to a 5% change from open circuit conditions—an entirely satisfactory regulation.

Readers having access to a high range D.C. voltmeter and a milliammeter might well consider taking a rectified voltage characteristic curve, as shown at A on the graph. This will be found of inestimable value in calculating the values of voltage-dropping resistances. The requirements of the set will be known, of course, since it is assumed that batteries have been employed hitherto.

Irish Amateurs.

The Wireless Society of Ireland has appointed a sub-committee to consider matters affecting membership, especially with a view to increasing the scope of the Society and forming branches in the principal provincial towns. A writer in the Irish Radio News advocates a very considerable broadening of the membership to include not only amateur experimenters and transmitters, but listeners, traders, and broadcast artists, each section conducting its own meetings and business but having its representatives on the governing council. By this means he considers that all shades of wireless interest would be united and radio activity spread over the whole country instead of being confined almost exclusively to the neighbourhood of Dublin.

French Morocco.

CN 8MC, operated by Dr. G. Veyre, at 59, Avenue de General Monnier, Casablanca, Morocco, will relay the programme from Rabat, Morocco, will relay the programme from Rabat, Morocco, will relay the programme from Rabat, Morocco, will relay the programme from Rabat, Morocco, will relay the programme from Rabat, Morocco.

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The use of unrectified A.C. for amateur transmission is distinctly prohibited, under the terms of their licences, to British amateurs and, we believe, similar restrictions are imposed in all Continental licences, yet the interference caused by the use of unrectified or badly smoothed A.C. is still a source of great trouble on the 7,000 kc. and 14,000 kc. wave-bands. British amateurs in general are careful to observe the regulations in this respect, but there are, unfortunately, Continental stations causing interference, especially on the 7,000 kc. band, by careless use of raw A.C.

We believe that most of the offenders are, in fact, unlicensed stations, but their interference is so great that many British amateurs have almost given up working on the narrow 42-metre band. The combined efforts of the R.S.G.B. and the R.E.F. seem unable to bring about any reduction of the nuisance. Probably the offending stations, being unlicensed, are hard to trace, but in the interest of amateurs in general no pains should be spared to induce them to "play the game" and to remember that the restrictions on amateur activities are now considered rather drastic, and that any infringement of regulations or of the desirable courtesy of the ether, tends to tighten up these restrictions.

On the Riviera.

Mr. M. W. Pilpel (G 6PP) will be spending a month in Nice, and hopes to obtain some interesting notes on the comparative difference in conditions of reception in the South of France. He will probably be listening on most afternoons and some evenings up to the third week in February, and will be willing to report to any British stations on their 7 or 14 mc. signals, if they will write to him c/o Mrs. Schmidt, 14, ter. rue Buffa, Nice, France.

The Havoc of the Storm.

The gale on the night of Sunday, 12th, caused considerable havoc among amateurs' aerials. We hear that the 50ft. steel mast at G 5AR— the station of Mr. E. D. Ostermeyer, of South Woodford—which for six years has withstood every onslaught, snapped at the height of the gale and fell, carrying away trees and his neighbour's aerial in its wake. It may, therefore, be some time before G 5AR is again "on the air," and his neighbour lamented the destruction of his own aerial just before Radio Week.

New Call-Signs and Changes of Address.

G SQP J. V. Paramos, 34, Upper Holland Rd., Sutton Coldfield. (Change of address).
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Frequency Modulation

A Possible Cure for the Present Congestion of the Ether.

By JOHN HARMON.

It is well known that as soon as a broadcast station begins to speak its carrier wave becomes bordered by a halo of nearby frequencies, and the station, which is a mere spectrum line in the ether when silent, becomes a spectrum band when its jazz band begins.

This frequency band extends over at least 5 kilocycles on either side of the carrier wave, so that each station requires a space 10 kilocycles wide for its exclusive use. This position was all right five years ago, but to-day the stations of the world have used up all the available frontage and there is no room for further extensions.

Accordingly, inventors have been intent on the problem of communications on narrower frequency channels. No improvement is conceivable while the principle of modulating the amplitude of the carrier wave remains, and so a completely different method has been tried in which the carrier frequency is wobbled while the amplitude remains constant.

Wobbling the Carrier Wave.

Imagine an oscillator set up as in Fig. 1. In parallel with the tuning condenser a small special condenser is inserted, composed of two parallel plates, one of which consists of the diaphragm of a magnetic telephone. If a 1,000-cycle oscillation be impressed upon the electromagnet the motion of the diaphragm will vary the capacity of the small condenser and the frequency of the carrier wave will alter 1,000 times per second, as in Fig. 2, while the magnitude of the frequency change will be proportional to the magnitude of the A.C. current which flows through the windings of the electromagnet.

Hence the usual picture of a carrier wave accompanied by two side-bands (Fig. 3) is replaced by a blurred carrier wave of unvarying amplitude, and the important fact emerges that the transmitting station may now occupy a much smaller frequency channel.

Indeed, we can make the wobble as small as we please by diminishing the capacity of the two-plate condenser in Fig. 1. But the impressed wobble must be made considerably greater than the unavoidable wobble of the carrier wave itself.

A New Conception.

A wave of this kind is a new conception in wireless and has some peculiar features. If we listen to it on an oscillating detector we can never get a silent point; instead, we hear a gliding tone similar to those given by the Parlophone gramophone test records, where a note sweeps rapidly up and down the scale, producing a sound somewhat similar to the chirp of a bird.

Again, though a wave with amplitude modulation can be represented as a carrier accompanied by two side-bands, no such analysis can be got on a wobbling wave.

Reception.

If such a wave is received on a set tuned to the undisturbed frequency of the carrier, practically nothing is heard since the wave is sweeping back and forward with constant amplitude across the summit of the resonance curve, in which region the sensitivity to small frequency changes is least. The best place to receive the signal is on the steepest part of the slope (Fig. 4), so that the frequency changes may give rise to the maximum changes in amplitude.

Thus, if a single-tuned circuit is used for reception, the ratio of the reactance of the coil to its resistance, i.e., the coil magnification, being 100, which is a figure corresponding to a rather poor coil, the resonance curve at 300 metres is shown in Fig. 5 (a). If the incoming
Frequency Modulation.—

wave is received at the point A on the curve, then a frequency wobble of 2 kc. in either direction will be required to change the amplitude of the received signal by 20 per cent.

Fig. 5 (b) gives the resonance curve for the same wavelength of 300 metres when a 2-stage H.F. receiver is used having three tuned circuits, each coil having a magnification of 100. In order to obtain a modulation of 20 per cent. of the signal amplitude the wobble need only be 1 kc. each way. Hence the transmitting station need occupy only a frequency channel 2 kc. in breadth instead of the 10 kc. required with the usual system of amplitude modulation.

But we can go much farther by using a local oscillator at the receiving end to give a beat note of, say, 50 kc. with the incoming wave, and amplifying this intermediate frequency. If the intermediate amplifier has three tuned circuits, the magnification of each coil being 100, we get the resonance curve of Fig. 5 (c).

Accordingly, if this resistance is varied at speech frequency the oscillator undergoes frequency modulation. The resistance may be replaced by a valve (Fig. 6 (b)) whose grid is controlled by speech currents, and the varying impedance of the valve acts in the same way as the variable resistance in Fig. 6 (a).

The frequency modulation so produced is necessarily small, since the quartz plate is equivalent to an inductance of about 100 henrys in series with a capacity which is only a fraction of a micro-microfarad, so that the loading coil does not produce much change in the total inductance. However, it is possible to change the frequency by as much as 1 kc. in a 1,000-kc. wave.

It should be noted that this change is produced with no change of the amplitude of the H.F. oscillations. Readers who wish for more complete details of these inventions will find them in Patent Specifications 292,469, 293,803, and 296,678. The methods do not seem to have attracted attention in the wireless Press up to the present, but they are worth studying, and experiments on similar lines are well within the resources of the amateur.

Fig. 6.—To prevent wandering of the carrier frequency, a tuned anode circuit is used together with a quartz-plate oscillator in the grid circuit (a). The resistance in (a) may be replaced by a valve as in (b) whose grid is controlled by speech currents.

Wireless Theory Simplified.

Part XVIII of this series dealing with Dynamic Resistance of Tuned Circuits will appear in next week's issue.
ANOTHER POLYGLOT STATION.
The example set by FCJ, Eindhoven, in announcing items in several languages will probably be followed by Kalandborg in the near future.

WECKDAY WIRELESS IN CHURCH.
Argyle Congregational Church, Ruth, is being equipped with a wireless set for the daily reception of the morning religious service from Daventry. Passers by are invited to come in and listen.

ANOTHER GERMAN GIANT.
A new "super broadcasting station" for Germany as to be erected at Miel- hacker, mid-way between Stuttgart and Carlsruhe, and within thirty-seven miles of Strassburg. French listeners are beginning to fear that the new Strassburg station may be within the interloper's wipe-out area.

ANTI-INTERFERENCE CLUB.
According to our Paris correspondent, a club has been formed in Campagneole (Jura) for the express purpose of suppressing interference to broadcast reception caused by noisy generators and other sources of "perturbation." If the club ultimately fulfils its purpose, remarks our correspondent, it is assured of a very long life.

AN OBLIGING TRAMWAY DEPARTMENT.
The Nottingham Tramways Department is making special efforts to overcome interference caused to broadcast listening by defective "collectors" working on the overhead current wires. Experiments are to be conducted with an improved form of collector which has been found successful in Blackpool and Birmingham.

MAINS SETS ON TRAINS.
Living up to their reputation as the most enterprising of the world's railway systems from a radio point of view, Canadian National Railways are now installing mains-operated wireless receivers on their Trans-Continental expresses. The power is supplied from a motor generator driven by the car lighting batteries. It is stated that the new system will considerably reduce maintenance costs.

Another innovation is the use of electric gramophones for use in parts of the line, such as in the Rockies, where radio reception cannot be relied upon to give good quality.

GERMAN SHIP-TO-SHORE TELEPHONY.
The famous German coastal station at Norddeich is to be equipped with short-wave telephony apparatus for communication with fishing fleets in the North Sea and with German ships in all parts of the world.

POST OFFICE PATIENCE.
In the case of a wireless "pirate" fined at Pudsey, evidence was given that the Post Office sent three warning notices before taking action.

THE UPWARD TREND.
On January 1st, Germany's licensed listeners numbered 3,066,682, making an increase of 431,115 during the past year. The British increase over the corresponding period was 339,344.

A HINT TO THE B.B.C.
Havana broadcasting stations are forbidden to transmit after 10:30 p.m., the object being to allow listeners to tune in the American stations.

R.M.A. GIFT TO THE BLIND.
Over £10,000 has been contributed by listeners in response to Mr. Winston Churchill's appeal on Christmas Day for the "Wireless for the Blind" Fund. The Radio Manufacturers' Association has decided to present 1,000 complete wireless sets, representing a retail value of £10,000.

TEN YEARS FOR ILICIT TRANSMITTER.
Alexander Pertini, the Italian lawyer who was recently arrested at Nice, charged with broadcasting anti-Fascist news from his villa there, has been sentenced in Rome to imprisonment for ten years and nine months, to be followed by three years of police supervision.

NEW RADIO SHOWROOMS.
London's latest radio landmark is Rov- burgh House, 283, Regent Street, W., which houses the new West End show rooms of Burndept Wireless (1928), Ltd. It would have been difficult to choose a site nearer the centre of musical London and the designers have availed themselves of the opportunities presented by introducing a modern scheme of decoration and furnishing which should satisfy the most discriminating visitor. A large selection of Burndept radio- gramophone instruments are available for demonstration.

HIDDEN ADVERTISEMENTS COMPETITION.
The competition announced in our issue of January 8th brought entries from all parts of the country and from the Continent. The following are the prize-winners:

1st Prize (value £7 10s.)—Mr. Walter Beck, 13, Houlditch Road, Leicester.
2nd Prize (value £5)—Mr. H. A. Pothegilh, 9, Mosley Street, Nelson, Lancs.
3rd Prize (value £2 10s.)—Mr. William Brainston, Lamport Maresfield, Cockfield, Susset.

Consolation prizes (each to the value of £1) are awarded to the following:—
Mr. F. Sytor (Antwerp), Mr. J. Goddegr (Worthing), Mr. Henry R. Kuhler (Lon- don, S.W.9), Mrs. M. Diggie (Salford), Mr. H. J. Layzell (Herne Bay).

The following are the correct solutions:—(1) Brownie Wireless Co. (G.B.), Ltd.; (2) British Institute of Engineering Technology; (3) Sheffield Magnet Co.; (4) Dubler Condenser Co. (1925) Ltd.; (5) Igranic Electric Co., Ltd.; (6) Claude Lyons, Ltd.
CHINA FREIGHTENS THE CABLE

Several high-power wireless stations are now being erected in China for communication across the Pacific, and the cable companies covering this route are growing apprehensive. According to a Shanghai message, China's radio seal is being inflamed by American capital.

BELGIUM'S BEAM STATION.

The Belgian Government has concluded a contract for the establishment of a high-power short-wave station at Rubselsele, near Bruges, for international telegraphy and telephony communication. The station will be built on the Marcoen beam system and will be primarily intended for working with the Belgian Congo. It will later be used for services to South America and Japan.

POLICE AND CAR WIRELESS.

Among recent daily papers, the police view with alarm the advent of a wireless-equipped motor car, a saloon model of which is expected to be in production shortly. Next it is stated that the police base their anxiety on the probability that the new car will become popular with gangs of criminals. Are our contemporaries forgetting that anyone can equip his car with wireless at a moment's notice by taking a portable? "

SIR RICHARD GLAZEBROOK.

The Council of the Institution of Electrical Engineers have elected Sir Richard Tetley Glazebrook, K.C.B., D.Sc., F.R.S., to be an honorary member of the Institution. Sir Richard Glazebrook was the first Director of the National Physical Laboratory, and was a member of the Technical Committee inquiring into the Imperial Wireless Scheme.

A RADIO RAILWAY.

"Radio Features" is the title of a new monthly publication issued by the radio department of the Canadian National Railways. This brightly written and illustrated journal, which is distributed to passengers on the company's system, summarises the month's programmes with biographical details concerning the broadcasting artists besides interesting facts relating to the operation of the radio service.

There are now seventy-two cars permanently wired for radio reception, and in nearly all cars now under construction provision is made for the installation of wireless gear. A staff of nearly sixty uniformed operators specialises in the control and maintenance of the train receiving equipment.

DR. DE FERRANTI.

The death of Dr. Sebastian de Ferranti at Zarich on January 13th will be widely regretted. To the majority of wireless amateurs Dr. de Ferranti's name has become a byword through its association with the famous firm of transformer manufacturers. Electric engineers, however, Dr. de Ferranti will also be remembered for his pioneer work in electrical supply. Born in Liverpool in 1864, Sebastian Ziani de Ferranti spent most of his life in this country. As far back as 1895 de Ferranti's help was enlisted in the development of an electric lighting supply for the West End of London, and four years later he set up a generating station at Deptford with two 1,500 h.p. sets with a pressure of 2,300, which he transformed up to 10,000. As there was no form of meter in those days capable of registering such a pressure he was reduced to the expedient of connecting up a hundred 100-volt lamps in series, judging that the correct voltage was reached when the lamps gave their normal brightness!

WIRELESS WORLD

FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 22nd.

Edinburgh and District Radio Society.—At 8 p.m. At 15, Royal Terrace, Shortwave Transmissions. Golders Green and London Radio Society.—At 8.15 p.m. Informal meeting at 45, Red Lion Road. Institute of Wireless Engineers.—At 7 p.m. At the Engineer's Club, Guernsey Street, W. Lecture: 'The Tale of Wireless Supply.' Mr. A. M. Houston, F.R.T.T.

THURSDAY, JANUARY 23rd.

Short Wave Radio (Birmingham).—At the Park social Hall, Bromfield Road, Erdington. Test of members' loudspeakers.

MONDAY, JANUARY 27th.


TUESDAY, JANUARY 31st.

Thursoon High Radio Society (with South Croxden and Whitchurch Middle Schools Wireless Societies).—At 8.15 p.m. In St. Paul's Hall, Thursoon Heath. Cinematograph film exhibited by Messrs. Sources Ltd.

JANUARY 22nd, 1930.

When in 1910, Dr. de Ferranti delivered his address as President of the Institution of Electrical Engineers, a time when all fuel used for heat and power would be transformed into electrical energy and distributed throughout the country from a few large generating stations. He was awarded the Institution's Farnaday Medal in 1924, and in 1927 was elected a Fellow of the Royal Society. He received the honorary degree of D.Sc. from the University of Manchester in 1911.

CLUB NEWS.

Difficulties Dissolved.

"Fasts Which Have Failed" was the subject of an animated discussion between members of the Westley Wireless Society at a recent meeting, at which many earnest experimenters had their problems solved. A social evening has been fixed for February 7th. A special sub-committee has been appointed to deal with all applications for further particulars, which will be a very attractive one. Completions will be introduced and prices will be reduced to the ladies and gentlemen taking part.

"Wireless Theory Simplified" must be of the greatest value to members, said Mr. Child, and should be most carefully read and studied by all interested in wireless.

To satisfy the request for informal meetings, Mr. Zwengbarg has placed his laboratory and workshop at the disposal of the members. The Society's fourth dinner will be held on January 29th. Full partnership is now available and will be sent on application to the Hon. Secretary, 110, Hillaries Road, Grassley Hill, Birmingham.

For South London Experimenters.

"We are still going strong," is the report from the Furadary Radio Club, which holds meetings every Saturday at 7.30 p.m. at the London Men's Institute, John Runkin L.C.C. School, Putney, 5.5.5. Prospective members are always welcome.

Hon. Secretary, Mr. J. H. Payton, 30, Penton Place, London, S.E.17.
Gramophone Needles Wear

The Reasons for Frequent Needle Changing.

By E. M. PAYNE
(Research Department, The Gramophone Co., Ltd.)

Why do all the gramophone companies recommend the changing of the needle after every single record side has been played? Is it just another dodge to get the public to buy more needles?
The answer is easily arrived at by examining the various figures in this article and considering the actual facts.

Gramophone needles may be roughly divided into three classes:—(1) Steel (loud, medium, soft, etc.); (2) Fibre; (3) Permanent. The wear on each of these three types is of a rather different nature, but in every case the effects upon music reproduction are similar. They are (a) loss of treble notes and (b) a peculiar combined woolliness and harshness. The effects upon the records themselves are disastrous in respect of the steel needles of class (1).

First, it is necessary to correct a popular fallacy. The term "soft" as applied to gramophone needles does not mean nowadays that the steel has been tempered to a lower figure in the hardening scale and is thus more easily abraded, but it is only a reference to the intensity of musical reproduction obtained from its use, thus a "soft" needle means a quiet needle. In the early days the loudness of a gramophone was easily regulated by using needles of different hardness temper, hence the origin of "soft" as applied to needles. A "soft" tone needle does not necessarily wear any faster than a loud tone, in fact, sometimes the reverse occurs.

An examination of Fig. 1 shows the R.M.S. voltage output actually obtained from a pick-up when playing a range of constant note records with various needle conditions. It will immediately strike the reader that the principal effect of using a soft tone needle or fibre needle is to quieten the treble notes, the bass notes remaining almost as loud as when using a loud tone needle. This is a rather surprising fact. Curve B is of great interest because it shows us that the treble response is again reduced when we use a worn needle.

Why does this reduction occur? Record and needle groove models of truly gigantic proportions have been made up in order to solve this problem. Figs. 2, 4, 6 and 7 are photographs (considerably reduced in size) of the records which accompany this article are reproduced by courtesy of The Gramophone Co., Ltd.

Fig. 1.—These curves reveal the behaviour of a gramophone pick-up when various types of needles are used.

Fig. 2.—Large scale model of a steel needle moving in the groove on the record. The furrows represent a note of 4,000 cycles per second.
Gramophone Needle Wear.

needle tip and groove. The scale of the model was 400 times full size, so that the complete needle would be a pointed steel cylinder, 20 ft. long, weighing 11.3 tons, and the complete record stood on end would be as tall as St. Paul's Cathedral. To make the extreme tip of the needles was obviously easy, but to ensure the accurate production of the record groove cheaply was very difficult. Thousands of identically shaped lamina of very thin material were stamped out to the exact contour of the cross-section of an average record groove, and these lamina were gripped between a pair of blades in a special framework. The blades were about 18 in. long, and were shaped up in pairs to various desired wave forms. The form in Fig. 2 is that of a 4,000 cycles per second sine wave.

Effects of a Worn Needle.

The best relative angle (65°–70°) between needle axis and record face for a good quality pick-up was determined by experiments upon normal sized needles, and the big scale needles were cut away on their flanks so as to reproduce the various abrasions which had been noted from microphotographs of needles worn under various conditions of playing, such as heavy and light orchestral passages, soprano notes and so on.

Incidentally, some very interesting discoveries were made in this work, for example, some needles were found to be worn off on the left-hand only, and scarcely touched on the opposite flank, while other needles were worn on the right-hand flanks only. It was afterwards found that in the first case the face of the record was not truly horizontal, and the pick-up was thus running down hill towards the centre of the record with the needle acting as a brake; while in the second case the pick-up arm back bearing had been adjusted too tightly, and thus the needle point had a very unfair load placed on one side of it. Needless to say, the effect on the records was disastrous, and reproduction of music was "woolly" and dull towards the end of the record.

Now let us look at Fig. 3 which shows an average loud tone needle at various stages of wear. The new needle has a nicely domed tip which fits snugly the curvature of a 5,000 cycles per second note, but does not quite touch the bottom of the groove (Fig. 4). After playing one side of an average 10 or 12 in. record the needle tip takes up a form similar to the centre pictures, whilst after two heavy records the wear approaches that of the right-hand side view. We must, of course, work on average records in general, as it was found that special notes, such as a sustained soprano note, would cause a definite narrowing of the extreme point of the needle combined with striations on the worn flanks.

Returning to Fig. 3, consider the flat flank of the needle which has been worn away, and it will be found that the length of the flat is of the same order of magnitude as the wavelength of a 4,000 cycles per second note on a record.
Gramophone Needle Wear.

From actual measurements and calculation the above wavelength is around four thousandths of an inch on a two-inch radius groove, whilst the length of flat of the left-hand centre worn needle is around three thousandths of an inch. It is obviously impossible for the needle point to follow accurately the minute waves of frequencies above 4,000 cycles per second or so when once this flat flank has been formed by abrasion.

Here then we have, in our models, a tangible means of showing that there is a limit to the reproduction of treble notes which it is possible to obtain from a record-needle groove system. As a further check on this fact, greatly magnified traces of the angular motion of the armature spindle of a pick-up were made when playing a passage of music on a record with a new and a worn needle. These traces are shown in Fig. 5. It will be observed that there is a definite loss of the finer treble frequency "kicks" on the record. It should be remembered that top "C" of a grand piano is around 4,100 cycles per second. Now if we consider the right-hand worn needle of Fig. 3 which has two distinct flats, and also look at Fig. 6, the weight of the sound box is taken by these small flats which scrape along the top of the walls of the record groove. This causes a very objectionable scraping and tearing noise, while the needle tip itself is free to wobble about in the groove, being pushed over first by one side wall and then by the other. Distortion of all frequencies except the very lowest bass is caused. Thus we find that the loss of treble and the peculiar combined wooliness and harshness are definitely accounted for along quite obvious lines when we study these huge models.

Improved reproduction of treble notes can be obtained by increasing the radius of the music groove from the centre of the record; this has the, effect of increasing the surface speed of the record, and hence increases the wavelength so that the flat flank of the needle is of small dimensions compared with the wavelength. This improvement unfortunately is not at present practicable. Another improvement may be made by using an exceedingly hard needle such as a diamond and shaping the point specially so as to reduce the above interference. These changes, however, are not commercially possible.

Fibre needles are quite good for users who like to preserve their records indefinitely, but even with these it is essential that the record faces be kept clean and free from dust or grit, as the fibre picks up the grit and acts in the same way as a "lap" for cutting a diamond facet. The reproduction of treble notes when using a fibre needle is definitely poor, as is shown by curve D on Fig. 1. This is due, first, to the presence of distinct flat flanks quickly forming on the needle tip, secondly, to the very low stiffness figure which the stick of fibre possesses, and thirdly, to the quick formation of "shoulders" on the needle tip, which are rather similar to those of the much worn steel needle. The fibre should be repointed after every playing, and the point should be lowered gently into the groove always.

Fig. 7 shows the advantage of using a permanent needle such as the Tungstyle needle. The chief character of this needle is that in its extreme tip it contains a short piece of soft tungsten wire only six thousandths of an inch in diameter. Now the maximum width of groove on an average record is slightly larger than this diameter, so that no matter for how long the needle is worn away, it is impossible for "shoulders" to become worn on the needle tip, and the only distortion obtained with their use is to attenuate to a very slight degree the
Gramophone Needle Wear.—

Treble frequencies around the high notes of the piano. Care must be taken when using these, or in fact, any needles to ensure that the pick-up is not dropped or handled clumsily when placing it on the starting grooves of a record, also it is not advisable to change the position of the permanent needle in the needle holder, as fresh flat flanks have then to be worn upon the needle tip, and the record grooves may suffer.

The flat flanks which so soon appear on steel needles act like chisel edges upon the rapidly moving record groove walls, and carve an ever-widening passage for the needle tip in a similar manner to a bulky barge being dragged along a neglected canal (Fig. 8). Record wear, however, is a different study from needle wear, and must be treated separately, although always with very strict reference to needle wear.

This article has dealt with needle wear pure and simple, and does not take into account the differences of wear which are found when various pivot-bearing suspensions are used, or when various weights of pick-ups are used. The reaction of the needle to the groove in these cases plays a very important rôle at certain selective bands of frequencies.

THE RADIO SITUATION IN THE STATES.

By AN AMERICAN CORRESPONDENT.

It may be interesting to British readers to learn how the recent financial crash in Wall Street circles has affected the American radio industry. One thing is clearly evident, namely, that although radio has been thought to have passed from the luxury to the necessity class, it was, with automobiles, almost the first trade to be affected by the financial troubles.

Just before the trouble came the bulk of the radio business was in the hands of the following makers: Radio Corporation of America, Zenith Radio of Chicago, Sparton, Atwater-Kent, Grigsby-Grunow, makers of the Majestic set and with the reputed biggest output in the States, amounting to over 6,000 sets per day, Stromberg-Carlson, and Crosley. The effect of the crash was electrical. Several companies immediately reduced their prices, notably Grigsby-Grunow, Atwater-Kent and R. C. A. Whether this panic legislation was due to the crash is known to themselves only, but rumour has it that the price reduction did none of them any good, but on the contrary hardly enhanced their reputation. Others, notably Stromberg-Carlson, actually increased prices, while Zenith immediately announced by nation-wide advertising that they were not going to reduce prices as their goods were worth every cent that was asked for them. The fact remains that several of the above-mentioned manufacturers with an output running into literally thousands of sets per day had to close down entirely, and that in the very busiest part of the radio season. Others, however, have carried on at a reduced scale.

One well-known company, Earl Radio, which incorporates Fried-Eisemann and Freshman, is now in the hands of a receiver, but it is said that it will probably be reconstructed on a fresh basis.

A significant fact is the entry of that gigantic automobile trust, General Motors, into radio by the launching of a radio subsidiary company in conjunction with R.C.A. Dayfan Radio has also been bought up and others are said to be included in the merger. The result will be the provision of radio sets in automobiles in the General Motors range at an early date.

Everything here points to the fact that the radio industry will be in the hands of a smaller number of firms before long, just as the motor industry is mainly in the hands of General Motors, Ford, Chrysler, Packard and one or two more.

Another interesting rumour is to the effect that a set has been evolved without the use of valves, and that it has been thought to be so dangerous to the valve groups here that the inventor has been persuaded to take a large sum of money and his invention put on the shelf. This rumour is, however, not taken very seriously here.

Considerable interest is still being shown in television in theory, but no manufacturer yet has dared to put out a televisor set. Enquiries among many of them elicit the fact that they still consider television to be an interesting scientific toy, but not having yet reached the practical stage. At the same time, a noted maker of radio parts and accessories—Carter Radio Co.—is said to propose marketing television parts this season and to have predicted that television will be commercially practicable within a year. It is not believed that this statement is based on the use of any of the present television systems. The same company is preparing to market a home talkie.

Rumours of mergers are in the air continually, it being recognised that in the States the day of the small manufacturer has gone, and only combination can meet the pressure of the competition of the big groups. Home construction, having almost ceased for some years, appears to have suddenly revived, but it may only be a spasmodic attempt and not a serious revival.
One advantage of separate meters grade moving currents and voltages generally met with others following in the order mentioned. The first being the left-hand meter and the other meter, are available to extend the current meters and series resistances for the purpose of measuring the D.C. power output valves demanding a greater accuracy than 5 per cent. cannot be expected on the lower parts of the scale, but it is just possible to read within 1.5 per cent. on the upper portion. Tests made with standard laboratory instruments showed that, without multipliers, the maximum error did not exceed 2.5 per cent. This was recorded on the lower range of the voltmeter, and decreased as the voltage was raised. The milliammeter exhibited the same characteristic, but in this case the greatest error was 2 per cent. only. The ammeter showed its greatest error at full scale, viz., 1.6 per cent., and this decreased towards the lower end. The same high order of accuracy was not maintained when the shunts and series resistances were fitted, in some cases an error as high as 8 per cent. being recorded. At most parts of the scales the average error was of the order of 4 per cent.

The price of the test set without multipliers is £5 5s. Shunts cost from 7s. 6d. to 15s., and voltmeter resistances from 7s. 6d. to 39s.

**MODIFICATION TO MULLARD RECTIFYING VALVES.**

The increasing popularity of super-power output valves demanding a relatively heavy anode current has induced the Mullard Wireless Service Co., Ltd., Mullard House, Charing Cross Road, London, W.C.2, to redesign the DU.2 and DU.10 rectifying valves. Hitherto the maximum output was 40 milliamps., and to meet the present demand this has now been raised to 75 mA. for the full- and half-wave models. The filament voltage and current remain the same, viz., 4 V. at 1.1 amp. The price is unchanged; 22s. for the DU.2 (full-wave) and 15s. for the DU.10 (half-wave).

**DUBILIER WAVE-TRAP. Type BRI.**

This unit has been designed especially for use in the London area, its function being to reduce interference from the 358-metre regional transmitter and enable alternative programmes to be received on a set not sufficiently selective to achieve this under present conditions. It consists of an absorption rejector circuit which is connected between the aerial lead and the set, no alteration to the receiver being required. Practical tests made using a simple receiver which normally would not separate the transmission from 2LO and 5GB within eight miles of Brookmans Park. With the rejector connected interference from the local station was restricted to a narrow band of from 340 to 370 metres, and below and above these two limits signals from various sources could be tuned in without a whisper of interference from 2LO.

The rejector is housed in a neat case moulded in bakelite, the terminals and condenser adjustment being protected by a circular cover. It is supplied adjusted to reject the 358-metre transmission, but a small correction will probably be found necessary owing to the effect of aerial capacity on the tuning of the rejector circuit. An adjusting screw, with a small slot for insertion of a screwdriver, is provided for this purpose.

The makers are the Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W3, and the price has been fixed at 15s. 6d.
BURDNEPT NEEDLE ARMATURE PICK-UP.

In designing a gramophone pick-up the principal difficulties are associated with mechanical resonances in the vibrating system. As explained in a recent article, the most satisfactory way of overcoming these difficulties is to reduce to a minimum the inertia of the armature. In the latest Burndept pick-up this policy is carried to its logical conclusion; the needle itself forms the armature, and the vibrating mass is consequently brought down to the irreducible minimum. Actually, there is a small boss N embedded in rubber which acts as the needle-holder, but as the axis of motion passes through the centre of the mass the moment of inertia about the axis is small. The needle-holder is of square section and fits, with its rubber packing, into a parallel-sided slot in the needle housing H, so that the movement of the needle is controlled and the inertia of the armature pick-up is the absence of any sign of record wear. While the average pick-up commences to chatter and jump the groove at about 100 cycles on the standard frequency records (in which the amplitude at low frequencies is, of course, much greater in an ordinary record), the Burndept needle armature pick-up follows the groove with perfect silence down to 25.5 cycles the lowest frequency recorded. At this frequency the double amplitude (total width) of the groove is no less than 24 in.

The general level of voltage output is considerably below the average and the usual two-stage amplifier does not give sufficient magnification for normal loud speaker volume. In general a three-stage amplifier with volume control is recommended. A 10,000-ohm potentiometer is specified by the makers, and the pick-up was shunted by a resistance of this value when taking the characteristic. An appreciable reduction of high frequencies results from the use of this comparatively low resistance. The high-frequency response of the Burndept pick-up, however, is such that without it surface scratch would obtrude. In arriving at a value of 10,000 ohms a satisfactory compromise has been effected between these conflicting factors.

TRADE NOTE.

Messrs. James McQueen, Ltd., Monk Road, Leicester, have forwarded as a specimen copy of their "Kwik-an-Eeze" Account Book, which should prove invaluable to the small trader whose business does not warrant a staff of book-keepers or an elaborate system of book-keeping.

The book comprises 52 pages for analysing the various receipts and payments, and a "Private Ledger," with pages ruled for summarising the weekly totals and with skeleton trading accounts and balance-sheet in which the correct position for the various summarised totals is clearly shown. A detachable sheet is provided for a certified copy of the year's profit and loss account, and much useful information is given in the supplementary notes. The price is 4s. 6d.
The Height of Tactlessness.
Radio Week—the one week in the year when the Post Office detector van might have been veiled in decent obscurity—was chosen for a special "war" against the wireless pirates of Manchester.

Nature and the Land-line Listener. All is not well between the Post Office and the B.B.C. This time Nature herself has upset the apple cart, and many listeners will rise up and call her blessed. The trouble has arisen over the recent gale which wrecked the overhead lines between London and Daventry.

It's an Ill Wind... The catastrophe has suddenly caused Savoy Hill to reflect that there are such things as underground cables, and the question is being asked: Why can't the B.B.C. have them as underground cables, and the administration by giving broadcasting a special "war" against Nature when the Post Office detector van might always be enrolled if the programmes had been invented with a continuity interest. A problem could have been propounded on Monday, growing increasingly complicated from night to night, until the final unravelling on Saturday. There is still time to develop such an idea before the winter is out.

The Swing of the Pendulum. Four years ago the old B.B. Company obliged a young couple by broadcasting Mendelssohn's Wedding March, but the present Corporation refuses to encourage the individual at the expense of the multitude. It would certainly concede nothing to Mr. John S. Martin.

Weather Permitting. At present the only underground cable used by the B.B.C. is the short stretch between Savoy Hill and Brookmans Park. The results on this line are nearly perfect, as the fortunate listeners who can tune in direct are ready to testify, but this is small consolation to the vast majority of the fortunate listeners who can tune in direct are ready to testify, but this is small consolation to the vast majority who have to rely on the network of exposed wires which carry the mangled remains from London's End to John o' Groats. In view of the gale experience the B.B.C. is thinking of announcing programs with the proviso "weather permitting."

The Plea of a Mortician. Odd requests blow into Savoy Hill at times, but I am glad to think that nobody in this country has gone so far as Mr. John S. Martin, of New Jersey, described as a "mortician," who asks the U.S. broadcasting authorities to set aside a fixed hour daily for the nationwide broadcasting of funeral music.

Discouraging the Individual. Not long ago it seemed as if the pessimistic advice from certain quarters was taking effect, and that listeners were abandoning the glories of the chase for distant stations in order to concentrate on local reception. Happily this parish pump attitude is losing what prestige it ever possessed. Listeners are reaching out and are finding that the Prague Plan, with all its failings, enables one to obtain real pleasure from Continental programmes.

Support for the B.B.C. More recruits would have been enrolled if the programmes had been invented with a continuity interest. A problem could have been propounded on Monday, growing increasingly complicated from night to night, until the final unravelling on Saturday. There is still time to develop such an idea before the winter is out.

The Plea of a Mortician. A B.B.C. official tells me that many foreign listeners are concentrating on the reception of Brookmans Park. Apparently the Corporation need not worry too much over complaints from British listeners, as it can always count on staunch supporters in Poland and Czecho-Slovakia.

Radio Week Surprise. "Every Week is Radio Week" is a newly suggested slogan for the B.B.C., arising out of the exciting discovery that this week's programmes are even better than those of last week. The B.B.C. has done well to realise the futility of enticing new listeners with a programme standard which was not to be maintained.

More Stunts Required. At the same time, I think that during Radio Week the Programme Department might have relaxed their apparently hard rule to avoid "stunts." An occasional stimulant is good for the system. More recruits would have been enrolled if the programmes had been invented with a continuity interest. A problem could have been propounded on Monday, growing increasingly complicated from night to night, until the final unravelling on Saturday. There is still time to develop such an idea before the winter is out.

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FUTURE FEATURES.

London and Daventry (1XK).
JANUARY 26TH.—Service relayed from Chester Cathedral.
JANUARY 27TH.—"La Boheme," an opera by Puccini.
JANUARY 30TH.—"Huntingtower, or, The Adventurous Holiday of Mr. Dismas McCunn," John Buchan's novel adapted for broadcasting.
FEBRUARY 1ST.—Running Commentary on the International Rugby Football Match, Scotland v. Wales.
Daventry Experimental (5GB).
JANUARY 27TH.—"La Boheme."
JANUARY 28TH.—Liverpool Philharmonic Society Concert relaid from the Philharmonic Hall, Liverpool.
MANCHESTER.
JANUARY 25TH.—Liverpool Philharmonic Society Concert, relaid from Philharmonic Hall, Liverpool.
GLASGOW.
JANUARY 25TH.—"What's Right With Scotland?" a talk.
JANUARY 26TH.—"Huntingtower." Belfast.
FEBRUARY 1ST.—"Blakely on the Subway." a New York Phanmat magneta.

Broadcasting House.
One more stage is reached in the progress of Broadcasting House by the signing of the building contract between the owning syndicate and Messrs. Ford and Walton, Ltd. The erection of the superstructure is to begin early next month when the spade work below street level is completed.

G.B.S. at the Microphone.
Mr. G. Bernard Shaw's speech at a public meeting at the Kingsway Hall, London, convened for January 31 by the British Drama League in support of the Nvisional Theatre, will be relayed to 5GB.
APPARATUS of interest to wireless students always occupies an honoured place at the Annual Exhibition of the Physical and Optical Societies, and this year’s event, held at the Imperial College of Science and Technology on January 7th, 8th, and 9th, was no exception to the rule.

In the Research and Experimental section of the Exhibition the exhibit of the National Physical Laboratory (Wireless Division) aroused considerable interest, much attention being paid to an automatic recorder of bearings from a rotating beacon transmitter, similar to that now in operation at Orfordness. The bearings are recorded on a circular drum, which is rotated synchronously with the transmitter by means of a phonic motor and tuning fork.

Of more immediate interest to the experimenter was the N.P.L. apparatus for the measurement of the overall performance of radio receivers. A radio frequency oscillator, operating a wide range of frequencies, is used for the supply of small input voltages on the receiver under test. The R.F. oscillations are modulated to any desired degree with the aid of a separate audio-frequency source. The current output from these generators is passed through a resistance of special design, and a suitable tapping point is provided in order that a known radio-frequency potential difference may be applied to the input terminals of the receiver under test. The audio-frequency output from the receiver is then measured with the aid of a valve voltmeter connected across a small resistance in series with the output or loud speaker load. In the N.P.L. exhibit the oscillators were contained in a metallically shielded cabin, and the receiver in a separate room screened with wire netting.

The study of acoustics is becoming more and more necessary to radio research workers, and in this connection the research laboratories of the Gramophone Co., Ltd., and the Marconiphone Co., Ltd., exhibited several models of unusual interest. One of these, showing a rapid visual method of measuring reverberation in a hall, included a loud speaker, which, after setting up a steady sound at a given frequency, is switched off. The sound of the reverberation in the hall is picked up by a microphone.
The Physical Society's Annual Exhibition.-

and recorded on a cathode ray oscillograph with linear time base, so that the dying away effect can be observed and a visual estimate made of the time.

Another fascinating exhibit was a model of a photographic sound-recording system, comprising a glow lamp, the brilliance of which is modulated by speech current from a pick-up. A slit of light after traversing an optical system impinges on the film and makes a record of the variable density type.

Elsewhere in this issue is an article describing a demonstration of the methods employed for reproducing physically the conditions in a gramophone record groove and of examining the behaviour of different types of needles.

The two companies also showed a filament-maintained mercury vapour tube in which the conductivity can be greatly increased when a magnetic field is applied in a direction parallel to the filament. Over a certain range this increase is proportional to the strength of the magnetic field, and can, therefore, be continuously varied by means of a permanent magnet which, for example, can be suspended from a pendulum.

Mr. E. B. Moullin exhibited a new form of small-capacity variable condenser, suitable for precision measurements at very high frequencies, and an absorption wavemeter for use on short waves. A new directional short-wave transmitter operating on wavelengths between 6.04 and 8.65 metres was shown by Messrs. L. S. Palmer and L. L. Honeyball.

A New Loud Speaker Demonstration.

An interesting acoustic exhibit was that of Capt. B. S. Cohen and Mr. Robt. W. Paul. This was a new moving-coil loud speaker using pistons of Balsa wood, which combines an extremely low density with considerable elasticity.

The measurement of sound pressure was demonstrated by the research laboratories of the General Electric Co., Ltd., employing a condenser, transmitter, and amplifying system for dealing with frequencies from 50 to 5,000 cycles per second. The Mercury Vapour Triode Thyration is the term applied to an interesting exhibit of the British Thomson-Houston Co., Ltd., showing the principle of grid control applied to a hot-cathode mercury vapour rectifier. With a given potential applied between the anode and cathode no current flows providing that the grid potential exceeds a critical value. Once the anode current is started, however, the grid loses all control due to the presence of ionised vapour, and to stop the anode current the circuit must be opened, if on D.C. supply. When A.C. voltage is used, the current stops at the zero of the cycle.

As might be expected, the Exhibition dealt generously with electrical measuring instruments. Many of the smaller instruments were of really practical interest to the amateur. A new galvanometer (of 2 mA. and 80 mV. full scale)
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of considerable laboratory utility was shown in the trade section by Crompton Parkinson, Ltd. One pattern has even scale divisions, while the other has uneven divisions with wide calibration about zero.

Wireless workers are always attracted to the display of the Weston Electrical Instrument Co., Ltd. New features this year included a new multi-range D.C. testing set and a "valve checker" for testing any A.C. or D.C. valves having filament voltages of from 1.5 to 7.5 volts. The Cambridge Instrument Co., Ltd., also presented their wide range of laboratory apparatus, one of the most interesting items being the new Campbell Standard Mutual Inductometer, which has a wide range for the direct measurement of self-inductance.

Apparatus for radio-frequency measurements was the main feature on the stand of H. W. Sullivan, Ltd. A new item was the Lucas-Sullivan Quartz-Crystal Standard and its associated apparatus for standardising frequencies from 50 to 3,000 kc. Several precision wavemeters for a varied range of frequencies were also displayed.

The thermionic valve, always the darling of the research engineer, was well represented. The exhibit of the M.O. Valve Co., Ltd., included valves for every purpose, from modest 2-volt detectors to the high-power cooled-anode transmitting types as used at G.P.O. and B.B.C. stations. An automatic grid-making machine was seen in action. Valves of all kinds were also displayed by the Mullard Wireless Service Co., Ltd., who showed in addition a working model demonstrating the operation of a low-frequency amplifier. A complete range of rectifiers was shown, ranging from 30 mA./250 v. to 2 amps./12,000 v. An extensive range of transmitting and receiving valves was also exhibited by the Ediswan Co., whose stand included the products of their associated concerns, the Metropolitan Vickers and B.T.-H. companies. These included loud speakers, gramophone pick-ups, microphones, and several different eliminators.

The variety of exhibits on the stand of the Marconi Company gave it a special attraction. One exhibit was an aircraft direction-finder with a streamline frame aerial designed to enable the loops to be supported in a rigid position as far as convenient from the body of the machine with minimum air resistance. The ever-growing necessity of maintaining the frequency of broadcasting stations at a constant pitch lent special interest to the exhibit of a thermostatically controlled tuning fork for use between 700 and 1,400 cycles.

This fork is maintained by a tuning fork drive circuit whose output is amplified and the frequency doubled ten times by a series of push-pull selecting circuits. This form of control is used at the B.B.C. relay stations. Among many other exhibits was a telephony set for...
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USE by unskilled operators. Designed specially for service on trawlers, lightships, etc., this transmitter will operate on 600 metres and on any fixed wavelength between the limits of 150 and 400 metres.

Other stands dealing largely with wireless apparatus were those of the Telegraph Condenser Co., Ltd. (newcomers to the Exhibition), showing a comprehensive range of condensers for wireless reception and transmission purposes; Bakelite, Ltd., whose products were shown in a bewildering variety of mouldings, rods, insulating varnishes, etc.; the Fuller Accumulator Co., Ltd., displaying a profusion of L.T. and H.T. batteries in all shapes and sizes; the Zenith Electric Co., Ltd., specialising in resistances; Isonthal and Co., Ltd., who displayed, among other items, photo-electric cells, Kerr cells, and glow relays; the M.L Magneto Syndicate, who exhibited for the first time a D.C. to A.C. rotary transformer specially designed for operating A.C. mains receivers from a D.C. supply; and Gambrell Bros., Ltd., who featured mains sets and the Gambrell Novotone Compensator (Dr. N. W. McLachlan's patent) for improving gramophone reproduction at extreme frequencies.

**CORRESPONDENCE.**

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

**OUTSIDE BROADCASTS.**

Sir,—At 8 p.m. onwards on Sunday we listeners should demand and see that we get the best programme from the studio. It should be possible for the B.B.C. to broadcast a programme (real music, real singers, real modulation, no talking or intervals until 10.30 p.m.) to gladden the hearts of an Empire. There are over three million B.B.C. supporters paying for programmes, so why should we put up with second-hand rubbish? It is useless constructing palatial premises with fine studios when the programmes on the principal days of the week when most people have time to listen are all relayed. London, S.W.6.——“FRAME ARRIVAL.”

**RECEPTION OF CONTINENTAL STATIONS.**

Sir,—I have been interested in the very controversial views expressed by your correspondents recently on the above. It seems to me the sceptics who deny the possibility of decent Continental reception fail altogether to take a broad enough view of the matter.

Primarily a favourable locality is the first necessity, and localities differ enormously—hereabouts I'd say it was good; in other parts of the country I've found it vary to definitely bad. As a second consideration I'd place the question of the set, and here I would like to endorse heartily Mr. J. H. Borrill's remarks on the "Kilo-Mag Four." I'm in agreement with him on every point—and this after six years of experimenting with nearly every sort of set both of your publication and, other journals.

I would say that this circuit sets a standard for efficient reception and reproduction of both home and Continental transmissions if properly supplied and controlled. My last point is this: Why so much ink scattered, even if one can't hear Warsaw or Rome as perfectly as 5GB at 50 miles range? Surely one does not expect to hear and see the opera, as well, "up in the gods" as when favourably situated in the stalls; neither does one get the same feeling of being "in" the football match when it's viewed from the outside fringe of the crowd instead of the front row of the grand stand; but there's no need or tendency to debate this point—we've got used to accepting it in its right perspective; why not do the same with Continental reception and enjoy as much of it as circumstances allow?

Sc. B. Wakefield.

Sir,—The somewhat heated discussion on foreign station reception prompts me to support the views held by Mr. A. W. Scott. His rather "more forcible than accurate" statements are borne out in practice, as a really unbiased criticism of almost any evening's ether-searching will show.

A real "programme" entertainment is rarely obtainable on the broadcast band below about 300 metres, those stations receivable at good strength being accompanied by a medley of splutters, burbles and whistles, to say nothing of periodic fading.

More 2ZY the ether is comparatively clear, and good reception is possible from some half dozen stations, including 5GB, but the frequent occurrence of talks, etc., together with the long waits between items, deter one from listening.

In case correspondents with the "distance itch" should tell me to make a "family set," I would state that the "family set" is a S.G., Det. and L.P., using Cosmos A.C. valves, anode bend detection and no reaction.

With this combination I could, on summer nights, when interference was less pronounced, put on the speaker about three dozen stations at comfortable strength, and the selectivity is sufficient to separate 2LO, Hamburg and sometimes Toulouse within five miles of 2ZY.

A. C. WILDSMITH.

Manchester.

THE RECORD III.

Sir,—Particulars of a modification which I have made in my "Record III" receiver may be of interest to readers.

My output valve is a pentode and was, of course, much overloaded when the detector was working most efficiently. To correct this it was necessary to set the variable resistance across the transformer primary in almost its minimum position, which made the reproduction rather harsh and shrill. Desiring to retain the pentode as being the most convenient power valve for a moving coil loud speaker, I evolved the following circuit:—

Switch in position (1) gives resistance coupling. As the resistance is only 25,000 ohms the output from the detector does not overload the pentode and no further volume control is needed. The high inductance of the transformer secondary is used instead of a grid leak. This coupling is used for the more powerful stations.

In (2) gives parallel feed coupling. In both cases the anode potentiometer may be used as a volume control when necessary.

H. HOW.

Sheffield.
SHOULD MANUFACTURERS CONTRIBUTE TOWARDS PROGRAMMES?

Sir,—Most certainly they should.

Your only reason for stating they should not is that in your opinion the price of receivers would be increased.

If the manufacturers did contribute we should undoubtedly obtain better programmes, with better talent, which the B.B.C. is not at present afford. The B.B.C. would have more money to spare for station erection, including an Empire service which we could feel was adequate.

But the most important effect would be a doubling of the listening public, leading to genuine mass-production by our manufacturers, and definitely cheaper and more efficient receivers for the public.

Our programme service has time and again been compared with the American service by English writers, but have any of your readers read any reliable criticism of our service by American writers? I have, and in several instances it has been described as inadequate and puny.

Compare our licence statistics with those of America; there are half the receivers per head of population here.

My qualifications for writing this letter: I have been in the radio trade for six years and have made a special study of our own broadcasting service and those of other countries, and I am firmly convinced that unless more money than that now being spent is made available for the use of the B.B.C. our radio industry will never be in the same position as those of other countries, to the serious detriment of our export trade.

Gl. Yarmouth.

S. WEST.

IN SEARCH OF QUALITY.

Sir,—It is a painful business when one's idols are shattered, and so with sadness I read Mr. Bertram Munn's disturbing article in your recent issue. So great is the appeal that Mr. Munn uses nothing more convincing than a trumpet, and does not even tell us that he at least detects the diaphragm with a moving-coil unit. Really, sir, he will next be confessing that his receiver is a simple affair with a leaky grid detector (with, of course, just a touch of reaction to ginger up the selectivity) and a brace of transformer-coupled L.F. stages. He will doubtless conclude by cheerfully admitting that his output is devoid of a filter-choice circuit, and that he does not believe in such abominations.

And now, sir, may I as a moving-coil enthusiast take up the challenge—but let me add that for my part the conflict will not be the gruesome affair anticipated by Mr. Munn, I wish not to destroy my great-grandfather, old-fashioned though he be, so why should I harm the venerable hairs of Mr. Munn (for, of course, he rejoices in the possession of a long, flowing white beard).

That, may I ask if Mr. Munn has carefully examined the receivers coupled to the moving-coil speakers to which he takes exception, because long before I made up my moving-coil unit two years ago I had been repeatedly warned that no speaker was a receiving set so ruthlessly—and I have since confirmed this too often to be good for sellers of these units. If his experience is based on the groans and boomy thuds which emanate from most "demonstration sets," then am I almost tempted to sympathise with him. Such results are, however, but a travesty of what a moving coil can do when properly fed and adjusted.

As regards my own outfit, the receiver is quite straightforward and consists of four valves only, but it has been carefully put together and is based on the best wireless practice as advocated in The Wireless World. The single H.F. stage is an ordinary neutralised triode, and the detector a diode. This latter feature I consider indispensable. The first L.F. is a medium power valve, and is coupled via a first-class transformer to the output—a single P.X.650 working under its maximum conditions. The transformer primary is isolated from the H.T. fed to the first L.F. valve, and the output to the speaker is via a heavy-duty choke and filter circuit. All stages are, of course, carefully decoupled. The loud speaker was assembled from standard units, and to the coil R4, especially wound, was added impedance of the output valve. (I must thank The Wireless World for help in such technical matters.)

The pot is wound for twelve volts one amp, but is frequently fed with eighteen volts.

Mr. Munn will please note that I do not use batteries of L.S.5 valves, and that my H.T. maximum is of the order of 250 volts; but I can assure him that the sound is undistorted power from undistorted power from the highest quality and, I am prepared to assert, superior to anything he can do with his trumpet. Transients such as the clash of cymbals are amazingly good; a violin sound, like a violin and not like a piccolo; and even the much-maligned studio piano is pleasing. Alas! but I can hear Mr. Munn scratching away with his quill pen: "What about the announcer's voice?" "Alex! I must admit that, when it is adjusted correctly for a musical item, it is too loud. It does not, however, boom at one through a tunnel lined with cotton wool as Mr. Munn would have us believe. But it certainly is too loud. That defect in the balance of certain items is noticeable with any sensitive speaker and has already been the cause of much correspondence and complaint. It can, however, be easily remedied by the addition of an efficient volume control on the output valve. By turning this control any item can be made to full strength to suit requirements, and the announcer's voice can be made a pleasure to listen to without the slightest trace of boominess, lisping or hissing.

May I conclude my defence of the moving coil with a repetition: use a diode rectifier and eliminate all reaction, back-coupling, and overloading of individual components.

And now, sir, if it is to come to cracking heads open after all that the weapons he loves so well my service will back my 16 lb. pot any day against all the cardboard trumpets in Bedlam.

E. H. PALM.

THE MACCALLUM SCHEME.

Sir,—I have looked up Mr. G. B. Bennett's earlier letter, July 20th, 1929, and am very interested to find that a scheme so similar to my own should have been put forward nearly 2 years ago. I imagine that a good many of us have been thinking along the same lines during the last few years, and in my own case I held my hand until I was quite sure that the synchronisation idea was entirely practicable, i.e., until Reesley published his paper on the subject in April, 1920. I ought to say I consider the grouping of programmes into classes and that I do not mind very much how the ideal is arrived at. The kind of alternative at present offered by the B.B.C. would not satisfy me at all.

Mr. Warren says that our present wave is not good enough and indicates that it will take "at least five years" to put this right. I believe that the excellent engineers of the Post Office could give us the quality we desire, provided the money is forthcoming and that the more important circuits at any rate could be brought up to the desired standard by the time the rest of the scheme is ready. I put it at about two years.

There is, of course, the alternative of the wireless link, and the possibilities of Dr. Robinson's new system should not be overlooked in this connection. It would seem possible by this means to feed the broadcasting stations from central high power stations, using fairly long waves, without interfering with existing services.

Mr. Warren's statement re the superiority of the B.B.C. regional scheme is somewhat dogmatic to say the least. My own view is that the programme grouping suggested by me would be more acceptable to the public, and I have yet to be convinced that mine is not a perfectly feasible proposal.

Mr. K. McCormack puts forward four propositions but, unlike Euclid, he does not prove them. The first two would appear to be true or untrue according to the meaning attached to the terms "restricted area" and "mutual interference," and, of course, everything depends upon the position, in reference to the mutually interfering stations, of the point at which the observations are made. The third is a corollary to the first two as it is very probably, the fourth, but as the meaning of the latter is not clear to me, I may be quite wrong in regarding it as such.

Mr. McCormack is an "anti-landlino" and an "anti-common-wave," who demands good programmes and direct transmissions for "the provinces" on "an independent wavelength." Is there any practicable way of satisfying his requirements? London, W.1.

H. MACCALLUM.
Incidental Rectification.
By accident, the grid bias battery supplying voltage to my anode bend detector was completely short-circuited, with the result that the grid circuit was connected to the negative filament supply. What puzzles me is the fact that the set still gave signals, though at reduced strength. How can a valve, connected in this way, work as a detector?
L. L.

As a matter of fact, it is rather difficult to connect a valve, particularly if it be of the comparatively high-impedance type, with fairly low anode voltage, in such a way that it will not rectify slightly. Possibly the effect you have noticed is due to lack of complete "straightness" in the characteristic curve, or to asymmetrical conditions brought about by the flow of grid current; this will tend to restrict the development of voltage (across the tuned input circuit) due to impressed positive half-cycles as compared with that due to negative half-cycles.

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.P. chokes, power transformers, etc., cannot be supplied.
(6) Queries arising from the construction or operation of receivers must be confined to components 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 pamphlets.

Repairing Condenser Blocks.
For smoothing purposes in my eliminator I am using a multiple condenser, with a number of separate elements. Unfortunately, one of the units (of 2 mfd.) has broken down, and I am wondering whether it would be possible for me to repair it myself.
Will you give me a word of advice?
N. M.

The internal connections of these multiple condensers are not always readily accessible, and it is sometimes rather difficult to remove a unit without doing damage. Further, you may not be able to get a replacement unit of suitable size. If you have any doubts as to your ability to do the repair, we advise you to get in touch with the makers.

Grid Circuit Loading.
In the description of the "1930 Everyone Four" mention is made of the fact that a certain value of detector anode by-pass condenser is chosen in order to minimise reduction of H.F. input due in grid circuit loading. This set has anode bend detection, and I was under the impression that, properly adjusted and operated, this method of rectification does not allow the flow of grid current and does not impose any loading on the circuit immediately preceding it. Will you please give me a word or two of explanation?
A. H. H.

Unfortunately, it is incorrect to assume that an anode bend detector does not damp its tuned grid circuit. It has been appreciated for some time that there is a "reversed reaction" effect, due to the valve capacity, that, under certain circumstances, may exercise a very serious influence in restricting signal voltage on the grid. This trouble is overcome to a great extent by a judicious choice of anode load values.

The whole subject was discussed at length in articles published in our issues of March 27th and May 22nd, 1929.

H.F. Filament Switching.
Will you please show me how a gramophone pick-up jack may be connected to the "New Kilo-Meg Four" in such a way that the H.F. valve filament will be automatically switched off when the plug is inserted?
C. N. H.

The method of connection you require is given in Fig. 1. For this arrangement a "single closed filament" jack will be required.
It will be realised that the pick-up is connected across the contacts of the plug, and that insertion of this plug will automatically break the positive feed lead of the H.F. valve filament as you require, and at the same time will make the necessary change in bias for converting the detector into an amplifying valve.

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Fig. 1.—A pick-up jack arranged for automatic control of H.F. filament circuits.
The Right Rheostat.

My "Kilo-May Four" is working quite satisfactorily except for the fact that the rheostat controlling the H.F. valve filaments does not seem to function properly as a voltage control; a very slight movement from the "full on" position has the effect of cutting out signal altogether. Can you suggest how this may be remedied?

A. D. G.

We expect that you are using two or six-volt filaments, and that the resistance of the rheostat is excessive. These valves consume considerably more current than those with four or six-volt filaments, and consequently the voltage absorbed by a given series resistance is commensurately increased. We suggest the fitting of a rheostat with a maximum value of some 10 ohms.

Voltage Regulation.

I have bought a small power transformer, rated to give an output of 4 amps. at 4 volts. It is proposed to use this for feeding the heaters of the radio-directly heated A.C. valves, consuming a total of 3 amps. Will you tell me what value of resistance should be inserted to prevent a rise in voltage across the heaters under this reduced load?

H. L. C.

Without seeing a regulation curve of your transformer or its specification, it is quite impossible to give a definite answer to your query, but it can generally be assumed that these components, if made specifically for feeding the heaters of A.C. valves, are designed on fairly generous lines. Consequently, no appreciable rise in voltage is to be anticipated when a load only 25 per cent. less than maximum is imposed; but if you are still in doubt, it would be as well to refer the matter to the manufacturers.

The "Tuned Grid" Amplifier.

From the fact that designers of receivers described in your journal do not seem to favour the "tuned grid" or "parallel feed" type of H.F. inter-valve coupling, I suppose it can be assumed that this method cannot approach the transformer in general effectiveness. Do you consider that it is worth while to include it in a receiver from which a moderately good standard of performance is required? I ask this because I already have a spare H.F. choke, and also because it is desired to simplify waveband switching as much as possible.

B. T. F.

It is quite wrong to think that the parallel-fed H.F. amplifier is ineffective, although there was at one time a fair tendency towards self-oscillation, due to an imperfect appreciation of the considerations involved, to belittle its possibilities.

Generally speaking, this arrangement is but little inferior to transformer coupling and has advantages of its own in the matter of easy wave-changing. The H.F. choke through which the valve mode is fed should be of the highest possible efficiency; possibly the circuit has occasionally been remedied through the use of an indifferential component for this function.

It may be pointed out that the single tuned-grid H.F. stages of a receiver described in The Wireless World for May 1st and May 8th, 1929, gave a measured H.F. amplification averaging 200 times. The theoretical aspects of the question were discussed in our issue of July 10th, 1928.

Where Decoupling Fails.

Since adding an H.T. battery eliminator, I have been troubled by L.F. oscillation, and in an attempt to put matters right, have inserted decoupling resistances (of course with suitable by-pass condensers) in the middle circuit of the detector and first-stage L.F. valves. Much to my disappointment, this has not completely cured the fault, although it has had an appreciable effect. What do you suggest would be my next step?

B. W.

There is a tendency to forget that the decoupling scheme of the former, suggested as a remedy for L.F. oscillation brought about by battery resistance, and, as has been pointed out on several occasions in this journal, this scheme is not the only one expected to provide a perfect cure for self-oscillation produced by high impedances in an eliminator, unless special precautions are taken in its application.

If you will send us a circuit diagram of your receiver and eliminator, it is probable that we can make some helpful suggestion, and in the meantime we suggest that an attempt be made to divide up the various feed circuits, being guided by the design of the D.C. eliminator described in our issue of August 29th, 1929. The introduction of this plan avoids the inclusion of high impedances common to several anode circuits.

FOREIGN BROADCAST GUIDE.

STAMBBOUL (Turkey).

Geographical Position: 28° 51' 48" E. 41° 11' 19" N.

Approximate air line from London: 1,550 miles.

Wavelength: 1,200 m.; Frequency: 250 Kc.; Power: 5 kW.

Standard Daily Transmissions.

15.30 G.M.T. Turkish music, news and agricultural report; 15.30 orchestral concert; 15.30-20.30 (except Mondays) music and news.


Interval signal: metronome (120 beats per minute).

Closes down with the Turkish National Anthem.

The Limit of Amplification.

My receiver, made nearly two years ago, comprises a screen grid H.F. amplifying valve, detector, and one L.F. stage; there is a plain vertical metal screen between the tuned grid and plate circuits. The set is hardly selective enough for my present needs, and in addition is somewhat lacking in sensitivity as compared with more modern receivers.

Do you consider that it would be possible to improve matters by using coils of lower H.F. resistance, or is it likely that this alteration would cause instability?

T. W. J.

Without full details of your present set, it is not possible to offer a definite expression of opinion, but in all probability your fears are well grounded, and we do not think it would be possible greatly to improve the receiver in the way you suggest.

It should be added, however, that if the set does not show any marked tendency towards self-oscillation at the lower end of the tuning scale, at least some improvement can be effected by using better coils.

Power Line Interference.

When your receiver was fed from H.T. batteries, power circuit interference was never heard, but using an eliminator, I am troubled by periodic interference, which is clearly due to this cause. It should be made quite clear that the trouble is not due to imperfect smoothing in the eliminator, as the interference is sometimes absent for considerable periods, particularly at week-ends. Can you make a suggestion as to any means whereby it may be overcome?

G. H.

Your description would indicate that high-frequency interference, possibly generated by electrical machinery at a considerable distance, is being conveyed along the power lines to your set via the eliminator.

We think it would be worth while to connect H.F. coils in the leads between eliminator and receiver, and also to make sure that adequate by-pass condensers are fitted. It is also worth while to try the effect of using a counterpoise in place of an antenna, and to see if this makes any difference to the quality of the signal transmitted.
Theodor Chaliapine, the great singer, says: "They tell me there is no orchestra inside a Marconiphone. But my ears contradict! They say where there is such music, there are musicians. So I believe my ears, too; for the music from a Marconiphone is real to me."

To hear every smallest detail of the programme, every note in the musical scale, every inflexion of the voice — radio as it really should be — a Marconiphone loud speaker!

Marconiphone engineers make these speakers. All the skill of thirty years' leadership in wireless is in their construction. Sir Edward Elgar, Albert Coates, Mischa Levitski, Peter Dawson, many other famous musicians delight in their clear tone, their unfailingly accurate reproduction. Any dealer will willingly demonstrate the Marconiphone speakers to you. If there is no dealer near you, write to The Marconiophone Company Limited, 210-212 Tottenham Court Road, London, W.1.

Listen with a

MARCONIPHONE LOUD SPEAKER

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BUILD YOUR OWN CENSER TEXTURE PROFESSIONAL.

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OPEN TILL 7 P.M. SAT. 1 P.M.

FREE CATALOGUE ON REQUEST.

APPLEBY'S.

A Service to our Readers.

We have made arrangements with the Patentees whereby readers who wish to dispose of a home-constructed receiver not listed under the patents made up by M.U.T.E., can license the set by means of the Deposit System referred to above.

The person desiring to sell, in sending us particulars for his advertisement, will in every case make use of a Box No. 50, and should add to the price which he requires the amount of royalty customary paid by manufacturers.

1 lb. of 2d. equals 1 3d. and any purchases made through us through the Deposit System are guaranteed to the seller, less 5% of the amount to the buyer. The deposit is paid by the issuer to the seller, a bill is sent to the seller for the amount of the purchase, and the goods are delivered by the seller to the depositee.

MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

The charge for advertisements in these columns is:

10 words or less, 4/-; and 2d. for every additional word.

Each paragraph is charged separately, and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions to the contrary, "copy" is repeated from the previous issue:

- 13 consecutive insertions, 5%;
- 20 consecutive, 10%.

ADVERTISEMENTS for these columns are accepted up to FIRST POST on THURSDAY MORNING (previous to date of issue at the hands of the Post Office). "The Wireless World," Dorset House, Taylor Street, London, E.C.1, or on WEDNESDAY MORNING at the Branch Offices at 19, Berford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 25, Orange Street, Manchester; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this issue will be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to Rifles & Sons, House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to "The Wireless World." When desired, the sum of £10 net is paid in advance on all advertisements, and should be accompanied by instructions to the contrary, "copy" is repeated from the previous issue unless accompanied by instructions to the contrary. All advertisements in this issue will be strictly prepaid.

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NUMBERED ADDRESSES.

For the convenience of private advertisers, numbers may be added at the end of each advertisement. The address must be counted.

MISCELLANEOUS ADVERTISEMENTS.

The Patent "DEBBIE" Cabinet is really high-quality and perfectly finished, and so exceptionally low in price that it is highly recommended to any who wish to be the owner of a radio set without much expense and skill. Perfectly self-contained, forming a cabinet for the housing of the most costly radio set. Priced at £2 2s 6d net, post free by post to the nearest radio shop.

The "Different" Photographic Camera, French Polished Oak, with hinged lids.

BUILD YOUR OWN CENSER TEXTURE PROFESSIONAL.

FOR SALE.

APPLEBY'S

FOR BARGAINS WATCH "THE WIRELESS WORLD". FOR MODERN HIGH-TRADE-PRICE ONLY.

CHAPPELL ST., LONDON, N.W.1.

OPEN TILL 7 P.M. SAT. 1 P.M.

FREE CATALOGUE ON REQUEST.

APPLEBY'S.

A Service to our Readers.

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CHAPPELL ST., LONDON, N.W.1.

OPEN TILL 7 P.M. SAT. 1 P.M.

FREE CATALOGUE ON REQUEST.

APPLEBY'S."
The finest Loudspeakers in the world in their class

Moving Coil Speakers.

Models 99 and 66 are the standard of comparison in music in the famous laboratories of the world. The speaker that has made Radio as enjoyable as the best concerts. 14 different models for all requirements, from £2 10 0 upwards. Write for Basket £E, giving full particulars and the 1 day free trial offer.

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RADIO - GRAMOPHONE

ACONE Speaker

CABINETS, finished 7½ in., unfinished 5½ in., with a variety of sizes; the same models in 5½ in.; 5½ in. extra, finished 6½ in., unfinished 6 in., 2½ in. extra, finished 3½ in., 2½ in. extra, 1½ in.; and all goods finished 1½ in. extra.

RADIOGRAMPHONE

COINS, TRANSFORMERS, ETC.

100-OFF Decoupling Resistance for Wireless World.

RADIOGRAMPHONE A.C. and D.C. DYNAMOS, ETC.

DYNAMOS. Dynamos. Dynamos. Great clearance!

CLIX WIRE.

CLIX 21 VARIETIES

BROWNE WIRE.

BROWNE POPULAR TRANSFORMER

No. 2 CLIX PIN TERMINAL

The pin with numerous uses. Red and Black. 2d.

LECTRO LINX LTD.,

254, Vauxhall Bridge Road, S.W.1.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
NEW
PUBLIC ADDRESS
and Broadcasting
MICROPHONES

The ideal instruments for addressing an audience through Loudspeaker (via Valve Amplifier or L.F. Stages of Wireless Set), and for relaying Speech and Musical entertainment to any distance.

Powerful Loudspeaker Reproduction with perfect Purity.

1. **Hand Type**
   - A highly distant microphone, yet guaranteed entirely free from distortion or microphonic noises, oscillation, or silent background. Superior to ordinary Microphone Transmitters for use with Valve Amplifier, Valve Set, or Valve Amplifier, L.F. Stages of Wireless Set, or Open-air Maurices, in Churches, Theatres or Concert Halls. Operates from 3 Volt tapping of L.F. Accumulator, through Microphone Transformers. Current consumption one-tenth Amps. Provision with detachable Rigid Collectors, handle, hook for suspension, and a lift, all connecting cord and illustration...

2. **Pedestal Type**
   - Highly sensitive Microphone or audio detector, provided with detachable Rigid Collector, handle, hook for suspension, and a lift, all connecting cord and illustration...

3. **Camera Stand**
   - Required for suspending Microphone on Speaker's Platform, in Pulpit, on top of frame on pedestal 8in high; for mounting by rubber-cord suspension in nickel-plated Collector, handle, hook for suspension, and a lift, all connecting cord and illustration...

4. **Special Microphones**
   - Special Microphones for use of Microphone and diagrams of connections free. and see. terminals fitted; full directions for use of Microphone and diagrams of connections free.

The above Microphones are rendered Directional by attaching the Sound Collector.

Microphone Transmitter, special design to obtain best possible results from sensitive Microphones when connected to high-resistance phones, Loud Speaker, Valve Set, or Valve Amplifier; best Transformer, and a 9ft. high, for mounting...a Speaker's Platform, in Pulpit, on top of frame on pedestal.

FROM RADIO DEALERS everywhere. Write for free leaflet, giving the uses of meters with diagrams, to

SIFAM ELECTRICAL INSTRUMENT CO., LTD.
Components, Etc., for Sale.—Contd.

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**TRANSMITTERS.**

Chebros. Transmitters and chokes of all descriptions, special transformers for transmitting and modulation; chokes a specialty; now for new edition; see displayed advertisement on "Sound Advice is Yours for the Asking"; write to BAKER'S SELFIURST RADIO amplifier, in MOVING Coil apparatus, 816.

BELLING-LEE Panel Fittings are 48 Enamelled wires, other fine sizes, from Frost, CHEBROS.

A.T. Radio Engineer, Clayton-on-Sea.

GRAMOPHONE Motors, ELIMINATORS, AC., wired for POTENTIAL POWER Chokes, circuits in eliminators dealing with currents 100-3000 henries; B.T.H. boil-OHMS AS Specified for A.G. Kit Set; 2 M.S.4 19/6 each.

Pianiste, 20, Bond St., Ealing.

FILTERS, oak container, 200/-; Sullivan key, gold lacquered, 5/6; B.T.H. Q.A.A.A., 19/6 each; 2 M.S.4 19/6 each.

1-7, 22/-; wanted, all above little used and new condition.—Box 7948.

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**WIRE.**

48 Enamelled Stocked, other fine sizes, too.—Frook 5.6, Clarendon Rd., E.C.1.

**COMPONENTS, ETC., FOR SALE.**

BELLING-LEE Panel Fittings are 48 Enamelled wires, other fine sizes, from Frost, CHEBROS.

POWDER Chokes, substantially built, for smoothing time-coupling currents; 10,000, 20,000, 300,000, 500,000, 1,000,000, 2,000,000, 5,000,000, 10,000,000, 20,000,000, 500,000,000, 1,000,000,000 micro farads; new, 2/-; used, 1/- each.

M.H.E. 12/6, guaranteed perfect, used 20 hours.—Nashville, 97, Manchester Rd., Bingham, Notts.

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**VALVES.**

A.MPLIFIER Valve.—If you require power you can do better than one of these. PILEAMENT Valve 6, plate volts 400, interstage gain 40, interstage frequency response 8000, amplification factor 3, mutual conductance 400, serial resistance 10,000 ohms; price £3/10/0 see article "The Wireless World," 24th July, 1929, and send to North Weston Valve Co., Ltd., 66/72, Barr St., Birmingham, 15.

Baker's, make, WIRE.

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**The WIRELESS WORLD**

Order Your **1930 "EVERYMAN FOUR" Metal Cabinet as described in "Wireless World, January 1st, 1930.**

**Components, Etc., for Sale.—Contd.**

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**DISTRIBUTION.**


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**COMPONENTS, ETC., FOR SALE.**

BRITISH ELECTRIC TRANSFORMERS.—Transmitters, receivers, transmitter and receiver, etc. for A.G. Kit Set; 2 M.S.4 19/6 each, 5 Varier, 15/6 each, 10-50 M.P. 5/- each; 50, 100, 200, etc. Ferranti A.F.3, 15/6 each.

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**DISTRIBUTION.**

Components, Etc., for Sale.—Contd.

TIFFANY Coil, new, 9/-; Tiffany Electric, adjustable, un-used, 17/6; Minot-Maxim, 8/6, 75-mile home phone, 40/-, new, 12/-; 2, 3, or 4 coil units, 40/-; 20, 6/-; 25, 7/6; 30, 8/6, and 40, 9/-; various other components both used and new, lists on request.

Hatchet, 42, Great Marlborough Street, Holborn.

BABY JUNIOR
2½ - 2/4

BABY
3 - 2/6

STANDARD
4 - 2/9

In Black or Brown.

A RADIO-GRAMPHONE Manufacturing Company (in voluntary liquidation)—Parts offered for sale by Order at the Liquidation. Fixed condensers: 220, 6/-; 22, 1/-; 24, 6/-. Variable condensers: 220, 6/-; 22, 1/-; 24, 6/-; 2700, 2/-. Crystallode 22, 6/-. Fixed and variable in stock, 5/-; 22, 1/-; 24, 6/-. 24 in stock, 1/-; 22, 6/-; 24, 12/-. Various other components as above, list on request.


“ISO” DIALS
“ISO” Dials have a definite grip. They do not slip.

HAW&Co.Ltd.
39, Chandler's
Lace, E.C.2.

[Advert forpermanent magnetics for construction of moving coil loudspeakers.]

£4.0.0
including all fettling charges.

A. M. E. SHERWOOD,

The “Utility” 1/2
—THE BEST VALUE

Ask your local Dealer to show you this condenser. It has a capacity of well built and well finished, and absolutely smooth reaction at all frequencies that you bring into your set. The best into your set will get the best results—always ask for the Guaranteed Wireless Components.

WILKINS & WRIGHT
POLYDIVISION

The PILOT SWITCH

A Power Switch for all uses, Mains Sets, Eliminators, etc. Handles 3 amperes at 220 volts. Supplied with black or brown Bakelite knob, and with lever and "on and off" plate.

Retail Price 2/6

USE PILOT COMPONENTS

Write for catalogue:

THOMAS A. ROWLEY, LTD.,
59 Skinner Lane, Birmingham.

Sole Agents for Great Britain and Ireland for all lines manufactured by The Pilot Radio Tube Corporation of New York.

Mail Orders to:-

16, Redcliffe Street, Bristol.
E.0.4. J. M., Advertising, 50, Welling.

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Control is everything

Your radio or electrical gramophone must carry on every time you snap on the switch. Your volume control must function smoothly, easily—consistently if you wish to be rewarded with perfect reproduction. No radio is perfect unless it is Centralab equipped. Centralab Modulators and Potentiometers are used as standard by all the leading manufacturers — this is an insurance of supreme quality.

POTENTIOMETERS

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
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<tbody>
<tr>
<td>P</td>
<td>0-400</td>
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<tr>
<td>P</td>
<td>0-2,000</td>
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<tr>
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MODULATORS

<table>
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</tr>
</thead>
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</tr>
<tr>
<td>X</td>
<td>0-500,000</td>
</tr>
</tbody>
</table>

Other Voltages Available.


Metal Cabinets

Complete with Base for 1930 Everyman Four, New Kilomag Four, and W.W. Record III. Jacobean Finish.

Terms: Cash with Order. Price 57/6.


The "Utility" Differential

—THE BEST VALUE IN ITS CLASS

Ask your local Dealer to show you this "Utility" condenser. It has a capacity of 0.001 mfd., is well built and well finished, and it provides absolutely smooth reaction at all points of the scale. Put the best into your set and you'll get the best results—always ask for "Utility" the Guaranteed Wireless Components.

Price 6/6

WILKINS & WRIGHT LTD.

WRITE FOR THE "UTILITY" LIST

POST FREE
WE ARE SATISFIED WITH TANNY PRODUCTS!

IF YOU ARE NOT SATISFIED WITH TANNY PRODUCTS THEN TANNY WILL REPLACE THEM FREE OF CHARGE.

TANNY PRODUCTS

ELECTRIC LIGHT?
Tanny mains units are the electric light. They are always constant, no more batteries running down.

Mains Units

High-grade

QUEEN ANNE STYLE
FIGURED OAK CABINET

Height 3ft, 3ins. Depth 1ft, 3ins.
For Panels up to 21ins. x 7ins.
Baseboards up to 11ins.

£5.5.0

Prices of other sizes in proportion.

Manufacturer of all types of wireless cabinets and furnishings. Illustrated lists free.

GILBERT, CABINET MAKER, SWINDON.

Estimates Free. Estab. 1866.

BE SURE OF YOUR PANEL

EBONITE IS GENUINE

Tested to 104,000 volts.

LOW LOSS FORMER.

LOOK FOR TRADE MARK.
Write for Handbook on Windings and Circuits. Post Free Ad.


GILMAN THE
LOUDSPEAKER CHASSIS

A completely assembled cone floated on felt in a highly polished aluminium casting. It incorporates our NEW adjustable unit fixing plate, ensuring the correct centering of the unit used in each cabinet. EXCLUSIVE TO GILMAN CHASSIS. Plates can be supplied for any make of unit in the World.

The NEW adjustable back plate for perfect centering of any unit.

Ask for GILMAN chass.


LISKENIN POSITIVE GRIP TERMINALS

Maintain their lead established five years since, and are acclaimed by the keen Radio experimenter as the ideal terminal. There is one for all radio connections. Write for descriptive leaflet. It's sent free to all "W.W." readers.

F. C. HEAYBERD & CO., 10, Finsbury St., E.C.2.

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Immediate delivery from stock of Heayberd mains transformers, filter chokes, metal rectifiers, condensers, rectifier valves, and resistances.

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BAYLISS ROTARY CONVERTER

A.C. from D.C.

Load 400 Watts.

ANY Input.

ANY Output.

PRICE

£12.10.0

Delivery from Stock.

William Bayliss Ltd.
Sheepcote Street
BIRMINGHAM

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Your L.T. supply need no longer depend on accumulators. Among the most recent and important improvements is the Mullard P.M. Transformer. This unique improvement makes possible a constant filament current that makes receiver operation so easy. Mullard has an A.C. valve especially designed for use with Mullard Master Radio receivers. It has an output that will normally supply five directly-sealed A.C. valves of this type.
The Wireless World

AND

RADIO REVIEW

The Paper for Every Wireless Amateur

Wednesday, January 29th, 1930.

SIZE VERSUS EFFICIENCY OF COILS

4D

"Ekco-Lectrify" your radio with an "EKCo" Power Supply Unit

Write for Free Booklet on "All-Electric Radio" to:

"Mullard" THE-MASTER-VALVE

TONE VOLUME DISTANCE

"Utilit" DIFFERENTIAL CONDENSER

6'/6

"T.C.C." CONDENSERS

No. 544. Vol. XXVI. No. 5.

Copyright. Registered as a Newspaper Transmission in the United Kingdom.
Use an EVER READY refill battery for your Electric Hand Lamp.

MENTION OF "THE WIRELESS WORLD," WHEN WRITING TO ADVERTISERS, WILL ENSURE PROMPT ATTENTION.
30th December 1929.

Dear Sirs,

It may interest you to learn that nearly 12 months ago I purchased from my dealer a GARDNER PERMANENT MAGNET MOVING COIL LOUD SPEAKER which has daily been in service on a "Philips all main three".

Personally I have never heard a Speaker I like so well as both music and speech come through so perfectly and naturally, and all my friends who have heard it have a like opinion.

Through my recommendation my brother purchased one recently and is most satisfied with the results obtained. It was only through this transaction I found that the GARDNER SPEAKER was actually made in my own city hence this belated unsolicited testimony which you may use as you wish.

Yours faithfully,

Price £6 net.

THE GARDNER Permanent Magnet MOVING COIL SPEAKER.

Made by THE SHEFFIELD MAGNET CO., BROAD LANE, SHEFFIELD.

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A Vote of Confidence in the T.C.C.

by the B.B.C.

HERE is a testimony of the confidence placed by those who know, in T.C.C. The British Broadcasting Corporation specified T.C.C. Condensers for use in their high power Brookmans Park transmitter. For such a job, only condensers having an extremely high standard of efficiency, of accuracy, of dependability could be considered and T.C.C. condensers were installed. Whether it's a bank of condensers illustrated above or just a small 2 mfd. condenser for eliminator smoothing T.C.C. are today the recognised standard. Consider this when you need a condenser.

The illustration above shows the bank of smoothing condensers tested to 24,000 V.D.C., for working at 12,000 V.D.C., installed at Brookman's Park.

THE NEW
CELESTION
LOUD SPEAKER
MODEL Z.20

PERCY HARRIS, a foremost radio expert, writes in the "Wireless Constructor"—"Z20, renowned for brilliancy and quality . . . speech and music particularly good . . . a handsome instrument."

Gloriously realistic in tone . . . holding undisputed rank as the finest of all loud speakers

Model Z.20 is designed specifically to give the finest possible results with any set from a Two-Valve to a Power Amplifier. Crowned with the Celestion hall-mark—a beautifully designed and hand-polished cabinet.

In Oak . . . . £7.15.0.
Mahogany . . . . £8.5.0.
Walnut (to order) . . . £9.0.0.
Other Celestion models from £3.15.0.

CELESTION
The Very Soul of Music

WRITE FOR AN ABSORBING FREE BOOK ON "SOUND RE-CREATION"

London Showrooms : 106, Victoria Street, S.W.1
Write to: Celestion Ltd., Dept. C
Kingston-on-Thames
**FERRANTI RADIO**

The three essentials of radio reception—

Purity of tone, Volume, and Selectivity—

are well and truly balanced.

FERRANTI LTD. HOLLINWOOD LANCASHIRE

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**DUBILIER CONDENSERS**

As used in all the most selective sets.

**K.C. CONDENSER**

With knob, dial and slow-motion device, .0003 or .0005 - 12/-

Without knob, dial or slow-motion device, .0003 or .0005 - 8/-

**K.C. DRUM CONTROL CONDENSERS**

With Drum Control and slow-motion device, .0003 - 15/6

Triple K.C. each condenser, .0003 - 38/6

Triple K.C. Combinations of .0003 and .0005 - 40/-

**MIDGET CONDENSER**

A small variable condenser for panel mounting, .0005, .0006 or .0007 - 5/6

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GIVE YOUR SET NEW "PEP"

WITH "PERTRIX"

You can do it with "Pertrix" H.T. Batteries!

There is no sal-ammoniac in "Pertrix" to strangle and corrode... to shorten life and mar the enjoyment that comes from perfect radio.

Your H.T. Battery is the heart of your set. Give it a good heart... a heart full of life and power.

Give it "Pertrix" — the H.T. Battery with a 60% longer life.

PERTRIX

SUPER LIFE
RADIO DRY BATTERIES

The Battery of Batteries.

Pertrix Ltd., 233, Shaftesbury Avenue, London, W.0.2.

Factory — Britannia Works, Redditch, Wares.

THE DECIDING FACTOR

No. 97b. 15/-

The deciding factor in radio reception is the Speaker. All the care that is taken by others in broadcasting, and by yourself in using a good circuit, will be wasted if your Speaker is poor. Therefore we ask you to take the first opportunity of hearing a Squire Speaker with a good Unit. We definitely claim that the quality of reproduction afforded is equal to, if not better than, that of the most expensive Speaker on the market.

The No. 97b, also shown here, with a cone of the latest climate-proof vellum type and constructed of solid cast aluminium, absolutely preventing chatter, will take any Unit at present on the market.

Frederick Squire Ltd., 10, Leswin Place, Stoke Newington, N.16.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
All who prefer Quality in Cigarettes

Say Player's Please

5 for 3d. 10 for 6d. 20 for 11½d.

When buying your A.C. Mains Receiver, battery eliminator, or battery charger see that it incorporates a Westinghouse Metal Rectifier which is one of the most important components in up-to-date radio equipment. There is nothing to wear out in this rectifier—no filaments, no chemicals nor moving parts. It is used in the majority of modern receivers and eliminators, designed and marketed by experts who are satisfied as to its reliability, and whose aim has been to provide TROUBLE-FREE RADIO EQUIPMENT.

For those who prefer to make up their own sets, our book "The All-Metal Way, 1930" will be invaluable. It contains 32 pages of circuits and instructions covering all types of A.C. Mains Units. Send a 2d stamp with your name and address.

The Westinghouse Brake & Saxby Signal Co. Ltd., 82, York Road, King's Cross, London, N.1.

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
ARE YOUR COMPONENTS UP-TO-DATE?

Look into your set! Are your components up-to-date? Are you getting maximum performance? Replace any defective part with a Burton—the very last word in wireless components. Easy to assemble, smooth in action and absolutely reliable, Burton components are the finest on the market.

Always replace with a Burton!

BUY BURTON COMPONENTS


Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
**MAZDA P.625A**

**EFFICIENCY AND ECONOMY**

**TYPE P 625A**

<table>
<thead>
<tr>
<th>GRID VOLTS</th>
<th>40</th>
<th>35</th>
<th>30</th>
<th>25</th>
<th>20</th>
<th>15</th>
<th>10</th>
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<tbody>
<tr>
<td>CURRENT (MA)</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>110</td>
<td>120</td>
<td>130</td>
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</table>

**MAZDA P.625a**

Type P625A is a super-power valve, and is capable of giving a high power output without distortion. It has been designed for operating cone and moving-coil type loud speakers. The volume obtained with this valve when used in the final L.F. stage is sufficient for most purposes, whilst the quality of reproduction over the whole of the musical range is bound to please all lovers of good music.

Those who desire a large volume of sound and better quality of reproduction should fit the valve in the final stage of their receivers.

These valves can be supplied matched for push-pull work.

**PRICE 15’**

The **AMAZING**

**MAZDA RADIO VALVES**

THE EDISON-SWAN ELECTRIC CO., LTD.

Ediswan Radio Showrooms:

1a, Newman Street, Oxford Street, W.1.

(Phone: Museum 9801.)

Showrooms in all the Principal Towns.

---

**Some amazing figures!**

Report of test by the FURZE HILL LABORATORIES

A thorough test was made of the Graham Parish H.F. Choke by Mr. Reiner of the Furze Hill Laboratories. The following figures are extracted from his report:

<table>
<thead>
<tr>
<th>Wave Length</th>
<th>Impedance</th>
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<tbody>
<tr>
<td>260 metres</td>
<td>45,500 ohms</td>
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<tr>
<td>245</td>
<td>50,000</td>
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<tr>
<td>380</td>
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<td>880</td>
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<td>1100</td>
<td>255,000</td>
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<tr>
<td>1400</td>
<td>385,000</td>
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</tbody>
</table>

The Graham Parish H.F. Choke was designed to obtain high impedance with low D.C. resistance, and these figures will show the success that has been achieved by careful research and scientific design.

**The New "MICRO-FICIENT" Condenser**, a brass-armed low-mid-range variable condenser using Bakelite as a dielectric. Rigid in construction, and ideal for portable sets. Can be mounted on either drum or ordinary dial control.

- .0015 mfd. 4/3
- .0003 mfd. 4/3
- .00015 mfd. 4/6

**GRAHAM FARISH GRADUATED RADIO VALVES**

BROMLEY, KENT
A wonderful combination!

The Lewcos High Frequency Choke and recently developed L.F. Transformer combine to give perfect radio reception.

**LEWCOS L.F. TRANSFORMER.**
Treble notes respond admirably, whilst the bass notes are reproduced with an effect more nearly approaching the true musical tones than is possible with the majority of makes. A feature of the L.F. Transformer is the provision of a Centre-Tapping on the secondary winding which renders it adaptable for push-pull amplification. Scientific research, finest materials and sound workmanship make the L.F. Transformer a worthy addition to the Lewcos range.

**LEWCOS H.F. CHOKE.**
Tested values of the Lewcos H.F. Choke:
- Natural Wave-length: 5,200 metres (tested with Moulin voltmeter).

These figures give assurance that there will be a minimum amount of H.F. leakage through self-capacity, while the position of the terminals, one at the top of the coil and the other at the base, is arranged so as to eliminate the risk of additional self-capacity in the wiring of a receiver.

**LEWCOS**
THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LTD.,
CHURCH ROAD, LEYTON, LONDON, E.10.

---

Get improved reception with this long-life BATTERY

**DUBILIER**
H.T. BATTERIES
DUBILIER CONDENSER CO. (1925) LTD., Ducon Works,

---

WEARITE COMPONENTS

1930 EVERYMAN FOUR.
- Coils per set £2-7-6

NEW KILOMAG FOUR.
- Coils per set £2-5-0

WIRELESS WORLD KIT SET.
- Coils per set £2-5-6

DECOUPLING RESISTANCES.
- 500 or 600 ohms . . . 1s. 6d.
- Fixed resistances wire wound
  - 1,000-5,000 . . . 2s. 6d.
  - 15,000 . . . 3s. 6d.
  - 20,000 . . . 4s.
  - 25,000 ohms:
  - 2s. 6d.
  - 3s. 6d.
  - 4s.

FOREIGN LISTENERS FOUR.
- B.B.C. Coils, per set of 3 £1-2-6
- 5XX Coils, per set of 3 £1-17-6
- Coil Bases, per set of 3 £0-7-6

Write for illustrated lists:
WRIGHT & WEARIE, LTD.,
746, HIGH ROAD, TOTTENHAM, N.17.
Telephone: Tottenham 8418.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
Don't spoil the fun...

Whether the dance music is coming over the radio or from the radio-gramophone—let them have it good and strong! Don't spoil the fun by using an H.T. battery that cannot give your valves all the current they demand. The C.A.V. rechargeable H.T. Accumulator gives purest reception, because the voltage remains as steady as a rock and there is no limit to the current flow. It will reveal to you a hidden power, a quality of reception previously unknown, for your valves will, for the first time, be working at 100 per cent. efficiency.

A C.A.V. Accumulator will reduce your expenses too; it is rechargeable like your low tension accumulator, and will not require replacement for years.

Write to Dept T S for latest Radio Accumulator Catalogue.

Specify the C.A.V Jelly Acid Battery—The Perfect L.T. for all Portables.

IF YOUR SUPPLY MAINS ARE D.C.
You can use an A.C. All Electric Receiver
By Employing The M.L.—D.C. to A.C.

ROTARY TRANSFORMER

Recommended and used by
Philips Radio,
Marconiphone,
Burndect,
Kolster—Brandes,
M.P.A., Etc., Etc.

Can be supplied to run from any Voltage 12—250 V. D.C.

40 WATT Model
£13—0—0
85 WATT Model
£19—0—0

M-L MAGNETO SYND. Ltd., Radio Dept., COVENTRY.
Telephone: 5001.

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Get the Experts to Advise You: The R.G.D. Radiogramophone

For the highest possible quality and tone for both radio and record, with ample volume; incorporating the latest developments in moving coil speaker; operates entirely from electric mains, A.C. any voltage, or D.C. 200 volts or over.

Mahogany Oak
£80 £75

Place your order now to ensure delivery and we shall be pleased to supply literature on application.

The Radiogramophone Development Co.,
St. Peter's Place, Broad Street, Birmingham.

Superior A.C. POWER TRANSFORMERS and CHOKES for the MAINS

from

35' for all Inputs and Outputs

Special Audio - Frequency Chokes and Transformers, and Smoothing Chokes for all purposes.

WILLIAM BAYLISS LTD., Sheepcote Street,
Telephone: "Drawbench, B'ham." BIRMINGHAM.

Wireless
from the Mains
SWITCH ON FOR £2-7-6

Hear deep bass notes and all the orchestra constantly.

Don't hear your radio perfectly only while the batteries are right up but get full H.T. and L.T. supply always.

Connect to your set (a matter of a few moments) and plug into the electric light, no danger, no trouble... just switch on.

"TANNOY" UNITS ARE CHEAPER.

H.T. complete from £2-17-6
L.T. £2-7-6

TULSES REH MANFG. CO.,
1-7, Dalton St., West Norwood,
Tel. Streatham 6732.
S.E.27

Mains Units

PARFAIT

THE PERFECT EBPONE PANEL
ONE QUALITY ONLY
THE BEST

SUPPORTED IN Matte Semi-Polished Mahogany Highly Polished Black Cube Surface High Polished Mahogany Semi-Polished Black, Shaded by most Wireless dealers. If any difficulty experienced, apply for name of nearest stockist to:
H.B. POTTER & Co., Ltd., Station Buildings, ROCHDALE.

Experimental Wireless
& The Wireless Engineer

The Journal for Professional Engineers and Advanced Wireless Experimenters

Monthly
2/6 net.

Annual Subscription 32/- post free.


Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
You cannot afford to use any but the best Condenser in an eliminator circuit.

HELSBY CONDENSERS are made and guaranteed by a firm with 30 years' experience in condenser making, from small telephone and radio condensers to Power Condensers weighing upwards of 2 tons.

Guaranteed working voltages:
Type M - 150 volts D.C.
Type 2A - 350 volts D.C.
Type 3A - 450 volts D.C.
Type 4A - 600 volts D.C.

All Hel psy Condensers are vacuum dried and impregnated with a special non-hygrosopic material which renders them moisture proof.

If unobtainable from your dealer, write to us giving his name and address.

BRITISH INSULATED CABLES LTD
PRESCOT - LANCs.
Makers of PRESCOT and HELSBY cables

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
Because of the exceptional strength and rigidity of its elements due to its Interlocked Construction the NEW Cossor Screened Grid Valve has definitely established itself as the most robust and the most dependable Screened Valve made in Great Britain. Over and over again in actual service it has proved itself shock-proof, noise-proof and break-proof. In your Receiver use the New Cossor Screened Grid Valve. Every Dealer sells it.

The NEW
Cossor
Screened Grid Valve

2-volt type now available.
The NEW Cossor 220 S.G. (2 volts:2 amp.) Anode volts 120-150, Impedance 200,000 Amplification Factor 220. Price: 2/6

Cossor 4 and 6 volt Screened Grid Valves are also available with similar characteristics at the same price.
The Wireless World
AND
RADIO REVIEW
(17th Year of Publication)

No. 544. WEDNESDAY, JANUARY 29TH, 1930. Vol. XXVI. No. 5.

THE POST OFFICE AGAIN.

We are glad to be able to publish in the Correspondence columns in this issue a letter from the Post Office which reassures us on the question of wireless licences in flats, to which we drew attention editorially in our issue of January 15th, under the title of "A Wireless Licence Scandal."

The Post Office reply is quite explicit and exonerates Post Office officials from all responsibility. The wireless correspondent of an important daily paper, whose published statement was so misleading, would not find it easy to excuse himself, for his statement read:

"... the Post Office contended in the very proper step of making acknowledgment of the assistance which he rendered. This incident, however, provides the opportunity for drawing attention once more to the broadcast licence regulations printed on the back of the licence form which we have previously criticised in The Wireless World. Following upon the decisions of the Washington International Wireless Conference, certain changes were made in the conditions under which broadcast licences are issued, and the wording on the back of the form now states that the licensee may only use his receiver for the reception of broadcast programmes and messages sent for general reception and messages sent from an experimental station in connection with experiments carried out by the licensee, and, further, that "... the licensee shall not use or allow the station to be used for the receipt of messages other than messages intended for receipt by him or sent for general reception.""

A perusal of the wording of this regulation makes it quite clear that, in his action with regard to Mr. Baron, the Postmaster-General has publicly approved of a breach of the Post Office regulations. Mr. Baron would have been unable to act as he did unless he had been listening to transmissions other than those permitted.

The Mullard Wireless Service Company was, we believe, the first to communicate the story of Mr. Baron's experience to the Press, and a statement in their report is, we think, significant of the general attitude towards what we regard as the unreasonable regulations of the Post Office. The paragraph to which we refer reads:

"... Moreover, those who are expert at reading the Morse code occasionally amuse themselves by listening to ships at sea." The Post Office cannot hope to prevent or control what listeners overhear on wireless receivers, however desirable it may be that secrecy should be observed, so that it seems to us only foolish to make regulations which cannot be enforced.

Mr. Cyril E. Baron, who during the recent gales picked up SOS calls from a ship in distress in the Channel, and, finding that the calls were not being answered, communicated the information by telephone to the North Foreland Radio Station, and by this action was the means of saving the ship and the lives of those on board. Following this action, Mr. Baron received a letter of thanks from the Post Office.

We consider that Mr. Baron's action was one deserving of high appreciation, and we are very glad to see that the Postmaster-General took what we consider to be the very proper step of making acknowledgment of the assistance which he rendered. This incident, however, provides the opportunity for drawing attention once more to the broadcast licence regulations printed on the back of the licence form which we have previously criticised in The Wireless World. Following upon the decisions of the Washington International Wireless Conference, certain changes were made in the conditions under which broadcast licences are issued, and the wording on the back of the form now states that the licensee may only use his receiver for the reception of broadcast programmes and messages sent for general reception and messages sent from an experimental station in connection with experiments carried out by the licensee, and, further, that "... the licensee shall not use or allow the station to be used for the receipt of messages other than messages intended for receipt by him or sent for general reception.""

A perusal of the wording of this regulation makes it quite clear that, in his action with regard to Mr. Baron, the Postmaster-General has publicly approved of a breach of the Post Office regulations. Mr. Baron would have been unable to act as he did unless he had been listening to transmissions other than those permitted.

The Mullard Wireless Service Company was, we believe, the first to communicate the story of Mr. Baron's experience to the Press, and a statement in their report is, we think, significant of the general attitude towards what we regard as the unreasonable regulations of the Post Office. The paragraph to which we refer reads:

"... Moreover, those who are expert at reading the Morse code occasionally amuse themselves by listening to ships at sea."
The Advantages of Low Stage Gain and Small Coils for Multi-stage Receivers.

By A. L. M. Sowerby, M.Sc.

The continuous evolution of the valve, and especially of the valves used for high-frequency amplification, is likely to open up divergent lines of receiver design. On the one hand, these new valves offer the possibility of attaining a tremendous amplification in a single stage, and will therefore tempt many designers to replace two Moderately efficient stages by a single “hotted up” stage giving superlatively high magnification. Besides the obvious advantage of the elimination of one valve, there must also be taken into consideration the fact that by adopting a design of this type, of which the “Record III” is an example, it becomes possible to use a band-pass filter while still not employing more than three tuned circuits. Further developments in this direction are not impossible, but it would appear probable that receivers of this general type will be limited to amateur construction, for which they are particularly suited.

The second possible line of development is similar in its aims, but different in its means of attaining them. Instead of pushing up the amplification until one stage, using a modern valve, will do the work that two valves did before, we may lower the efficiency of the tuned circuits to keep amplification still at or near its old level, taking our profits in the form of less “peaky” tuning and greater ease of ganging the tuned circuits if this should be thought desirable. The “Foreign Listener’s Four” is an example of a receiver designed on these lines. Judging by the present trend of commercial set design, it is in this direction that the manufacturer is most likely to progress.

It will be realised, of course, that from the commercial standpoint a set of this kind is the more practical proposition, in that careful elimination of losses always adds very considerably to the cost of manufacture, and increases the likelihood of the finished receiver requiring a final adjustment by highly skilled experts before it can be passed as perfect. Moreover, a commercial receiver has to work with almost any valves that may happen to find their way into it, and so must not be dependent for its good behaviour on an expert’s final touches.

For all these reasons, then, a multi-stage receiver of low stage gain suits the manufacturer. From an amateur’s point of view, too, it has its points. Although it is an extremely difficult task to set up and operate two ultra-high-gain stages, it is comparatively easy to extract the same overall amplification from three low-gain stages. To attain a total magnification of 25,000 times in two stages, each stage must amplify about 160 times. It is not difficult to stabilise one such stage, but two in cascade offer very considerable difficulties even to the expert. But if three stages can be used, the 25,000 times can be made up at the much more modest rate of 29 times per stage. This implies coils of quite high resistance, or transformers of high step-up ratio, so that a little stray reaction will not set up oscillation quite so infallibly as with the high-gain stages; in addition, there should be no great difficulty in ganging the tuned circuits without incurring any loss of amplification.

It will therefore be seen that a receiver deliberately made inefficient by choosing tuned circuits of higher losses than the amateur set builder usually permits has something to offer in exchange for its higher cost of construction and greater demands on the batteries. Those who do not mind providing an extra valve and an extra tuning coil and condenser, together with an extra screening box and decoupling components, will find that the multi-stage receiver of low gain is pleasant to use and offers good selectivity for a reasonably small loss of side-bands.

With receivers of this type (though not necessarily of three stages) in mind, a series of small, compact and inexpensive coils have been designed. Some discussion arose as to the best inductance to choose for these coils,
Size versus Efficiency of Small Coils.

and it was finally decided that 200 microhenrys should be fixed upon, partly because this inductance value goes well with a 0.0005 mfd. tuning condenser, which is the most generally used size, and partly because it ensures that even if, by compact construction and close shielding, the stray capacities in the finished receiver are brought up to high values, the wavelength range that they cover will still extend as far as is likely to be required in a downward direction. It should, however, be noted that where 0.00035 mfd. tuning condensers are available, and stray capacities can be kept reasonably small, 250 microhenrys is to be preferred. With the higher inductance the amplification does not fall off quite so much at the upper end of the waveband, and at the same time the higher ratio of inductance to capacity helps to flatten out the tuning curves and tends to check undue loss of side-bands.

In designing the coils, the method adopted was to take the diameter as a basis. Butterworth's formulae show that, for a fixed diameter, the lowest coil resistance is attained by making the coil very long. By calculating the copper losses for a number of coils of the same diameter, but of different lengths, it was found that the resistance at first decreased fairly rapidly as the length was increased, but that after increasing the length to equal the diameter, any further improvement that could be attained was not worth the extra space that the coil would occupy. The relation between copper losses and coil length, for the particular case of a 250 microhenry coil of 2 in. diameter, is shown in Fig. 1.

The Correct Gauge of Wire.

It should be noted that this result is not in contradiction with the well-established fact that the best coil shape is that which makes the diameter about double the winding length. This rule applies to a series of coils in which the overall surface is kept constant, both diameter and length changing when passing from one shape to another. If with a fixed diameter the length of the coil is increased, the departure from the best shape is more than counterbalanced by the increase in overall surface area.

Having settled the shape of the coil, it only remained to apply Butterworth's formula to find the best wire to apply Butterworth's formula to find the best wire gauge. In doing this, the decrease of dynamic resistance shown by all tuned circuits at the upper end of their tuning range was borne in mind, and as a small contribution towards lessening this effect the gauge of wire was chosen to suit 600 metres instead of a wavelength more nearly at the middle of the range.

The specifications arrived at by calculation are as follows:

<table>
<thead>
<tr>
<th>No.</th>
<th>Diameter</th>
<th>Wire Gauge</th>
<th>Wire Covering</th>
<th>Turns</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2½ in.</td>
<td>22</td>
<td>Double Silk</td>
<td>57</td>
</tr>
<tr>
<td>2</td>
<td>2½ in.</td>
<td>22</td>
<td>Double Silk</td>
<td>64</td>
</tr>
<tr>
<td>3</td>
<td>2½ in.</td>
<td>24</td>
<td>Double Cotton</td>
<td>71</td>
</tr>
<tr>
<td>4</td>
<td>2 in.</td>
<td>26</td>
<td>Double Cotton</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>1½ in.</td>
<td>28</td>
<td>Double Silk</td>
<td>73</td>
</tr>
<tr>
<td>6</td>
<td>1½ in.</td>
<td>28</td>
<td>Double Silk</td>
<td>80</td>
</tr>
</tbody>
</table>

All coils are intended to be wound with consecutive turns of wire touching; it is with the idea of providing automatically correct spacing that various coverings are specified.

It was considered advisable, for the interest of those who may wish to employ coils of this type in a receiver, to make actual measurements of the high-frequency resistance of some at least of these coils, since dielectric losses in the tuned circuit are usually of such a magnitude that the copper losses alone cannot be taken as a guide in receiver design. Coils Nos. 2, 4, 5 and 6 were therefore wound, the former being paxolin tube bearing the trade-mark "MIC." First, the inductance of the various coils was measured, and was found in no case to be exactly 200 microhenrys. This turned out to be due to the fact that the particular wire employed did not conform exactly to the overall diameter (including insulation) attributed to it in the wire tables used. The specifications, however, have not been amended on that score, as it is probable that the diameters given in the
Size versus Efficiency of Small Coils.

The equivalent series resistance of a complete tuned circuit, using each of the four coils in turn, was next measured. Besides the coil itself the tuned circuit contained a variable condenser in which the fixed plates were supported on ebonite. In order to reproduce the conditions existing in a practical receiver, a valve and valve-holder, together with a 3-megohm grid-leak, were connected in parallel with the tuned circuit. A "Burton" valve-holder was chosen as introducing unusually small dielectric losses; although it is not implied that there is no holder that is not better from this point of view, it is quite certain there are many that are very much worse. The valve was a '11/larconi or Osram HL610, while for the grid-leak was chosen a porcelain holder, owing to the fact that porcelain introduces only minute dielectric losses. This selection of components makes the tuned circuit representative of one in which the dielectric losses have been kept well in hand without going to such extreme measures as decapping the valve.

Dynamic Resistance of Small Coils.

In Fig. 2 the results of these resistance measurements are plotted. The curves do not, as a matter of fact, reproduce exactly the figures found experimentally, but have been to some extent adjusted to the values that the writer regards as representative of an average case. It was found necessary to "cook" the results in this way because the largest coil, which should naturally have had the lowest resistance, turned out to have a higher resistance, over part of the waveband, than any of the others. Analysis of the figures showed this to be due to an unusually large share of dielectric losses—presumably in the paxolin former, since every other factor was unchanged from coil to coil. It is thought, however, that the curves give, as they stand, a fair estimate of the resistance that may be expected in other coils made up to the same specification on good quality formers, and connected in a tuned circuit containing the same components.

In addition, the resistances found were all adjusted on the basis of constant magnification \( m = \frac{2\pi fL}{r} \) to the values they would have had if the inductances of all four coils had been exactly 200 microhenrys.

For receiver design, the series resistance of tuned circuits is of less interest than the dynamic resistance, since knowledge of the latter is required for the calculation of stage-gain, and in the choice of amplifying valves to precede the coils. The dynamic resistances of the same four tuned circuits at different wavelengths is therefore given in Fig. 3.

The Auto-coupled Tuned Grid Circuit.

As might be expected from the compact construction of the coils, their dynamic resistance is not high—it averages only some 100,000 ohms or so. The very considerable drop towards the upper end of the tuning range is partly due to the comparatively low inductance of the coils, and partly to the fact that they are wound with solid wire. The dynamic resistance of a Litz-wound coil is usually more nearly constant from low wavelengths to high.

For maximum amplification in a high-frequency stage employing a screen-grid valve, the tuned anode circuit, or its equivalent, must be used with these coils.
Size versus Efficiency of Small Coils.—

No separate primary winding is required for this arrangement, a tapping on the coil serving to convert it very simply into an auto-transformer. Where there are doubts as to the selectivity or stability of the amplifier, several different tappings may be provided, so that when the amplifier is being tested the most satisfactory compromise between selectivity, stability and amplification may readily be found by trying different tapping points.

The amplification per stage given by the 2in. coil, with the Mazda 215SG battery-heated valve and the Marconi MS4 mains valve, has been calculated, and is given in Fig. 5. The upper pair of curves refer to the use of the coil in the tuned-anode circuit or its equivalent (in the circuit of Fig. 4, with the lead from the coupling condenser connected directly to the upper end of the tuned circuit), while the lower pair give the amplification that may be expected if the coil is used as the secondary of a 2-to-1 step-up transformer (in Fig. 4, with the tapping at the mid-point of the coil).

Inductance Affected by Close Screening.

The high stage-gain that the best modern valves can provide, even with such modest coils as these, enables a receiver of high overall magnification to be built in a comparatively small space.

With coils of the type described here, which are of small dimensions and are comparatively long for their diameter, the extra resistance introduced by putting the coils inside screening boxes will be found quite small. Even with much larger coils of quite low resistance and more extended field it is possible to allow the screens to approach surprisingly close to the coils before any serious increase in resistance occurs. It must not be forgotten, however, that the close proximity of metal will lower considerably the inductance of a coil, and if too closely screened there may be a failure to tune over the wave-range expected.

Resonance Curves.

In examining the curves there are two points that claim special attention. For the proper reproduction of the high harmonics and overtones that serve to render one musical instrument distinguishable from another playing the same fundamental note it is necessary that the tuned circuits should pass frequencies up to some 5 kilocycles away from the fundamental at reasonable strength. The height at which the various response-curves cut the line marked "5 kc." thus enables the high-note loss involved by the various numbers of these coils at wavelengths towards the two ends of their tuning range to be estimated very readily. As a guide...
one might suggest that 10 per cent. at 5 kc., means acceptable quality, 25 per cent. means good quality, while 65 per cent. or over implies reproduction up to the best "local station" standard. But since different people have different opinions as to what constitutes "good quality" these figures need not be taken too rigidly, although they should assist in providing a clue.

The second piece of information that can be gathered from the curves is the degree of selectivity that may be expected. For determining this we must examine the height of the curve at a greater distance from the peak. If, for example, there is an interfering station B, 36 kilocycles away from the station A being received, and the curve for the tuned circuits in use cuts the line marked "36 kc." at 0.008, we know that once B is heard, as an interference to B's programme, at an intensity of 0.008 times that at which it is received when deliberately tuned in.

Attention is particularly drawn to the enormous difference in selectivity between the two figures, one of which refers to 225 and the other to 550 metres. At the latter wavelength selectivity is very high, and the side-bands of received telephony are very drastically cut down where three or four tuned circuits are used. At 225 metres even five or six tuned circuits would be perfectly harmless from this point of view, but selectivity is, of course, poor. For all-round reception, where any station that comes in well can be detuned a little, a three-circuit receiver would be found quite satisfactory even when high quality is required, for when the circuits are not accurately tuned to the station being received the resonance curve is broadened very considerably.

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**FORTHCOMING EVENTS.**

**WEDNESDAY, JANUARY 29TH.**

Muswell Hill and District Radio Society. At 8 p.m. At Tollington School, Tottenham, N.15. Lecture and demonstration: "The Testing of the Modern Gramophone Pick-Up," by Mr. E. F. N. G. Lennard. Edinburgh and District Radio Society. (At 8 p.m. At 16, Royal Terrace, Lecture "Frame Aerial Reception," by Mr. H. F. Fergusson, M.B., Ch.B.

**THURSDAY, JANUARY 30TH.**

Board and District Radio Society. At the Western Institute, High Road. Loud-speaker demonstration.


**MONDAY, FEBRUARY 3RD.**

Newcastle-upon-Tyne Radio Society. At 7.30 p.m. In the English Lecture Room, Armstrong College, Lecture "The Grid Feeding System," by Mr. W. W. Pope, followed by a demonstration of electrical reproduction.

**TUESDAY, FEBRUARY 4TH.**

Thornton Heath Radio Society. At 8.15 p.m. At St. Paul's, Lecture "Demonstration by Mr. R. M. H. Lucy, of Messrs. S. G. Brown, Ltd.

**WEDNESDAY, FEBRUARY 5TH.**

Institution of Electrical Engineers (Wireless Section). Visit to the Laboratory of the City and Guilds Engineering College, South Kensington, S.W.7.

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**CLUB NEWS.**

A new club.

A meeting to discuss the formation of a Radio Society in Market Harborough was held in the Old Grammar School on Thursday, January 14th, and nearly forty local enthusiasts enrolled as members. Dr. Crisp was elected president and Mr. F. Blesley chairman. All interested are requested to get in touch with the Hon. Secretary, Mr. A. W. Richardson, "Roneleigh," Waitmbury Street, Market Harborough.

A successful year.

At the Hackney Radio and Physical Society's annual meeting held recently, the secretary's report showed that the past year has been a successful one for the society. The following officers were elected for 1930—

Chairman: Mr. E. Cunningham

Vice-Chairman: Mr. W. J. Sampson

Hon. Secretary: Mr. G. E. Sandy

Publicity Secretary: Mr. G. W. Heath.

An interesting programme has been arranged for the coming year, and the Society will be pleased to welcome new members. Anyone interested should apply for particulars to the Hon. Secretary, Mr. G. E. Sandy, 4, Mildmay, Raynes Park, S.W.20.
HEAR MUSIC
... as it
really is!

The Junior "R.K." Unit has a 6 in. straight-sided cone with moving coil having an impedance of 10-15 ohms at 50/4,000 cycles. Copper damping rings are fitted to reduce the impedance at the higher frequencies. Price £6 6 0

The Senior "R.K." Unit incorporates a 10 in. corrugated cone with moving coil having an impedance of 10-15 ohms at 50/4,000 cycles. Copper damping rings are fitted to reduce the impedance at higher frequencies. Price £7 7 0

Senior "R.K." Unit with A.C. Field Excitation.
This "R.K." Unit has a 10 in. corrugated cone with moving coil having an impedance of 10-15 ohms at 50/4,000 cycles. The pot magnet is mounted in a pressed metal base which also contains a mains transformer, Mazda U.U. 60/250 rectifier valve, and smoothing condenser for the supply of field current. Price £11 10 0

When the "R.K." first appeared on the market it was hailed as the perfect reproducer and achieved instant leadership.

That leadership—so readily attained four years ago—is maintained to-day, and wherever fine reproduction is desired the "R.K." is the speaker to use.

THE EDISON SWAN ELECTRIC CO., LTD.,
Radio Division.
1, Newman Street, Oxford Street, W.1.
Branches in all Principal Towns.

EDISWAN
Little Bigger
than a match
box & weighs
only 7 ounces

12/6

PRIMARY INDUCTANCE OVER 50 HENRIES

Here at last is a transformer built with a CORE OF A NEW NICKEL ALLOY of enormous permeability, yet sold at a price which places it within the reach of the average home constructor.

The "Hypermu" at 21/- is, of course, the best transformer it is possible to buy, but the "Hypermite" gives an opportunity of acquiring at the popular price of 12/6 a modern transformer with a high inductance which guarantees the retention of the low frequencies without sacrificing the high.

A "Hypermite" leaflet with full diagrams will tell you all about it. Ask your dealer for a free copy, or send direct to the manufacturers.

12, HYDE STREET, LONDON, W.C.1.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
Accurate Wavemeter Design
Points in the Construction of Precision Instruments

At a meeting of the Institution of Electrical Engineers last year Capt. P. P. Eckersley, then Chief Engineer of the British Broadcasting Corporation, during his contribution to the discussion on wavelength standards, said: 'Some years ago (wavelength) accuracies of 1 or 2 per cent. were sufficient for ordinary stations. To-day, particularly in the field of broadcasting, 1 part in 10,000 is desirable if mutual interference is to be avoided.' Capt. Eckersley then explained the methods which are employed by M. Divoire (of the University of Brussels) to check the wavelength of all broadcasting stations of Europe from one central broadcasting control laboratory in Brussels. The wavelengths of ordinary 1 kW. broadcasting stations 7,000 miles distant from Brussels are measured to within 200 cycles in a million, an accuracy of 0.02 per cent.

It is natural, of course, that with the crowding of the available etherial waveband the necessity for accurate determinations and standardisation of wavelength should be every-increasingly felt.

In the early days of 'wireless' there was very little difference in accuracy between the carefully constructed standard wavemeter and one of an ordinary commercial type, whereas we now have wavemeters differing in accuracy by over a thousand to one. This must necessarily be the case when the measurement of any physical quantity becomes more precise, since the quality of workmanship then plays a far larger part in the overall accuracy of the instruments for its determination. Thus the accuracy of wavemeters (of any given type) to-day depends almost entirely upon the quality of their component inductances and condensers—particularly the latter. It is obviously ridiculous to impart a highly accurate calibration to a wavemeter whose variable condenser is, through mechanical imperfection, neither constant enough to 'hold' this calibration nor sufficiently uniform in capacity variation to permit interpolation (between adjacent calibrated points) of the same high order of accuracy.

The Relative Accuracy of the Various Types of Wavemeter.

The better the quality of variable condenser employed in any particular type of wavemeter and the smaller the wavelength range covered by a single sweep of its condenser, the more accurate will be its calibration.

The extent to which the accuracy of a wavemeter is determined by the quality and range of its variable air condenser varies with different types. In the case of the simple buzzer wavemeter, for instance, flatness of tuning will sometimes limit accuracy of reading and so render condenser quality of less importance. And in a wavemeter of the heterodyne type the quality and range of the variable condenser will only be the governing factor of accuracy if the initial calibration conditions of valve emission, etc., are exactly reproduced on all subsequent occasions.

The sub-standard wavemeter of the simple resonant circuit type is, on the other hand, almost entirely governed, as regards accuracy, by the quality and range of its variable air condenser, although the constancy of the inductance associated with the latter is also of importance.

The relative inaccuracy of the various generalised types of wavemeters is depicted diagrammatically in Fig. 1 by the relative areas of circles—the variation of accuracy being far too great for representation on a linear basis. To those inexperienced in the field of standardisation and measurement, the outstanding feature of this diagram is, perhaps, the relatively high inaccuracy of a good portable commercial heterodyne wavemeter. One must remember, however, that this inaccuracy, even if one ignores all other contributing factors, may be introduced by an uncertainty of capacity of 1 or 2 micro-microfarads, and that such a variation of capacity may be due to a great variety of causes in a portable instru-
Accurate Wavemeter Design.

The design of the resonant circuit of a wavemeter for accuracy is of primary importance, therefore, that the minimum value of capacity of the variable air condenser of a heterodyne wavemeter shall be augmented by a fixed condenser to such an extent that these unavoidable capacity uncertainties are rendered less important by being made a smaller percentage of the total circuit capacity. The range of wavelength covered by a single sweep of the condenser will, of course, be very considerably reduced even by a small increase of minimum capacity, and this will, in turn, increase the number of "range coils" required to cover a given total wavelength range, thus adding appreciably to the cost of the instrument and making it less convenient to use.

For a wavemeter either of the heterodyne or sub-standard (absorption) type the number of range coils required to cover a certain band of wavelength can be found from a curve such as (A) of Fig. 2, which is plotted for a wavelength range ratio of 100 to 1 (irrespective of the actual wavelength values), corresponding with any desired capacity range ratio of variable condenser.

In order to use this curve, however, one must first determine the capacity range ratio of the variable condenser to be employed. Since this depends upon the accuracy required of the wavemeter it is possible to plot another curve, Fig. 2 (G), connecting these two quantities. The right-hand scale in this case represents the inaccuracy to be expected due to capacity uncertainty in an ordinary commercial heterodyne wavemeter. Lower inaccuracy values would, naturally, be associated with laboratory sub-standard wavemeters.

Commencing therefore with only the total wavelength range and percentage inaccuracy permissible as data, the resonant circuit is designed by finding from curve G the capacity range ratio corresponding with the inaccuracy permissible and then from curve A finding the number of range coils corresponding with this capacity ratio. The ratio of the inductances of successive range coils will, of course, be the same as that of the condenser and their values are thus easily calculated.

For a variable condenser and wavemeter of any given quality the inaccuracy due to a small uncertainty of capacity will depend upon the total value of circuit capacity and any curve of inaccuracy such as G must be associated with one definite value of maximum capacity—in this case 1,000 micro-microfarads.

Tuning Range and Percentage Inaccuracy.

In Fig. 3 curves similar to those of Fig. 2 are given for the outline design of wavemeter circuits having various values of inaccuracy, for any value of total wavelength range, and for any value of maximum capacity. The curves A, B, C and D are plotted for wavelength ratios of 100 to 1, 40 to 1, 20 to 1 and 10 to 1 respectively. For other wavelength ratios interpolation between the curves may be applied and the next higher whole number of range coils employed. The straight line curves E, F, G, H and J give inaccuracy-capacity ratio relationship for circuits having maximum capacities of 500, 750, 1,000, 1,500 and 2,000 micro-microfarads respectively.

The curves have been made more complete by the addition of an alternative scale of percentage inaccuracy.

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**Fig. 2.** Curves showing the number of range coils and capacity ratio of condenser of a wavemeter.

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**Fig. 3.** Showing the number of range coils and capacity ratio of condenser of wavemeters of various accuracies.
to be used when the wavemeter under consideration is of the better-class substandard absorption type employing a precision variable condenser and well-designed range coils.

It will, of course, be understood that in the use of these curves only that component of inaccuracy which is due to capacity uncertainty is accounted for, and although this should always form the basis of design the possibility of other sources of inaccuracy should not be overlooked.

**Optimum Capacity Range.**

As will be seen from Fig. 3, the number of range coils rendered necessary becomes prohibitive if the capacity range ratio is reduced too much and, moreover, the attendant reduction of capacity uncertainty is not sufficiently great to justify this above a certain point. The value at which a still further reduction of capacity range ratio does not justify the added cost and inconvenience of extra range coils is found by plotting curves (as in Fig. 4) of economy factor against capacity range ratio. The economy factor is assumed to be the ratio of accuracy to number of range coils, the accuracy, of course, being taken as the reciprocal of inaccuracy. The curves of Fig. 4, which are plotted for wavelength ratios 10 to 1, 20 to 1 and 100 to 1, indicate an optimum economy value of capacity ratio of about 2.7, which is, incidentally, that employed in the best wavemeters.

(To be concluded.)

**CURRENT TOPICS**

**Events of the Week**

**FRANCE'S DX PRESIDENT.**

President Doumergue is reported to be a wireless "fan" of the DX type, leaving his bed in the early hours to listen to America.

**RADIO WEEK FOR IRELAND?**

The organisation of Irish Radio Week is being considered by the Irish Radio Traders' Association.

It seems to us that before the Free State can stage an effective Radio Week it will be necessary to provide a broadcasting service covering a bigger area of the country.

**WIRELESS IN PUBLIC LIBRARIES.**

The Sheffield libraries are setting an example to the country by allowing the public free facilities for listening to the B.B.C. language talks. Sets are in regular operation at the Walkley and Hillsborough branches, and visitors are invited to join the discussion groups which have been formed in connection with the B.B.C.'s Adult Education campaign.

**AS OTHERS HEAR US.**

Brookmans Park is receiving "a good press" in France, according to our Paris correspondent. Several journals draw the attention of the public to the excellent transmission from the new station, while "Petit Radio" praises the station for the prudent care taken to minimise in-convenience as a result of the application of new conditions of reception. This cryptic remark probably indicates satisfaction at the constancy of the Brookmans Park wavelengths.

**MARITIME TRIBUTE TO WIRELESS.**

A long-standing association between seafarers and the wireless service has been acknowledged by the Worshipful Company of Shipwrights by the admission of Mr. F. S. Hayburn, deputy managing director of the Marconi International Marine Communication Co., Ltd., as Freeman and Liveryman.

**PROPOSED NEW RADIO COLLEGE.**

A new form of wireless college, specially intended for youths who wish to enter the wireless trade, has been proposed by the Association of British Radio Societies, whose headquarters are in Manchester. It is believed that a need exists for a training centre in which the student would have an opportunity of handling modern commercial apparatus, such as moving-coil loud speakers, etc., of a kind which is usually absent in the ordinary technical colleges. While the theoretical side would not be neglected, the aim of the course would be to give the learner an acquaintance with the practical problems associated with the trade.

It is stated that the scheme has met with the approval of several important wireless firms.

**Tonic Touches in Australia.**

In Australia the month of January is witnessing the acquisition of more stations by the Australian Broadcasting Company, the latest to come under its control being Adelaide, 5CL, and Brisbane, 4QG. The recent broadcast legislation makes the "A.B.C." responsible for the direction of seven stations, two in Sydney, two in Melbourne, and one each in Brisbane, Adelaide, and Perth.

The company announces its intention of putting fresh life into the programmes.

**Greece to "Come on the Air."**

The "Isles of Greece" will shortly respond to the strains of national broadcasting as a result of the decision of the Hellenic Government to invite offers from organisations who would be prepared to operate a State-subsidised broadcasting service, the income to be derived from listeners' licence fees. At present there are no applicants for the monopoly, but the Ministry of Posts and Telegraphs is...
determined to waste no time on the ques-
tion and has already ordered a certain 
amount of transmitting equipment from 
the Marconi Company and the French 
Compagnie Radio Electrique. The sites 
chosen for the studios are at Zanli, Vare, 
and Sitta (Crete), with high-power trans-
mitters at Athens, Chios, and Heraklion 
(Crete).

EVERLASTING GRAMOPHONE RECORDS

Startling claims are made in a Wash-
ington message regarding the properties 
of a new type of gramophone record 
composed of a substance called Durium. 
The inventor is Dr. Hal T. Beans, pro-
fessor of chemistry at Columbia Univers-
ity.

Durium is laid by a dipping process. 
On these the impressions can’t be stamped 
at the rate of 200 records per minute. 
The inventor affirms that the records are 
practically everlasting.

PUBLIC LISTENING HALLS.

“I have often wondered why some people 
have not opened a public Radio Hall for 
listening to wireless programmes,” says a 
writer in The Manchester Guardian. 
must of necessity be scanty from 11 a.m. 
to 6 p.m., and there are lots of people 
whose opportunities for evening listening 
are very limited, who would appreciate 
daytime facilities in an airy hall with 
comfortable seats and rubber flooring. 
Wireless manufacturers might help to 
finance such a scheme in return for ex-
hibiting their sets and gadgets.”

THAT CANARY CALL.

Doubt is expressed by an Irish contem-
porary as to whether the canary interval 
call from the Tyrian station is produced 
by a real bird. Considering that so many 
birds, including canaries, nightingales, 
and cuckoos, are specially trained for 
broadcasting work, we feel sure that the 
station authorities would not deceive 
listeners with a gramophone record.

LEAMINGTON’S LOUD SPEAKERS.

The Leamington Town Council has sub-
mited a draft bylaw to the Home Sec-
retary for the suppression of noisy loud 
speakers and gramophones in public 
places.

A BORROWED WAVELENGTH.

Congestion on the long-wave broadcast-
ing band has led to an interesting situ-
ation in regard to the wavelength of 
and the line will handle not only the 
increasing telephone business between 
Toronto and the northern Ontario min-
ing districts, but will be a link in the 
Atlantic-Pacific system. On the com-
pletion of this transcontinental project 
persons in Halifax will be able to talk 
from 1930 over an all-Canadian route 
with perfect audibility.

GREAT "SUPERHETS" FOR FRANCE.

The Etablissements Radio-L. L., which 
manufacture and sell "superhets" under 
the patents of M. Lucien Levy, has 
trebled its capital, which is now 
35 million francs.

OPPORTUNITIES IN THE R.A.F.

The trade of wireless operator-
mechanic is among those open to success-
ful applicants for six hundred vacancies 
for aircraft apprentices in the Royal Air 
Force. The apprentices, who must be 
between the ages of fifteen and seventeen,
will be enlisted as the result of an Open 
and of a limited Competition.

Full information regarding conditions 
and prospects can be obtained on applica-
tion to the Royal Air Force (Aircraft 
Apprentices’ Dept.), Gwydyr House, 

GRAMOPHONE NEEDLE WEAR.

We regret that, owing to a printer’s error, 
three illustrations were misplaced 
in the article appearing under the above 
title in our last issue. The photographs 
represented as Figs. 3, 4 and 5 should 
have appeared as Figs. 4, 5 and 6 re-
spectively. The descriptive captions 
appeared in their correct places.

Catalogues Received.

Runbaken Motor & Electrical 
Accessories, Ltd., Magnet Works, 
Arvrdie, Manchester.—50-page illus-
trated catalogue of electrical equipment. A 
section is devoted to battery chargers.

Messrs. W. and G. Foyle, Ltd., the 
well-known booksellers of 119-125, Charing 
Cross Road, London W.C.2, have 
under a useful catalogue of new and 
second-hand books on all technical subjects 
and applied sciences, from aeronautics to water 
analysis and supply, including electricity 
and electrical engineering. We can re-
commend this list to readers, especially 
to those on the look out for special, 
out-of-print, or other rare books.

Messrs. Lissen, Ltd., Lissenium Works,
Worple Road, Ickenworth, Middlesex—
Illustrated and descriptive literature of 
Lissen radio components, valves, loud 
speakers, and gramophones. Also con-
structors’ broadsheet for building the 
Lissen "Screened Grid Three" receiver.

The Record Electrical Co., Ltd., Broad-
heath, Manchester.—Descriptive folder 
dealing with the Bridge Ohmmeter, a combined ohmmeter and Wheat-
stone bridge for insulation testing and 
measuring resistances of from 0.01 ohm to 
999,900 ohms.
Multi-Range Meter Conversions
Extending the Scale of D.C. Instruments.

By W. A. BARCLAY, M.A.

There is no instrument which is so universally serviceable to the wireless worker as a sensitive and accurately calibrated milliammeter. The uses of the D.C. moving-coil meter are legion and need not be enumerated here. Not the least among its advantages is the fact that it is possible to use it as voltmeter or ammeter at will over widely differing ranges of voltage and current.

The question is often put by beginners as to how the same instrument may be used for two such different purposes as to measure voltage and current. Happily, the answer may be found without much mathematics by the aid of that "Pons Asinorum" of electricity, Ohm's law. A current-measuring device such as a milliammeter necessarily has a small internal resistance, the smaller this resistance the more sensitive being the instrument. This resistance, $R$ ohms, let us say, remains the same no matter what the deflection of the needle, i.e., no matter what the current passing may be. If, then, our milliammeter needle is fully deflected when a current of 5 milliamps. is flowing, we can see by Ohm's law that there must exist a potential difference of $5R$ millivolts between the terminals of the instrument. If, to take an actual case, the internal resistance $R$ of the meter is 20 ohms, then if 5 milliamps. causes full-scale deflection the potential across the terminals will be 0.1 volt. Smaller voltages will, of course, give lesser readings in proportion, i.e., our milliammeter is also a voltmeter, and may be used directly to measure voltages up to this amount.

Although 0.1 volt is the highest E.M.F. it is possible to apply to the terminals of this instrument with safety we can utilise it to measure E.M.F.s of much greater amount in an indirect way. If, for example, it is desired to measure voltages up to 1 volt, we should employ the circuit of Fig. 1a, in which an external resistance of $\rho$ ohms is placed in series with the meter. Since 0.1 volt is all that we can apply across the meter to ensure full-scale deflection it is obvious that the value of $\rho$ must be so chosen that the remaining 0.9 volt is dropped across it. It will be seen that in the case considered this external resistance must have nine times the value of the meter resistance, i.e., 180 ohms. Generally, if the meter by itself reads up to $V_1$ volts, and it is desired to extend the range to measure up to $V_2$ volts, the value of the external series resistance $\rho$ required may be found from the formula:

$$\rho = R \left( \frac{V_2}{V_1} - 1 \right).$$

$R$ being the internal resistance of the meter.

Again, if the instrument is considered in its simplest aspect, that of a low-reading milliammeter, it is easy to see that it may be used to measure much larger currents than would be possible directly by shunting the meter with a resistance whose value is generally small compared with that of the internal resistance of the meter. In the case of the instrument considered above, full-scale deflection of the needle occurs for a current of 5 mA. Suppose now it were desired to measure currents up to a maximum of 50 mA; for a full-scale reading on the instrument it would be necessary to shunt the balance of 45 mA through the parallel resistance.

Since this parallel current has nine times the value of the meter current it will be seen that the value of the shunt would require to be one ninth of the internal resistance of the meter, or 2.22 ohms. Generally, if the meter by itself reads up to $A_1$ milliamps., and it is desired to extend the range to measure up to $A_2$ milliamps., the shunt resistance $S$ to be included...
This chart gives the value of resistance required in order to extend the range of an ammeter or voltmeter.
Multi-range Meter Conversion.

is found from

\[ S = \frac{A_R}{A_S - A_1} \]

where \( R \), as before, is the internal resistance of the instrument.

A Graphical Illustration.

A graphical illustration of the manner in which the range of voltage- and current-measuring instruments may be related to the auxiliary series and shunt resistances employed with them will now be given. In the case of the voltmeter (Fig 2a), let the distance \( OA \) represent the internal resistance \( R \) of the instrument, and \( OB \) the extra resistance \( p \) to be used in series with it. Let \( OC \), drawn perpendicularly to \( AB \), represent the original full-scale meter reading \( V \), in volts. Join \( A \) to \( C \), and produce it to meet the vertical through \( B \) in \( D \). The length \( BD \) will now represent (to the same unit as \( OC \)) the new full scale of the voltmeter readings \( V_2 \) for the external resistance \( p \).

Similarly, in the case of the ammeter (Fig 2b), let \( OA \) represent, as before, the internal resistance \( R \) of the instrument, while \( OB \) is now the shunt resistance \( S \) to be included. Let \( OC \) be now drawn perpendicularly to \( AB \), represent the original full-scale reading \( A \), in milliamps. In this case \( B \) is joined to \( C \), and produced to meet the vertical through \( A \) in \( D \). The length \( AD \) now represents the new full scale of ammeter readings \( A_2 \), for the particular shunt resistance \( S \).

An Alignment Chart.

For those experimenters who desire to have a rapid means of correlating meter readings with auxiliary resistances, the alignment chart has been prepared. In this chart it is found convenient to dispense with the actual values of the auxiliary resistances and internal meter resistances, substituting instead the ratios of the former to the latter. By his means a greater degree of generality is obtained over a wider range of auxiliary resistances than can be conveniently exhibited on the diagrams of Figs. 2a and 2b. The method of use will be familiar to readers of The Wireless World from the series of Useful Data Charts which have already appeared in the pages of this journal.

The centre and right-hand support lines carry values which may represent either current or voltage readings; the left-hand support gives the ratios of the auxiliary resistances to the internal resistance of the meter. It will be observed that this left-hand support carries two scales; that to the outside gives the radio \( S/R \) when current extension readings are in question, the inside one giving values of \( p/R \) when dealing with voltage extension readings.

Let us take, as an example of the use of the chart, the case of the milliammeter cited above which registers full-scale deflection for a current of 5 mA., and which it is desired to extend to read to 50 mA. Joining these two values on the right-hand and centre scales of the chart, it is found that the index line cuts the left-hand scale at the value \( S/R = 0.133 \), so that the shunt must be 0.133 times the value of the internal resistance.

The chart, of course, gives approximate values only. The practical work of rigging up and calibrating an accurate multi-range volt-ammeter calls for skill on the part of the constructor. Much care is needed, for example, to ensure that the small shunt resistances for the different ammeter ranges are of the correct values. For this reason anything in the nature of a multi-stud switch for the purpose of placing such resistances in circuit is to be deprecated, as such devices are apt to introduce unwanted resistance which might seriously affect the readings of the instrument.
No, it is not a misprint for "Wired," as you thought it was. Weird Wireless, as opposed to the ordinary forms of radio (wireless telegraphy, wired wireless, television and so on) about which the readers of this journal know most that is worth knowing, is that large branch of radio about which they know nothing. Do I realise what I am saying? I do. Am I not giving utterance to an unwarrantable and gratuitous piece of impertinence? I am not.

I have never, for instance, come across any animated correspondence in these pages on the subject of Paint and Varnish Radio. And yet paint and varnish radio is a very important—an increasingly important—subject. The research laboratories of big P. and V. manufacturing concerns are studying, by radio technique, the effects which heat and cold, oxidation and so on, produce on their latest products. Particularly useful here is what might be called an "ultra" edition of the Ultra-micrometer. If two circuits, each kept oscillating by a valve, are almost but not quite in tune and are carefully coupled together, the very least change in tune in the one will produce a great change in current in the other. In the Thoma variation of the ultra-micrometer, a slight increase in the thickness of a paint film alters the capacity of a condenser, brings about an infinitesimal change of tune in one circuit, and gives such a magnified result in the other circuit that the change in the thickness of the film can be recorded and studied very easily.

Robots: Efficiency 500 per cent.

It is said that this new "tool" is enabling the research people to investigate the why and wherefore of important actions going on in their paints, the very existence of which was unknown till now. But this is only one way in which wireless technique is being used in the paint industry. There is a most attractive, superhuman gadget which analyses the colours of paints (and writes down the results) quite automatically and five times as accurately as can be done by the human eye. The machine flashes a beam of red light (for instance) backwards and forwards between the sample under test and a standard colour. If the red beam is reflected more by the standard than by the sample, the result—thanks to the help of a photoelectric cell such as is used in photo-telegraphy and television—is a pulsating current. This, after passing through valve amplifiers, sets a little motor buzzing round and altering things so that the red beam now divides its attention between the sample and a second standard colour: if this does not correspond exactly to the sample, the motor keeps on buzzing round and tries a third standard, and so it goes on till a standard is encountered which gives an exactly equal reflection. When this happens, there is no pulsating current to drive the motor, which comes to rest with a feeling of duty well done. The machine makes a note of that particular standard, switches on a test beam of another colour, and the whole process goes on all over again. The complete colour analysis takes only a few minutes, which is far quicker than can be done by human beings.

Let us leave the stuffy laboratory and get into the vast open spaces of America, Canada and Australia. Here, screen-heroes in khaki shirts and shorts are busily using short-wave valve generators to explore for oil and minerals. Various methods are used, but one favourite plan is to compare the velocity of sound waves through the ground with that of short radio waves. The latter
Wireless World

Weird Wireless.

keep their velocity constant, while the sound waves vary theirs according to the nature of the soil: the presence of oil, in particular, has a marked effect. For minerals, the method usually employed involves the use of direction-finding loop aerials—plus the usual valve amplifiers.

Mutual Interference.

In fact, practically the whole resources of modern wireless are being concentrated on the unwarrantable spying-out of these harmless and carefully concealed minerals, oils, and so on. It is pleasant to be able to relate that occasionally the victims get a bit of their own back: it is reported from Wiesbaden that listeners have been worried by a strange kind of interference, rather like atmospherics but more regular, and this has now been found to come from the radio-active mineral springs under the town. Perhaps that will teach people to let well—and spring—alone. Which reminds me: I ended my last article with a suggestion, more or less flippant and for the sake of a neat ending, that perhaps the selenium cell, used as a burglar alarm; another burglar alarm, the way, is one in which the action—or the mere presence—of the burglar upsets the tuning of the grid circuit of an oscillating valve and causes an anode-current change which works a relay. The condenser-microphone, which some engineers swear by for broadcasting, is now being used by doctors to give them a record of their patients’ heart-beats. Thanks to the valve amplifier, the tiny resistance-changes in the human body, due to emotion of various kinds, can now be recorded—and this procedure, it is said, is going to be very valuable in studying the effects of drugs and in investigating nervous fatigue. Noises in gear boxes, ball bearings and other machinery, and noises indicating insulation trouble and the consequent danger of break-down in big transformers, are being tracked down by microphone and valve amplifier: the ordinary, normal running noises being filtered out by electrical filters such as are used in wireless, so that the trouble-noises can be distinguished.

A Ceaseless Stream of Development.

But since the Editor will only give me a miserable page or two, I must be much briefer than this if I am to keep anything like up to date. For every day seems to bring fresh developments which clamour for notice. Piezo-electric quartz, that high-brow laboratory phenomenon which was so promptly seized on to keep radio transmitters to their proper wavelength, is now being used to register variations of pressure in water mains: so is the effect of capacity change on a heterodyne note, one plate of a condenser being forced in towards its second plate by any increasing pressure. The photo-electric cell—direct descendent of Elster and Geitel’s “academic” experiment where light falling on to a spark-gap stopped the spark—is now used for about as many purposes as an Austin Seven. Apart from its jobs in picture telegraphy and television, it counts the traffic passing through the big tunnel joining New York to New Jersey; it judges the winning horse in a race; it sorts and counts mass-produced goods; it is used in chemical works to decide when enough alkali—

for instance—has been added to complete a reaction (some of you may remember the titration tests at school, when the critical last drop suddenly wiped away every trace of colour from a whole big flask-full of coloured liquid; the photo-electric cell watches for this, and when it happens, turns off the tap). It, as well as its brother the selenium cell, is used as a burglar alarm; another burglar alarm, the way, is one in which the action—or the mere presence—of the burglar upsets the tuning of the grid circuit of an oscillating valve and causes an anode-current change which works a relay. The condenser-microphone, which some engineers swear by for broadcasting, is now being used by doctors to give them a record of their patients’ heart-beats. Thanks to the valve amplifier, the tiny resistance-changes in the human body, due to emotion of various kinds, can now be recorded—and this procedure, it is said, is going to be very valuable in studying the effects of drugs and in investigating nervous fatigue. Noises in gear boxes, ball bearings and other machinery, and noises indicating insulation trouble and the consequent danger of break-down in big transformers, are being tracked down by microphone and valve amplifier: the ordinary, normal running noises being filtered out by electrical filters such as are used in wireless, so that the trouble-noises can be distinguished.

Flaws in Metals.

Flaws in steel axles are now being looked for by rotating the axle rapidly and exploring with an instrument rather like the magnet arrangement of a telephone receiver—the disturbances induced in the telephone windings by the presence of a flaw rapidly passing by are detected after amplification in the usual valve amplifier. A similar process is applied to steel wire ropes—but here the rope remains still and the magnetic flux rotates. Think of the accidents which may arise from flaws in axles and wire ropes, and you see how beneficial to man are these new applications of radio technique.

At least one company exists in America for testing railway lines for flaws and other defects in the rails: it provides a specially equipped railway truck which runs over the track at about five miles an hour. Two brushes, a little distance apart, continually conduct direct current to and from the bit of rail between them. Half-way between these main brushes is a trio of searching brushes connected in a kind of push-pull way to a transformer. The secondary of this transformer goes to a four-valve amplifier which works various relays, and when any kind of flaw upsets the symmetry of the current flowing in the rail, these relays do their work—they sound a warning buzzer, record the exact position on a traveling tape, and even go so far as to spray a blob of paint on to the offending bit of rail. Having done all this they send off a wireless message to H.Q., sacking the foreman responsible for laying that bit of rail... and that is the only bit of exaggeration this article contains.
Part XVIII.—Dynamic Resistance of Tuned Circuits.

By S. O. PEARSON, B.Sc., A.M.I.E.E.

(Continued from page 74 of issue dated January 15th.)

In dealing with the parallel type of tuned circuit in the last issue we arrived at the important conclusion that, when tuned to resonance, the circuit behaves like a pure resistance of \( \frac{L}{CR} \) ohms, where \( L \) is the inductance of the coil, \( C \) is the capacity of the condenser and \( R \) the "equivalent series resistance" within the closed loop itself. The value \( \frac{L}{CR} \) ohms was referred to as the "dynamic resistance" of the tuned circuit, and can be defined as the resistance measured between the ends of the circuit when accurately tuned to resonance, because under these conditions the current is exactly in phase with the applied voltage.

In Part XVI it was shown that a circuit consisting of a perfect condenser in parallel with a resistanceless coil would allow no current to pass to and from the circuit at the resonant frequency; that is to say, for such a circuit the dynamic resistance would be infinitely great. Now, a practical circuit having an effective series resistance of \( R \) ohms, as shown in Fig. 1 (a), is equivalent to circuit (b) at any frequency; but at the resonant frequency it is also equivalent to a perfectly resistanceless tuned circuit shunted by a pure resistance of such a value that the current is the same as that taken by the actual circuit. This equivalent circuit is shown at (c) in Fig. 1, and the equivalent parallel resistance represents the dynamic resistance of the tuned circuit, its value being \( R = \frac{L}{CR} \) ohms.

Numerical Values.

As a numerical example, suppose that a tuned circuit consists of a coil whose inductance is 2,532 microhenrys and whose high-frequency resistance is 50 ohms, connected in parallel with a condenser of 0.00025 microfarad capacity. The dynamic resistance will be

\[
R_d = \frac{L}{CR} = \frac{2,532}{0.00025 \times 50} = 202,000 \text{ ohms.}
\]

(Note that it is not necessary to convert microhenrys to henrys and microfards to farads in any formula where \( L \) and \( C \) form a ratio.)

This is the maximum impedance of the circuit, and in designing a tuned circuit the object in view is to obtain the highest possible dynamic resistance. The ratio of \( \frac{L}{C} \) should be chosen as high as practical considerations will allow, and the coil resistance should be as low as possible. Now, in practice there are always losses, not only within the closed circuit itself, but associated with it due to connected apparatus, induced currents in neighbouring circuits and objects, and due to actual radiation. All of these go to reduce the dynamic resistance of the circuit or to increase the equivalent series resistance. For instance, suppose that the tuned circuit LRC of Fig. 1 (a) is, in effect, shunted by a resistance of \( r \) ohms due to some connected apparatus. The arrangement would then be as shown in Fig. 2 (a), being a circuit having both series resistance \( R \) and shunt or parallel resistance \( r \). But we have already seen that the series resistance \( R \) has the same effect as a shunt resistance of \( \frac{L}{CR} \) ohms at the resonant frequency, and so the circuit of Fig. 2 (a) may be replaced by Fig. 2 (b).

![Fig. 1](image1.png)

![Fig. 2](image2.png)
Wireless Theory Simplified.—

Thus in its simplest form the equivalent circuit reduces to the arrangement of Fig. 2 (c) where \( R_D \) is the resulting dynamic resistance.

For the coil and condenser considered above the value of \( L/CR \) was found to be 202,000 ohms, or 0.202 megohm. Now, suppose that this circuit is shunted by a resistance of 500,000 ohms or 0.5 megohm. The dynamic resistance of the complete circuit will then be given by

\[
\frac{1}{R_D} = \frac{1}{0.5} + \frac{1}{0.202}, \quad \text{or} \quad R_D = \frac{0.5 \times 0.202}{0.702} = 0.144 \text{ megohm} = 144,000 \text{ ohms.}
\]

Thus the addition of the half-megohm resistance in parallel, has reduced the dynamic resistance by about 30 per cent.

Comparison of Series and Parallel Circuits.

Comparing the series-tuned circuit with the parallel circuit we find that at the resonant frequency the former has its minimum impedance whereas the latter has its maximum impedance. Furthermore, the series circuit, where the energising voltage is injected into the closed circuit itself, has the property of giving a voltage magnification or step-up effect; but with the parallel circuit the voltage is impressed between its ends and no voltage magnification can possibly be obtained. As regards selectivity the two circuits obey similar laws, but are used under entirely different conditions. For instance, the series circuit, on account of its very low impedance at the resonant frequency (its value being equal to the effective resistance in the closed circuit itself), is usually found in places where the remainder of the circuit, of which it is a part, has low impedance or where it is independent of other circuits altogether. As a case in point the ordinary tuned grid circuit inductively coupled to the aerial or other source of alternating E.M.F. was referred to in a previous section dealing in detail with the properties of tuned circuits.

The parallel circuit, on the other hand, has a very high impedance at the resonant frequency compared with its impedance at other frequencies, and is therefore always to be found in places where the rest of the circuit, in series with it, has a high resistance or impedance. The commonest example is the ordinary tuned-anode circuit where the A.C. resistance of the valve between the anode and cathode or filament constitutes the high resistance in series with the tuned circuit.

How a Parallel Tuned Circuit is Employed.

Since the tuned parallel circuit is incapable of giving any voltage step-up effect at the resonant frequency, it could not possibly have any selective properties unless used in conjunction with a series resistance in this manner, where the series resistance is more or less independent of frequency.

In order to see exactly how the presence of a series resistance of fixed value introduces selective properties, let us consider the circuit of Fig. 3 (a), where \( LRC \) is the tuned portion whose impedance depends on the frequency, and \( R_1 \) is a fixed non-inductive resistance independent of frequency. \( R \) is the effective resistance within the closed loop. Suppose that an alternating voltage whose R.M.S. value is \( E \) and whose frequency is \( f \) cycles per second is applied to the ends \( A \) and \( B \) of the circuit. Now, when the closed loop \( LRC \) is tuned to complete resonance with the applied frequency this part of the circuit is equivalent to a non-inductive resistance of \( L/CR \) ohms, this being the dynamic resistance \( R_d \), and is in series with the fixed resistance \( R_1 \). Thus the circuit as a whole behaves like a simple arrangement of two resistances in series, the total resistance being \( R_1 + R_d \) ohms, as shown by Fig. 3 (b). The R.M.S. value of the current is obtained simply by dividing the voltage \( E \) by this resistance.

Let \( E_1 \) be the voltage set up across the series resistance \( R_1 \), and \( E_2 \), the voltage across the tuned portion \( LRC \). Then by Ohm's law \( E_1 = IR_1 \) and \( E_2 = IR_d \) volts where \( I \) is the current. Each of these voltages is in phase with the current, and therefore they are in phase with each other. This means that the total voltage \( E \) applied to the ends of the circuit is equal to the numerical sum of \( E_1 \) and \( E_2 \), just as though it were a simple D.C. circuit; and, further, that the applied voltage is divided between the two portions of the circuit in the direct ratio of their equivalent resistances; that is to say, \( E_1 = E \times \frac{R_1}{R_1 + R_d} \) and \( E_2 = E \times \frac{R_d}{R_1 + R_d} \) volts at the resonant frequency.

A numerical example will make this clear. Suppose that \( L = 2,532 \) microhenrys, \( C = 0.00025 \) microfarad and \( R = 50 \) ohms as before. Then the dynamic resistance at the resonant frequency is 202,000 ohms. Suppose, further, that the series resistance \( R_1 \) has a value of 20,000 ohms and that the voltage applied to the ends of the circuit between \( A \) and \( B \) is 10 volts. The total resistance of the circuit when accurately tuned is 202,000 + 20,000 = 222,000 ohms and the current through it will be \( \frac{10}{222,000} \) ampere. Thus the voltage across the tuned circuit will be \( E_1 = I \times R_1 = \frac{10}{222,000} \times 202,000 = 9.1 \) volts. That is to say, 91 per cent. of the available 10 volts applied is set up across the tuned portion \( LRC \) of the circuit, the remaining 9 per cent. existing across the series resistance \( R_1 \).

At any other frequency, different from the resonant value, the impedance of the loop \( LRC \) is a great deal less than \( L/CR \) ohms, and therefore a very much smaller proportion of the total voltage is set up across it. In tuning the circuit to resonance the chief aim is to get the highest possible fraction of the total available voltage to be set up across the tuned portion and as little as possible across the series resistance \( R_1 \), which would normally constitute the internal resistance of a
LOTUS DRUM VERNIER DIALS.

These drums are supplied as single units or in dual form for semi-gangng two-tuned circuits. The drum dial is standard in both models, the principal difference being in the shape of the condenser support and escutcheon plate. An epicycloid friction gear is employed, giving a reduction ratio of 10:1. The dial runs smoothly and without a trace of slip or 'jumpsiness.' There is no backlash.

The driving disc is 4in. in diameter, 5in. thick and provided with a milled edge. An ivoryine scale 3½in. in diameter and 3in. wide is fitted and engraved 0/180. Provision is made to accommodate a 2in. condenser spindle, a small grub screw serving to position the dial.

LOTUS DRUM VERNIER DIALS.

Wireless Theory Simplified.

valve. Hence for good selectivity the value of the dynamic resistance L/CR ohms at the resonant frequency must be large compared with the series resistance R, whereas at other frequencies the impedance of the portion LCR should have a low value. This subject will be dealt with in greater detail when we come to the discussion of actual valve circuits.

The resonant frequency of the circuit considered above is

\[ f = \frac{1}{2\pi \sqrt{LC}} \]

200 kilocycles per second. Suppose now that the frequency of the applied voltage is increased to 210 kilocycles per second without changing the tuning of the circuit. The impedance of the tuned portion will now be \( Z_2 = 32,200 \) ohms, and, incidentally, the voltage across it will no longer be in phase with the current passed by the circuit. Thus for a 5 per cent. increase in frequency the impedance of the tuned portion of the circuit is reduced from 202,000 ohms to 32,000 ohms, and therefore the ratio of the voltage across this part to the voltage across the series resistance \( R \), is now only \( \frac{32,000}{20,000} \) or 1.61. At the resonant frequency of 200 kilocycles per second the voltage across the loop circuit was seen to be just over 10 times as great as that across the series resistance, whereas at 210 kilocycles per second it is only 1.61 times as great.

These figures emphasise the fact that the parallel type of tuned circuit is highly selective when used in conjunction with a series resistance if the dynamic resistance of the tuned portion is high at the resonant frequency. In the ordinary tuned-anode circuit the object in view is to get as large a proportion of the wanted signal voltage as possible across the tuned circuit, losing as little as possible across the internal resistance of the valve. On the other hand, any unwanted signals of a different frequency or wavelength must be "lost" as far as possible in the internal resistance of the valve in the manner indicated above.

The opportunity is here taken of correcting an error which occurred in Part XV of this series. The second line of the second paragraph on page 24 should read—

the external resistance \( r \) is \( \frac{E^2}{f} \) watts.

(To be continued.)

NEW APPARATUS REVIEWED.

COMBINED LAMP HOLDER AND PLUG-POINT.

A cleverly designed lamp holder embodying a plug-point to which can be attached a battery eliminator, or domestic electric device, has been placed on the market recently by Wm. Beardsall and Co., Ltd., Victoria Bridge, Manchester, at the attractive price of 4s. 6d. There is no exposed metal, either "live" or otherwise. The body consists of a cleanly moulded bakelite shell carrying the usual bayonet-type lamp holder at one end and a cord-grip fitting at the other. The two-pin plug makes contact direct with the mains leads and not via the lamp pluggers and springs. This is a point of some importance should the additional electric device demand a relatively heavy current. Massive contacts are provided, and these are rated to carry 5 amperes. It has not been thought necessary to fit a switch to control the extension point, removing the plug serves this purpose. A portion of the metal on one pin of the plug has been removed and the cavity filled in with some special insulating material. The contact points inside the plug are arranged so that on reversing the plug the lamp circuit is broken but without affecting the supply to the extension circuit. It is at once obvious that controlling the lamp by this means is possible only where A.C. is available—for battery eliminators or charging—or when the additional electric device operates irrespective of polarity. Reversing the plug changes the polarity of the supply on the extension leads. This useful accessory has been given the appropriate designation "Xtra-Point" lamp holder and plug.

R.G.D. PICK-UP AND TONE ARM.

Made by the Radio Gramophone Development Co., St. Peter's Place, Broad Street, Birmingham, this unit forms an essential component of this firm's radiogramophone equipment. The external appearance is particularly neat and businesslike, and the overall height is only 11½in., so that it can easily be accommodated under the shallowest cabinet lid. The tone arm is of hollow rectangular
section and is of negligible weight, and the pick-up unit is attached at such an angle that tracking errors are reduced to a minimum. The tone arm is extensible, giving a variation in length of about 1 in.

The pick-up movement is sound in principle. The armature is kept down to the smallest possible dimensions and is mounted between the pole pieces in such a manner as to give differential variations of the flux surrounding the pick-up coil. Adequate control of the flux is obtained by clamping the knife-edge pivot between rubber packing. The needle set-up is operated sets the demand for resistances, and its moment of inertia is negligible.

The characteristic shows these principles of design to be justified, for the output is practically constant from 250 to 1,500 cycles. The principal reed resonance occurs at about 3,000 cycles, which is near the upper limit of fundamental frequencies in common use. No objectionable resonance could be detected by ear when playing ordinary records.

A few readings taken below 250 cycles showed that the characteristic rises slightly, but not sufficiently to correct deficiencies in the average record. An improvement could be effected here by decreasing the air gap to the smallest value consistent with manufacturing difficulties and freedom from chattering, as this would improve the output at low frequencies where the amplitude is large.

However, taking a general view, this pick-up is well above the average in performance and in use possesses a noticeable freedom from producing record wear. The price finished in bronze is £3 and in oxidised silver £3 5s.

NEW COLVERN RESISTANCES.

With the rapid developments now taking place in the design of mains-operated sets the demand for resistances has enormously increased. In an all-mains A.C. receiver there may be more than half a dozen different resistances all capable of carrying a generous current and accurate to within narrow limits. To meet the need for an inexpensive component, Colvern Ltd., Mawney's Road, Romford, Essex, have developed a new series of wire-wound resistances carried on glass tubes measuring 3 x 1/4 in. diameter. The wire, which is nickel chrome, is accurately space-wound as a single layer. The winding is terminated on metal bands, and a hard covering of bakelising material renders the resistance durable. To avoid the use of several series-connected resistances, tapping points are arranged by the use of additional clips. It is to be noted that with this form of winding the capacity from end to end of the resistance is exceedingly low, an important requirement when a resistance is used for the purpose of isolating H.F. circuits. Even with the highest value resistances the turns of wire are generously spaced.

The standard sizes advance in steps of 10,000 from a minimum of 10,000 to a maximum of 100,000 ohms, intermediate and higher values being supplied to order.

The rating of the resistances is 10 watts, but on test it was found that 15 watts could be dissipated across a 50,000-ohm resistance without excessive temperature rise. A current of 10 mA. is safely passed by the 100,000-ohm resistance, and as 1,000 volts is required to produce this current it is obvious that in ordinary use the resistance cannot be over-run. Small bent metal sockets are used for fixing, the connections being soldered direct to the clip on the resistances.

In sizes up to 50,000 ohms the price is 2s. 6d., and 50,000-100,000 ohms, 3s. 6d. Tapping points are provided to order at 1s. extra.

T.C.C. CONDENSERS.

A new process of manufacture has enabled the Telegraph Condenser Co., Ltd., Wales Farm Road, North Acton, London, W.3, to make a considerable reduction in the size of some of their well-known types of large-capacity condensers intended primarily for use in high-voltage battery eliminators. This applies particularly to the 4 mfd. 800-volt D.C. test models. It has been found possible to reduce the physical size by half without impairing the quality of the condenser. The working pressure is 400 volts D.C., and the price is 8s. 6d. Large-size terminals, well insulated from the metal container, are fitted.

The 400-volt D.C. test models are now fitted in moulded bakelite cases provided with two sets of fixing lugs, thus allowing for either upright or sideways mounting. Large terminals are fitted to this model also. The type illustrated is a 4 mfd. size, working voltage 200 D.C., and the price is 6s. 6d.
Regional Perplexities.

"You are wrong," wrote a listener to Savoy Hill last week. The Technical Correspondence Department had told him that the 261-metre transmission would come in better if he tried changing his present dial setting from 26 to about 24. "You are wrong. I find the correct setting is 22."

A Clean Start.

This is the sort of client (and there are many of them) who has driven the engineers to yet another literary effort, this time in the form of an "A.R.C. of Correct Listening."

How to Tune.

The instructions are simple enough to be intelligible to a novice who might mistake the tuning dial for a barometer. For example, listeners who cannot hear the 261-metre transmission are advised to try the effect of turning the tuning adjustment of the receiver, which is usually a numbered scale, DOWNWARDS. This means, it is explained, that the adjustment should be turned to a lower number. But enough of technicalities. Even the pamphlet desert's higher mathematics after a time with the admonition: "See your local dealer."

A Popular Fallacy.

One disturbing feature of the correspondence regarding Brookmans Park is the prevalent idea that mutual interference between the twin transmitters can only be temporary and that all will be well "when the stations have finished testing."

More Power from Brookmans Park.

On the whole, the letters are of a friendly nature, and the majority of listeners seem to be taking steps to meet the new situation. I think their difficulties are increased rather than diminished by the fact that the B.B.C. is gradually increasing the power of the 261-metre transmitter.

An Opening Ceremony.

By the way, I hear that schemes are now in hand for a most impressive opening ceremony at Brookmans Park when the two transmitters finish their tests. The inaugural speech will probably be made by the Postmaster-General.

Synthetic Echo.

Have you noticed an increase in the echo effect in the Savoy Hill studios during the past week or two? The engineers are introducing more "synthetic echo" with orchestral transmissions, and many letters of approval have already been received. Hitlevem and Radio Tou- lance both make good use of artificial echo.

The Millionth Oscillator.

What a world of drama lies behind the discourses from Savoy Hill. The B.B.C. has nearly exhausted its stock of anti-oscillation pamphlets. I hear that the original printing order was for one million copies.

Instead of ordering a reprint, the B.B.C. has decided to prepare an entirely new edition, in which the experience of many of them (who has driven the engineers to yet another literary effort, this time in the form of an "A.R.C. of Correct Listening")

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A Short-wave Triumph.

The honours go to 5SW. Several stations on the Continent which had arranged to take the broadcast by landline chose the less expensive but equally efficient method of tuning in Chelmsford. Among the stations which preferred this method were Turin, Naples, Stockholm, and Vienna, the last two starting with land-line, but resorting to 5SW because the transmission was better.

The Australian Beam.

There was also the "hush-hush" relay to Australia by means of the new telephony beam, which has not yet been put into public service. This was moderately successful.

Last week should certainly go down in wireless history as the occasion of the first real "world-broadcast."

Why Not a Carillon Recital?

It seems a pity that the B.B.C. cannot be persuaded to broadcast a recital on the New Zealand War Memorial Carillon now temporarily erected in Hayle Park. A Savoy Hill official tells me that the proposal has been rejected because the carillon was broadcast from the North-East Coast Exhibition, but the excuse seems inadequate. Apart from the fact that carillon music broadcasts extraordinarily well, the B.B.C. might remember that the repertoire of available selections is fairly extensive, and there would be no necessity to repeat the pieces already heard.

New Series of National Programmes.

The first of the 1930 National programmes, to be broadcast on February 5, will consist of a tribute to France. Other countries to figure in the series later will be Belgium, Czecho-Slovakia, Holland, Italy, Poland and Sweden.

Women M.P.s at the Microphone.

"The Week in Westminster" will be described in a series of broadcasts from 210, starting on February 5. The three M.P.s who will be responsible for describing what Parliament is doing, turn and turn about, are Miss Helen Wilkinson, Lady Astor and Miss Megan Lloyd George.
WIRELESS LICENCE SCANDAL.

Sir,—I strongly disapprove of your article on the so-called "Wireless Licence Scandal," and fail to see why the tenants of the luxury flats should not have cheap wireless, if legally entitled to it, without your commissary stuff being slung at them!

In any case the tenants of these flats are probably paying several thousands of pounds in taxation compared with the cottager—who is probably on the "dole"!

BM/R.V.O.

Sir,—Very pleased with "Editorial" in January 15th issue of The Wireless World. Gratifying to know that the Editor has such an eagle eye for an "injustice," and is broad-minded enough to give prominence to such a scandal in a technical journal. One of the roots of war is man's injustice to man. It is difficult to comprehend the mentality of people who will corner and violate the spirit of an Act. I suppose they would politely term it good business. Business is so often akin to charity; begins at home and covers a multitude, etc.

Sir,—The Postmaster-General's attention has been called to an injustice, but is not brought to the light of day.

Wishing The Wireless World continued success.
Chatham.

H. R. FORSTEP.

REJECTOR CIRCUIT.

Sir,—Selectivity and quality of reproduction are seldom synonymous yet, and as one of the best known makers of sets can apparently do no better than provide three independent variables at the H.F. end, adjustment of any of which capsizes the lot, I send you this sketch of an arrangement which, though it contains much that is old, has the merit that it is easy to operate, needs no screening or decoupling gadgets, hairbreadth tuning, or even geared condensers, and, whilst amply sensitive, gives good reproduction with freedom from interference.

Neglecting the rejector unit for a moment, which we will suppose is disconnected by its switch above E on the left, the H.F. part consists of a straightforward arrangement of tuned anode with a tiny condenser between the aerial and the grid end of the variometer, which latter is used because, in conjunction with the variable condenser, it facilitates control of the waveform in the grid circuit, and can be adjusted so that the resonance curve will embrace the side bands. The tuned anode inductance can be damped by the variable grid leak across it, so that the H.F. valve will not oscillate, and this provides an easy control which introduces no distortion.

The rejection inductance should be made of something like copper strip, and the condenser should have definitely low resistance connections, particularly to the rotor, and the leads to the inductance should be of heavy flex.

As a guide to the ratio of L and C, for the region 2LO to Budapest, C can be increased to one-sixth of L, provided that no inductive coupling is present in the receiving set, and that the noise is not increased. It will be noted that the aerial capacity is drained away from the aerial as C becomes larger while L decreases, but that the voltage across the rejector falls somewhat as L decreases, all provided that the resistance is exceedingly low. The rejector inductance

W. R. WESTON.
For the Secretary.

A 35
IN SEARCH OF QUALITY.

Sir,—Let us congratulate Mr. Bertram Munn for his courageous article "In Search of Quality," even though we may not agree with his hearty condemnation of our particular set.—Nothing is quite as bad as being reproached with his present unit is superior to a really good moving coil with an appropriate amplifier behind it, but undoubtedly his castigations of the average M.C. are well merited. There is, Mr. Munn, such a thing as a moving-coil speaker that does not thud.

But this letter is meant to be helpful and is prompted by Mr. Munn's penultimate paragraph, wherein he realises that his unit is not beyond reproach. Actually I am wondering if he has heard of the Western Electric 555W receiver. Moving-coil cone enthusiast that I am, I must admit that this unit on a large logarithmic horn beats the cone type easily. Added to which it is more efficient. But there are snobry snags: (1) I do not know if they are easily obtained, (2) they are probably expensive, judging by the workmanship, (3) the field eats up 14 amps. at 7 volts, and (4) an output transformer would be required, the impedance being 15 ohms. And I hope that Mr. Munn will pardon me if I suggest that his horn would hardly do it full justice—the firm use a 14ft. horn cutting off at 57 cycles.

On reading this over I am afraid that it does not sound so helpful as it was intended to be, but I am sure that Mr. Munn would find that the results obtained would more than counterbalance the snags mentioned.

Incidentally, there was an article in The Wireless World about two months ago describing the fitting of such a unit on a horn some 25ft. long—R. C. PLAYER.

B.B.C. TRANSMISSIONS.

Sir,—The trouble with the "Look to your set" type of apologists for the shortcomings of the B.B.C. transmissions is that they seem to be as deaf to argument as they appear to be deaf to the imperfections of wireless. They ignore the fact which so many of us experience, namely, that, given a constant instrument at the receiving end, the quality of the sounds emitted by that instrument varies very considerably even when they are caused by the same transmitter on the same evening.

Speaking for myself, let me say that I am very conscious of the imperfections of my receiver, though it happens to include a liberal H.F. input to a diode rectifier, a resistance-coupled L.F. amplifier, L.S.5A output valve with 350 volts on its plate, a M.C. loud speaker and most, if not all, other modern improvements; and though some of my undiscriminating friends are kind enough to say that it gives results just like "the real thing." The receiver, like all others, is undoubtedly imperfect. But that is really quite beside the mark.

The point is that, if we really want to, we can take a striking example, accentuate the sibilants at one moment and almost entirely omit them the next, if that receiver remains unaltered. The receiver, like all others, is undoubtedly imperfect. And the gentleman in the control room sometimes pulls something which, I take it, corresponds to a joystick forwards when he ought to push it back, and vice versa. That all is not really perfect at the transmitting end is surely clear from the following quotation from the B.B.C. Year Book, p. 65 (the italics are mine):—"The microphone and the loud speaker continue to be the weakest links in all the long chain between artist and listener. The B.B.C., however, can record an advance in microphone design. A high quality capacity microphone has passed several severe tests and looks like being a standard for most studio work. The simpler and more robust carbon microphone must still carry the load of outside broadcasts, cruder transmissions, and so on, for some time to come. But this is merely to say that the future which it seems fair to conclude that even the most up-to-date microphone has its failings and that the "cruder" carbon microphone is responsible for at least some of the distortion which those of us who have ears to hear with so often notice.

But why, one wonders, is information of this kind tucked away in a publication which appears but once a year, and why is it so very meagre as regards details? The B.B.C. transmissions are, in general, so good that surely the B.B.C. themselves can well afford to publish more information about them and more fair criticism of them? If this were the case, then we at our end would be in a far better position to "look to our sets" and correct as far as we can such failings as are there.

E. C. RICHARDSON.

Sir,—I must reply to Mr. A. Gregson, of Bolton. I have heard fifty-nine stations on my set (not all at once), and without any doubt whatever, Manchester has the other fifty-five stations beaten to a standstill when it comes to quality. Blackpool.

GRAMOPHONE SPEED TESTER.

Sir,—Your gramophone speed tester is a most useful auxiliary. The supply here is 220 v. 100 cycles, and, as there are many here who will no doubt like to have this advantage without having to draw up a fresh disc, perhaps you would publish the enclosed diagram, which enables it to be used without any further trouble.

No damage is done to the battery, which can be connected either way round. Impulses are passed one way only, giving a 50-cycle effect.

Bournemouth.

J. P. J. CHAPMAN.

RECEPTION OF CONTINENTAL STATIONS.

Sir,—With regard to the "Regional Scheme," "Reception of Continental Stations," and "Listen to Foreign Stations," I should like to contribute some observations. Each country has its own scheme. Warsaw, our capital, now has a station working with 12 kW. which in the near future will be 30 kW. In this department we have no difficulty at all and are very happy with it. The station is quite good, although we do not have as much power as our German neighbours. But this is not important as long as we have a station working. We are happy with it. G. F. W. POLAR.

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**Lost Volts.**
The screening grid of my 1-v-1 receiver is set through a 1,000-ohm decoupling resistance. In determining the correct location for a receiver fed from an eliminator, or from a battery with a high internal resistance, how can you supply data for making an indication of the L.F. battery to which the lead feeding this circuit should be connected, is it necessary to take into account the voltage absorbed in the resistance? A. C. P.

Practically speaking, no. Assuming a screening grid current of 0.5-millamp., 0.5 volt only will be "dropped" in the screening grid current of 0.5-millamp., in the circuit you describe. The number of black lines required on the stroboscopic disc is arrived at by multiplying the A.C. frequency by 120 and dividing by the required r.p.m. of the gramophone turntable. This calculation will reveal that 60 bars will be needed on the disc when running at 30 r.p.m. and used with a 40-cycle supply. For 78 and 79 r.p.m., the relationship between frequency of supply and revolutions per minute is not an exact quantity.

**Rules.**
(1) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Technical 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 replies.
(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 details described in "The Wireless World" or to standard make/receivers.

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

**The Output Filter as an Aid to Stability.**
In the "Stabling Problems" section of your issue for December 25th, I have been trying to connect a microphone in the detector grid circuit of my "Everyman Four" receiver (referred circuit, as described in the fourth edition of the booklet). Unfortunately, this addition results in instability over a good deal of the tuning scale unless the H.F. valve filament is dimmed considerably; for local station reception this is not a serious drawback, but it is rather inconvenient to have to disconnect the microphone transformer when distant stations are to be received.

Can you give me any hints as to how the trouble may be overcome, and at the same time suggest a method of using the L.F. battery of the set for supplying current to the microphone circuit—if this is possible, as I believe it is? W. B. R.

It is not unusual to find that the addition of any extra wiring in the detector grid circuit will bring about instability unless all the leads are kept very short, and in the first place we would suggest that you should try to improve matters in this respect.

Perhaps it would be as well to adopt the arrangement shown in Fig. 1; this includes an arrangement of non-inductive resistances and a by-pass condenser which will tend to prevent the development of H.F. potentials at points where they may be passed back by stray inductive or capacitive coupling to the grid circuit. If possible, we recommend you to earth the core and metal shield (if any) of the microphone transformer. The by-pass condenser, given as 0.002 mfd., should be as large as it is possible to make it without bringing about too serious a reduction of microphone signal strength.

**Another Harassed Parent.**
Inspired by your reply to "T. S. W." in the "Stabling Problems" section of your issue for December 25th, I have been trying to connect a microphone in the detector grid circuit of my "Everyman Four" receiver (referred circuit, as described in the fourth edition of the booklet). Unfortunately, this addition results in instability over a good deal of the tuning scale unless the H.F. valve filament is dimmed considerably; for local station reception this is not a serious drawback, but it is rather inconvenient to have to disconnect the microphone transformer when distant stations are to be received.

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**Station-to-Station Switching.**
Will you please tell me if it would be possible to adapt the method of tuning (with fixed coils and semi-variable condensers) included in the "Twin-Station Two" for reception of the two Daventry stations? W. T. B.

This method is not applicable to the design of a set intended to receive two transmissions of widely different wavelength. To attain this object with a switch change-over it is, practically speaking, necessary to duplicate both the coils and condensers.
Switched Neutralised H.F. Amplifiers.

From statements made from time to time in "The Wireless World," it is by no means easy to apply the principle of waveband switching to a neutralised H.F. amplifier. Will you please tell me if a practical design of a receiver including this arrangement has been published? C. D. N.

As you suggest, it is rather difficult to introduce a switching scheme into an amplifier of this sort, partly because it is necessary to make provision for changing over at least three circuits—primary, secondary and neutralising. Trouble is most likely to be encountered when one is aiming at high efficiency on both medium and long wavebands. The problem could be simplified a good deal if one were content with comparatively low amplification on, say, the long waveband.

A receiver with neutralised H.F. amplification (three-electrode valve) was described in our issues of July 4th and July 11th, 1928.

"A Quality Receiver."

I live almost exactly midway between the London and Daventry stations, taking into account the comparatively high power of these transmissions, do you consider that the receiver shown in Circuit No. 3 of "The Wireless World Diary" for 1930 would be sufficiently sensitive for the reception of these transmissions?

If it is considered that more amplification is necessary, I take it that a neutralised triode would provide all that is necessary, and should like to have a circuit diagram showing the modifications necessary to this receiver, plus an added separately tuned aerial circuit.

T. D. B.

In our opinion it would be unwise to expect this comparatively insensitive receiver as it stands to provide sufficiently strong signals from the stations whose programmes are required, and we feel sure it would be best and safest to add an H.F. stage—which, as you suggest, may be of the low-gain variety. It is assumed that the long-wave Daventry transmission will not be required, so the design may be simplified accordingly.

The circuit diagram for which you ask is given in Fig. 2; for the sake of completeness, we have added the L.F. amplifying portion of it, and have included capacity-controlled aerial coupling, as this arrangement is both simple and adequate.

FOREIGN BROADCAST GUIDE.

MOSCOW-POPOFF
(Russia)

Approximate Geographical Position: 55° 47' N. 37° 39' E.

Approximate air line from London: 1,552 miles.

Wavelength 1,103 m. Frequency 272 kc.

Time: Eastern European (two hours in advance of G.M.T.)

Standard Daily Transmissions.

14.30-16.00 C.M.T. musical concert (Wednesdays: 10.00-18.30). 16.30 or 18.30 relays of other Russian stations, or foreign programmes. Tuesdays: gives own studio programme, and dance music at 21.00.


Closes down with words: Das-tiee-dan-gee speaker-gee-notch (au revoir, good night).

Absorbing Surplus Voltage.

Is there any limit to the voltage that can be safely absorbed by a resistance inserted in series with the anode of an amplifying valve?

T. D. B.

In my own particular case I wish to reduce a voltage of 150 volts—the maximum specified by the makers of the valve.

In this case it should be quite in order to insert a series resistance (of a value depending, of course, on the current consumed by the valve). It is safe enough to do this when dealing with an amplifying valve, but it would hardly be wise in the case of an anode bend detector, of which the mean anode current varies with impressed signal voltages.

Accumulator Charging at Home.

I estimate that it would be required to pass the necessary current for charging my L.T. accumulator from the D.C. mains supply. It is understood that lamps of approximately this wattage can be obtained, but they are very expensive, and I am inclined to think that in this case some other form of resistance would be much better. Will you please give me your advice?

E. R.

Although lamps will serve as voltage-reducing resistances, it is hardly recommended that they should be used when a heavy current is to be passed, but it may be pointed out that in your case (there is no need to use a single expensive lamp of the full required wattage) it would be more economical to employ a number of cheap carbon filament lamps connected in parallel.

Perhaps your best plan is to use a "bowl heater" or similar appliance. These are not very costly, and in many cases the heat given off may be used to advantage, thus offsetting the usually heavy cost of charging low-tension accumulators from a D.C. supply.

Fig. 2—A "Wireless World Diary" circuit with two low-gain L.F. stages, modified by the addition of an H.F. amplifying valve.
3 HOURS
— 300 MILES!

10,000 FEET UP! Giant Air Liner roars through clouds. Airport wirelesses warning—"Fog over French Coast." 'Plane in constant touch — receiving orders, reporting weather conditions — through Marconi Valves. All Imperial Airways machines are fitted with Marconi Valves. So is Croydon Control Tower. All British Broadcasting Stations . . . all Trinity House lightships . . . all Trinity House beacon stations . . . most British passenger ships . . . use Marconi Valves. For their reliability. For their long life. For their wide range.

In cases like these, when unfailing efficiency is essential, men insist on Marconi Valves

FIT
MARCONI VALVES
TO YOUR RADIO SET

Give you clearer tone, greater volume, longer range. Cost not a penny more. Fit any set.

The first and greatest name in wireless

MARCONIPHONE COMPANY LIMITED, 210-212 Tottenham Court Road, London, W.1

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.
MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is:
12 words or less, 2/- and 3d. for every additional word.

Each paragraph charged separately and name and address must be included.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders in the same series amounting to:

$10 to $49 inclusive, 10% off
$50 and over, 15% off

All trade advertisements are receipted for, and payment is due in respect of royalties, which amount will be paid by the Purchaser of the set.

license the set by means of the Deposit System referred to. The receiver not licensed under the patents made use of, can dispose of the set by means of the Deposit System. whereby readers who wish to dispose of a home-constructed set may deal in perfect safety by availing themselves of our Deposit System.

RECEIVERS for SALE.

SPECIAL NOTE: Readers who reply to advertisements in this section must be strictly prepaid.

If a sale is effected, the buyer instructs us to remit amount to the seller, but if not, the seller instructs us to return amount to the depositor.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of issue in all such cases the use of the Deposit System is recommended.

In every case care is taken to avoid mistakes.

Readers who hesitate to send money to unknown persons should be addressed No. 400, c/o "The Wireless World," 38, Stroud Green Road, N.8, or, writing to advertisers, will ensure prompt attention.

If any advertisement is rejected, the space will automatically be inserted in the following issue.

The Head Offices of "The Wireless World" are located at:

Chester ; Navigation Street, Birmingham; 260, Deansgate, Manchester.

The Metropolitan Group's "S.W.13." is unlikely, we will return the parcel, carriage paid.

The MISCELLANEOUS COLUMNS THIS MONTH, 8829 13

FOREIGN LISTENERS 4 B.B.C.

RADIO TECHNICAL CIRCULAR No. 36.

BROADCAST BARGAINS.

THE MISCELLANEOUS COLUMN THIS MONTH, 242 (2 lines)

THE GREAT DEMAND.

for C.D.M. components has compelled larger premises to be taken when sending for goods, please note new address, to save delay.

C.D.M. H.F. CHOKES.

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