TRACING TROUBLES

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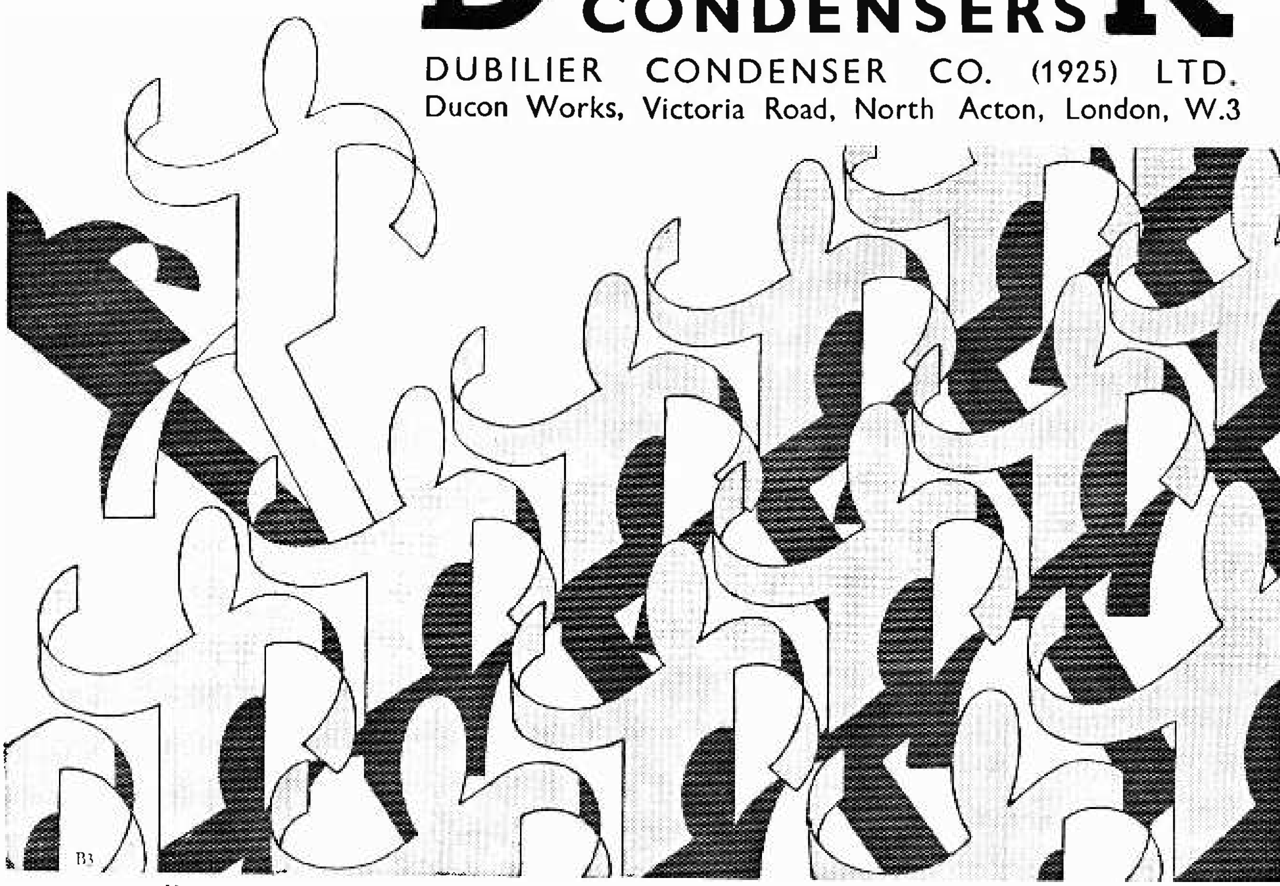
The Wireless World

AND RADIO REVIEW

The Paper for Every Wireless Amateur

Wednesday, January 13th, 1932.



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

Editorial Comment.

Detail of Modern Receivers.

THE year 1931 has seen a remarkable all-round improvement in the standard of the British commercial broadcast receiver, and the achievements of the manufacturer are, perhaps, the more outstanding when we consider the rapidity with which changes in conditions of reception and the development of new circuits and valves have combined to force upon the set designer frequent modifications in order to keep sets up to date and in a position to compete with products from abroad.

Rapid Development of the Selective British Set.

It is only within the past twelve or eighteen months that need for extreme selectivity in receivers used in this country has become imperative, whereas in America selective sets have been in demand for a number of years, so that manufacturers there have been in the position of tackling design and developing selective models over a considerable period. Those manufacturers in this country who have made a determined effort to keep pace and produce British sets incorporating the latest features and capable of meeting the new requirements of selectivity, are to be congratulated on the success they have attained. But to reach this position in a comparatively short time has been something of a scramble, and in saying this we do not think that any manufacturer who has been faced with the task would deny the truth of such a statement. The time has, we think, now come when, having got over, perhaps, the most difficult stages of the scramble, designers can relax a little from the intensity of their efforts on the electrical side of receivers, and pay more attention in future designs to mechanical parts, the proper functioning of which is so essential to the satisfactory performance of the set as a whole.

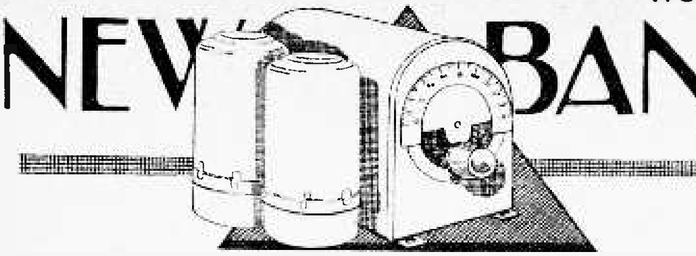
In our opinion, attention to these matters of detail in the modern receiver should take precedence even over questions of general appearance of the set, for the first consideration should be to make the wireless receiver an instrument of service.

Poor Efficiency of Switching.

Far too often it has been our experience in examining and testing receivers to find that a set which electrically is first class, comes through a test with a comparatively poor average performance solely because of the low efficiency of switching and other purely mechanical details. The act of switching, for example, from one wavelength to another, or from gramophone to radio, should, in our view, be silently accomplished, but in the majority of sets this action produces unpleasant and, in some cases, ear-splitting noises sufficient for the set to be condemned by a layman who would not make allowances for the otherwise excellent qualities of the receiver which a technical man, perhaps, would regard as compensation.

Another direction in which there is room for considerable improvement is in the design of tuning indicators. Too often, where scales are used, these are cramped and extremely difficult to see, either because they are awkwardly located or are not illuminated. There is room for so much improvement in this direction that one is almost tempted to ask designers to forget entirely the indicating contraptions at present in existence and try to launch out on some entirely different principle, which will enable the user to tune in to stations he requires readily and with certainty.

If manufacturers will realise that efficiency in mechanical design is equally as important as the electrical side, we believe we can look forward to remarkable all-round improvements in the sets of 1932.



NEW BAND PASS CIRCUIT

Constant Peak Separation with "Double" Capacity Coupling.

By N. R. BLIGH, B.Sc.

(The General Electric Company Research Laboratories, Wembley, England.)

THE band-pass method of tuning which has gone a long way towards solving the problem of selectivity-with-quality, sometimes suffers from a change of behaviour across the waveband. Constant selectivity and constant peak separation can be obtained by the use of a "mixed" filter as described in these pages last February, but in the accompanying article an even simpler method is given in which no negative inductance winding is required.

OWING to the growing number of stations at present working and to their increasing power, a great deal of attention has recently been paid to the use of band-pass filters preceding the first valve in wireless sets, and this journal has been to the forefront in advocating the use of such filters. Unfortunately, although we may adjust our filter to give all the selectivity we require at any one wavelength and to give a satisfactory response curve so that all the sideband frequencies are faithfully passed on to the detector valve, as soon as we alter the setting of the tuning condensers the shape of the response curve changes greatly.

In Fig. 1 are shown the three most useful types of band-pass filter, and in Fig. 2, curves (*a*), (*b*), and (*c*) give examples of the actual band-breadth variation of these filters at various wavelengths for circuits of very low resistance.

It can be seen that while circuit (*a*), Fig. 1, only changes its band breadth in a ratio of about 3 to 1, the circuit (*c*) changes about 50 to 1, and hence should especially be avoided. The graphs show that some means must be found to reduce this variation, and Fig. 3 shows two ways of doing this. The first has been previously described,[1] and in Fig. 2 (*d*) is given a curve showing the improved constancy by using the second circuit with both the capacities of the same magnitude as used to obtain curves (*a*) and (*c*). For want of a better name we will call the circuit of Fig. 3 (*b*) "double" capacity coupling where there is a condenser at both high and low potential ends.

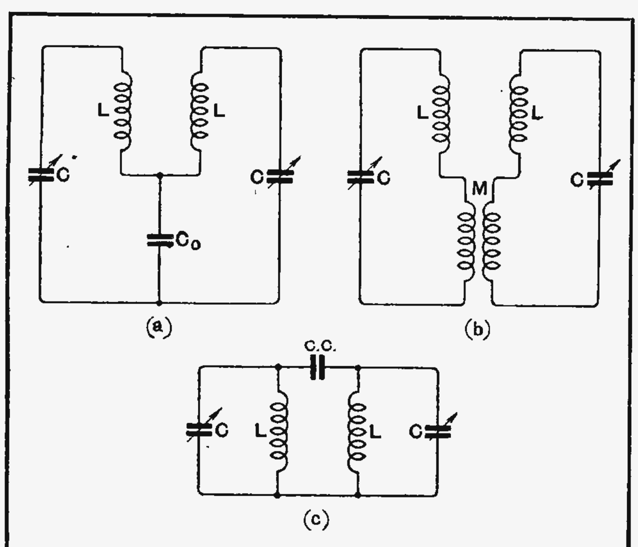


Fig. 1.—Three popular band-pass filters. (a) Capacity coupling. (b) Mutual inductance coupling. (c) Capacity coupling at the high-potential end.

It has previously been pointed out to readers of this journal that the actual resistance of the coils affects the behaviour of the filter to an important extent. With increasing circuit resistance the band breadth and selectivity are reduced, though the response curve may have a flatter top. Formulæ are often given in terms of the band breadth of the filter, but it is sometimes better to express it slightly differently. The carrier wave of frequency f_0 is tuned to the middle of the filter, and hence a sideband corresponding to a low-frequency note of frequency f is at a frequency f cycles from the middle of the filter, and it is best to express the amplification in terms of this frequency f. Now, at the peaks of the filter the maximum amplification takes place at a sideband F cycles from the middle of the band, and therefore F cycles is the semi-band breadth of the filter. It can be shown that

$$F = \pm\sqrt{X^2 - R^2}/4\pi L,$$

where X is the magnitude of the reactance coupling the two circuits together, e.g. $2\pi f_0 M$. or $\frac{1}{2\pi f_0 C_0}$ in Fig. 1(*b*) or (*a*). R is the resistance and L the tuning inductance of each circuit.

One particularly interesting feature of these circuits which has not previously been pointed out is that at a frequency $\sqrt{2}F$ cycles from the carrier wave the amplification is exactly the same as at the carrier wave frequency. This means that a high note of frequency $\sqrt{2}F$ (or $\sqrt{2}$ times the frequency of the note which has greatest amplification) has the same amplification as a note of a few

[1] See "New Band-Pass Filter," *The Wireless World*, Feb. 18th, 1931.

New Band-Pass Circuit.—

hundred cycles. Hence it is often much more important to decide the band breadth of the filter by remembering that if the peaks of the filter are, say, 8 kilocycles apart, then the notes at a frequency of 4 kilocycles get most amplification, but notes up to $4\sqrt{2}$ or 5.6 kilocycles are as well reproduced as the low notes. Therefore, if we wish the filter to give a good response up to n thousand cycles, we arrange that the peaks of our filter are $\sqrt{2}n$, and not $2n$ thousand cycles apart.

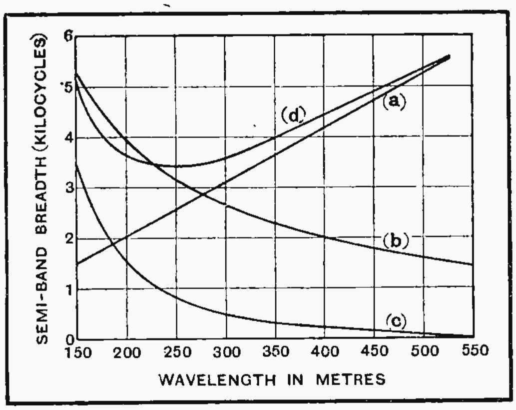


Fig. 2.—Band-width variation with frequency. (a) For capacity filter. (b) Inductive coupling. (c) Capacity coupling at "top" end. (d) "Double" capacity coupling.

We can easily calculate the actual response curve of these filters. If we consider the case where a small voltage is injected into one circuit by means of a coupling coil, and consider the voltage produced across the condenser of the other, and call the ratio of these voltages the magnification of the filter, we find that the maximum magnification is $2\pi f_0 L/2R$, and that at the low audio-frequency sidebands by $2\pi f_0 LX/(R^2+X^2)$. Hence an approximate response curve such as that shown in Fig. 4 can be easily sketched out. In this curve the magnifications "y" are given by the maximum amplification, and those at "x" by the low-frequency magnification. From a study of these simple equations we come to a most important conclusion. If the shape of the filter curve is to remain the same at all wavelengths, then both the actual circuit resistance and the coupling reactance must remain constant at all wavelengths. In general the circuit resistance increases with increase in wavelength, and thus if the band breadth is maintained constant the curve becomes flatter and flatter as the shorter wavelengths are approached, with the result that the selectivity from interference is greatly reduced.

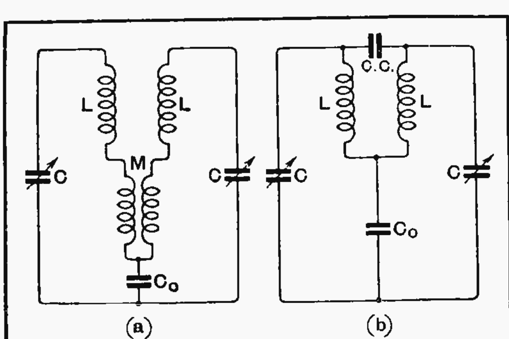


Fig. 3.—Two constant peak filters. (a) Mixed capacity and negative mutual inductance coupling. (b) "Double" capacity coupling with condensers at both high and low potential ends.

Two methods of maintaining a constant band breadth are shown in Fig. 3, and practical details of a filter of the first type have already been given, so we will confine our attention to the second method.

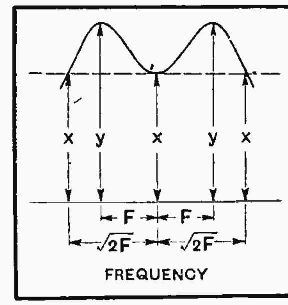


Fig. 4.—An approximate response curve plotted from theoretical considerations.

It can be seen that the circuit of Fig. 3 (b) is actually a combination of the circuits of Figs. 1 (a) and (c), and the easiest way of analysing its behaviour is simplifying it so that it corresponds to one of these circuits.

Taking the circuit shown in Fig. 5, it can be shown that this circuit behaves in almost exactly the same way as that of Fig. 3 (b) if the condenser C_x is made equal to C^2/C.C., where C is the particular setting of the tuning condenser C at the wavelength considered. Then the two capacities C_x and C_0 can as usual be combined into one capacity C_a by the well-known expression C_0C_x/C_0+C_x. To design the filter, it is best to consider the longest and shortest wavelengths at which it operates and then to allow for the increasing resistance of the circuits; the band breadth at the shortest wavelength, say, 250 metres, should be chosen as not greater than three-quarters that of the longest, say, 550 metres.

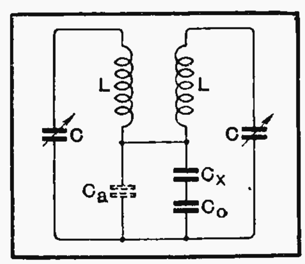


Fig. 5.—Equivalent circuit of Fig. 3 (b).

Then, either by experiment or by slightly rearranging our formula, for the band breadth to give $C_a = 1/2\pi f_0\sqrt{16\pi^2F^2L^2+R^2}$, we can obtain the actual value of C_a required to give these band breadths at the two wavelengths already referred to.

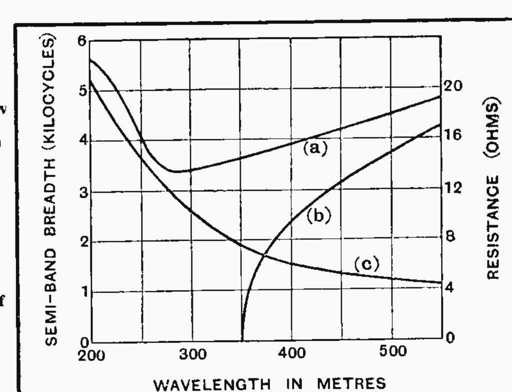


Fig. 6.—Curves (a) and (b) show band width change with frequency for double and single capacity filter, while curve (c) gives the high-frequency resistance of the tuned circuit.

In practically all cases it will be found that the presence of the small condenser C.C. only increases the band breadth of the filter very slightly at the longest wave-

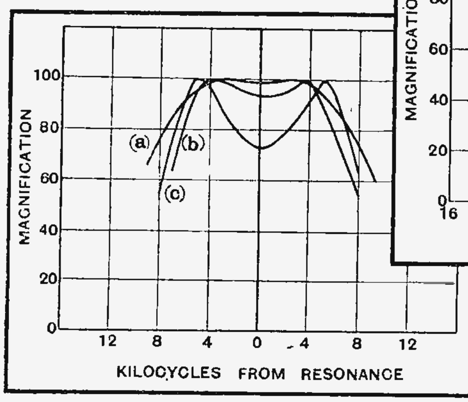
New Band-Pass Circuit.—

length to which it is tuned. We can therefore choose the condenser C_0 to have a value slightly greater than that decided upon for the longest wavelength, as shown above. Attention is then turned to the shortest wavelength, and the value of C_x is found, which, in series with C_0, gives the required value of C_a at this wavelength, and this in turn gives the required value of C.C.

A curve showing the band breadth of a filter designed on these lines, but in this case with the band breadths at 230 metres and 550 metres equal to each other, is shown in Fig. 6 (*a*) together with a curve showing the resistance of the coils at the various wavelengths. In this case C_0 was 0.025 microfarads, and C.C. 0.75 micromicrofarads.

In most cases all that is necessary is to find, by experiment, the capacity of condenser C_0 required at a fairly long wavelength and then to tune the filter to the shortest wavelength used and join the condenser C.C. across the two high potential ends of the coils and adjust it to give the required band breadth. Generally, it will then be found that the band breadth is nearly correct at all wavelengths.

As an example of a filter so constructed, complete response curves are shown in Fig. 7, which is for a filter consisting of sixty turns of 29 D.S.C. wire on a 2in. diameter ebonite former. The large-capacity C_0 was 0.02 microfarads, and the smaller consisted of two small brass plates, 1.5 cms. diameter and set 0.4 cms. apart.



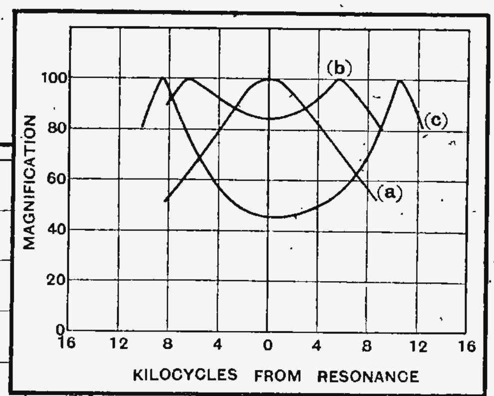


Fig. 7.—Response curves of the double-capacity filter (left), and for the same filter with a single capacity only (above). Curves (a) are for 250 metres, curves (b) for 350 metres and curves (c) for 550 metres.

There are one or two other points of particular interest in the filter design. One of these is that the maximum magnification of a band-pass filter is just half that of a single tuned circuit, and that this maximum magnification does not vary as the band breadth is increased, though the low-frequency amplification decreases as the band breadth increases. It is of interest to note also that if the interference from a station well off tune is considered, it is much greater if the two tuning circuits are coupled as a band-pass filter than if they are used as separate tuned circuits in a valve amplifier. As a rough approximation for a station well off tune, the interference of the former case will always be more than twice as great as in the latter case, even if the band-pass filter has only one peak.

A word of warning must be issued here before we leave the subject. The filter must be carefully tuned, otherwise the band breadth will be greater than that expected, and the interference may be much worse. It is hoped that enough has been said to show that it is not a difficult task to design an efficient band-pass filter without elaborate calculations. Generally, with a calibration chart of the set, the number of kilocycles for each degree on the tuning dial is easily found, and then, by using a milliameter in the anode circuit of the detector valve, it is quite easy to arrive at the most suitable values of the coupling condensers by tuning in stations at various points of the scale.

"THE WIRELESS WORLD"

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CONDITIONS OF THE NEW SERVICE.

(1) THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

(2) Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Tudor Street, E.C.4, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

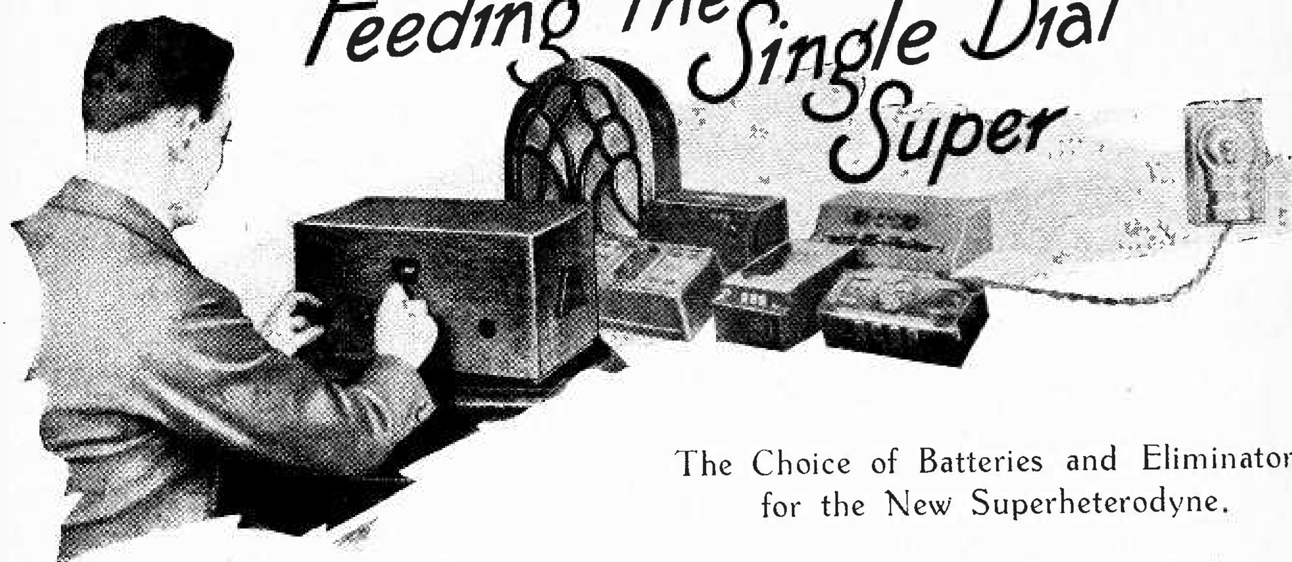
(3) The fee of 5s. covers the reply to any wireless technical difficulty, but in special cases, where the enquiry may involve a considerable amount of investigation, an increased fee may be necessary. In such cases a special quotation will be made.

(4) Questions should be clearly written and concisely worded in order to avoid delay. Where enquiries relate to trouble experienced in receivers built to specifications in *The Wireless World* a complete account should be given of the trouble, and especially the symptoms.

(5) Where reference is made to published articles or descriptions of apparatus, the title of the article, the date of publication in *The Wireless World*, and the page reference number should be given, in order to facilitate reply.

(6) Full circuit diagrams, constructional details of apparatus, or values of components for home-designed receivers cannot normally be supplied, but circuit diagrams sent in with queries will be checked and criticised.

(7) Particular makes of components cannot, in general, be recommended, but advice will be given as to the suitability of an individual component for a particular purpose specified by the enquirer.



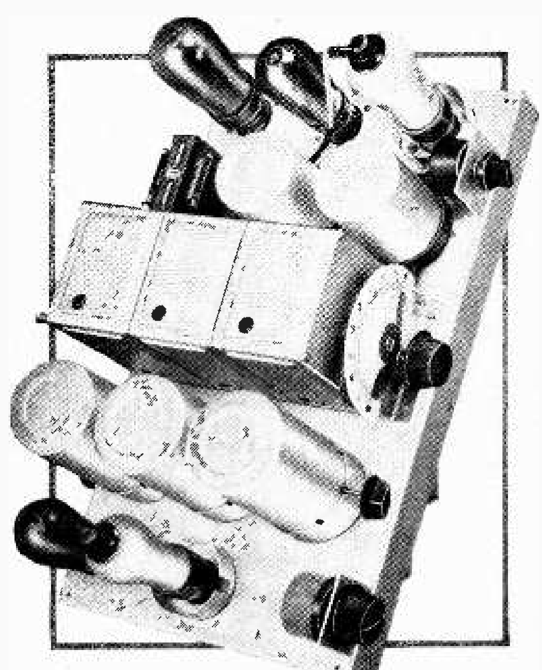
Feeding the Single Dial Super

The Choice of Batteries and Eliminators for the New Superheterodyne.

THE power supply of a battery-operated receiver is always a question of considerable importance. The maximum power which can be obtained economically from a battery is strictly limited, and it is necessary so to design the receiver that its requirements are kept at a minimum. In the case of the Single Dial Super, this has been achieved largely by the employment of the new low-consumption pentode in the output stage, and, as a result, the total current consumption for the whole receiver is kept within bounds..

The low-tension supply need give no concern, since a two-volt accumulator of 20 ampere-hours (actual) capacity should operate the set for some ten days to a fortnight on a single charge, assuming that the receiver is used for about two hours a day. It is the H.T. supply which is so important, for, unless the right capacity batteries are used, the running costs may easily be excessive. It is hardly possible to give exact figures for the anode current consumption, since not only do the characteristics of different valves of the same type vary, but in the case of the oscillator and first detector valves the current depends upon a number of factors apart from the valves and their applied potentials.

To be on the safe side in estimating the battery requirements, therefore, it is wise to take the figure of 12 mA. as representing the minimum likely to be obtained under ordinary circumstances, and to reckon that it may be somewhat higher than this. It will be obvious, therefore, that where dry batteries are used for the H.T. supply, it is hopeless to expect economical running from small-capacity cells, and that they must be at least of medium size. In general, fairly large-capacity cells will prove the most economical, and batteries such as Pertrix-Super, the Ever-Ready "Popular Power," the Lissen Super, the Drydex "Triple Capacity," and the Siemens "Power" types can be confidently recommended.



Described in our issues of December 9th and 16th, 1931, *The Wireless World* Single Dial Super is the first full constructional article on a single dial two-range superheterodyne to be published in this country.

There is no doubt, however, that where facilities for recharging are available, H.T. accumulators prove the most economical. Although expensive in first cost, their upkeep is small, and they give perhaps the most perfect known source of H.T. current, for their internal resistance is very low, and the voltage does not fall appreciably during use. Even with accumulators, however, it is wise to select a type having a large ampere-hour capacity, so that frequent recharging is obviated and the maximum useful life is obtained. A capacity of 2,500 milliampere-hours is usually sufficient, and accumulators such as the Exide type W.J.

Feeding the Single Dial Super.—

and the Oldham type O.H.T. should give many years' satisfactory service.

H.T. Battery Eliminators.

Although the Single Dial Super is designed primarily for battery operation, and, therefore, includes no decoupling, it can be worked satisfactorily from most H.T. battery eliminators, provided that the receiver and eliminator are correctly connected together. The reason for this, of course, is that most eliminators include some measure of decoupling. In cases where the eliminator decoupling is insufficient, however, trouble may be experienced, and this usually takes the form of self-oscillation in the receiver. Where this trouble is found it may usually be cured by the insertion of the usual decoupling resistance, with its associated by-pass condenser, in the screen-grid (H.T.1, orange wire) battery lead of the set.

Most readers wishing to run a set from the mains, of course, will prefer to build a receiver specially designed for the purpose. Many, however, already possess an eliminator which they do not wish to throw into disuse, and so they prefer to build a battery set, while others make their introduction to radio through the medium of a battery receiver, and, afterwards, wish to take their H.T. supply from the mains in order to avoid battery replacements. The Single Dial Super, therefore, has been tested with a number of commercial A.C. eliminators, and it may be said that in very few cases did a unit fail to give a satisfactory performance.

A group of eliminators tested with the superheterodyne and mentioned in this article.

Any eliminator will give a poor performance if the receiver is connected to it incorrectly, and so the best connections for a number of representative units are given in the accompanying table. This list is necessarily incomplete, for it is impossible to test every eliminator on the market with the superheterodyne. In general, however, it may be taken that an eliminator will be satisfactory provided that it has a maximum tapping giving an output of about 150 volts at 15 mA., and one decoupled variable tapping with an output of some 50 to 75 volts for the screen grids.

Eliminator.	Receiver Cable Leads.			
	H.T. — Black to	H.T.1. Orange to	H.T.2. Green to	H.T.3. Blue to
Clarke's Atlas, Model AC/290	— neg.	0/100 var.	0/120 var.	150
Ekco, Model K.25	— neg.	50/80 plug at "low"	120/150	120/150
Formo, Special Minimo	— neg.	S.G. var.	120/150	120/150
Junit, Model 120/T.C.	— neg.	Vf.	Max.	Max.
Regentone Model W1C	— neg.	2 var.	3	3
Tannoy Model P.2.	— neg.	Screen	Max.	Max.

It has been found that a fixed voltage tapping for the screen grids is not generally satisfactory; it is unnecessary, although not disadvantageous, for it to be continuously variable, for units in which the S.G. tapping is variable over a small range by means of a plug and socket connection have been found to function correctly.

Apart from the question of obtaining the correct voltages, one must always bear in mind the possibility of hum when using an eliminator. This, of course, depends largely upon the amount of smoothing which is incorporated by the makers, and on test, whilst all were good, the Regentone unit proved to be particularly satisfactory in this respect. With the type of speaker likely to be used with this receiver, however, no trouble from hum should arise, but where a moving-coil speaker is employed particular care should be taken in the choice of an eliminator.

It will have been noticed that in most cases the table shows that the H.T. leads for the anodes and the pentode screen grid are connected together, and have the full voltage applied to them. This has proved the most satisfactory with the eliminators tested, for it allows of the maximum output being obtained from the pentode, and the increased drain on the H.T. supply is negligible when mains are used.

Whether working from batteries or the mains the grid-bias battery is important, and should be retained even in cases where the eliminator is of the type providing free bias. The voltage of this battery should be checked frequently, and it should be replaced as soon as it commences to fall. A defective bias battery will not only lead to poor reception, but will result in the set drawing an excessive anode current, and so give a short life to the H.T. battery. This battery must particularly be watched when using an eliminator, for a considerable fall in its voltage might lead to the pentode being damaged.

Modifications to the set itself cannot be advised. Requests have been received for details of the alterations necessary for using a gramophone pick-up, but it can definitely be stated that the receiver is unsuitable for this purpose. Owing to the small output obtainable from battery valves, the reproduction obtainable from a record reproduced via a battery set is usually inferior to that given by an ordinary gramophone. It is only with mains-operated apparatus that the electrical reproduction of gramophone records is worth while.

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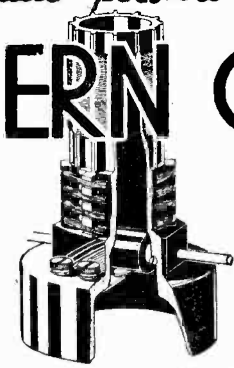

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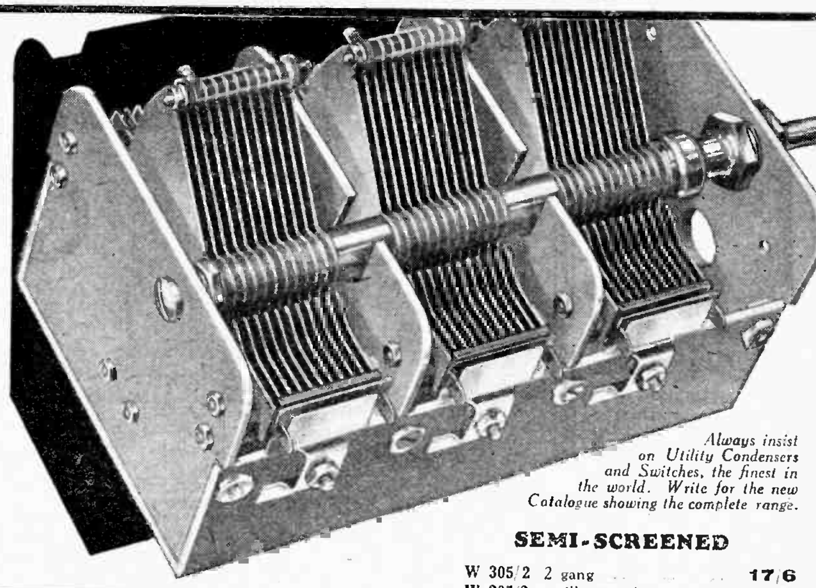

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Nuts to Crack

HERE we have a new feature which "The Wireless World" introduces for the benefit of readers who like to be able to work out little problems arising in every-day experience of building and experimenting with wireless receivers. Confidence is gained every time a new problem has been solved by means of a simple calculation.

The purpose of the present series is to educate the reader by means of questions and fully worked-out solutions to various problems. The questions will be given in advance, in order that readers may try to arrive at the answers for themselves before seeing the solutions.

WIRELESS is a quantitative science; that is to say, it deals with accurate numerical values. One cannot fail to be impressed by the importance of choosing the correct working values for the different components of a modern receiver; a condenser or resistance of wrong value may jeopardise the whole performance of an elaborate set which has cost many hours to build, and to locate the trouble may take an even longer time. The reasons why each component should have just its prescribed value and no other should, therefore, be understood by every wireless enthusiast worthy of the name.

Moreover, the underlying principles are by no means difficult to understand, and are authoritatively dealt with from time to time in the pages of this journal. Nevertheless, in attempting to apply the theory to his own problems, the beginner is often at a loss just how to proceed. More often than not, too, he is unwilling to spend much time on the attempt to unravel a problem on the answer to which he has no sure check.

Think It Out for Yourself.

In the present series it is intended to present readers every week with two or three wireless problems over which they may like to test their ingenuity and polish up their arithmetic. Answers, together with some explanation of possible points of difficulty, will be given in the issue of the subsequent week.

The writer has kept carefully before him the needs of those who, beginners or professional "service" men, are anxious to improve their knowledge by taking a little trouble week by week to think things out for themselves. The questions will not usually be of any great difficulty, so that even those who have little wireless knowledge will, it is hoped, find themselves being led on by easy stages to the more complicated calculations of modern design work. It should be emphasised, however, that, although mainly arithmetical, these problems will not be entirely devoted to "figuring." By the simple device of providing some extra details connected with a problem such as would be ordinarily available in practice, the solver will be required to eliminate the unessential from the essential data necessary for its solution, and this in itself constitutes a valuable exercise in the application of theory to practice. It is hoped that this feature will commend itself to many readers.

NEXT WEEK'S PROBLEMS.

Problem No. 1.—**A 2-volt accumulator is used to supply filament current to a multi-valve receiver. An ammeter is inserted in one of the accumulator leads, and shows that a current of 0.8 ampere is being taken. What is the total resistance of the filament circuit?**

Problem No. 2.—**After the accumulator of the previous question had been fully charged, it was noticed that the current reading had increased to 1 ampere. What difference does this indicate in (a) the circuit resistance, (b) the e.m.f. of the accumulator?**

Problem No. 3.—**In order to protect the filaments from the excessive current due to the freshly charged accumulator, it is proposed to include a small variable resistance in the leads. What should be the value of this resistance, and what should be the ammeter reading?**

Problem No. 4.—**What power is consumed by the filaments when the e.m.f. of the accumulator is 2 volts and the filament current is 0.8 amp.? When the e.m.f. has its maximum value after charging, and the above series resistance is used, will the power taken by the filaments be increased? What power is dissipated in the resistance?**

NUTCRACKER.

Practical Electrician's Pocket Book, 1932.

The thirty-fourth annual edition of this pocket book contains, as usual, all kinds of information and data of use to electrical engineers, including a wireless section, in which various types of circuits are described, and articles on Picture Telegraphy, Batteries and Accumulators. The supply voltages of the various towns in the United Kingdom are given in a convenient tabular form. Edited by F. H. Robinson, the edition contains nearly 600 pages, with numerous illustrations and diagrams. Published by "Electrical Trading and Electricity," London. Price 2s. 6d. net.

LOTUS

Three-Valve A.C. Mains Receiver

FEATURES.

GENERAL: Completely self-contained A.C. mains receiver, with single-dial control. Gramophone pick-up switch. Moving-coil loud speaker.

CIRCUIT: One H.F. stage resistance-fed to tuned grid circuit of detector. Grid rectifier coupled to triode output valve by filter-fed intervalve transformer. Differential capacity reaction. Output transformer coupling to moving-coil loud speaker. Full-wave rectifying valve.

CONTROLS: (1) Single knob tuning control. (2) Series aerial condenser. (3) Differential capacity reaction control. (4) Combined wave-change and gramophone pick-up switch. (5) On-and-off switch.

PRICE: £15 15s. complete.

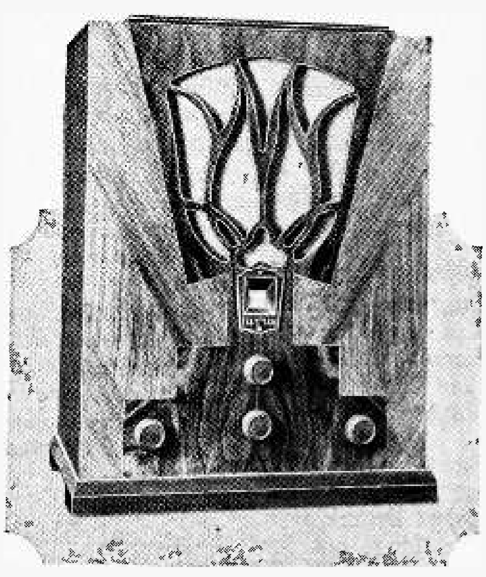
MAKERS: Lotus Radio Ltd., Lotus Works, Mill Lane, Liverpool.

IT has already been emphasised several times in *The Wireless World* that the most popular class of commercial receiver available to-day is the three-valve mains-driven type which, save for aerial and earth, is completely self-contained. This type of instrument is usually obtainable for a sum which is a little on the sunny side of twenty guineas. Such things as first-class workmanship, good design, and sound performance are usually taken for granted, and, of course, it almost goes without saying that the loud speaker is of the moving-coil type, and that only one control is required for station selection.

When, as in the case of the Lotus A.C. three-valve receiver, the price is as low as fifteen guineas, then it must be confessed that a feeling is engendered that something must have been sacrificed to come down to this figure. A couple of hours testing with the receiver referred to is quite sufficient, however, to dispel any such fears; indeed, for the expert only a few minutes' cursory examination of the receiver is all that is necessary, for it is scarcely likely that any manufacturer would be so foolish as to put into his receiver what is obviously first-class workmanship and material without paying equal attention to the question of technical design of the apparatus itself.

High Selectivity.

The receiver is housed in an attractive walnut cabinet of conventional type for this class of instrument, its dimensions being approximately 19½in. × 14½in. × 9¾in. The loud speaker—which is a Magnavox—is mounted in the usual position over the receiver chassis, and is as easily and quickly removed from the cabinet as is the chassis, there being no need to break any connections—soldered or otherwise—when this is done for test or examination purposes should a fault occur.



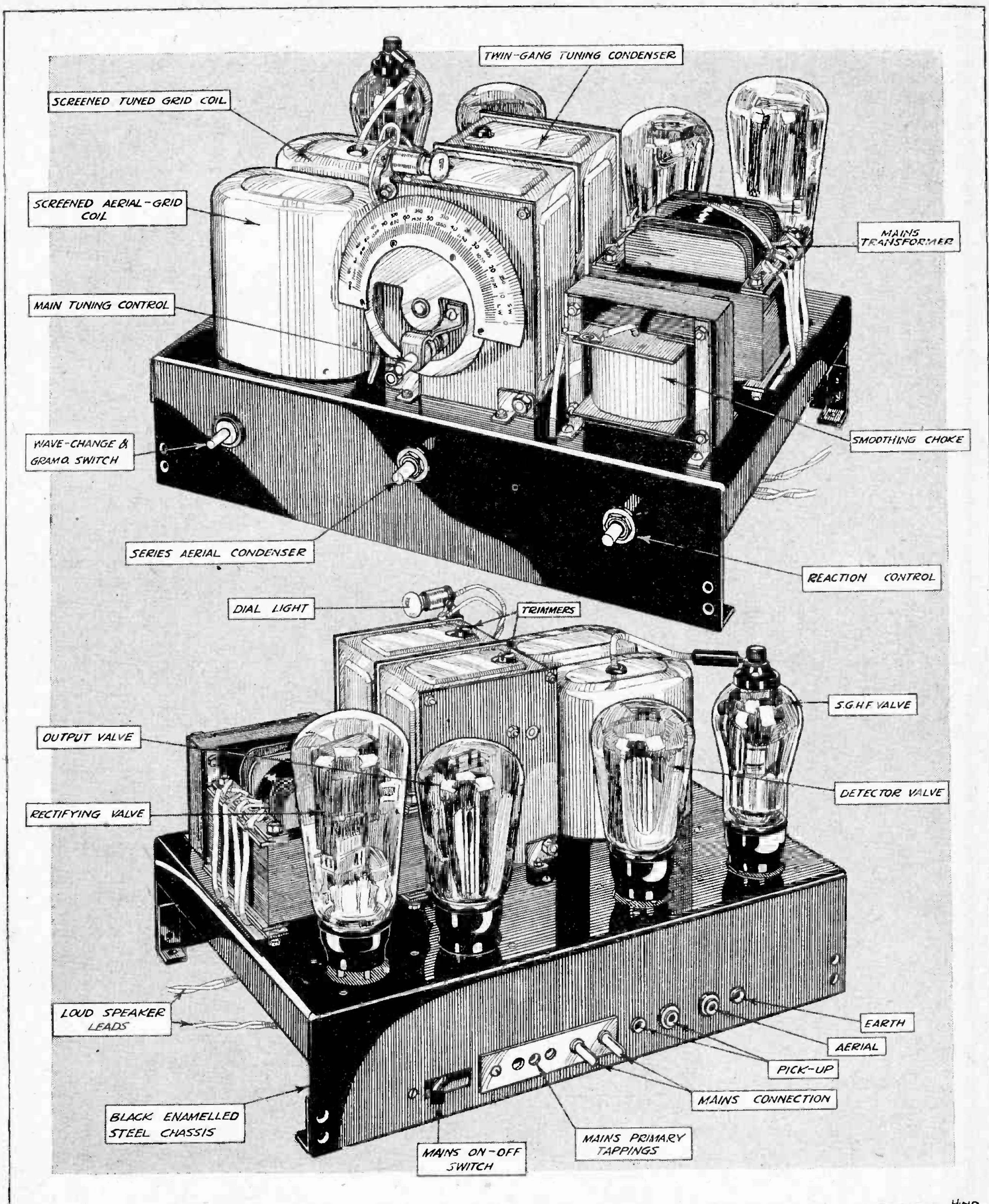
The set is self-contained with built-in loud speaker and has single-dial tuning control.

The circuit employed is a perfectly straightforward one; band-pass tuning is not used, but, notwithstanding this, the selectivity is of no mean order, this being due to the exceedingly careful arrangement of the aerial-input circuit. In series with the aerial is a variable condenser of the solid dielectric type having a capacity of 0.00035 mfd., which is, of course, many times greater than the value normally found in this position. At first it might be thought that this has such a serious effect on the adjustment of the first tuned circuit that ganging is thrown completely out of gear. The effect of this capacity is offset, however, by the use of a small independent aerial coil set in permanent inductive relationship to the grid circuit of the first valve. On long waves the switching arrangement connects the aerial to a point which is not very far from the earth end of the grid circuit loading coil, but the short-wave aerial winding is still left in circuit, and it cannot be doubted that this has a great bearing on the almost complete absence of "break through" of the medium-wave stations when the receiver is adjusted to the lower end of the scale on the long-wave side; indeed, this fact was proved by temporarily cutting it out of circuit when immediately short-wave "break through" made its presence felt.

The two tuning condensers follow the usual practice in-so-much that they are completely screened and embody internal trimmers which are naturally adjusted before the receiver leaves the factory. When the chassis is withdrawn from the cabinet they are, however, easily accessible to the service man if for any reason they require readjustment on some future occasion. The main tuning control, which is fitted just underneath the window through which the illuminated dial can be seen, operates through a reduction gear having a ratio of 6:1, and is commendably smooth in its action. The tuning dial is marked directly in wavelengths, and is also scaled from 0 to 100 degrees. Of the remaining three controls, series-aerial condenser, reaction condenser, and wavelength switch, only the last mentioned requires a brief word of explanation.

The operating control is attached to a long brass rod which terminates in a special switch arranged to connect the grid of the detector valve to the tuning coil or to

MAINS RECEIVER—THE LOTUS A.C. THREE.



Two views of the receiver chassis indicating the principal controls and components.

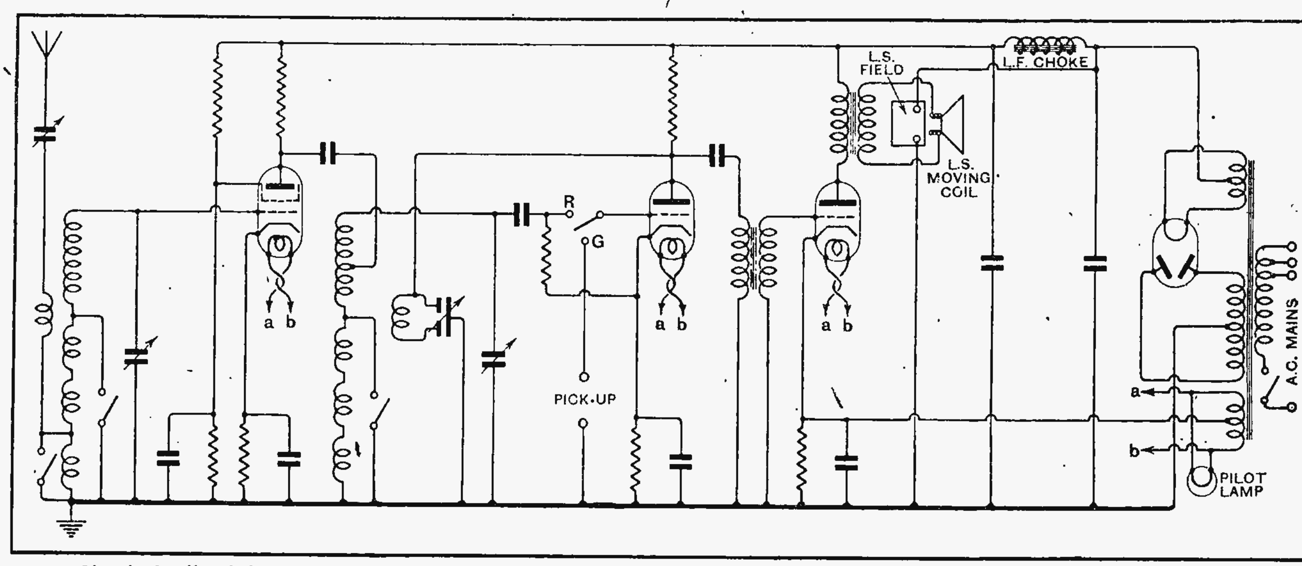
Lotus Three-Valve A.C. Mains Receiver.— the high-potential gramophone pick-up connection, as occasion demands. Cams made of suitable insulating material are mounted at convenient positions on the rod for operating the wave-change switches associated with the two tuning circuits. There are actually four positions for this rotary switch, although only three are marked on the controlling knob. This is likely to cause some confusion among users until they realise that the gramophone pick-up is brought into circuit at two settings of the switch. Another quite trivial criticism is the position of the quick-break on-and-off switch, which is situated at the back of the receiver, a place which it unfortunately occupies in more than one high-class set. This position is, without doubt, an awkward one, and there seems no reason why it should not be mounted unobtrusively on the front.

Plugs and sockets are fitted at the back for the connection of aerial and earth and of the gramophone pick-up. Here also will be found the mains connection and quite a conventional type of voltage adjuster for rendering the receiver suitable for voltage values of 200/210, 220/230, or 240/250. Other models of the receiver are supplied for voltages of 100/110 and for mains having a 25-cycle frequency.

The question of aerial coupling has already been touched upon, and therefore attention can at once be drawn to the rather unusual coupling between the H.F. and detector valves. The familiar tuned-grid circuit is employed, but in place of the customary H.F. choke in the plate circuit of the screen-grid valve there is a 20,000-ohm resistance. It must be confessed that at first this arrangement was looked upon with some disfavour, but quite a short period of testing sufficed to reveal the astonishing efficiency of the H.F. stage, as shown by the performance of the receiver with the reaction control set at minimum. Naturally, in a set having but one H.F. stage, the application of reaction has a marked effect on sensitivity, and, of course, selectivity is also affected slightly. The arrangement of the detector and the coupling to the L.F. valve, which consists of the conventional parallel-fed transformer, need little comment.

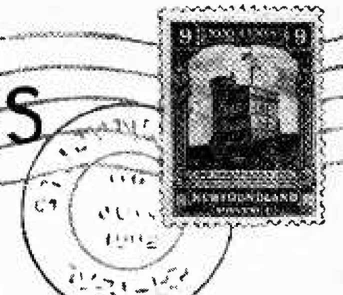
One of the most interesting features of the design is the method of energising the field of the loud speaker, although, of course, the arrangement is by no means new. In their earliest days moving-coil loud speakers were energised by separate rectifying units of their own. Latterly, increasing use has been made in A.C. receivers of loud speakers having field windings of moderately high resistance—usually about 2,500 ohms —connected in series with the main high-tension positive feed to the receiver. In the present set the field winding of the loud speaker—which has a resistance several times greater than the figure given above—is merely connected in parallel with the ordinary rectifier which supplies the needs of the set, and thus it obtains the benefit of the maximum voltage available, and so renders it possible to obtain the necessary wattage with a fairly small field current.

Little need be said regarding selectivity, which is fully up to the standard expected of a set of this class. At a distance of nine miles from Brookmans Park the highest wavelength on which London National provided a background accompaniment was 280 metres, and the lowest wavelength on which London Regional caused interference was 345 metres, thus leaving an entirely clear waveband of 65 metres between them. Reaction is perhaps not as smooth as it might be on long waves, but the defect—if it can be called such—was not sufficiently serious to prevent half a dozen long-wave *programmes* being received comfortably. In these tests resort was, of course, made to the series aerial condenser, but at no time was it necessary to use this device anywhere near its minimum setting; the figures quoted above were obtained with this condenser adjusted to the half-way position. Sensitivity is remarkably good for a receiver having but one stage of H.F., and the quality of reproduction is fully up to the high standard set by the particular loud speaker used.



Circuit details of the Lotus three-valve A.C. receiver. The resistance-fed tuned grid circuit is unconventional but effective.

RADIO POSTAGE STAMPS



Wireless History Portrayed.

By HERBERT ROSEN.

WHOEVER regards postage stamps, not as objects of so much value in £ s. d., nor as playthings for children, but as things to be studied and learned from, will discover in them many things hitherto concealed from him.

A close consideration of individual stamps brings to light the fact that there is an increasing tendency for every event of general or cultural importance occurring in each country to be commemorated for ever by pictorial representation in the national stamps. Whether it be the unveiling of a memorial, the opening of a canal, or of an exhibition, the holding of a conference, the achievement of an ocean flight, or the celebration of a jubilee, the likelihood is that the story will be told in stamps.

(1) Wireless masts are prominent in an Air mail stamp issued in the Belgian Congo in 1920; (2) Popoff, the Russian "inventor of wireless," seen against a forest of aerials in a 1925 issue; (3) An Italian stamp commemorating the 100th anniversary of Volta's death; (4) The Prague Post Office, with its stately aerials, pictured in Czecho-Slovakia's tenth anniversary issue.

It is hardly surprising, therefore, that wireless, the most modern tool of our technique, is also represented. A glance at one of those stamps which carry the image of ships will tell you whether it is a modern issue or one of a previous era, for, without exception, the modern specimens will show a stately aerial between the two main masts. Again, it is hardly possible to find in any country a postal organisation which does not employ wireless; it is only natural, therefore, that giant masts and aerials should occur in the designs of many lands. Celebrated physicists and engineers, too, are commemorated in postage stamps. Volta, without whose fundamental discoveries at the beginning of the past century radio engineering could hardly have developed, is honoured in the stamps of Italy, and the Russian engineer Popoff is immortalised in the stamps of his country. He is given the challenging title of "The Inventor of Wireless."

A Radio Landmark.

But the most interesting stamp of all, from a wireless point of view, comes from Newfoundland, for on it is portrayed the historical Cabot Tower, which in 1901 served to receive the first Morse signals from Europe, i.e., those transmitted by Marconi from Poldhu. (This stamp is shown in the title illustration.) Thus a great landmark in human progress is preserved to posterity for all time. As the years pass on, no doubt many other events connected with wireless will find their place on the postage stamps of the world, but it is doubtful whether these will ever surpass the existing specimens in interest unless they record some radio happening altogether eclipsing in importance the events which laid the foundations of the science.

(5) As early as 1918 Guatemala illustrated a wireless station in her stamps; (6) A Belgian issue of 1929, showing a modern steamship with the indispensable radio aerial; (7) A recent Honduras stamp, incorporating a radio station design; (8) Newfoundland's record breaking ship, "Caribou," flourishing a wireless aerial, appears in the 1928 issue.

WIRELESS ENCYCLOPEDIA

No. 10

Brief Definitions with Expanded Explanations.

***ELECTRONS AND ELECTRIC CURRENT.** An electron is the smallest quantity of negative electricity that can be moved from atom to atom in a material, or passed through space. A translatory movement of electrons round a circuit represents an electric current.*

ACCORDING to the electron theory, every atom of matter, solid, liquid or gas, is made up of positive and negative charges of electricity combined together, and the particular element or substance represented depends on the amount of electricity combined in this way in each atom. But the structure of the atom is far too complex to be discussed in a few words—we are more concerned here with the enormous numbers of minute negatively charged corpuscles, called electrons, which are normally associated with every molecule of matter on the earth and which are free to be moved about by suitable forces.

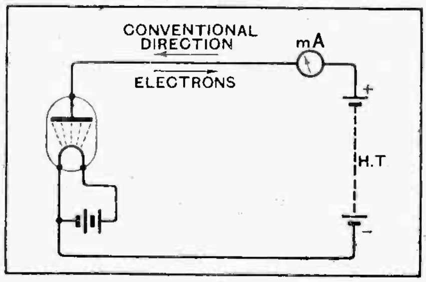
Every electron represents exactly the same minute quantity of negative electricity, and it has been proved that each of these tiny charges has a definite mass which is estimated to be a little less than 1/1,800 of the mass of a single hydrogen atom. When an electron is moving it possesses kinetic energy or energy of motion—the anode of a valve is heated by the countless numbers of electrons colliding with it and giving up their energy.

When a body is negatively charged with respect to the earth it means that there is an accumulation of electrons on it, over and above the number normally present when the body is electrically neutral, and when a body is positively charged there is a *shortage* of electrons, not an accumulation of positive electricity; for all the positive charges, or *protons* as they are called, comprise the centres or nuclei of the atoms and are permanently fixed there, inseparable from their respective atoms.

In a conducting material, such as copper, electrons can be moved very freely from atom to atom within the material, but in the case of an insulator the so-called free electrons cling very tenaciously to the particular molecules to which they happen to be attached, and very large forces (electromotive) are required to dislodge them.

Current of Electricity.

A current of electricity in a conductor is merely a drift or stream of electrons moving within the conductor from atom to atom; as electrons enter at one end others leave at the opposite end in equal numbers, so that the conductor itself neither gains nor loses any electricity. The conductor carrying a current can be likened to a hose-pipe carrying water, where the molecules of water moving through the pipe correspond to the moving electrons in the conductor. The electric current is a flow of electrons, and the strength of the current is represented by the number of electrons passing a given point in one second. When the current is "switched off" the electrons simply stop moving and remain where they are, so that a conductor will have the same "weight" whether it is carrying a current or not. Similarly the weight of the hose-pipe full of water will be the same whether the water is moving or not. This analogy serves to explain why the presence of a current of electricity in a wire does not change the weight even though the electrons themselves possess mass or inertia; for, after all, a current is only a movement of electrons which were present before the current was started.



Simple diode illustrating that the electrons representing a current move in the opposite direction to the conventional one in which a current is assumed to flow.

To start and maintain an electric current some form of driving force or motive force is necessary, just as a pressure or head is required to drive the water through the hose-pipe. This electrical driving force is called an *electromotive force* (E.M.F.). In the case of a simple conductor the electromotive force is utilised in forcing the stream of electrons through the conductor against the resisting forces opposing their transfer from one atom to the next during their passage, and it is these resisting forces which constitute the *resistance* of the conductor.

In a thermionic valve a current passes between the anode and cathode through the intervening vacuous space, and in such circumstances it is called a pure electron current to distinguish it from a current of conduction. Electrons are emitted from the hot cathode and attracted to the relatively positive anode. But, according to the usual notation, current is assumed to flow from a point of positive potential to a more negative one, and so we see that the electrons representing an electric current actually move in the opposite direction to the conventional one in which the current is assumed to flow. This state of affairs has arisen out of an unfortunate choice of sign in the early days of electricity when it was believed that both kinds of electricity moved simultaneously in opposite directions when a current was flowing. We now know that only the kind that was then designated negative is mobile with respect to matter, whereas the other kind, given the positive sign, is permanently fixed within the atoms.

Current Topics.

News of the Week in Brief Review.

WAITING. The photo-electric cell and amplifier set up in readiness to time Mr. Norman Smith's attempt in New Zealand on the world's car speed record.

Train Radio Difficulties.

THE decision of the London and North Eastern Railway Company to install wireless receivers on other trains in addition to the Leeds express, which is already fitted, is a direct outcome of the popularity of the service. An official of the company told *The Wireless World* that the "Flying Scotsman" and, perhaps, one of the West Riding expresses, will be the next to be radio equipped, and it is likely that apparatus may also be installed on the Eastern Counties trains running from Liverpool Street.

An obstacle in the case of some long-distance trains lies in the fact that these are often "split up" at different stages of the journey, and if the reception were to be carried on in the detached portions additional receivers would be necessary. These would be supplied if the service proved sufficiently popular.

o o o o

A Licence Point.

A DUDLEY "pirate" has failed in an enterprising attempt to escape the consequences of operating an unlicensed receiver between October 1st and 20th. On being summoned, he took out a licence expiring on September 30th, 1932, but the Dudley magistrate has refused to accept the licence as retrospective.

o o o o

Lawyers and Radio.

RADIO has received the signal distinction of being chosen as the subject for a thesis to be written by candidates for legal posts in the French Administrative Tribunals. The future "legal luminaries" were given six hours in which to draw up a comprehensive survey of the present broadcasting situation, the rights of citizens, and the use of radio in war-time.

We understand that, although the task was regarded as a tall order, most of the candidates were able to supply happy arguments "evolved from their inner consciousness."

The Bradford Mystery.

HAS Bradford set up a wireless record? The licence figures for the district reveal an increase of 33⅓ per cent. during the past twelve months, bringing the present total to well over 45,000. More than 50 per cent. of Bradford's householders possess licences.

No doubt the opening of the Moorside Edge transmitters is partly responsible for the increases, but it fails to explain why the biggest influx of licence fees has occurred during October and November, six months after Northern transmitters made their début.

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Oldest and Youngest.

NATURALLY the first claim of possessing the oldest and youngest radio transmitting amateurs in the world comes from America. The "baby" is Charles Beard, of Asheville, North Carolina, who owns and operates W4ZM at the age of ten. At the other end of the scale is venerable Dr. George W. Kirk, who, although in his eighty-first year, is an active and consistent operator of his station, W8ARJ.

Can you beat it?

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Feminine Voices Not Wanted.

A GENERAL demand that lady announcers should be dispensed with is the outcome of a plebiscite just conducted by the Austrian broadcasting authorities. Feminine voices, it is declared, are unsuited to the microphone.

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U.S. "Economy Campaign"?

THE possibility that America will carry out widespread economy cuts in radio during 1932 is suggested by the news that "as a measure of economy" the Navy Department is closing down its radio stations at Savannah, Ga., St. Augustine, Fla., and Great Lakes Naval Training School, Chicago.

Rue Edison?

PARIS municipal authorities are considering the renaming of one of their thoroughfares to perpetuate the memory of Thomas A. Edison.

o o o o

Icebergs Calling.

SOVIET explorers, according to a Leningrad message, are planning to establish a wireless transmitter on the drifting ice in the centre of the Arctic basin. The transmissions should be a useful antidote after listening to Christopher Stone's hot dance records.

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FYA Carries On.

THE studio of France's overseas short-wave broadcasting station has been transferred from Vincennes, the site of the Colonial Exhibition, to Boulevard Haussman, Paris. It is stated that the station is giving great satisfaction in the Colonies, both artistically and technically. Transmissions are on 20 and 25 metres.

o o o o

Broadcasting "Political Palaverers."

USING parabolic microphones so sensitive that they can pick up whispers at a considerable distance, Senator Dill has just conducted an experiment in the American Senate House to show that the public broadcasting of debates is practicable. Test speeches were reproduced on loud speakers for the benefit of senators and other dignitaries.

According to our Washington correspondent, both the National and Columbia broadcasting organisations are anxious to put the Senate as well as the House of Representatives "on the air," while Senator Dill insists that this measure "would create better understanding between the people and their Government."

Whether the listeners themselves are of the same opinion is doubtful, and at least one body of persons is opposed to the idea. These are the "O.B." and programme officials who dread too many interruptions in their regular schedules in order to please "the political palaverers."

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U.S. Radio Reporters to Scour Europe.

THE arrival in Switzerland of Dr. Max Jordan as Central European representative of the American National Broadcasting Company is the prelude to a big scheme for supplying American listeners with regular programmes from Europe. Within the next week or two representatives of the National and Colombia networks will start for Geneva in order to stage relays from the Disarmament Conference.

We understand that Dr. Jordan, whose headquarters are in Basle, intends to build up an organisation of radio reporters who will scour Europe for events likely to interest American listeners.

SELECTIVITY *and* TONE CORRECTION

The Difference Between Modulation and Heterodyne Interference.

By F. M. COLEBROOK, B.Sc., D.I.C., A.C.G.I.

(*Concluded from page 736 of previous issue.*)

IN the instalment of this article which appeared in last week's issue the principles of tuned-circuit response to a modulated carrier wave were discussed at some length.

We must now consider the response to an interfering transmission. It will be assumed that there is an interfering transmission at $f+10$ kc./sec., i.e., with a 10 kc. separation, and that the two transmissions give equal field strength at the point of reception. To compare the wanted and unwanted intensities we will assume that each station is modulated at, say, 2,000 cycles/sec. It is suggested that perfect tone correction applied to the circuit will have the effect of making the note of modulation frequency from the interfering station of the same intensity as that from the wanted transmission. Let us see if that is so.

At 10 kc./sec. from resonance, the resonance curve is very nearly a straight line parallel to the bottom axis, so that all three components of the interfering wave will be magnified to practically the same extent, and, further, an inspection of the vector form of the resonance curve shows that approximately the same phase change of nearly 90 degrees will be imposed on each component. Thus the original phase and amplitude symmetry of the original wave is very little affected by the reception process, and its modulation percentage also is very little affected. Assuming 50 per cent. modulation, the three components of the condenser voltage due to the interfering transmission will be as shown in Fig. 4. From what has already been stated it is clear that the carrier-wave response is reduced, as compared with that given by the wanted transmission, in the ratio of $f/2n$ to M, where M is 1,000, f is 1,000 kc./sec., and n is 10 kc./sec. The ratio is therefore 1/20. The modulation percentage of the interfering transmission is practically unaffected, and the side-wave condenser voltages will be respectively slightly more and slightly less than one quarter of the carrier-condenser voltage. For the wanted transmission, on the other hand, the reduction in modulation percentage calculated as shown above will be one fourth, i.e., 50 per cent./4, or 12½ per cent. Thus, assuming that each carrier wave gives an induced e.m.f. of 1 millivolt, the simultaneous reception of the two transmissions will give rise to two modulated waves of condenser voltage, that corresponding to the wanted station having a value of 1 volt, modulated 12½ per cent., and that corresponding to the interfering transmission having a value of 1/20 volt, modulated 50 per cent., the modulation frequency being 2,000 cycles/sec. in each case.

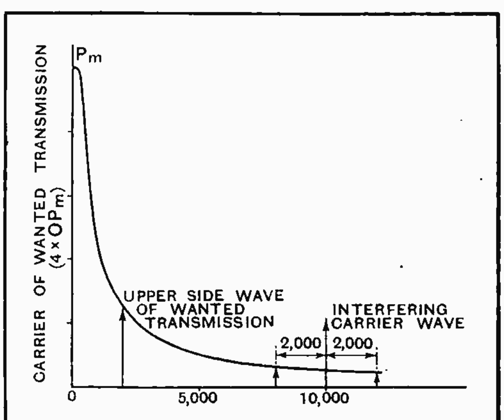

Fig. 4.—An interfering transmission modulated at 2,000 cycles and separated from the wanted stations by 10 kc. will be applied to the resonance curve where it is practically parallel to the bottom axis.

Rectification and Tone Correction.

At this point we must consider the rectification process, and here, as Prof. Fortescue has had occasion to point out in a letter published in *The Wireless Engineer and Experimental Wireless* in August, 1931, there has been some rather confused thinking. It has been suggested in various places, for example, that if a fairly strong signal and a weaker one act together on a rectifier, the rectification will be linear for the strong signal, on account of its large amplitude, and more nearly square law for the weak signal, on account of its small amplitude. This would be true if the signals were acting separately, but it is most emphatically not true when the signals act together on the same rectifier. The simultaneous operation of a number of signals on a rectifier is an exceedingly complicated matter. As Prof. Fortescue points out, the simultaneous square-law rectification of two pure-tone modulated waves will produce eighteen audio-frequency components!

In the simultaneous rectification of a number of signals, the type of rectification will depend on the total of the various voltage amplitudes, and if the stronger signal be such as to produce sensibly linear rectification, the rectification of the weaker signal will be of similar type, modified in some cases by the demodulation effect which the writer has already described in an earlier

Selectivity and Tone Correction.—
number of this journal. Thus in considering the rectification of the interfering transmissions specified above we shall take linear and square-law rectification as representing the extremes, and assume the same law for each transmission. Before doing so, however, one point can already be made clear. The tone correction is applied after the rectification process, and will apply equally to the modulation-frequency responses from each transmission. It will not, therefore, affect the ratio between these responses. Therefore, as far as the reproduction of the modulation of the interfering transmission is concerned, tone correction will not modify the effect of the high selectivity of the circuit.

Square Law *versus* Linear Rectification.

For present purposes a very simple distinction can be made between square-law and linear rectification. In square-law rectification the modulation-frequency response will be proportional to the *product of the carrier and side-wave components* of the rectifier voltage. In linear rectification the modulation-frequency response will be proportional to the *side-wave component only*. Another way of saying the same thing is that in square-law rectification the output is proportional to the product of the modulation percentage and the square of the carrier-wave voltage on the rectifier, while in linear rectification it is proportional to the product of the modulation percentage and the first power of the carrier-wave voltage. As already pointed out, other factors enter into simultaneous rectification, but the above simple distinction will serve as a first approximation.

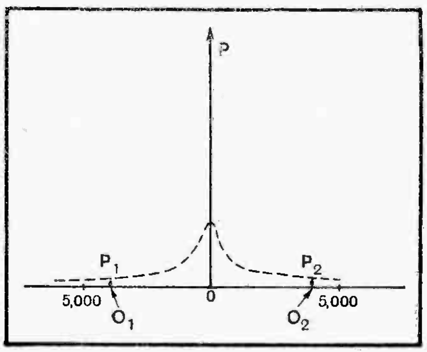

Fig. 5.—If the wanted transmission is modulated at 4 kc. the condenser voltages will be O_1P_1 and O_2P_2.

On this basis the ratio of the modulation-frequency responses from the above two transmissions is easily calculable. Assuming square-law rectification, we have 12½ per cent. times the square of 1 for the wanted transmission, i.e., 1/8, and 50 per cent. times the square of 1/20 for the interfering transmission, i.e., 1/800. Each of these will be multiplied by a tone-correction factor of four, but this will not affect the ratio of 100 to 1 between them. This is a voltage ratio. The acoustic ratio will be as the square of this, i.e., 10,000 to 1.

For linear rectification the outputs will be respectively proportional to 12½ per cent. times 1 and 50 per cent. times 1/20, i.e., to 1/8 and 1/40. Here the voltage ratio is only 5 to 1, giving an acoustic ratio of 25 to 1, and it would seem that the apparent selectivity would be far greater in the square law case. The matter is not quite so simple as this, however, for in the linear case there will be some degree of demodulation. It is true that the demodulation effect on the weaker signal assumes that the frequency difference between the two carriers is supersonic, and in the case assumed it is not, strictly speaking, supersonic. It is unlikely, however, that the rectifier will have an audio-frequency characteristic which is uniform up to 10 kc./sec. There will be, that is to say, some degree of smoothing out of the heterodyne frequency between the two carriers, and a corresponding degree of mutual demodulation effect, resulting in a considerable reduction of the modulation frequency output from the weaker or interfering station. The matter is too complicated to consider quantitatively in these pages, but the difference between the apparent selectivities will undoubtedly be less than that indicated above. The example shows, however, that where linear rectification is involved, a high intrinsic selectivity is particularly desirable, not only with the object of reducing the relative intensity of the interfering station, but also because the demodulation effect on the weaker signal increases with the disparity of the two intensities.

Before passing on to consider the effect of circuit selectivity and tone correction on the heterodyne intensities produced by the interfering transmission, it may be of interest to point out one other general conclusion relating to linear rectification which follows from the preceding description. It was stated above that with this type of rectification the modulation frequency response will depend only on the magnitude of the side-wave components of the condenser or rectifier voltage. It was also stated that when the power factor of the receiving circuit is reduced by retroaction, a condition is reached in which the height of the skirts of the resonance curve (which determines the side-wave condenser voltages) does not depend on the coil resistance, but only on the frequency ratio n/f. Beyond this point, therefore, a further increase in retroaction will not give any further increase in the output of modulation frequency n.

We must now consider the interference which is due to the heterodyning of the various components of the interfering transmission with the carrier wave of the wanted transmission. In the example so far considered, there will be a 10 kc. note due to the heterodyning of the two carrier waves, and an 8 kc. note due to the heterodyning of the carrier of the wanted transmission and the lower side wave of the interfering transmission. The published response curves of present-day sets show that neither of these is likely to figure very prominently in the output, so for a more practical case we will assume the interfering station to be modulated at 6 kc./sec.

Heterodyne Interference.

There will be a 4 kc. note due to the heterodyning of the carrier and the interfering side wave. The most appropriate criterion for estimating the degree of the interference is the comparison between the intensity of this 4 kc. heterodyne note and that of a 4 kc. modulation of the wanted transmission, assuming equal carrier and side-wave amplitudes in the two transmissions.

Considering first the 4 kc. modulation of the wanted transmission, we have the condenser voltages represented by the lines O_1P_1, OP, and O_2P_2 in Fig. 5. For the heterodyne interference due to the lower side wave of the interfering transmission, the diagram will be

Selectivity and Tone Correction.—

exactly the same, except that O_1P_1 is omitted. Thus the ratio of the two 4 kc. intensities, considered separately, is simply the ratio between the outputs of a double and single side-band system with equal amplitudes of the components, and *the selectivity of the circuit does not enter into the matter at all.* Equally, of course, tone correction will not enter into the matter either. Thus, tuned circuit selectivity, assuming symmetry in the resonance curve, will in itself do nothing to minimise the heterodyne interference ratio, whether this selectivity be that of a plain tuned circuit or of a band-pass filter arrangement. The ratio is thus a constant for all types of symmetrical resonance curve, and is, in fact, about four to one in acoustic output in favour of the wanted transmission. This figure is only very slightly affected by the type of rectification.

(It must be emphasised at this point that nothing is here stated or implied about the behaviour of circuits in which selectivity is obtained by means other than the use of tuned circuits, or in which special means are adopted for the elimination of specific heterodyne interferences. The article refers exclusively to selectivity obtained by normal arrangements of tuned circuits.)

Nothing has yet been said of the *simultaneous* operation on the rectifier of the double and single side-wave system considered above. This is, of course, rather an artificial abstraction, but it may be of interest to note that the response is theoretically indeterminate, between limits which are probably 0.25 and 2.25 times the acoustic output of the double side-wave system acting alone. It is indeterminate because there may be any phase relation from 0 to 180 degrees between the two coincident side waves, giving a resultant amplitude of any value from zero to twice the original single side-wave amplitude.

It appears, then, that, whereas the selectivity of a very selective circuit is not impaired by tone correction and remains fully effective in reducing the intensity of the modulation of an adjacent interfering transmission, it does not confer any immunity in respect of heterodyne interference involving the carrier of the wanted transmission, and that such immunity cannot be obtained by any normal arrangement of tuned circuits without some sacrifice of quality in the reproduction of the modulation of the wanted transmission. Fortunately, such interference will generally be confined to the higher audio-frequencies, and can be eliminated by manipulation of the audio-frequency elements of the circuits in ways such as those described in *The Wireless World* of November 4th, 1931, but this obviously involves the deliberate sacrifice of the higher audio-frequencies. It is greatly to be hoped that this sacrifice of quality will be made unnecessary in the future by a more satisfactory distribution of stations both in space and frequency.

CLUB NEWS.

The Popular Superhet.

A VIGOROUS discussion on the revival of the superheterodyne receiver took place at a recent meeting of the South Croydon Radio Society, at which it was announced that in the near future a demonstration would probably be given of *The Wireless World* Super Selective Six, which is considered as representative of the best in superheterodyne practice to-day. The Society has prepared an ambitious programme for the coming weeks, and enquiries from prospective members will be welcomed by the Hon. Secretary, Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

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Loud Speaker Efficiency.

STARTLING statements concerning the efficiency of loud speakers were made by Mr. A. Kershaw, lecturing recently on "Loud Speaker Characteristics" before the Huddersfield New Radio Society. Mr. Kershaw contended that in the case of horn-type speakers the efficiency was not more than one per cent. With cone loud speakers of either the reed or moving-coil type the efficiency was greater, approaching, perhaps, three per cent.! Dealing with the general standard of reproduction obtained from loud speakers, Mr. Kershaw vigorously condemned all horn types which did not employ the exponential form. Very useful advice was given on the construction of such different types of speaker as the balanced armature, inductor dynamic, moving coil and electrostatic.

Hon. Secretary: Mr. E. G. Whitfield, Riber, Gledholt Road, Huddersfield.

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Horn Speakers Again.

THAT the horn speaker can still give a good account of itself was proved at the recent meeting of the Liverpool Wireless Society, when Mr. Percy H. Naftel, A.M.I.E.E., demonstrated a speaker constructed with a 10ft. Truvox horn and a Baldwin unit. The speaker was fed from a Lotus receiver kindly lent by Mr. L. C. Smith. The demonstrator had got rid of the last trace of horn and cabinet resonance by packing the cabinet with Sorbo rubber. A Magnavox moving-coil speaker was used for comparison, and the members were surprised at range of frequencies covered by the horn speaker, which, in the opinion of many, was superior to the moving-coil example.

The next meeting will be held on January 11th, and new members will be welcomed. Full particulars can be obtained from the Assistant Hon. Secretary, Mr. R. Reid Jones, 24, Oak Leigh, The Brook, Liverpool.

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The Tungar Rectifier.

MR. A. P. HILL, of the Edison Swan Electric Company, lectured on "The Tungar Rectifier" at a meeting of the Golder's Green and Hendon Radio Society, held on December 10th. After a brief review of the history of the Tungar rectifier, Mr. Hill described the process of manufacture, the various types of lamp and their respective uses. The lecture was illustrated by many lantern slides.

Particulars of this Society will be sent to anyone interested on application to the Hon. Secretary, 22, The Parade, Golder's Green, N.W.11.

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"A Good Domestic Proposition."

THE Woodford, Wanstead and District Radio Society had on Thursday, the 10th December, an A.C. model of the "Umello" receiver working during their meeting at headquarters, 20, High Street, Wanstead.

Mr. Crisp, quoting from an earlier issue of *The Wireless World*, gave some details of the circuit. From the point of view of cabinet work and compactness he thought it was a good domestic proposition. It could also be used as a gramophone amplifier. Provision is also made for the attachment of a short-wave adaptor.

The Society meets at Overton House, Wanstead, at 8 p.m. on Thursdays, and Mr. H. O. Crisp, 2, Ramsay Road, Forest Gate, E.7, is the hon. secretary.

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The Westinghouse Rectifier: Illustrated Lectures.

MEMBERS of the technical staff of the Westinghouse Brake and Saxby Signal Co., Ltd., are giving lectures on the uses of the metal rectifier, illustrated by lantern slides and a special cinematograph film, before a number of radio societies. The fixtures for the present month include: January 4th, Newcastle-on-Tyne Radio Society; January 5th, Northumberland and Durham Group Radio Society; January 8th, Edinburgh Wireless Society; January 11th, Harrow and District Radio Society; January 20th, Lensbury Radio Society; January 25th, Derby Radio Club.

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Slade Radio's Annual Dinner.

MEMBERS of Slade Radio, Birmingham, recently held their first annual dinner, which was attended by a large number of members and friends. A musical programme followed, and during the evening the chairman gave a brief and interesting history of the Society.

Two films illustrating the manufacture of valves at the Osram Works accompanied the lecture recently given by Mr. W. G. J. Nixon, of the General Electric Company.

Hon. Secretary: 110, Hillaries Road, Gravelly Hill, Birmingham.

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Hum-free Reception.

A "HUM-FREE" D.C. mains receiver was recently demonstrated by Mr. F. E. Henderson, of the General Electric Company, before members of the Muswell Hill and District Radio Society. The set employed the new Osram D.C. mains valves. Great interest was also aroused by a description of the Osram variable-mu types.

Full particulars concerning membership of the Society can be obtained from the Joint Hon. Secretary, Mr. F. A. Tunstill, 15, Queen's Avenue, Muswell Hill.

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Filming the Metal Rectifier.

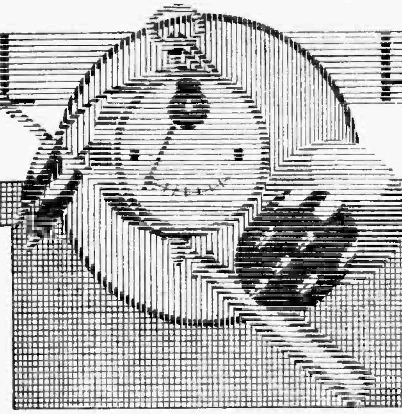
"METAL Rectifiers" was the subject of a lecture given before the Bristol and District Radio and Television Society by Mr. Stevens, of the Westinghouse Brake and Saxby Signal Co., on December 11th. Various forms of A.C. rectification were contrasted, and a film was shown on the screen explaining the actual flow of current through the components of various circuits.

Those wishing to join the Society are advised to do so now as membership confers the right to attend free classes at The Merchant Venturers' Technical College on Wednesday evenings, in addition to the excellent series of lectures by individual experts at the University on Friday evenings.

Hon. Secretary: Mr. G. E. Benskin, 12, Maurice Road, St. Andrew's Park, Bristol.

PRACTICAL HINTS AND TIPS

SIMPLIFIED AIDS TO BETTER RECEPTION



WHEN planning a short-range "quality" set it sometimes happens that a detector-L.F. combination, unaided by H.F. amplification, would hardly be sensitive enough for the requirements of the user. But, on the other hand, a highly efficient H.F. stage would give more magnification than necessary. In such cases, the receiver may be simplified and cheapened by employing a relatively inefficient H.F. amplifier, which will not need elaborate screening, and which may be made up in a very small space.

REDUCING H.F. AMPLIFICATION.

Here we have an instance where our usual aim—the attainment of just as much amplification as possible—need no longer be kept in view. Instead, precautions must be taken to ensure that amplification is no greater than can be coped with by, perhaps, a somewhat sketchy screening system.

The same problem must sometimes be approached from a rather different angle in cases where it is found that the amount of screening and decoupling actually provided in a receiver does not confer stability over the whole of the wave-range covered. Whichever way one looks at it, means must clearly be found to reduce amplification, and it is by no means easy to determine exactly the best way of doing so.

The efficiency of a tuned coupling circuit, and consequently stage amplification, can be reduced to any desired extent by shunting it with a suitable value of resistance, or, alternatively, by interposing a resistance in series. But as this plan will destroy selectivity, as well as reduce sensitivity, it is not a practical one nowadays. Perhaps the best scheme of all, when a transformer is used to link the two circuits, is to reduce coupling between the primary and secondary windings by removing turns from the former. When the more popular tuned-grid system of coupling is employed an exactly similar effect is produced by "tapping down" the connection from the preceding anode on to the tuned coil. After all, we are generally not so much concerned with reducing amplification as with reducing a tendency towards instability, and, by adopting this scheme, the H.F. voltage on the anode (which causes instability) is in most practical cases reduced at a greater rate by thus loosening coupling than amplification is reduced by the same process.

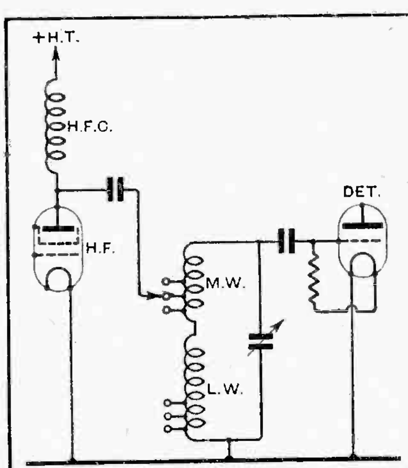


Fig. 1.—Controlling H.F. amplification: the tuned-grid coupling coils are used as variable-ratio auto-transformers.

By trial and error it is easy to determine the best position for the tapped connection; of course, it will generally be necessary to reduce coupling on both wave bands, and so tapping points must be provided on both medium- and long-wave windings (see Fig. 1).

Selectivity will actually be increased by adopting this plan, and at the same time that proportion of anode-cathode capacity (of the preceding H.F. valve) that is transferred to the tuned circuit will be considerably reduced. This is rather an important point when dealing with sets having a ganged tuning system, and suggests a solution of the problem that is sometimes encountered when an excessive amount of trimming capacity has to be added to other circuits in order to compensate for the large amount of stray capacity that may exist across a tuned-grid coupling circuit.

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UNTIL recently the possibilities of screening connecting leads carrying H.F. currents have not received the attention they deserve. Provided that reasonable care is taken to keep the added stray capacity that is inevitable with this method of wiring within reasonable bounds, it does not introduce any really undesirable effects in a modern set, and often enables the designer to plan a much better layout than would be possible if the position of all the components had to be determined solely with a view to keeping the connecting leads as short as possible.

SCREENED REACTION LEADS.

A case in point is that of the connections to a reaction condenser. When an attempt is made to plan a fairly sensitive set which is to be housed in a container of unconventional shape, it may well happen that these leads—which carry amplified H.F. energy—must be passed close to the input circuit, and so may cause instability. When this takes place, the plan of enclosing the wires in earthed metallic braiding may be adopted with full confidence that it is most unlikely to have any untoward results; indeed, there is less need than usual to take great trouble to reduce the capacity between the conductor and its screening cover to an especially low value.

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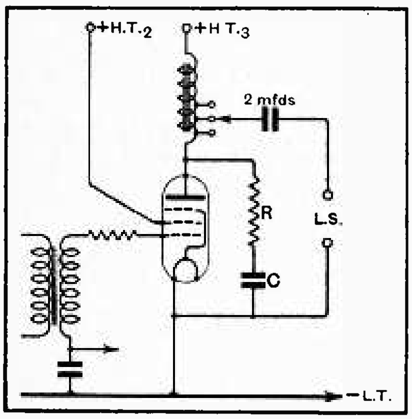

Fig. 2.—Modified output circuit of "The Wireless World Two," allowing the use of a standard loud speaker.

THIS receiver is primarily intended for operation with a special Celestion or Ormond loud speaker, which is wound to match the new high-efficiency pentode. In these circumstances, of course, no special matching precautions are necessary, and the loud speaker, shunted by a tone corrector, may be inserted directly in the anode circuit of the output valve, as described in the constructional article.

"THE WIRELESS WORLD TWO."

Sometimes it may be desired to use an existing loud speaker with standard windings, and, if so, it should be emphasised that the full benefit of the new valve is only to be obtained if some care is taken in matching the loud speaker impedance, and also in correcting the natural tendency of all pentodes to over-emphasise the higher frequencies. Fortunately, the necessary modifications are neither difficult nor costly, consisting merely in the addition of a special output choke, preferably tapped at several points, so that it may in effect act as a step-down transformer, giving various ratios between 1 : 1 and 2 : 1.

Matters are arranged as in Fig. 2, which shows that the usual feed condenser is connected in series with the loud speaker. Suitable values for the tone-correcting condenser (C) and resistance (R) are, respectively, 0.002 mfd. and 50,000 ohms, although some modification of these values may be necessary in certain cases. It should not be forgotten that the characteristics of high-efficiency pentodes are changed to a great extent if one varies their working conditions; for example, a change in output transformer ratio may be called for if a considerable increase is made in anode voltage.

In practice, there is no difficulty in making this adjustment by aural means with the help of the tapped choke already mentioned; it has been found easiest to determine the best adjustment when listening to a transmission that contains a good proportion of the lower frequencies, as, for instance, a deep male voice. Having obtained maximum output in the lower register in this way, the balance of tone may be corrected, if necessary, by altering resistance or capacity values.

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IN making up a self-contained all-mains set from a published design there are one or two possible dangers in replacing the original components by those which the constructor happens to have in stock. Dangers, that is, in addition to the obvious possibility, common to all sets, of finding that the substituted component is of less good quality, or less well suited to the set, than that selected by the designer.

UNEXPECTED HUM.

Of the troubles peculiar to mains sets, the most likely to arise is that of hum. In laying out the components on the baseboard, the designer may quite likely have found that the L.F. transformer requires to have one quite definite position with respect to the mains transformer, the penalty for departing from this particular position being the interlinking of the fields of the two components, resulting in the introduction of hum of a particularly incurable variety. The designer may have been even more subtle and knowing than this, and may have deliberately introduced hum by induction between mains and intervalve transformers in such a way that it neutralises and offsets hum derived from some other source.

It will be evident, bearing these possibilities in mind, that the replacement of either of the specified transformers by another may give rise to very appreciable hum, and that if it does do this no blame need be laid at the door either of the designer of the set or of the designers of the substituted transformers.

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A COMPACT home-made portable set is often enclosed in an extemporised ready-made container—a suit-case, attaché case, or something similar—that was never intended by its makers for such a purpose. As often as not, the material of which these cases are made has deplorable dielectric properties, as can sometimes be proved by the fact that the set works much better when the frame aerial is withdrawn entirely from the container.

FRAME AERIAL WINDING.

It is always a safe rule to allow a certain amount of air spacing between a frame-aerial winding and any solid material that may be likely to introduce losses.

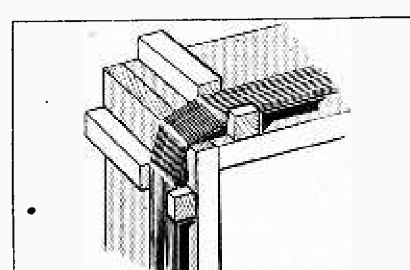


Fig. 3.—Frame aerial supported on slotted battens, providing air spacing between the winding container and wooden framework.

This spacing may easily be provided by making the usual wooden framework rather smaller than the inside dimensions of the case, and by fitting, as supports for the winding, a number of slotted battens, arranged as in the accompanying sketch. The battens may be about ½in. square.

BROADCAST BREVITIES

By Our Special Correspondent.

Prophets Confounded.

TWO "Surprise Items" in three days is good going. On December 28th we had "Eros," and on December 30th the appointment to the B.B.C. Governing Board of Mr. Harold G. Brown, who succeeds Sir Gordon Nairne.

Gazing back at the procession of names with which the prophets have dazzled us in the past few months it would seem that Mr. Brown's was the only one omitted.

No Axes to Grind.

The new governor brings to the Board a wide experience in City affairs, which should be useful in matters affecting the commercial and financial side of the B.B.C.'s activities.

There will be some heartaches, I fear, among the various bodies who consider that their special interests should be represented at the governors' table; however, the Corporation continues to emphasise the point that governors are chosen not, as it were, because they have axes to grind, but because of their wide outlook and experience of men and affairs.

The Other Surprise.

And now a word about "Eros"—the brilliant little "Surprise Item" which, I hope, inaugurates a new series. The idea of a "Pageant of Piccadilly" was conceived and executed by the originator of the Surprise Items—John MacDonell—and it is no betrayal of secrets to say that the B.B.C. Productions Department under Val Gielgud put the whole thing through in the space of ten hours.

Who can now say that "Surprise Items" are not practicable?

"Good Luck and Good Listening."

Two months ago I began advocating the revival of the feature, and the plea was taken up immediately by the national Press. It will not be John MacDonell's fault if surprises are not once more included in the regular programmes, for he tells me that he is ready and anxious to supply the ideas if Savoy Hill will give him the scope.

"Good Luck and Good Listening" is the slogan he appended to the Piccadilly broadcast. If we wish him the one he may soon be giving us the other.

A Western Regional Mystery.

TWO mysterious photographs were going the rounds of Fleet Street last week. They purported to show the "33,000-volt switching structure which will supply power to the new B.B.C. West Regional Station at Williton."

Impressive.

As pictures they were quite impressive; the brawny workmen straddling across the massive girders looked important enough to be on a B.B.C. job. But, funnily enough, the B.B.C., having arranged to generate their own power on the spot, know nothing about this power supply structure.

How now, my dear Watson?

Spade Work.

The authentic news concerning Western Regional is that the foundations are now being dug and that the contract for the building has been placed with a Gloucester firm.

In practically every respect Western Regional will be a replica of its sister stations at Brookmans Park, Moorside Edge, and Falkirk.

America to Entertain Europe.

OUR New York friends have been anxious for some time to give European listeners a typical American programme. Apparently we shall get it on Monday next, January 11th, for, between 9.15 and 10.15 (G.M.T.) on that evening the B.B.C., in common with Continental broadcasting organisations, will take a Columbia programme over the transatlantic telephone.

The First of Many?

The concert will contain light musical gems by star artistes of the Columbia system, including Freddie Rich and his orchestra, Tony Wens in a poetry reading, Jacques Renard's orchestra, Morton Downey, the tenor, and other attractions.

I understand that this programme will be the first of a series in which American broadcasters will show Europe what they can do—"and how." The concert will be relayed simultaneously in Paris, Vienna, Budapest, and Prague.

I wonder what Prague will make of the poetry reading?

A Feast of Song.

The next American concert, which is planned for February 15th, will, it is understood, provide a feast of song for those who like "negro spirituals."

A Cheer from America.

Lest we labour under too deep a sense of obligation to America, it should be recorded that the B.B.C. have received a charming cable from Mr. Elwood, vice-president of the National Broadcasting Company, congratulating them on the success of the Christmas pantomime "Aladdin." Americans are keen listeners to 5SW.

B.B.C. Concert for Europe.

THE Sunday evening symphony concert in Studio 10 on February 21st consists of an all-British programme, with works by Elgar, Delius, Holst, and Ireland. The concert will be relayed to all the chief broadcasting countries in Europe, and, of course, will be heard, in addition, by Regional listeners in England.

"Science and Civilisation."

EARL RUSSELL, who is better known to the public by his former name, the Hon. Bertrand Russell, will broadcast this evening (Wednesday) for the first time since he succeeded to the earldom. He will give the opening talk in the symposium on "Science and Civilisation."

Vitamins.

NO less an authority than Sir F. G. Hopkins, president of the Royal Society, will tell us about "Vitamins as Necessities for Life," in the National Lecture to be broadcast on January 22nd.

What They Think He Thinks.

SELF-CRITICISM is a new urge in American broadcasting, and the following extracts from the "Listeners' Decalogue," compiled by Mr. John W. Elwood, the N.B.C. vice-president, are impressive in their frankness.

THE NEW B.B.C. GOVERNOR. Mr. Harold G. Brown, whose appointment as successor to Sir Gordon Nairne, was announced last week.

"I am the listener. I am the final word in determination of the popularity of a radio programme.

"I will listen to a reasonable amount of sales talk, but make it snappy.

"Tell me not the same story again and yet again. I have no desire to memorise your stuff.

"Crash not in upon my uplifted mood inspired by noble music with barkings about your product.

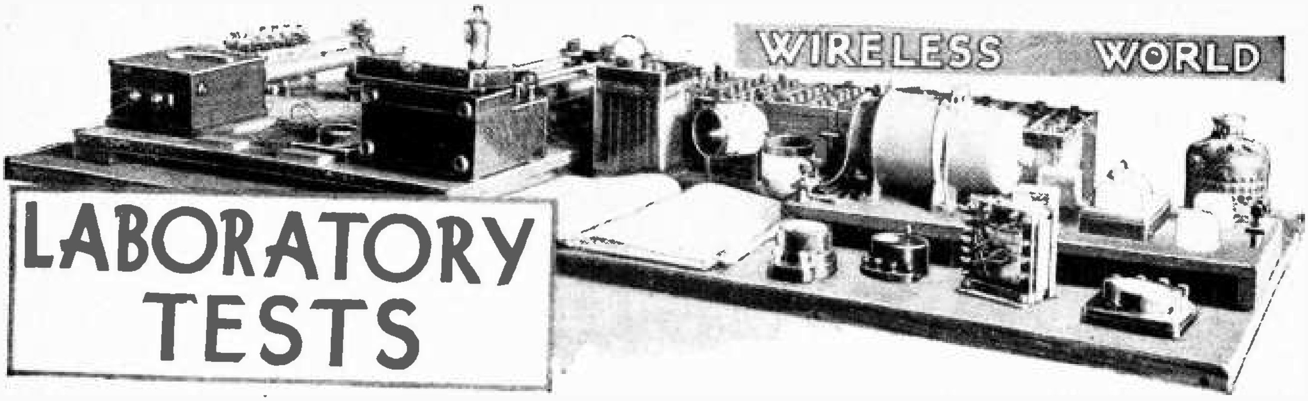
"Speak not in the tongue of the liar, neither use superlatives until I sicken.

"Conform to the rules of good taste, courtesy, decency, and common sense. You enter my humble abode as an invited guest, but mistake not the warmth of my welcome for an invitation to become a permanent lodger. These be my whims and caprices. By them are you judged. Hearken to me and practice these precepts lest I give you the razzberry and turn off the darn thing, clap on my hat, and to the movies."

Not Forgetting the Dentist.

A WORD of praise to Mr. J. C. Stobart, who performed a miracle of originality with his "Grand Good Night" on Friday morning last. This time he remembered even the dental surgeons—"for a special reason"! But what of the painters of spots on rocking horses?

LABORATORY TESTS



A Review of Manufacturers' Recent Products.

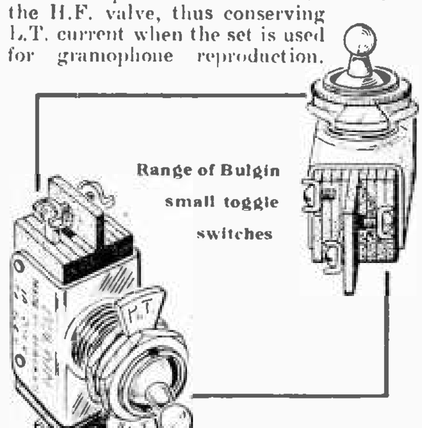
BULGIN TOGGLE SWITCHES.

The small quick-action toggle switches made by A. F. Bulgin & Co., Ltd., 9-11, Cursitor Street, Chancery Lane, London, E.C.4, are now available in three different styles. The single-pole make-and break pattern will carry up to 3 amps. at 250 volts if required, and as the consumption of the average mains set rarely exceeds 0.25 amp., there is a big margin of safety. Its other uses are legion.

There is now a three-point switch in this design which may be used for wave-change purposes where the circuit calls for a switch on these lines. The three contacts are joined together only in the "on" position.

The last of the series is a two-circuit alternative make-and-break switch having two pairs of contacts which are entirely separate By connecting one of the contacts at one end to a contact at the other end, the switch is converted into a single-pole change-over model.

As a two-circuit switch it could be employed to bring a gramophone pick-up into circuit with one set of contacts while the other pair break the L.T. circuit of the H.F. valve, thus conserving L.T. current when the set is used for gramophone reproduction.



Range of Bulgin small toggle switches

Single-hole fixing is adopted for all models, and in every case the fixing bush is insulated from the electrical contacts so they can be mounted on metal panels without the need for special bushes.

The prices are very reasonable; the "on-off" switch costs 1s. 9d., the three-point model, and the two-circuit model, cost 2s. each.

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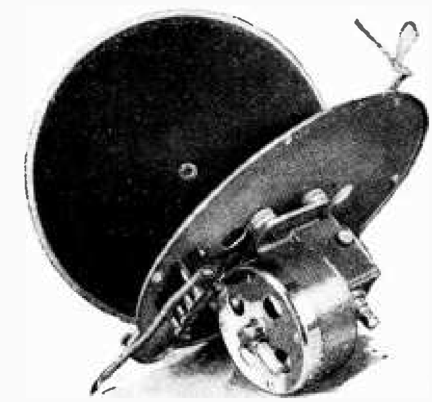
COLLARO INDUCTION MOTOR.

The turntable is driven through gearing by a high-speed motor with a drum-type armature. All the moving parts, including the governor, are enclosed in a one-piece aluminium casting, which effectively protects the bearings from dirt and prevents the flinging of oil. Incidentally, both main bearings are provided with spring-loaded wick lubricators. Incorporated in the vertical turntable spindle is a flexible coupling which ensures freedom from speed fluctuation due to variations in the supply voltage.



Collaro induction-type gramophone motor.

The performance is in every way excellent, and no reduction of speed is likely even with abnormally heavy pick-ups and loud recording. The motor runs cool, and there is a total absence of vibration. This is in part due to the four-point rubber suspension of the motor unit.

The electrical circuit includes an automatic stop switch of the pre-set type and an ingenious reversible contact plate for adjusting the windings to 100/130 or 200/260 volt A.C. mains. The workmanship throughout is impeccable, and at £3 the unit is excellent value for money.

Makers: Collaro, Ltd., Culmore Road, Peckham, London, S.E.15.

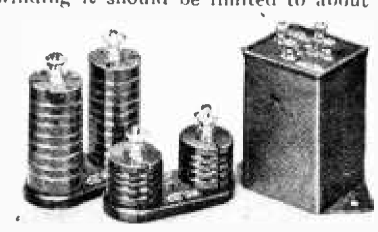
CLIMAX "MU-MAX" TRANSFORMER AND H.F. CHOKES.

The "Mu-Max" L.F. transformer, being wound on a high permeability core, possesses the dual qualities of a reasonably high primary inductance and small physical size. Its overall dimensions are 2⅜in. over fixing lugs, 1⅝in. wide, and 2⅜in. high measured over the terminals. Transformers with this style of core are best used in the parallel-feed circuits, as the steady anode current is deflected through the resistance, or choke, and the higher primary inductance available under these conditions will give better amplification at the lower frequencies.

The following inductance values were obtained by measurement at 50 cycles, and with 10 volts A.C. across the winding.

D.C. (mA.).	A.C. (mA.).	Inductance (Henrys).
0	0.95	31.5
1	1.6	19.2
2	2.2	13.5
3	2.5	10.8
4	3.5	9.0
5	3.8	7.7

The most suitable valve to precede the transformer would be one with an A.C. resistance of some 10,000 ohms, and if the anode current is passed through the winding it should be limited to about 1.5 mA. This assures that there will be a reasonably good amplification at the lower frequencies. The step-up ratio is 1 : 3½, and the price is 5s. 6d.

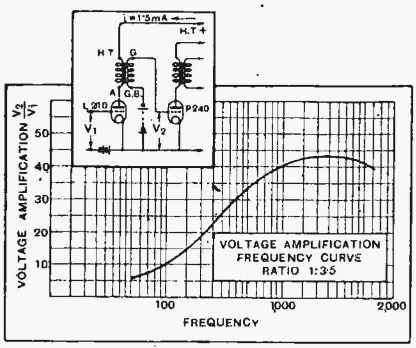


Climax "Mu-Max" L.F. transformer and binocular H.F. chokes. Note the small size of the Bijou model.

Two types of H.F. chokes were submitted for test; both are binocular wound, and have a negligible external field. The larger model, costing 6s. 6d., was found to have an inductance of 224.4 millihenrys, with a self-capacity of approximately 6 mmfds.

This high inductance throws the resonant wavelength well above the upper limits of the long broadcast waveband, so that in a practical circuit the choke will without doubt be satisfactory in every respect.

The smaller model, styled the Bijou H.F. choke, showed an inductance of 67 millihenrys, with a self-capacity of 9 mmfds. The higher self-capacity is introduced by using fewer sections in each coil of the binocular winding. Despite its lower inductance, no difficulty will be experienced in a practical circuit, for, taking into consideration the distributed shunt capacities, the choke will not resonate below 2,000 metres. The price of the "Bijou" model is 3s. 6d., and the makers are Climax Radio Electric, Ltd., Haverstock Works, Parkhill Road, Hampstead, London, N.W.3.



Voltage amplification—frequency curve of the Climax "Mu-Max" L.F. transformer taken under working conditions.

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EDDYSTONE SHORT WAVE COMPONENTS.

A selection of Eddystone short wave components deemed suitable for the construction of the special Superhet adaptor described in *The Wireless World* dated December 23rd last has been sent in by Stratton and Co., Ltd., Balmoral Works, Bromsgrove Street, Birmingham. For some years past this firm has specialised in the development and manufacture of short wave components and apparatus.

The oscillator coils are wound on a skeleton former measuring 2¼in. in diameter, and consist of a two-section grid coil with the reaction winding accommodated in the space between the sections. A switch short-circuits one section for receiving on the lower wave range. The coil is not screened, but the omission will not affect the performance of the unit.

It would be advisable to use the Eddystone special short wave condenser with this coil, as, although the maximum capacity is only 0.00016 mfd., the wave range covered is sensibly the same as that of the unit described recently. This condenser is exceptionally well made, and has a very low minimum capacity. The coil, complete with switch and mounting bracket, costs 8s. 6d., and the price of the short wave condenser is 10s. 6d.

The Eddystone short wave H.F. choke is wound on a hollow former provided with six wings, the overall diameter being 1in. The turns are space-wound, and the effective wave range is from 9 to 100 metres.

Selected Eddystone components for the Short-wave Superhet Adaptor described recently.

Its self-capacity is 1 mmfd. only, and the price is 3s.

A midget tubular-type neutralising condenser is available for use in series with the aerial lead; this has a maximum capacity of 12 mmfd., and, complete with mounting bracket, it costs 2s. 9d.

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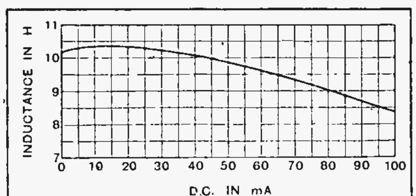
"GOLTONE" FLEXIBLE METALLIC SCREENED SLEEVING.

Modern screen-grid valves are so much more efficient than those of a year or two ago that more complete screening of all circuits and leads carrying H.F. currents is essential if full advantage is to be derived from the excellent chaacteristics of the valves. Thus it is necessary to employ screened wiring for the anode leads, but the screening must be arranged so that it does not introduce an appreciable capacity to earth, otherwise a serious loss of H.F. energy will be inevitable.

The special braided metal flexible sleeving introduced recently by Ward and Goldstone, Ltd., Frederick Road (Pendleton), Manchester, is particularly well suited for this purpose. It consists of 2-millimetre bore insulated sleeving covered with a braided metal outer casing. If a thin gauge of wire is threaded through the sleeving, the capacity between the conductor and the metal casing will be sufficiently small to preclude noticeable H.F. leakage.

This material is supplied in one-yard lengths, the price being 9d. per piece.



Inductance curve of Sound Sales filament choke with D.C. flowing through the winding.

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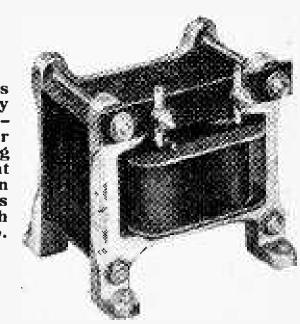
SOUND SALES FILAMENT CHOKE.

When a D.C. mains-operated receiver is fitted with valves requiring 0.1 amp. for the filament, smoothing equipment is essential, and it is sometimes advisable to adopt the same expedient when the indirectly heated valves of low filament consumption are employed. Sound Sales, Ltd., Tremlett Grove Works, Junction Road, Highgate, London, N.19, have produced a choke suitable for this purpose which will give an adequate inductance even when passing 0.1 amp. It is rated as a 10-henry choke, and the D.C. resistance is 118 ohms only.

The inductance of a specimen choke was measured at a frequency of 50 cycles with various amounts of D.C. flowing through the winding. It will be seen from the curve that the inductance is maintained at a satisfactory level throughout, and even with the rated maximum of 100 mA. of D.C. flowing a value of 8.4 henrys is available.

There are various other uses for a component of this type; for example, it could be employed as an output choke in conjunction with a valve of low A.C. resistance whose normal anode current may attain a value of about 100 mA. The inductance would be adequate for this purpose.

Sound Sales 10-henry choke designed for smoothing the filament current in D.C. sets fitted with 0.1 amp. valves.



The price of the choke is 15s.

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Catalogues Received.

East London Rubber Co., 29-33, Great Eastern Street, London, E.C.2.—108-page well-illustrated catalogue of receivers, accessories and components, also electrical fittings handled by this well-known firm of wholesalers.

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R. Cadisch and Sons, 5 and 6, Red Lion Square, London, W.C.1. — New radio catalogue for the 1931-1932 season, containing 268 pages of descriptive matter and well illustrated.

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Telsen Electric Co., Ltd., Aston, Birmingham.—Illustrated booklet describing the full range of current Telsen components.

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Marconiphone Co., Ltd., 210-212, Tottenham Court Road, London, W.1.—Illustrated and descriptive catalogues dealing with the current range of Marconiphone receivers, loud speakers, and Marconi valves.

CORRESPONDENCE

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

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

SLOW SPEED RECORDS.

Sir,—I notice that in *The Wireless World* of December 16th Mr. Huxter suggests that the slow-speed gramophone record is long overdue.

In this connection, the results of a test made with a 4,500 cycle note will, no doubt, be of general interest.

A 4,500 cycle note was cut in the ordinary way.

(1) At the outside of a 10in. record (9in. diameter surface, vel. 38in./sec.).

(2) In the middle of a 10in. record (6in. diameter surface vel. 25in./sec.).

(3) In the centre near the label (3⅜in. diameter surface vel. 14in./sec.).

Optical examination confirmed that the recorded intensity was substantially constant.

On reproducing this note the intensity of reproduction obtained was in the proportion : 55 for cut No. 1; 40 for cut No. 2; 15 or less for cut No. 3.; the last value varying with the condition of the needle point.

The test was repeated with cuts of different intensity, but the ratio of response remained fairly constant.

As perfect reproduction demands preservation of the overtones, it is obvious that slower speeds than those used at present are not desirable. P. G. A. H. VOIGT.

Upper Norwood, S.E.19.

WHY A TUNING NOTE?

Sir,—As a reader of *The Wireless World* in 1913 I feel I have some claim to address you. You often refer to the crowding of the ether and the difficulty there seems to be in effecting a remedy. I think we ought to put our own house in order first. What about this antiquated "tuning signal" of 15 minutes every Sunday afternoon from the B.B.C.? Now that there is some "brightness" in the air, and that from Paris, this miserable siren creeps in and largely spoils our gramophone reception. I quite fail to see any need for this "tuning note" nowadays, when everyone is quite well versed in working a wireless set. A. M. SHERRIFFS.

Hale, Cheshire.

INTERFERENCE.

Sir,—Whilst it is always unwise to be dogmatic when describing interference remedies, we believe Mr. Nugent C. A. Gilders is mistaken in his ideas on the subject. In his recent letter Mr. Gilders, lamenting the interference caused by a battery charging plant, states, ". . . the only satisfactory solution of the problem is more and more power to the broadcasting stations and shorter and shorter aerials to the receivers."

We agree that more powerful transmissions will have the desired effect, although for other reasons this may not be a popular solution, but why "shorter and shorter aerials to the receivers"? What have the receivers done to deserve such treatment?

The extent to which interference becomes troublesome depends upon the relative voltages due to the wanted signal and the unwanted interference which are fed from the aerial to the first valve of the receiver. Any means of increasing the voltage due to the desired station and decreasing that caused by the interference will result in a reduction in the apparent noise level.

The ideal remedy is naturally to remove or suppress the interference at its source, and quite often this can be done effectively without incurring any great expense. In any case the aerial-earth system of a receiving installation adversely affected by interference also offers considerable scope for improving reception. The reason for this is as follows: The majority of electrical disturbances which give rise to interference in the loud speaker are conveyed from the source of interference to the aerial system over the incoming lighting or power mains, and sometimes even *via* the gas pipes and telephone lines. This being the case, the best aerial is an outside one so erected that the maximum effective height is obtained for a given length of wire. The advantages of such an aerial over a short indoor aerial are twofold. First, the intensity of the desired signal is increased due to the increase in effective height of the aerial, and, secondly, the intensity of the interference is decreased, due to the weaker coupling between the aerial in its new position and the house wiring which radiates the interference. For the reasons outlined above, a long lead-in wire should be avoided at all costs, particularly with a sensitive receiver.

A word regarding the earth connection of the receiver may not be out of place. It is not always appreciated how important a part the earth connection plays in reducing interference. The earth system must have low H.F. as well as D.C. resistance to be effective for this purpose. A copper earthing tube or plate is preferable to indoor methods of earthing, unless perhaps the receiver can be placed close to the incoming water main. The wire connecting the receiver to earth should be of heavy section copper wire, and when possible a place should be selected for the earth tube, so that a direct run can be obtained between the receiving set and earth.

For further information on this subject Mr. Gilders is referred to an article by the writer entitled "Eliminating Static," published in the March 11th issue of *The Wireless World*.

London, W.C.2. A. B. CALKIN,
Philips Lamps, Ltd.

ELECTRIC SUPPLY.

Sir,—I have read with interest your recent Editorial re Electric Supply Companies, but was sorry to note that you did not touch on a point which is, to my mind, extremely important, namely, supply variation.

At my address the supply is at 240 volts—sometimes. During daylight the voltage is constant at 240, but, shortly after sunset, begins to fall, and falls steadily to about 200 volts.

I say steadily, but actually the voltage is fluctuating violently while falling. Imagine the fun this provides when one is trying out, say, voltage droppers in a mains set. The only hope, apart from waiting for the week-end, is to put a meter in each circuit, with a sharp eye on mains volts, and the moment it reaches 240, if at all, take simultaneous readings of circuits under test.

I had quite thought to overcome "running" difficulties in my radio-gram by fitting a series mains resistance with shorting switch, and setting mains transformer at 200 volts. This worked fine at first, but recently the mains have several evenings dropped as low as 190 volts, reproduction in these conditions being very poor.

I have had a lengthy correspondence with the company, and a recording meter was installed for some days, but they did not disclose the graph. In the last letter, some months ago, the company stated that it was their intention to install plant locally to meet the situation as soon as possible. The position is, of course, contrary to B.O.T. regulations. I believe this sort of thing is in no way uncommon.

Possibly the opening of your columns to correspondence on this matter may bring to light other cases, and may even lead to a method of bringing these companies into line with regulations. May I, in closing, record my appreciation of the continued assistance of your journal? M. V. PIRIE.

Middlesex.

Readers' Problems.

These columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.

Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found elsewhere in this issue.

Radio Gramophone "Faders."

TO judge by requests for information on the subject, the ability to make a smooth and progressive change-over from radio to gramophone reproduction or *vice versa* is attractive to a large number of home constructors. Unfortunately, it is not altogether easy to devise a simple and entirely satisfactory method of making the change, unless an intermediate stage of resistance-coupled L.F. amplification is interposed between the detector and output valves; where it is, the method employed in the R.G.D. radio-gramophones is to be recommended. This scheme is illustrated in Fig. 1; all that is required for its execution is a tapped potentiometer having a resistance value between points X and Y that is suitable for operation with the coupling condenser C.C. Similarly, the resistance between the tapped connection Y and point Z should be that recommended by the pick-up makers—generally about 50,000 ohms or more.

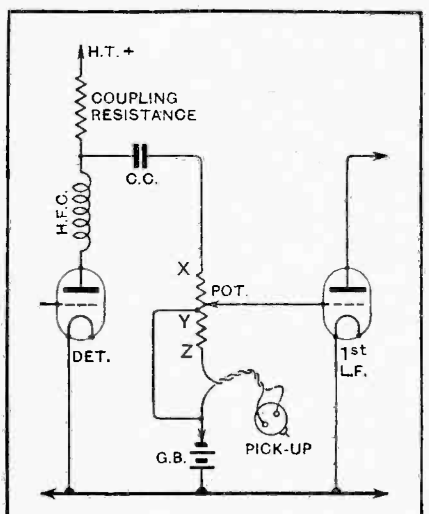

Fig. 1.—Explaining the principle of a radio-gramophone "fader"; the volume of either method of reproduction may be regulated, from inaudibility up to maximum, by rotation of the potentiometer control knob.

When the potentiometer slider is at the zero point Y, the first L.F. valve grid is virtually short-circuited with respect to both "radio" and "gramophone" inputs, and so no signals from either source will be heard. On moving the slider towards X, radio signals will become progressively louder, while input from the pick-up is similarly increased as the slider is moved from Y towards point Z.

For use with receivers in which the detector feeds directly into the output valve, Fig. 2 represents what is probably the simplest possible arrangement. In this case the change-over is normally not entirely automatic, as, when passing from "radio" to "gramophone," it is necessary to close the switch S, which short-circuits the detector grid condenser. It would be possible to effect this operation by means of a trip-action mechanism controlled by the potentiometer.

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Eliminators and Portables.

THE upkeep costs of a self-contained portable or transportable set may be reduced appreciably by installing an eliminator for supplying H.T. current, and a great number of sets originally designed for battery feed have been modified in this way with complete success. But occasionally motor-boating or L.F. howling is produced as the direct result of abandoning the H.T. battery, and questions are often received as to the best and simplest way of preventing this trouble.

As a general rule, the first step to take is to decouple the detector anode circuit by feeding it through a resistance of about 20,000 ohms; if a by-pass condenser is not already included, it must, of course, be added. This alteration in itself will often provide a complete cure; if it does not, the next move is to add a choke filter feed system for the loud speaker.

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Directional Properties Lost.

ANOTHER minor difficulty associated with the substitution of an eliminator for batteries in a self-contained set is the almost complete loss of directive reception properties that usually accompanies this alteration. It may be found that the usual well-defined point of minimum signal strength is no longer obtained as the frame aerial is rotated.

If it is desired to retain this property as an aid to selectivity, the simplest way of doing it is to alter the input circuit by making a centre tapping on the frame aerial.

Pentode Tone Control.

DUE to the difficulty that is sometimes experienced in obtaining an entirely suitable output transformer for matching a pentode valve to a moving-coil loud speaker, it is quite usual to use a tapped choke output system in conjunction with a loud speaker having a built-in transformer of the type designed for an ordinary triode valve. In fact, the loud speaker-transformer combination is treated exactly as a loud speaker unit. This plan is particularly to be recommended when dealing with highly specialised pentode valves, and where it is adopted it is usual—and quite satisfactory—to connect the usual tone-control device (resistance and condenser) across the choke rather than across the transformer.

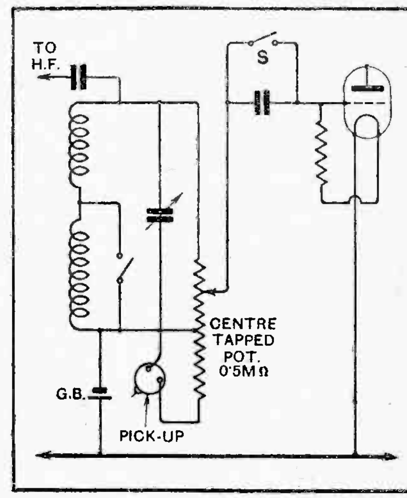

Fig. 2.—Radio-gramophone "fader" in the grid circuit of a detector valve.

The "Variable-mu Three."

SEVERAL readers have asked whether an H.F. amplifier on the lines of that included in the "Variable-mu Three" (November 18th and November 25th, 1931) could be made up successfully with other types of intervalve coupling. It may be recalled that the set in question embodies the tuned anode system for both stages.

The answer to such questions is that the tuned anode system is hardly a part of the basic design of the set in question, but an important point is that one of the great advantages of a set with a combined detector-output valve is that it is much less prone than usual to stray intervalve couplings, with the consequence that the simple, effective and inexpensive tuned anode system may be employed without risk of instability.

An amplifier on exactly the same lines could be made with either transformer or parallel-fed tuned-grid couplings, and no alterations other than those that are fairly obvious would be necessary.

Alternative Valves.

SEVERAL readers who are temporarily unable to obtain supplies of AC/SG valves, which were originally specified for the "Super-Selective Six" (A.C. model), have asked whether Marconi or Osram M.S.4B valves could be substituted without making any alterations to the receiver.

The characteristics of these valves are very similar, and such slight differences as exist are not sufficient to render necessary any changes. In consequence, they can be regarded as being interchangeable with those used in the original model.

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Testing by Absorption.

IN the "Hints and Tips" section of *The Wireless World* for November 26th, 1931, there was described a simple method of determining the comparative "goodness" of a number of tuned circuits by observing the amount of energy absorbed from an oscillator by each of the circuits under test. A correspondent now tells us that, by applying this method to a two-stage H.F. amplifier that has never worked satisfactorily, he has been able to localise the trouble in the tuned-grid coupling between the second H.F. amplifier and the detector.

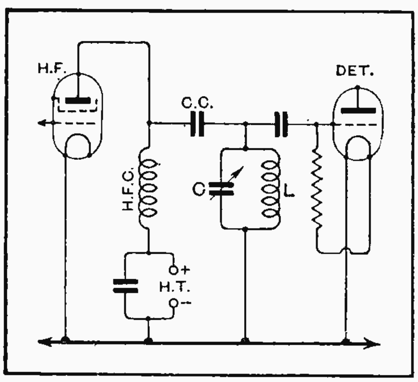

Fig. 3.—A conventional "tuned-grid" H.F. coupling, drawn so as to emphasise the fact that the H.F. choke is effectively in parallel with the tuned circuit LC.

Having progressed thus far, the somewhat drastic step was taken of replacing each suspected component in turn by a new one, and it was not until the H.F. choke was changed that any noticeable improvement was effected. On substituting another make of choke, the performance of the set left nothing to be desired, although the original one was apparently in good order. We are asked what kind of a fault could possibly exist in such circumstances, and also why a defective feed choke, "which is not really in the tuned circuit," as our reader puts it, should have such a serious effect in reducing efficiency.

If it can be assumed that the choke is well designed, the fault must be ascribed to a more or less complete internal short-circuit. In one case that came to our notice, the ebonite base on which the choke terminals were mounted was found to have a conductive "skin" of about 500 ohms resistance: a fault like this is naturally very difficult to find by ordinary means, as an ordinary test of resistance will show a fairly normal value.

The statement that the feed choke of a "tuned grid" H.F. stage is not *in* the tuned circuit is true enough, but it is virtually in parallel with the circuit, and so a defective specimen is capable of impairing its efficiency. This matter will be made clear by considering Fig. 3.

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Volume and Quality.

SOME of the receivers described in this journal are designed to give an exceptionally large output—in the order of several watts of undistorted speech-frequency energy. Such large volume as is represented by this output is not necessary for the majority of wireless users, but there are apparently many readers who believe in the principle of having a large margin of safety. But they hesitate to embark on the construction of a very ambitious amplifier because they are not certain whether such a piece of apparatus when "throttled down" will provide quality of reproduction that is in every way as good as when working to full capacity.

Their doubts may be set at rest by saying that provided a carefully designed system of volume control is included, the output of such an amplifier is not adversely affected, even when it is handling but a small percentage of the energy with which it is capable of dealing. Of course, the question of loud speaker reproduction is another matter; instruments of the moving-coil type are generally at their best when fed with a considerable amount of energy, but few, if any, really need the full output of an amplifier of the type under consideration.

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Nearly Right.

A READER who wishes to convert an 0—5 milliammeter (moving coil) into a voltmeter asks if he is correct in assuming that the necessary value of series resistance may be calculated by dividing "maximum voltage" by "current registered at full scale deflection." Actually, he wishes to read H.T. voltages up to 300, and so in his case the figures would be 300 divided by 0.005, which gives 60,000 ohms as the external resistance required.

Our querist reasons that, knowing a pressure of 300 volts will drive a current of 5 milliamperes through a resistance of 60,000 ohms, it can safely be assumed that exactly 300 volts is applied when a full deflection is observed, and that intermediate scale readings will indicate proportionately lower voltages.

But he has forgotten that the meter itself has a certain resistance, which should, strictly speaking, be taken into account. When dealing with high voltages, as in the present case, it is permissible to ignore it, as it is most unlikely to exceed 100 ohms at most, but when adapting the meter for reading L.T. voltages it is essential that the internal resistance should be deducted from the value obtained in making the calculation described by our reader.

Still on the same subject, he asks whether commercial wire-wound resistances would be suitable. The answer is that some of the better makes are guaranteed within a limit of 5 per cent. This error would be reflected in the voltage reading, but it is not too high for most practical purposes in connection with radio apparatus. Certain manufacturers are ready to select resistances of much higher accuracy at an extra cost.

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Low-voltage A.C. Supplies.

THERE are, throughout the country, a number of 110-volt A.C. supply systems, and it would appear that a misapprehension exists in some quarters with regard to the suitability of such a supply where operating an A.C. set. This is probably due to the fact that many standardised power transformers have primary windings designed for pressures in excess of 200 volts.

In actual fact, of course, a 110-volt supply can be used as satisfactorily as any other, but it is necessary when ordering a power transformer for operation on such systems to specify clearly that it must have a primary winding designed to suit the low voltage available. Any manufacturer can supply such transformers.

FOREIGN BROADCAST GUIDE.

BEROMUENSTER

(Switzerland).

Geographical position: 47° 24′ 22″ N.; 8° 30′ 29″ E.

Approximate airline from London: 476 miles.

Wavelength: 459.4 m. Frequency: 653 kcs. Power: 75 kW.

Standard time: Central European (coincides with B.S.T.).

Standard Daily Transmissions.

Relays broadcasts from Basle, Berne and Zurich studios.

09.30 G.M.T., sacred service (Sun.); 11.40, concert; 13.30, relay of outside broadcast; 16.00, sacred service (Sun.); 19.00, play or concert; 21.00, weather, news, dance music (Sat.).

Announcers: Man and woman. The German language only is used.

Opening call: *Hallo! Hallo! Hier Schweizerischer Landessendern* followed by the name of the studio, *i.e.*, Basle, Berne or Zurich from which programme is taken.

Interval signal: musical box melody.

Closes down with good-night greetings in Swiss dialect: *Guete Nacht mitander schlafts alle reeht woehl* (Good Night, everybody, sleep very well), followed by a short march, namely *La Retraite* if from Zurich or *La Marche de Berne* if from the latter city.

The Wireless World AND RADIO REVIEW (19th Year of Publication)

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Editorial Comment.

Should Sets Follow Fashions?

SINCE the days when broadcasting began, very great progress has been made in the direction of producing wireless receivers as compact units and making them, apart from their electrical qualities, serviceable instruments, neat in design and simple to control, whilst at the same time suitable to harmonise with the furnishings of a room.

In those days a wireless set, or a wireless receiving station, as it was then more appropriately designated, required quite a good-sized table to accommodate the many components which contributed towards the assembly of the set as a whole. The receiver consisted very often of a number of separate valve panel units wired together with a tuning unit, batteries, and loud speaker, all connected with numerous straggling leads.

Increasing Compactness.

The progress in design which has brought about so great a change was directed at first towards assembling the set itself in a cabinet; later, the batteries were included as well (or the mains equipment where the set operated from the electric supply), and more recently the further step has gained in popularity of including the loud speaker in the cabinet in addition so as to make one complete unit.

There are, of course, a number of good reasons for including the speaker in the cabinet; the arrangement has the advantage of compactness and absence of connecting wires. In the design of modern receivers there has also to be taken into account the necessity for ensuring that the speaker is matched with the output of the receiver; and in some cases, also, that it is complementary to the response frequency of the receiver as a whole.

No doubt other arguments could be put forward to support the policy of housing the loud speaker in the same cabinet, but we would suggest that it is possible to allow fashion to influence policy too far. It recently came to our notice that if we wish to locate our loud speaker at some point in the house or room where it would not be equally convenient to place the set as a whole, we have a very limited choice of modern receivers on the market to-day from which to pick a set which has not a speaker incorporated.

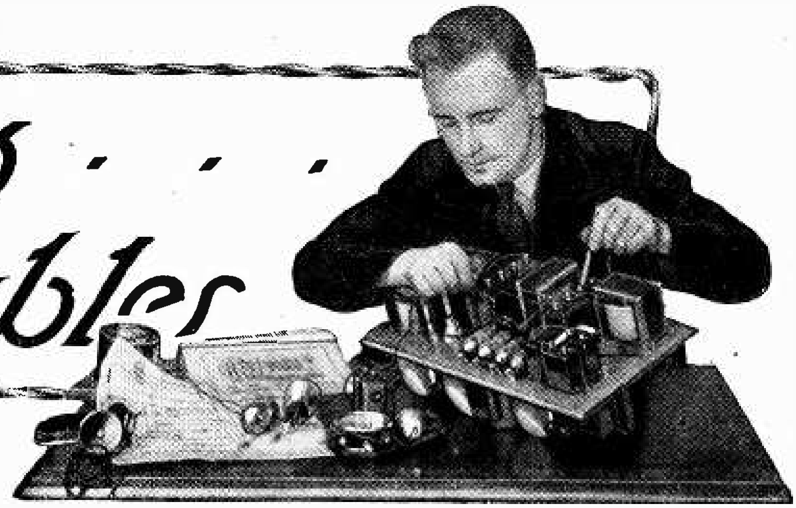
Importance of Location of Speaker.

It must very frequently happen that the user wishes to place his loud speaker in some particular position in his room, but that position may be, and very often would be, a most inconvenient spot for the set as a whole. Where an outside aerial is used it is not desirable to carry the aerial and earth leads across a room, and, consequently, it would be best to place the receiver near the window. Again, those sets which operate from the mains require to be located near an electric point, and it is surely unsatisfactory that the ideal location for the *loud speaker* in any room should have to be sacrificed because of other circumstances which contribute to deciding on the position for the *receiver*.

With a large number of modern self-contained sets additional terminals are provided for an extension loud speaker, and this is, of course, a very useful addition, but we cannot recollect any set having this provision where it is also possible to turn off the loud speaker incorporated in the set and operate only the extension loud speaker.

These are, perhaps, small points, but they seem worth consideration lest the tendency of radio should be to standardise too much along lines which do not provide the most convenient arrangement for the listener.

Tracing . . . Troubles



By M. G. SCROGGIE, B.Sc., A.M.I.E.E

No. 1.—Testing Equipment Required.

THE ordinary amateur who does not possess elaborate testing equipment often feels baffled when confronted with a set which "won't work." This series of five articles will constitute a simple guide to fault tracing, using only impromptu apparatus and one or two meters.

A SURPRISINGLY large proportion of the activities of this world are devoted to correcting things—and people—that have gone wrong. The Service Department of a radio manufacturing concern generally is not the smallest department. And the individual who builds his own receivers is not likely to be an exception to the general rule. Tracing radio troubles is a complete art in itself, and even the advanced worker is quite often faced with faults which are extremely baffling, while much time may be wasted over the less obscure ones unless they are tackled in the right way. Each separate set has its peculiarities, which cannot be dealt with exhaustively in a general article like this, but it is intended here to indicate the faults which most commonly develop, and how to spot them, without assuming very great technical knowledge or experience.

First of all it must be assumed that some sort of meter is available. The commonest forms of electrical measuring instruments measure voltage or current (amperage), corresponding to pounds-per-square-inch and gallons-per-minute respectively in the case of a water supply. Now, an ideal instrument would give a reading without in any way affecting the conditions it is supposed to indicate. Like most other things, what we have is not as good as what we want, and a voltmeter can only be made to give a reading by drawing off a little—and in some notorious makes not a little—current, while an ammeter (or milliammeter) necessarily offers more or less obstruction to the flow of current, and thereby robs the circuit of some pressure or voltage. It is absolutely vital to grasp this thoroughly, for failure to do so is responsible for many over-scratched heads. There is a court-of-law feeling of respect for the readings of an accurate instrument which it is the duty of this article to dispel, for even a truthful witness may cause the wrong man to be hanged, and even a blameless meter may mislead one terribly. There are several reasons why this is so, which will be considered in turn. Another indispensable qualification for test work is a firm grasp of how to apply Ohm's Law, which, as everybody knows, can be expressed as $I=E/R$, or, more vulgarly, amps = volts/ohms. In radio receiver circuits one nearly always works with milliamps, so for convenience the following are the three useful forms:—

Milliamps = volts × 1,000/ohms. Volts = ohms × milliamps/1,000. Ohms = volts × 1,000/milliamps.

Suppose we are measuring the voltage of a battery. We connect the voltmeter across the battery, i.e., straight from positive to negative terminals, thus forming a closed circuit through which the battery can supply current, and the greater the voltage of the battery the more current is forced through the voltmeter and the higher it reads. Unless the voltmeter is a very nasty specimen its resistance is very much greater than the internal resistance of a reasonably fresh battery, so that almost all the voltage generated by the battery is required to pass current through the voltmeter, and very little of it to overcome its own resistance; in other words, the voltage at the terminals of the meter, which is what it indicates, is very nearly as much as that of the battery. An ordinary 100-volt H.T. dry battery, intended to supply 10 milliamps or thereabouts, when new will do so without losing more than perhaps 2 or 3 volts. Some cheap moving-iron voltmeters take much more than 10 mA. at 100 volts, and even if they read correctly, which is highly unlikely, the reading is no definite indication of the voltage under working conditions.

But voltmeter tests are usually made on a battery when it is running down, in order to find out whether it is time to replace it. A dry battery which is running down is doing so because its internal resistance is increasing so much that a large part of the voltage is used

Tracing Troubles.—

up in overcoming its internal resistance, and is, therefore, not available for useful purposes. The voltmeter reading in this case may be anything, according to the voltmeter used. To take a concrete example: suppose our second-hand 100-volt battery has a resistance of 5,000 ohms. If it is connected to a circuit which takes 10 mA. at the full 100 volts the resistance of this circuit is, according to Ohm's Law, $100 \times 1{,}000/10 = 10{,}000$ ohms. But with 5,000 ohms battery resistance one-third of the voltage is lost in the battery, so that the actual voltage given at this stage of its life is $66\frac{2}{3}$. Now, the current taken by a voltmeter is usually quoted in the form of ohms per volt full-scale, e.g., a 25,000-ohm voltmeter scaled up to 250 volts has 100 ohms per volt, and requires 10 mA. to push the pointer over to full scale.

Milliammeter as Voltmeter.

A special laboratory high-resistance voltmeter might take so little current that even a very aged battery would show as near its original 100 volts as would not be noticed. A 1,000-ohms-per-volt meter would in our example read 95 if scaled up to 100, or 98 if scaled up to 250. A so-called voltmeter of the type which is found, but not by reference to the maker's catalogue, to have a resistance of 10 ohms per volt would be telling the truth if the pointer came finally to rest at 16.7. Obviously, neither of these results would be helpful in deciding the matter in question, so what does the good tester do? He can do one of several things. He can use a high-resistance voltmeter connected *while the battery is doing its work*, and so long as it takes only a small additional current, or in other words, has a high resistance compared with that of the circuit which is being fed, the indicated voltage is very nearly the same as that with no voltmeter there.

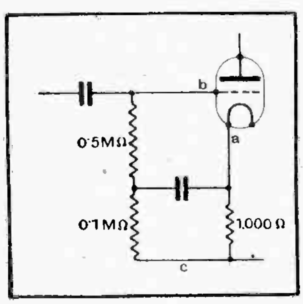


Fig. 1.—A voltmeter connected across ab will not measure the grid bias. The grid cathode-path of infinite resistance is in parallel with the voltmeter.

Another method is to use a voltmeter which imposes about the same load as that which the battery is intended to supply, thus combining both meter and load. Or what amounts to practically the same thing, but with different apparatus; instead of using a voltmeter one can use a milliammeter in series with a known variable resistance, adjusting the latter until the battery is delivering its normal current, and then getting at the voltage by applying Ohm's Law once more. After all, a voltmeter is in effect an instrument for measuring current, the current which can be forced through a high resistance, thereby giving an indication of the pressure. Make sure before you start that the resistance will carry the current without burning out or making a nasty smell.

There are other voltage readings that require still greater care if one is to avoid being conducted gently up the garden. Suppose that a certain valve circuit is suspected of a fault, and, in order to locate the trouble, the voltage at the anode of the valve is to be measured. If the part of the circuit between the anode and the positive H.T. consists of a tuning circuit, which usually has a D.C. resistance of no more than a few ohms, the voltage measured at the anode is practically the same as that at +H.T., while, of course, a failure to read at all indicates a break in that part of the circuit, which is what we set out to find. If the circuit contains the primary of a L.F. transformer, which is commonly of the order of a thousand ohms, it is necessary to consider the effect of the voltmeter, which may lower the voltage at this point considerably. But if it is a resistance-coupled stage, even a good high-resistance voltmeter reads far less than the true amount, i.e., in the absence of the meter. Take, for example, a 100,000-ohm coupling resistor passing 1.25 mA. on a 200-volt H.T. supply. It follows that the actual voltage from the anode of the valve to negative H.T. is 75. Suppose, however, that we attempt to measure it on a 0-150 voltmeter with 300 ohms per volt, i.e., 45,000 ohms in all. The resistance of the valve is $75 \times 1{,}000/1.25 = 60{,}000$, which in parallel

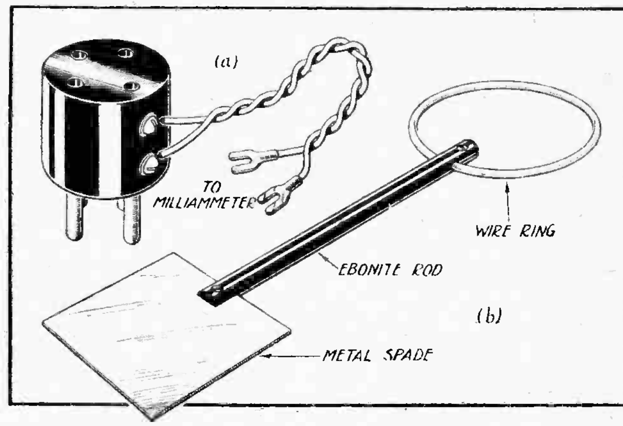
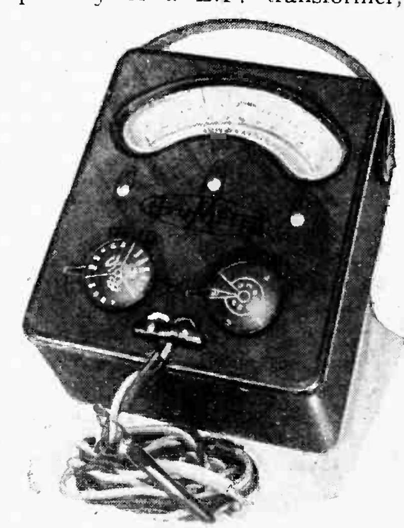


Fig. 2—(a) A valve holder adaptor with the anode connector broken and brought out *via* two leads to a meter provides a very useful means of testing valve circuits. (b) To obtain fine adjustment of inductance and capacity, a valuable aid is an ebonite rod with a metal ring at one end and a spade at the other.

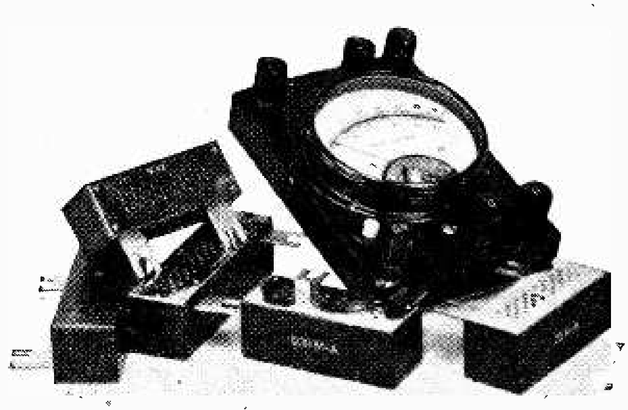


A testing meter of universal application—the Avometer. Readings of current, voltage and resistance can be made.

Tracing Troubles.—

with 45,000 is 25,700, so the total circuit resistance is 125,700, and the voltage across the valve and voltmeter is 200 × 25,700/125,700 = 41. Of course, it is quite sound to use a voltmeter in this way to make sure that there is not a break in the circuit, but if it is desired to know the actual voltage on the anode it is necessary either to calculate the effect of the voltmeter, which is not too easy and, in any case, does not give quite the right result, for the valve resistance is not obliging enough to remain constant while the test is made, or to put a milliammeter in series with the resistor, when, if the value of the latter is known, it is easy enough to calculate the voltage drop in it. It may not always be quite simple to break into the circuit to connect the milliammeter; the voltmeter has the advantage in this respect, that it is easier to connect, preferably by means of insulated prods.

It will have been realised by now how utterly futile it is to attempt to measure the grid bias in such a circuit as Fig. 1 by connecting a voltmeter across *ab*. The resistance in parallel with the voltmeter is the grid-cathode path, which should be almost infinite if the valve is in order, and in series is a half-megohm leak, among other things. Consequently, the effect of connecting the voltmeter is to reduce the voltage almost to nothing. On the other hand, by connecting it across *ac*, the parallel resistance is 1,000 ohms and series resistance is not known, but so long as the voltmeter resistance is a good many thousands of ohms it will not alter the state of affairs much. Unfortunately, there is plenty of scope for trouble between *c* and *b*, and the existence of bias between *ac* does not prove that it is getting to the grid of the valve in right measure. That question will be dealt with later.



The multi-range Dixonemeter, together with a number of multipliers. Such equipment provides the amateur with al necessary measuring facilities.

Measuring Resistance Values.

This disadvantage of voltmeters may be turned to good account in a handy method of measuring resistance. The only other thing required is a battery; a single cell is suitable for low resistances and a high-voltage source for high resistances. The battery voltage is measured with and without the unknown resistance in series. If V_1 is the voltage of the battery direct and V_2 with the resistance R in series, then if *r* is the resistance of the voltmeter: $R = (V_1 - V_2)r/V_2$. The most accurate results are obtained when R is about equal to *r*; with a multi-range meter and variable battery it is possible to manipulate things so as to get somewhere near to this ideal.

There is another prevalent source of error in the use of voltmeters. The majority of good-class instruments are of the moving-coil type, which is very nice in many ways so long as it is used strictly for D.C., that is, for measuring steady smooth voltage (or current). Most people do not require to be informed that it is of no use for A.C. The pointer merely vibrates over the zero mark, or does nothing visible at all. But what is not such common knowledge is that perplexing discrepancies are likely to arise in circuits where there is pulsating current or voltage, that is to say, constant in direction but varying in strength, as, for example, the product of a rectifier before it is smoothed. In fact, the whole matter of rectifiers and rectified current is full of complications, and the detailed explanation of them is rather beyond the scope of this article, but some of them will be referred to. In the meantime, it should be observed that two perfectly accurate voltmeters, one moving coil and the other moving iron, may simultaneously show quite different readings across the same two points. They are both right. One measures the average voltage and the other the "effective" voltage. Whenever a substantial ripple is present be careful not to depend too much upon calculations based on meter readings.

Coming now to the choice of a test instrument, in these days it can be safely assumed that cost is one of the most prominent considerations governing the selection, and therefore the object is to secure a single meter which will serve a large variety of purposes, though naturally if one can afford two or more separate instruments it is possible to extend one's range of tests, but it is far better to have one dependable meter than any number of doubtful ones. The moving-iron type of meter can be produced more cheaply than the moving-coil type. As regards accuracy, however, it has not been taken seriously until recently, when it has been revived as an instrument of precision, and, at the same time, it has been possible largely to overcome another of its disadvantages—a very unevenly divided scale—but such instruments are quite expensive and cannot be regarded as cheap substitutes for a moving coil. As the majority of tests requiring anything like accurate results are on D.C., a moving-coil instrument is generally advisable, and is conveniently in a form which permits it to be used either as a voltmeter or as a milliammeter, by the use of series and shunt resistances respectively, which may be brought into action by a switch, by separate terminals, or by external fittings, as the case may be.

A tool, which is also easy enough to make, and which is very useful for testing gang-tuned sets, consists of a stem of insulating material with a wire ring or closed loop at one end and a "spade" at the other.

In a continuation of this article we shall consider the actual tracing of faults.

The G.U.1. Rectifier.

THE THYRATRON

A Gas-discharge Valve with Grid Control.

By F. E. HENDERSON, A.M.I.E.E.

THE growing interest which is being shown both in this country and abroad in the various commercial applications of the gas discharge valve known as the "Thyratron" makes it appear that a short article dealing with the general principles and performance of this device may be acceptable.

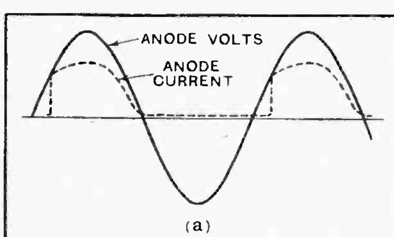
The applications of the Thyratron in commercial spheres have undoubtedly been developed to a much greater extent in the United States of America than in this country, but its possibilities are so widespread, and some of its applications so important, that it may be safely forecast to be only a matter of time for similar demands to arise on this side of the water.

Fundamental Principles—Two-electrode Tube.

Let us consider first what are the fundamental principles underlying the action of the Thyratron.

To do so it is of advantage to turn first to a study of the gas-filled rectifier, a type of which, in the form of a Hot Cathode Mercury Vapour Valve, has already appeared on the market in this country, an example of this being the G.U.1 Rectifier.

This valve consists of an electron-emitting oxide-coated helical cathode capable of a very considerable saturated emission current and a plate anode, the whole enclosed in an air-exhausted bulb in which a few drops of mercury have been introduced. The enclosed space therefore becomes filled with atoms of mercury vapour at low pressure.



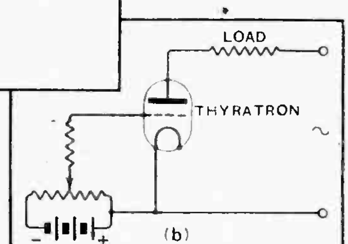


Fig. 1.—(a) The waveform produced with A.C. on the anode and D.C. on the grid. (b) Simple grid control circuits.

On heating the cathode to the required temperature to emit electrons, and on applying a low positive voltage to the anode, a small anode current passes limited by the internal resistance, which is now comparable to that of a similar hard valve at very low anode voltages. Immediately the positive anode voltage is increased to about 15 or 20 volts, however, the whole action of the valve is changed. At this voltage a much larger current equal to the full saturated current will now flow, owing to the ionisation of the atoms of mercury vapour by bombardment, the positive ions thus released going to neutralise the space charge. The anode volts will, however, remain at about 15 whatever the current taken up to the saturated emission. If higher voltages and no limiting resistance are used, the current will become excessive and the valve will be destroyed.

THE hot-cathode mercury-vapour rectifying two-electrode valve has already appeared on the market in this country. When a grid is added the valve is called a Thyratron, and possesses some remarkable properties which are likely to find wide application in the future. By its use it is practicable to convert D.C. to A.C., to transform D.C. to a higher or lower voltage, and, as larger sizes are developed, a new method of transmitting power at a high D.C. voltage becomes a possibility of the future.

In this condition of ionisation the valve exhibits the blue glow typical of a mercury vapour discharge. It is important at this stage that the value of external resistance, or "load," is sufficient to limit the anode current. As the internal resistance of the valve, as explained above, is very low, due to the neutralisation of the space charge, this anode-cathode voltage is maintained constant at about 15 volts, and is practically independent of the load up to load currents which would cause excessive ionisation, bombardment of the filament by positive ions, and its consequent disintegration and destruction as a low-temperature emitter.

The main advantage of the mercury vapour rectifier, therefore, is the greatly improved regulation when compared with the hard valve, due to its very low internal resistance with a constant voltage drop of about 15 volts. This low anode voltage means less watts in the anode, and to handle a given amount of power the bulb can be made very much smaller than with the hard thermionic rectifier.

The action of the grid in a three-electrode hard valve is well known, its function being to act as a continuous control to the flow of electrons between cathode and anode. Under normal operation conditions, however, the action of a grid placed in a mercury vapour discharge valve has an entirely different effect.

The Thyratron.—

The Thyratron under normal working conditions may be broadly described as a "Controlled Rectifier" of the mercury-vapour type.

We saw that in the mercury vapour valve a small space current flows at very low anode voltages, i.e., voltages below which the discharge commences. The valve under such conditions may virtually be considered as a hard valve, and with the grid included, as in the Thyratron, the same control on this small space current is exerted as in a hard triode valve. This means that a negative voltage applied to the grid can suppress the anode current.

Now, if with a negative bias the anode voltage is gradually increased it will arrive at a certain value, depending upon the geometry and negative voltage of the grid, at which, as in an ordinary three-electrode valve, the anode begins to take a small current. At this point, if the anode voltage is at least 15, the discharge commences, and once it has done so the grid exercises no further control on the anode current. The value of anode voltage at which the discharge will commence is equal to the amplification factor of the Thyratron multiplied by the negative grid voltage applied. For a given design the larger the negative grid voltage the higher will be the anode voltage required to start the discharge. It is not now possible to stop the anode current, no matter how much negative voltage is put on the grid, and this would continue to flow indefinitely until the anode positive voltage is removed or reduced below 15.

As with the two-electrode mercury vapour rectifier, while the discharge is in progress the resistance is extremely low and the anode voltage maintained at about 15 volts. It will be seen, therefore, from the above brief description of the Thyratron action that the grid, by the choice of its geometry and its relation to the rest of the electrodes, and by its negative voltage, can be made to act as a trigger by which the anode current can be started on the anode voltage arriving at a specified figure, *but once started the grid exercises no further control.*

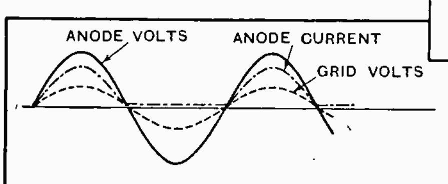


Fig. 3.—The grid volts arranged to be in phase with the anode volts.

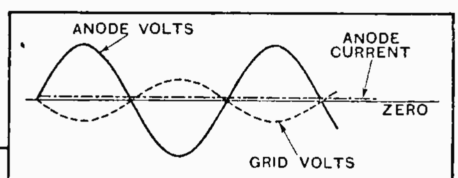


Fig. 2.—The grid volts 180° out of phase with the anode volts.

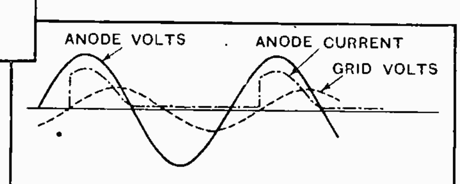


Fig. 4.—Where the grid volts and anode volts are 90° out of phase.

Some Applications.

The applications of Thyratrons open up wide and fascinating possibilities, and may be broadly divided into two classes—those with A.C. applied to the anode, and those with D.C. Let us consider the A.C. class first:

A.C. applied to the Anode and D.C. Grid Control.

To consider the performance of a Thyratron with A.C. on the anode, turn to Fig. 1, which indicates the anode volts waveform due to the A.C. applied to the anode. As we saw above, the negative grid voltage can be fixed at a critical value so that the discharge will commence at any given anode voltage above 15. We can thus by means of a small potentiometer in the grid circuit arrange the grid voltage so that as the anode volts rise during the positive half-cycle of the A.C. wave the grid will cease to hold the anode current in check at any point of the rising voltage up to the maximum in the half-cycle.

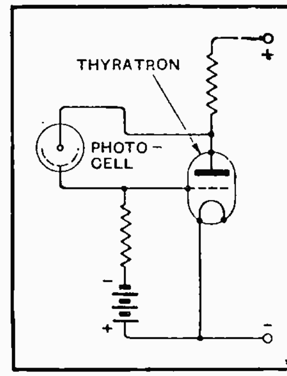


Fig. 5.—An interesting application of the Thyratron where a photo cell is made to act as a grid potentiometer.

On the anode voltage falling to zero again the anode current will cease, and the grid will once more exercise control and prevent the discharge commencing until the anode voltage has reached a similar point on the next position half-cycle. During the negative half-cycle no anode current can flow. By means of a very small control in the grid circuit, therefore, we can arrange things so that any required degree from the maximum rectified current to half this value may flow through the load. Thus, considerable load currents may be controlled by a small knob.

A.C. Grid Control.—The disadvantage of the above D.C. grid control is that the anode current can only be cut down to half-value. A better method is to utilise phase differences in anode and grid voltages. Now let us refer to the diagram of the anode voltage wave shown in Fig. 2. By making the grid volts 180° out of phase with the anode volts the grid voltage will gradually become more negative as the anode becomes more positive, so that the grid exercises complete control throughout the positive half-cycle, no discharge can take place and no anode current can flow. This is providing the anode voltage does not exceed the amplification factor of the Thyratron multiplied by its grid voltage.

In Fig. 3 the grid volts are shown in phase with the anode volts, and it will be seen here that the grid permits current to flow during practically the whole of the positive half-cycle. Referring to Figs. 2, 3, and 4, it will be seen that by a continuous control on the phase difference between anode and grid voltage any proportion of the maximum anode current can be made to pass from complete cut-out to maximum current.

The Thyratron.—

This is of particular utility in all light-dimming circuits, and is undoubtedly an important application of the Thyratron under the A.C. condition. Compared with the resistance dimmer the Thyratron may be said to have the advantage that it has no moving parts carrying load current, it is of high efficiency, there is very little heat to be dissipated, connections are electrical rather than mechanical, and a small space only is required for the control.

D.C. applied to the Anode.—With D.C. on the anode the Thyratron can be used to record events such as transient voltages. As we have seen, the anode and grid voltages can be so adjusted that the grid will act as a very delicate trigger and start up the anode current at any desired point. Once started, it will continue to flow until the anode voltage is removed. The general method of stopping current in a D.C.-operated Thyratron is to make the anode negative for an instant. During this instant the ions diffuse away from the grid, thus restoring grid control.

Application as a Relay.—The action is similar to that we have described for the A.C. anode voltage condition except that the discharge will continue instead of ceasing and restoring grid control under A.C. conditions.

A particular application shown in Fig. 5 is utilisation of a photo cell as the grid potentiometer. When light falls on the photo cell its resistance falls, and the circuit can be so arranged that the grid of the Thyratron attains a positive potential. This enables the discharge to commence and the load current to flow. A permanent negative voltage is applied to the grid so that before light falls on the photo cell this negative charge prevents the start of the glow.

Inverter Circuits D.C. to A.C.—Let us consider the case of a Thyratron in a simple trigger circuit, where a switch is used to make the anode negative for an instant and thus restore grid control after discharge.

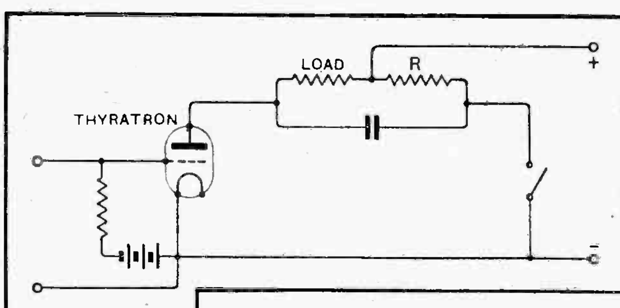


Fig. 6.—(Above) A trigger circuit using a switch to make the anode momentarily negative.

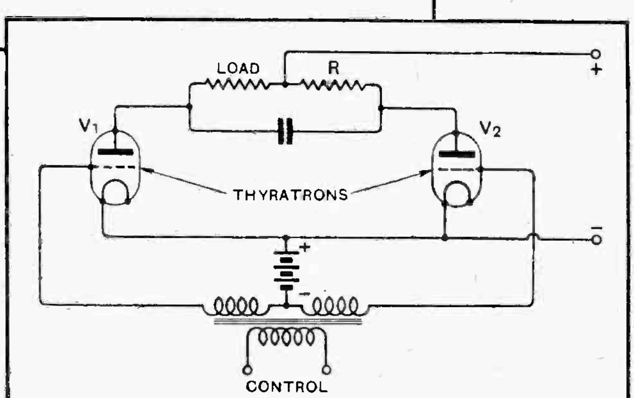


Fig. 7.—(Right) By employing a second Thyratron instead of a switch of Fig. 6 a circuit for transforming D.C. to A.C. results.

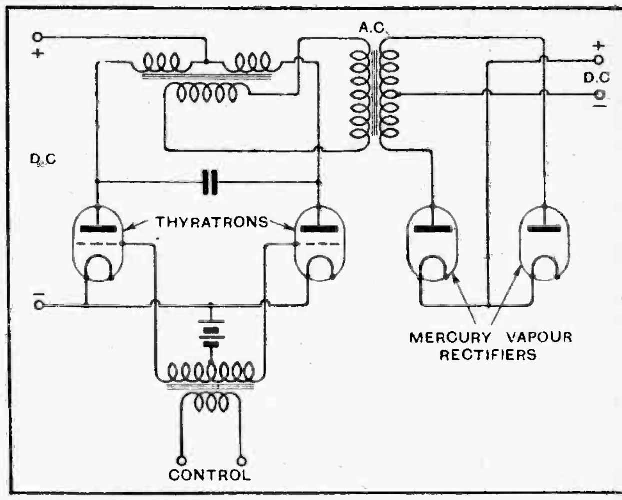


Fig. 8.—The use of two-electrode mercury vapour rectifiers in conjunction with Thyratrons renders it possible to make a D.C. transformer which has no moving parts.

Instead of a switch it is possible to use a second Thyratron, see Figs. 6 and 7. Making the grid of Thyratron V_2 positive is equivalent to closing the switch in the previous case. In this way the current is transferred from Thyratron V_1 to V_2. By means of a small subsidiary A.C. control it is possible to reverse the position of things and make the grid of Thyratron V_1 positive. Thus, the current may be transferred back again to Thyratron V_1.

Now, instead of the load resistance R, substitute the primary of a transformer. In the way just described the small subsidiary A.C. grid control can now be made to divert the heavy D.C. anode current first from one Thyratron to another, thus setting up what is equivalent to an A.C. voltage across the primary of the transformer. This A.C. voltage may be transferred to a suitable secondary winding, and we have thus the phenomenon of D.C. input being transformed into A.C. output. This method utilises a small independent A.C. source to determine the frequency of the resultant A.C. voltage and actuate the grid voltages as required.

It is possible, however, by connecting a tuned circuit between the two anodes to make such an inverter operate at any frequency determined by the tuned circuit.

One of the great advantages of the use of Thyratrons for this purpose is that only 15 volts out of the total supply available is used up across the valve. The use of hard valves in such circuits would be rendered impracticable due to their high internal resistance.

For high voltages the efficiency of the Thyratron as an inverter may be higher than 99 per cent. The higher the voltage the greater the efficiency, and at 10,000

The Thyratron.—
volts the efficiency is as high as 99.85 per cent. Allowing for cathode heating watts at 60 watts per ampere output, the overall efficiency is 99.25 per cent. The efficiency of a mechanical converter cannot attain such figures.

D.C. Transformer.—By combining the properties of the Thyratron in an inverter circuit such as described above, and the mercury vapour rectifier, it will be seen how it is easily possible to transform direct current of one voltage into direct current of any other voltage desired, thus effecting a D.C. transformer (Fig. 8).

Such a D.C. transformer may be said to have many advantages over rotary converters, such as absence of moving parts, small bulk, and ready replaceability of any defective part.

Power Transmission.—The reason why alternating current has been employed up to the present for long-distance power transmission is undoubtedly the ease with which its voltage may be transformed at either terminal of the line, and, therefore, its extreme flexibility operation. It is well known, however, that the transmission of A.C. power offers several serious disadvantages compared with D.C. Thus, for a line designed to carry a given A.C. voltage R.M.S., the permissible D.C. voltage along such a line would be $\sqrt{2}$ times this, or a line designed for 132,000 volts A.C. peak would safely carry 186,000 volts D.C.

Also, with A.C. transmission, the power factor of the line is a most important feature, and calls for considerable additional compensating machinery involving great cost. With D.C. transmission such power factor compensation is avoided. The possibilities of D.C. transmission of power are fascinating, and the whole subject is one of intense interest to all electrical engineers.

The principle of the Thyratron is proved—it remains for the development of the principle to provide Thyratrons with increasingly greater power-handling capacities, as the practical utility of this device would appear only to be limited by the volt-amperes it is capable of handling.

As at present known, no Thyratrons have been made to stand above 20,000 volts pressure. If Thyratrons could be made to withstand voltages of the order of 100,000 they immediately become of the greatest interest for D.C. power transmission—undoubtedly one of the most far-reaching applications of this latest addition to the thermionic-valve family.

NEW BROADCAST POWER RATINGS.

THE B.B.C. announces that a modified system of rating the power of all European broadcasting transmitters, known as the Copenhagen rating of the International Technical Consultative Committee for Radio Electric Communications, has been adopted by the Union Internationale de Radiodiffusion, having come into force on January 1st, 1932. The power of British transmitters is unchanged, and the new power ratings are given below:—

Name of Station.	Carrier Power supplied to aerial.	Maximum percentage peak modulation employed.
	kW.	%
London Regional	50	80
London National	50	80
North Regional	50	80
North National	50	80
Daventry National (5XX)	30	80
Midland Regional (5GB) ..	25	80
Aberdeen	1	80
Belfast	1	80
Bournemouth	1	80
Cardiff	1	80
Glasgow	1	80
Newcastle	1	80
Edinburgh	0.3	80
Dundee	0.12	80
Plymouth	0.12	80
Sheffield*	0.12	80
Swansea	0.12	80

* Not radiating at the present time.

"THE WIRELESS WORLD"

Information Bureau.

CONDITIONS OF THE NEW SERVICE.

(1) THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

(2) Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Tudor Street, E.C.4, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

(3) The fee of 5s. covers the reply to any wireless technical difficulty, but in special cases, where the enquiry may involve a considerable amount of investigation, an increased fee may be necessary. In such cases a special quotation will be made.

(4) Questions should be clearly written and concisely worded in order to avoid delay. Where enquiries relate to trouble experienced in receivers built to specifications in *The Wireless World* a complete account should be given of the trouble, and especially the symptoms.

(5) Where reference is made to published articles or descriptions of apparatus, the title of the article, the date of publication in *The Wireless World*, and the page reference number should be given, in order to facilitate reply.

(6) Full circuit diagrams, constructional details of apparatus, or values of components for home-designed receivers cannot normally be supplied, but circuit diagrams sent in with queries will be checked and criticised.

(7) Particular makes of components cannot, in general, be recommended, but advice will be given as to the suitability of an individual component for a particular purpose specified by the enquirer.

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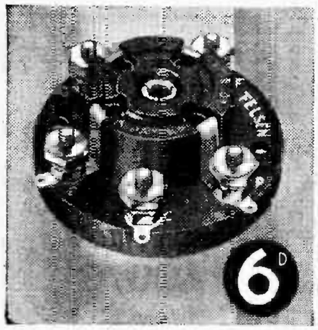

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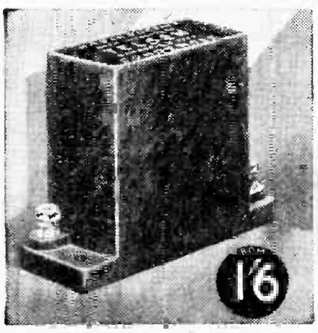

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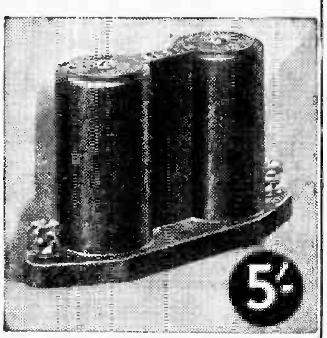

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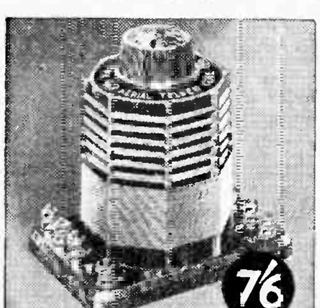

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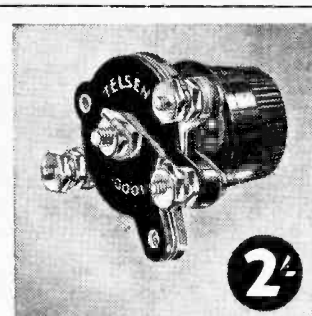

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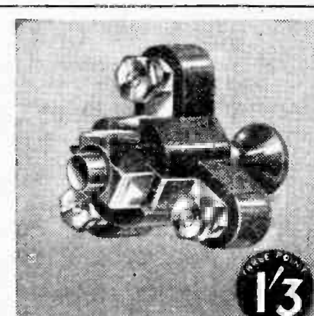

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Two-point	1/-
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Full practical constructional details in "The Wireless World" of December 9th and 16th.

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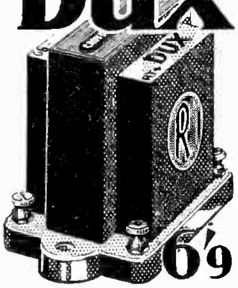

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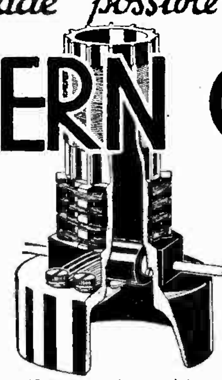

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The Performance of the SINGLE DIAL SUPER

Practical Advice Based on Readers' Experiences.

IT is significant that, notwithstanding the very great appeal of the Single Dial Super and the numbers already assembled, complaints of failure have been conspicuous by their rarity.

A few technical hints, however, may be helpful. It is, perhaps, needless to caution readers to ensure separation between screw-heads on the valve holders and the underside of the plate as well as to give correct fitting to the small insulating pieces supplied with the terminals.

Notes on Ganging.

A few remarks on ganging the tuned circuits may be helpful. The various sets made are so much alike that the trimming adjustment applied to one is similarly required in others. The process of adjusting the trimmers is as follows: Set the first intermediate coupler and the front trimming lever in the positions indicated in the pictorial view of the set as shown on page 657 of the issue of December 9th. In the second intermediate coupler the primary and secondary coil should be almost touching. Spring off the dust covers of the tuning condensers and, if necessary, bend up the top blade of the trimming condensers so as to give generous adjustment. On replacing the covers screw down home the trimming control of the back condenser and then unscrew by an amount of *six half turns*. Tune to a weak station between 20 and 60 divisions on the scale and then adjust the other two trimmers for maximum signal. Lastly, the front lever on the first intermediate coupling may be slightly moved to the position of best quality, and any necessary adjustment may finally be given to the remaining three levers of the intermediates.

It has been found that adjustment carried out in this way gives every set the same tuning scale within small limits, so that the calibration curves and station settings given here will apply to most sets. Should a discrepancy be experienced, adjust the oscillator condenser (the back one) so that the dial setting obtained, say, for a station between 300 and 350 metres agrees with that given in the table. The front two trimmers can then be brought to the position of best signal strength. One is recommended when the receiver is to pass out of the hands of the constructor to reverse the two rear dust covers when the trimming has been finally completed in order to prevent further access to the adjustments. The trimmer on the front condenser may then be regulated to give best results on a particular aerial, the station calibration still holding good. No attempt should be made to adjust the two screw controlled trimmers fitted under the coils, or a complex state of affairs will result, and precise ganging over the entire tuning scale on the two wave ranges be difficult to attain.

Those whose interests are limited to quality beyond reproach need have no scruples over the possibilities of the superheterodyne. If the results are considered to be lacking in quality, this will arise in nearly every case through one cause only —*incorrect matching of the loud speaker to the output valve.* Conditions in this respect are not normal and are, indeed, critical, owing to the use of the sensitive pentode output valve. Tests have been made with a number of loud speakers, and one need not assume that the Osram P.T.2 or Mazda Pen.220 are unsuitable for giving first-class results with moving-coil loud speakers. Details of output transformers and ratios cannot be given, owing to the variation in the winding of the moving coils, but the output ratio in the case of permanent-magnet loud speakers with exceedingly compact coil windings is usually of the order of 80 to 1.

If incorrectly matched, signal strength may be lacking, but the particular effect will be poor quality usually taking the form of a rattling

---

Features of Interest.

First single-dial two-range superheterodyne with correct tracking of input and oscillator circuits.

Simple construction on aluminium baseplate.

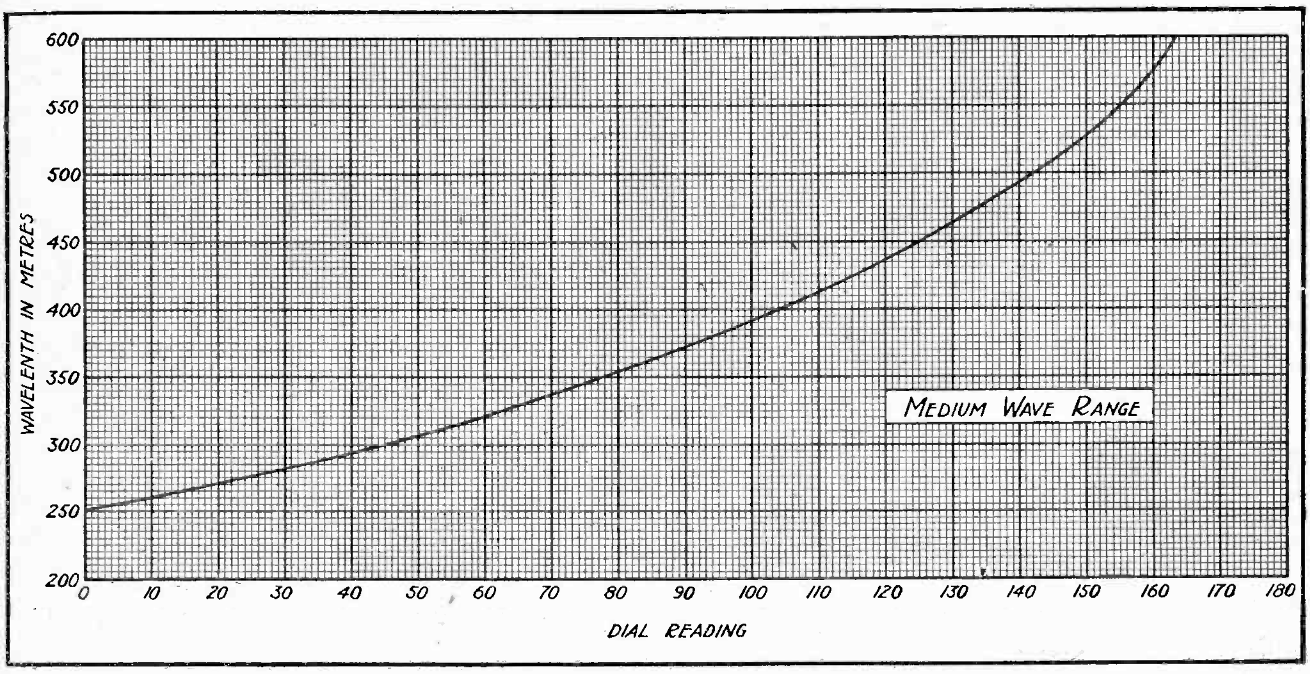
Selective band-pass input circuits and band-pass intermediate couplings.

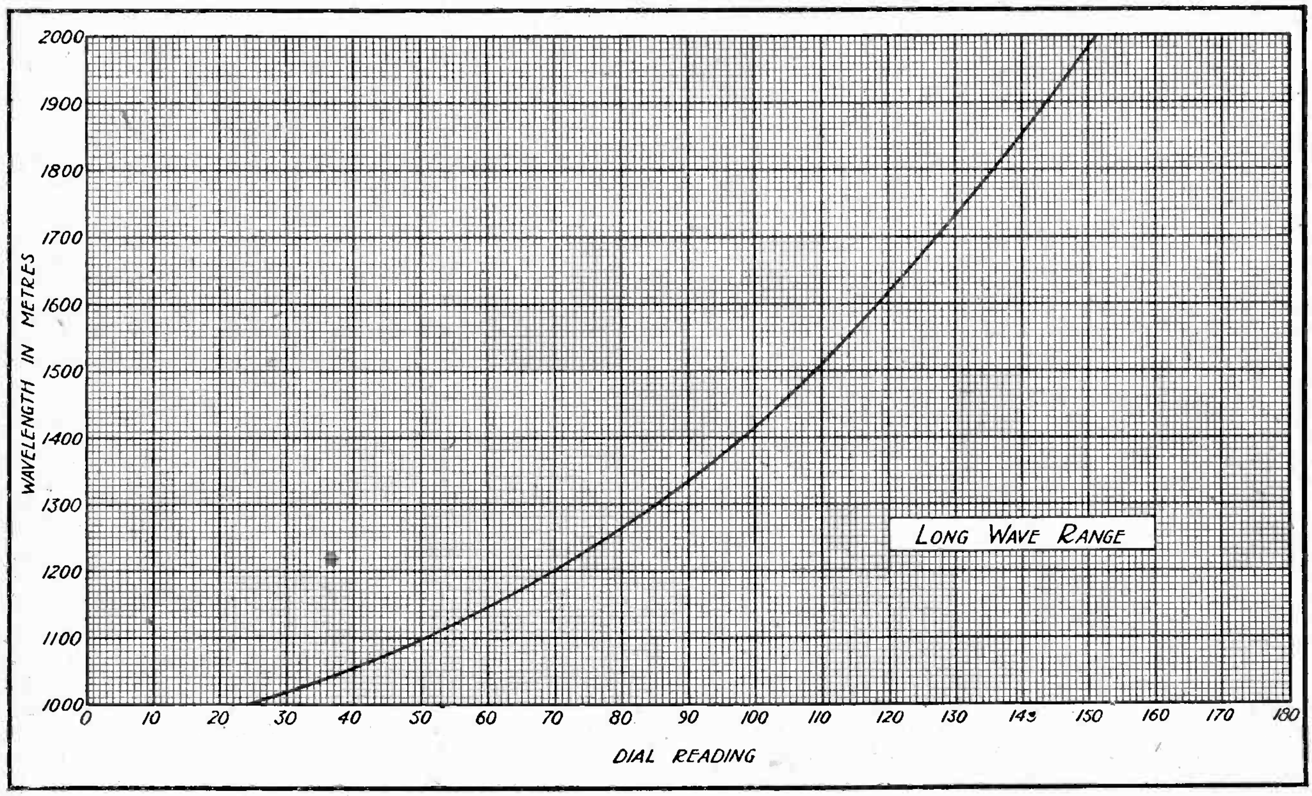
Compensated pentode output. Power output about 350 milliwatts. Input volume control.

Gives daylight reception of most foreign stations when used with a small aerial.

Complete constructional details are given in the issues of December 9th and 16th, obtainable from the publishers.

CALIBRATION CURVES OF THE "SINGLE DIAL SUPER."





Station identification is rendered quite simple by the use of these curves which give at a glance the tuning condenser dial readings for stations within the two wavebands.

or "papery" sound when any attempt is made to advance the volume from anything but a weak output. The constructor can satisfy himself that such an effect, if encountered, has nothing to do with the superheterodyne by removing the first two valves and linking across a wire on the underside of the set between the grid terminal of the first S.G. valve holder and the grid condenser and leak detached from under the screw terminal of the second intermediate. A simple detector L.F. arrangement results, consisting of band-pass and input volume control which will give reception of the local station. When the use of a moving-coil loud speaker is not contemplated, the employment either of the Ormond chassis-type loud speaker 1Z or the Celestion-type M.12 originally specified is strongly recommended, both these speakers having windings specially suited to the output valve used. Where D.C. supply is available for field excitation, the Magnavox Model D.C.143, Type H, with its adjustable output transformer set for pentode working, will give a generous quality output. Among permanent-magnet loud speakers, the B.T.H. minor R.K. works well but requires an input transformer of the order of 70 to 1.

Should the loud speaker leads exceed more than a few feet in length, a condenser having a value of up to 0.002 mfd. must bridge the L.S. terminals, for, owing to the great sensitiveness of the set, coupling may occur between aerial and loud speaker leads, giving rise to an audio-frequency whistle.

Distant Daylight Reception.

A great merit of a battery set of this kind is entire freedom from background noise, while it is probably the only type of easily operated battery receiver giving daylight reception of foreign stations. On the long waves all the stations mentioned can be received with certainty, with the exception, perhaps, of Stamboul, and with complete separation. The list given has been compiled by listening, and includes only those stations definitely and readily recognised. In the London area it is no longer necessary to claim as outstanding the separation of Mühlacker and the London Regional, and, with

STATION	DIAL READING
Medium Waves.	
Ljubljana	160
Freiburg	159
Hanover	158
BUDAPEST	155.5
Sundsvall	153.5
Münich	151
Riga	149.5
Vienna	147
BRUSSELS NO. 1	145
Milan	142.5
Trondjhem	140
Prague No. 1	138
NORTH REGIONAL	135
LANGENBERG	133
BEROMÜNSTER	128
Paris P.T.T.	124
Tallinn	122
ROME	122
STOCKHOLM	119
Belgrade	118
Berlin No. 1 (Witzleben)	113
Rabat	112
Dublin	110
Katowitz	108
SOTTENS	106
MIDLAND REGIONAL	103
BUCHAREST	101
Frankfurt-on-Main	99
TOULOUSE	97
LWOW	94
Glasgow	92
Hamburg	90
Helsinki	88
Algiers	85
MÜHLACKER	83
LONDON REGIONAL	81
Graz	79
BARCELONA	77
Strasbourg P.T.T.	75
Brno	73
BRUSSELS NO. 2	71
Naples	67
Grenoble P.T.T.	64
Breslau	62
GÖTEBORG	61
Cardiff	52
Bordeaux-Lafayette P.T.T.	47
NORTH NATIONAL	46
Huizen	44
TURIN	41.5
Viborg	38
Aberdeen, Bournemouth, Dundee, Edinburgh, Plymouth, Swansea, Newcastle	36
BRATISLAVA	27
HEILSBERG	25
Moravska-Ostrava	13
LONDON NATIONAL	11
Leipzig	9
HÖRBY	7
Gleiwitz	2
Long Waves.	
HILVERSUM	142
LAHTI	135
RADIO PARIS	129
ZEESEN	121
DAVENTRY NATIONAL	114
EIFFEL TOWER	103
WARSAW	99
MOTALA	92
MOSCOW	85
Stamboul	70
KALUNDBORG	61
OSLO	47
LENINGRAD	24

the setting of intermediate coupling advocated earlier in this article, complete separation of these two programmes results. It is recommended that constructors of the set carefully peruse the list and check over the dial settings of the stations. In operating the set the volume should be opened up no farther than is necessary, just as a high-powered car should not be driven with its accelerator pedal pressed right home.

A few heterodyne whistles may be encountered, but the number is small, and these are entirely unavoidable, being the result of the frequency relationship of certain of the stations. If near to a powerful broadcasting station, it becomes important that the under baseboard screened wiring shall lie close up against the plate, or otherwise pick-up on the leads beyond the input band-pass will give heterodyne trouble, an observation which draws attention to the desirability of screening the leads of a superheterodyne such as results in the use of the metal baseplate form of construction.

The Intermediate Amplifier.

Many of the enquiries regarding modification to this receiver suggest that the querists have yet to gain acquaintance with the principles and working of the modern superheterodyne. Experience shows that it is unnecessary to increase the range.

Some who presumably have not yet built the set have hinted at the introduction of a second intermediate stage, but a moment's acquaintance with the set would reveal the futility of such a modification. Additional amplification of the input to the second detector by at least twenty times would render the set completely unmanageable. Those having D.C. supply have enquired as to the possibilities of introducing a push-pull output stage. If this is to be effected, then an L.P.2 valve should be substituted in the detector stage and the transformer filter fed through an 0.5 mfd. condenser. Anode current to the detector will need to be taken through a 15,000 ohm resistance which, tapped at 5,000 ohms from the H.T. end and taken to earth through a 2 mfd. condenser, provides decoupling. Valves of the P.2 type may be used in the output stage.

UNBIASED

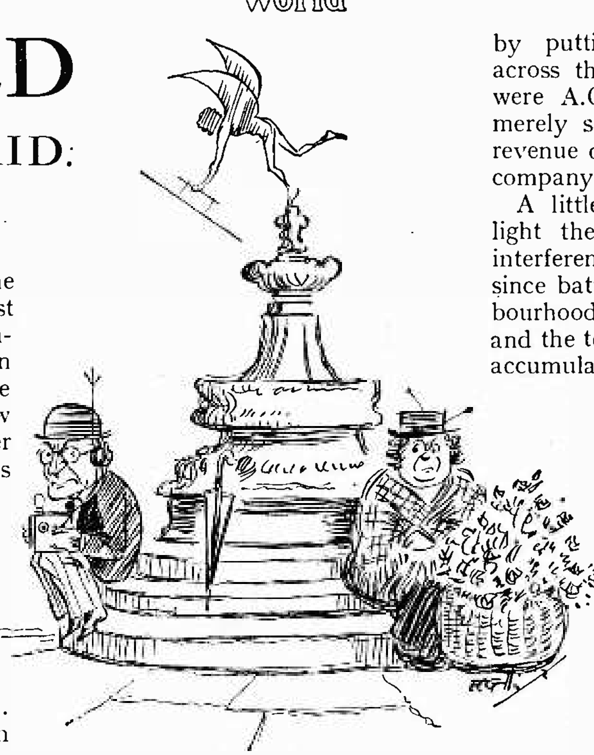
By FREE GRID.

"This 'ere 'oss."

AN enthusiastic Erotophile, as he styled himself, wrote to me last week in great indignation concerning the disreputable incident in which the bowstring of the little god in Piccadilly was bent a few nights ago. He pointed out rather heatedly that the resultant shape was just right for it to form a di-pole aerial for the B.B.C. seven-metre broadcasting experiments, and went so far as to suggest that the bowstring was deliberately bifurcated by a bibulous B.B.C. engineer during experiments conducted under the guise of New Year revelry.

His statement furnished me with an irresistible temptation to sally forth to the West End after dark to investigate matters myself. To my chagrin, "Eros" had gone, and I had to content myself with a brief repose on the steps while I allowed my imagination to roam. From seven metres my thoughts flew at a correspondingly high frequency to the mangling department of the B.B.C. that can turn out such masterpieces of mispronunciation that the little god's name can suggest a Piccadilly cabby's reference to his equine friend. Their efforts in this direction are exceedingly poor when one considers that they come from a body of men who at one time used continuously to ram down our throats the fact that they had a nodding acquaintanceship with Greek by referring to us by the somewhat contemptuous name of Hoi Polloi. I am no Greek "scolard," but I think that I could at least manage to be consistent even if not accurate; so far we have had three different forms of pronunciation by B.B.C. announcers.

Now, in my school-days I well remember that a great upheaval occurred in the matter of Latin pronunciation, and to this day much confusion exists, but I don't recollect any such thing in the case of Greek. I suggest that the B.B.C. ring up Smith Minor and take his advice upon the matter; if he was in any doubt I feel sure that he would have the gumption to Latinise the name into Cupid.



Allowed my imagination to roam.

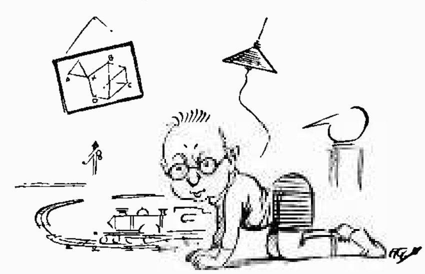
Since the above was written the B.B.C. have shamelessly attempted to take the wind out of my sails by the old dodge of putting up what the Yanks call a "mouthpiece" to make mild confession and an apologio on their behalf. If they think that they are going to steal my thunder in that way they are considerably mistaken.

Train Murder Pending.

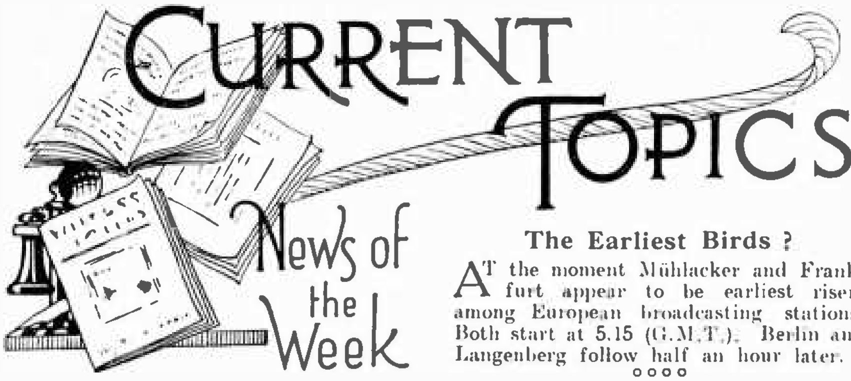
SINCE Christmas I have been plagued by an entirely new kind of electrical interference—new, at any rate, to me. The trouble began quite early on Christmas Day when I attempted to tune in a foreign transmission. Diligent enquiries revealed that the whole rumpus was due to the fact that a pestilential child in the neighbourhood had been presented by his fond parents with a model electric railway, complete with transformer, for running it off A.C. mains. A well-meaning neighbour who lived in the adjacent house had already preceded me and had attempted to quell the disturbance by putting a 10-mfd. condenser across the rails, but as the mains were A.C. and not D.C. he had merely succeeded in increasing the revenue of the electric power supply company.

A little investigation brought to light the interesting fact that the interference came in via the mains, since battery-set users in the neighbourhood were entirely unaffected, and the temporary substitution of an accumulator as the motive power of the railway caused all trouble to cease. No amount of jugglery with elaborate filter circuits in conjunction with the mains eased the trouble, and I was, therefore, deputed by a committee of fellow-sufferers to interview the wretched child and put a proposition before him.

He was, I found, a serious, bespectacled specimen of post-War vintage, with what his fond parents described as a scientific bent. Briefly, I proposed that he surrendered the transformer in exchange for an accumulator, which we undertook to charge without fee when required. He scornfully refused, but himself suggested that if the commutator were got rid of the trouble would cease; in fact, he expressed his willingness to surrender the offending locomotive if we would supply him with a new one fitted with an induction motor. To this I assented, and at once sought it at a large London emporium, only to find that such a thing had never been heard of. Humanitarians desiring to avert a case of justifiable infanticide should tell me where to get one or suggest other ways of tackling the trouble. They must act quickly, however.



With a temptingly scientific bent.



World-wide Amateur Tests.

WORLD amateur radio is to make a move to secure international goodwill, concentrating on the weeks of February 21st to 26th and March 11th to 16th. During these weeks are to be held the first series of "International Goodwill Tests," arranged by the American Radio Relay League, in which it is expected nearly all the active proportion of the 40,000 amateurs of the world will take part. Full particulars are to be announced shortly

oooo

Sir Oliver Lodge's Early Apparatus.

AN addition of great interest and importance to the Royal Scottish Museum, Edinburgh, is the gift of some early radio apparatus by Sir Oliver Lodge, F.R.S. The collection, which is housed in the permanent radio section of the museum, includes an original Branly-Lodge coherer, apparatus used in the original experiments in "syntonised" or tuned radio-telegraphy, and the Leyden jar arrangement to obtain spark discharges at various frequencies.

oooo

"Jump to It!"

THE Polish Broadcasting Company has been worrying lest listeners should attach insufficient importance to the Government announcements which are broadcast each evening together with the ordinary news bulletin. So it has been decided that all official announcements shall in future be preceded by the roll of a drum reproduced on a gramophone record.

oooo

"Wireless World" Diary, 1932.

IN consequence of the unprecedented demand for *The Wireless World* Diary for 1932, the Publishers cannot now supply copies, although readers who have not yet purchased a copy may be able to secure one from a bookseller or bookstall.

oooo

New Moving-coil Microphone.

IT is regretted that a mistake occurred in the caption describing the moving-coil microphone illustrated on p. 683 of our issue of December 16th. As explained in the text, the instrument is a product of the Western Electric Company.

The Earliest Birds ?

AT the moment Mühlacker and Frankfurt appear to be earliest risers among European broadcasting stations. Both start at 5.15 (G.M.T.). Berlin and Langenberg follow half an hour later.

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175 kW. Station for Hungary ?

ACCORDING to a correspondent, Hungary's projected broadcasting system includes a 175 kW. transmitter at Budapest which will be "entirely automatic," i.e., it will be worked at a distance requiring only periodical inspection to maintain its efficiency.

oooo

Problem for Irish Amateurs.

IRISH listeners are perturbed by the 33⅓ per cent. duty now imposed on wireless parts and accessories coming into the Irish Free State. A correspondent in the "Weekly Irish Times," whose complaint seems to be representative of the general opinion, points out that many of the parts on which he must pay duty are not made in Ireland. "If," he asks, "there is nothing to protect, why the duty?"

Can it be that Irish amateurs' purchases of foreign taxed radio goods continue to be so large as to provide an appreciable revenue to the Government?

oooo

100 kW. from Athlone.

AS forecast many months ago, the high power broadcasting transmitter for the Irish Free State is to be situated at Athlone, which is considered to be very near the geographical centre of the country. Transmission will be on 413 metres, the present wavelength of the Dublin station, and the power may be as high as 100 kilowatts.

There is still some doubt as to when construction will begin, but the Irish Free State Government seems to be anxious to have the transmitter working by 1933.

Listeners in this country are thus faced with the prospect of sponsored programmes at a strength comparable with that of reception from the B.B.C. stations.

oooo

Try a Police Thriller.

"WHAT a thrill to get police calls and perhaps witness a daring robbery or pick up some other event which never appears in print!" runs the advertisement of an enterprising Cleveland, Ohio, radio dealer who is marketing a short-wave adaptor for ordinary broadcast receivers. Even if you want it only for amateur reception you must remember to ask for the "Bud Police Thriller," because that is its name.

99·999 Per Cent.

THE figure of 99.999 per cent. is the impressive accuracy attained by Boyd Phelps, owner of amateur station W2BP, in winning the American Radio Relay League frequency measuring test. Perhaps (says a League statement) he was even closer than that—no one knows, for that was the highest accuracy the Government radio division measuring stations could reach. Approximately 65 per cent of the participating amateurs won certificates of merit in the contest, signifying that they had achieved accuracies of 99.900 per cent. or better.

The well-known British amateur, Mr. H. L. O'Heffernan (G5BY), won a certificate for securing an accuracy of 99.934 per cent.

oooo

Fifty Stations for Paris Police.

THE Paris police prefect, M. Chiappe, who is well known to Londoners on account of his recent visit, is determined to make the fullest possible use of wireless for the suppression of crime. The budget for 1932 shows that the existing radio organisation, comprising seven transmitting and receiving stations, is to

A 500-kW. VALVE. On view at the Physical and Optical Societies' Exhibition last week, this Marconi-Osram 500-kW. cooled-anode transmitting valve is regarded as the biggest "hard-pumped" valve in the world. The electrodes are unusually large, the anode having a diameter of 8 inches.

be scrapped in favour of a network of stations costing about four million francs. There is to be a powerful central station of the Police Prefecture maintaining touch with twenty "postes"—one in each of the arrondissements—together with nearly thirty stations in the suburbs.

And if this fails to strike terror in the breasts of evildoers, let them note that a wireless receiver permanently tuned in to the central station will be carried on every police patrol car.

PYE 'Q' PORTABLE

Exceptional Range and Economy of H.T. Current.

THOSE who two or three years ago welcomed the portable wireless receiver as the ideal medium for obtaining entertainment at any time and anywhere have latterly had grave misgivings. Rumour had it that the popularity of the battery portable was fast waning, the real cause being its inability to provide the H.T. current necessary to avoid distortion with a reasonable power output.

Great importance, therefore, attaches to a product in which this vital problem is tackled from a new angle. In the "Q" portable the possibilities of the new high-efficiency pentode are exploited to the utmost extent in such a way that distortion is avoided with the very minimum of current consumption; to be precise, the anode circuit of the last valve claims only 5 milliamperes for an undistorted power output of well over 200 milliwatts. The consumption of the other three valves is small enough, the total drain on the H.T. battery being but 9 milliamperes, ensuring for it a reasonable life.

As soon as the hinged lid at the back of the set is unscrewed one is at once impressed by the compactness of the construction and sturdiness of the metal chassis, which is built from 14-gauge aluminium of an angle section. The manufacturers have made it their aim to safeguard the interests of the consumer as far as possible by giving their attention to mechanical strength. Tests are made at the factory with a special machine subjecting the set packed ready for transit to a heavy jolting, the vibrations occurring at the rate of one hundred a minute. Both the loud speaker and chassis are resiliently suspended in the cabinet, the chassis being held by a steel spring in conjunction with rubber buffers. This method of suspension has for its object the prevention of damage in transit, and, further, avoids acoustic reaction. To the service agent the accessibility of the chassis when removed from the cabinet should appeal, especially as circuit identification is carefully carried out with different coloured wiring. For instance, all wires connected to L.T. minus are covered with black sleeving, and those with H.F. currents passing through them have a yellow covering.

The High-efficiency Pentode.

We were especially pleased to find that with the receiver is provided a well-prepared instruction booklet containing a wealth of information concerning the voltage distribution to the control grids, screening grids, and anodes of the various valves, also hints on how to obtain the best performance, together with a fault-finding chart and a full circuit diagram. This is a commendable practice which might well be emulated by all other manufacturers.

Except for the high-efficiency pentode with a special compensating circuit coupled to the high-impedance loud speaker, the circuit design is straightforward and follows accepted practice. The frame aerial and tuned anode coils are tuned by a twin-gang condenser, a trimmer for final adjustment of the aerial circuit being mounted on the control panel. Reaction is applied to the intervalve inductance by means of a differential condenser, the latter being ganged to a rheostat controlling the filament temperature of the screen-grid valve. As the filament temperature rises, more reaction is applied, the combined adjustment providing an effective volume control. The screen-grid valve is not metallised, but electrostatic fields are kept well in hand by the screened compartment in which the valve is housed. Metallised H.L.2 valves are used both in the detector and first L.F. positions. There are two L.F. stages, resistance- and transformer-coupled respectively, and although this represents a somewhat unorthodox arrangement in a four-valve set, in view of the high sensitivity to distant trans-

FEATURES.

GENERAL: Battery-driven cabinet-type portable with built-in frame aerial and moving-iron loud speaker with winding of special impedance to match the pentode. Undistorted output over 200 milliwatts, the anode consumption of the last valve being 5 mA. Wavelength calibration. All-metal chassis. Turntable provided.

CIRCUIT: Tuned anode coupling to leaky grid detector. Two L.F. stages, resistance and transformer coupled respectively.

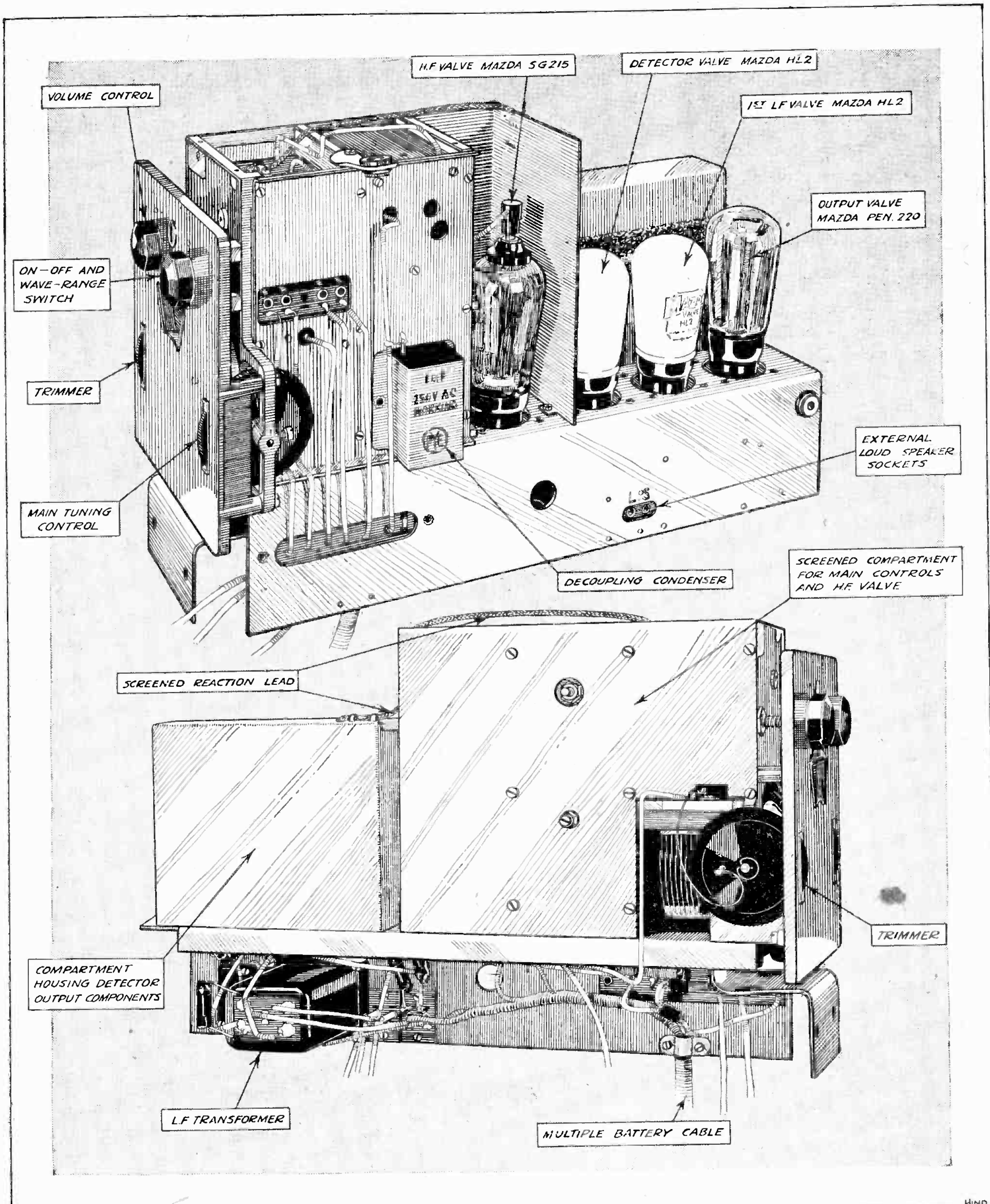
CONTROLS: Single-dial tuning with trimmer on panel; combined reaction and H.F. filament rheostat as volume control; combined on-off and waveband switch.

VALVES: Mazda 215 S.G.; H.L.2; H.L.2; Pen.220.

PRICE: 14 guineas.

MAKERS: Pye Radio Ltd., Paris House, Oxford Circus, London, W.1

CHASSIS DETAILS OF THE PYE "Q" PORTABLE.



Comprehensive screening and the use of metallised valves ensures stability.

Pye "Q" Portable.—

missions, the makers would seem justified in embodying only one H.F. stage.

The resistance-capacity network connected between the anode of the output valve and earth is arranged to give a cut-off at about 5,000 cycles, so that not only is shrillness of reproduction due to the pentode avoided, but also heterodyne whistle is minimised.

Performance.

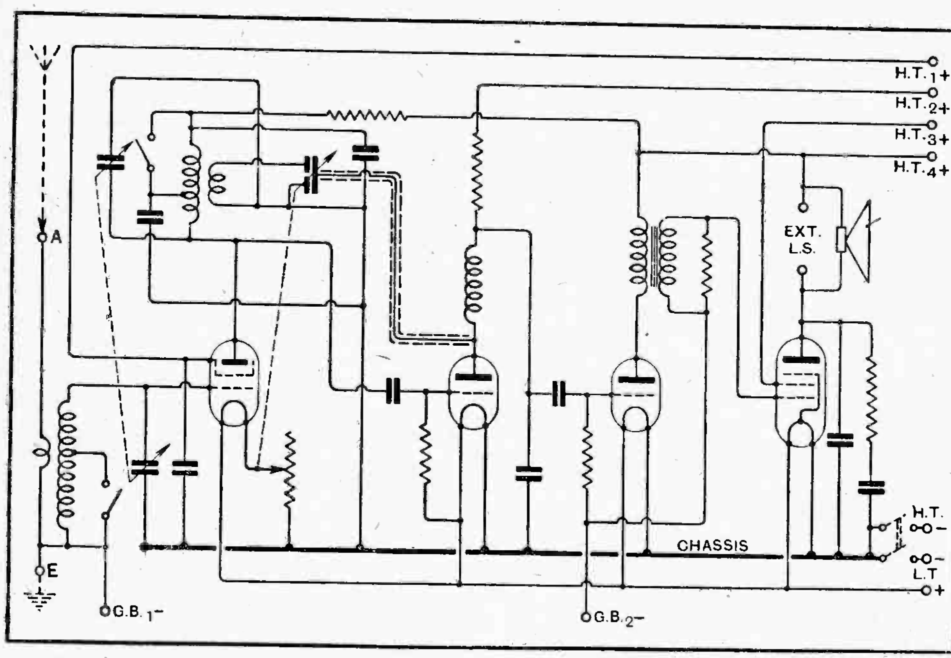
The first tests were made on the local Regional transmissions, and we were immediately impressed by the large volume that could be obtained without appreciable distortion. Speech is inclined to be a little low-pitched, but not to an extent that is objectionable, whilst the rendering of music leaves little to be desired. There is a well-defined minimum to the frame aerial, the orientation of which is facilitated by the turntable. The pre-detector volume control has a slightly delayed action which is accounted for by the temperature lag of the filament of the screen-grid valve. This may be a little disconcerting at first, but one soon becomes accustomed to the interval amounting to a second or so before the full response takes place. Ample range of control of output, even when working with signals of large field strength, is provided, and a change of the reaction control has practically no effect on the ganged tuning—in fact, once the trimmer is set the volume control can be varied considerably without the need for re-trimming.

The performance on distant stations is exceptionally good, being well above the ordinary standard of portable sets. No fewer than twelve stations on the medium band were received at comfortable loud speaker strength, and background noises and whistles at the higher audio-frequencies are effectively suppressed by the 5,000 cycle filter. On the long waves the set gave a good account of itself, giving entertainment value with some seven stations. The directional properties of the frame aerial were found to be very useful in the case of Königswusterhausen, which could be received free from the interference of Daventry.

Station identification is considerably simplified by the wavelength calibration, which is found to be reasonably accurate. In no case were stations on the medium waveband more than 3 metres out, and the high degree of selectivity brought about by the frame aerial ensures separation of those stations which are hard to isolate when using an outside aerial.

We have had the opportunity of examining a works specification sheet to which all sets must conform before being released for sale. The thoroughness of inspection is evident when the details of the sensitivity, selectivity, and fidelity tests are seen. For sensitivity data the microvolts per metre to produce the standardised 50-milliwatt output are measured with both critical and minimum reaction for various wavelengths. About 670 microvolts per metre are required on the medium waveband with full application of reaction. Selectivity is checked by measuring the microvolts for 50 milliwatts output at 10 kc. off tune and dividing by the input required at resonance.

Altogether, the "Q" receiver represents a distinct advance in portable technique, giving, as it does, an outstanding performance as regards both range and volume.



Circuit of the Pye "Q" portable. To prevent undue accentuation of high notes the pentode is well compensated. Note the provision for a separate loud speaker and external aerial and earth.

Next Week's Set Review:—
McMICHAEL SUPER-RANGE PORTABLE FOUR

BROADCAST BREVITIES

From time to time the B.B.C. invites members of the public into the studios, but in— —America the microphone is now taken into the street. A recent scene in New York.

By Our Special Correspondent.

The Last to Leave.

LIKE all Scots, Sir John Reith is a sentimentalist, so it does not really surprise me to hear that he has decided to be literally the last person to leave the Savoy Hill building, having been the first to enter it.

Who would miss the sight? Imagine the sad little gathering of higher officials and secretaries poised on the kerb outside, the opening of the door, the jingle of keys, the swift emergence of the cat, followed by the last milk bottle; and then . . .

The Dim Future.

It is worth warning anyone who proposes to take up a stance outside the old B.B.C. building in hopes of witnessing the scene that no one knows just when it will be enacted. The prospect of that ultimate family reunion in Portland Place is fading farther and farther into the future.

Whence the Delay?

It is true that, with the exception of the studios, "Broadcasting House" is practically ready. The staff offices are completed, and so are the council chamber, the "D.G.'s" sanctum, and all those other apartments which impress one with their magnificence. But until the studios have been written off as satisfactory, first by the engineers and then by the decorators, broadcasting must continue from Savoy Hill.

Surprising the Artiste.

Most of the acoustic problems have been solved—in one case by removing a ceiling and "plugging" the void with sound-absorbing material—but the decorative artists are still busy making each studio different from its neighbour. I am told that every studio will furnish a surprise for the impressionable artiste. Let us hope that the effect will be satisfactory!

A Farewell Effort.

If there is to be no flourish of trumpets with the opening of Broadcasting House, there will at least be a farewell programme on the last day at Savoy Hill. I understand that its preparation has been left in the capable hands of Lance Sieveking.

Those Board Meetings.

TO-DAY (Wednesday) Mr. Harold G. Brown, will probably be attending a meeting of the B.B.C. Board of Governors for the first time.

What happens at these meetings? It has been suggested to me that they resemble too much the conclaves of the Ku-Klux-Klan; that they glow with the aura of "secret diplomacy."

No Secrets?

Surely this is putting the case too strongly. The B.B.C. Governors may be afraid to let the cat out of the bag, but this, I believe, is simply because the cat would turn out to be a very small kitten.

Why Not a Governors' Bulletin?

It would be a pity, however, if the idea gained ground that the B.B.C. Governors were suppressing matters of public interest, and, therefore, I heartily support a suggestion that the Board should issue monthly reports showing the trend of policy and the progress of affairs during the past month.

Exciting? Perhaps not, but it would stop the spread of rumours.

Ice Hockey Thrills.

A RUNNING commentary on the International Ice Hockey match between England and Canada will be relayed from the Park Lane Ice Club in the Regional programme on January 18th. The commentator is to be Mr. George F. Allison.

Niagara.

THE real "silly season," as everyone knows, occurs during the holiday months of August and September, but I think a place should be found in the calendar for the "little silly season" occurring in January. This would provide an opening for such ideas as the Niagara broadcast, which has come up for the third and (I hope) last time.

The B.B.C. "effects" department can easily outdo Niagara.

A Disappointment.

THREE days after the B.B.C. had inaugurated the thrice-daily news bulletin service from 5SW not one word of thanks or congratulation had been received from the Colonies. One imagines that a Colonial Governor or two might have sent a complimentary cable.

But perhaps the bouquets will have come flying in since the week-end, for the service has now been extended to include Saturdays—a concession for which Colonials have been asking ever since 5SW started operations in 1927.

Are You a Group Listener?

WIRELESS discussion groups are now a recognised phenomenon, and the B.B.C. has done well to publish a booklet full of meaty advice on what they are and how they should be run.

Here are a few extracts:—

Do not have too large a group.—A dozen or fifteen people will discuss better than thirty or forty. Have your large group, if you like, but it will not be a real discussion group, and it will require special organisation.

Do make people comfortable.—The point is worth stressing. Comfortable chairs, permission to smoke, a fire, are all desirable.

Place the loud speaker where every member of the group can see it easily.

Do test the set before people come.—Groups have been known to carry on through the period of a "slight technical hitch," but the experiment should not be lightly risked. When the talk starts, it is well to remember that some people find it hard to listen to a loud speaker. Therefore it pays to get the set adjusted properly first and not to "twiddle the knobs" while the talk is on. Variation in tone and pitch is irritating.

Treat It as a Gentleman.

And here is profound wisdom:—

Don't treat the apparatus with less respect than you would the speaker if he were present.

Don't forget to turn on the set before the advertised time of the talk.

First Relay from Sadler's Wells.

SADLER'S WELLS THEATRE, the new "Old Vic for North London," which was opened about a year ago, will be the venue for a relay of the third act of "The Tales of Hoffmann," Offenbach's tuneful opera, on January 30th. This will be the first relay from the theatre.

The First Broadcast Play.

ON January 26th West Regional listeners will hear a revival of "Danger," the first play written specially for broadcasting in 1924. The author, Mr. Richard Hughes, is a Welshman.

Guard Drill for American Listeners.

AMERICAN listeners are to have an opportunity of hearing the Ceremony of the Keys, which is to be relayed from the Tower of London to-morrow evening (Thursday). On this occasion the National Broadcasting Company will attempt to pick up the relay from 5SW

The Reason.

THE French Press has been guying the "Buy British" movement with a pretty story of an old lady who was about to purchase a multi-valve set from a London shop when the salesman mentioned that it would pick up sixty foreign stations.

"It does, does it?" exclaimed the customer. "Well, give me a crystal set instead, as I prefer to 'listen British.'"

PRACTICAL HINTS AND TIPS.

SIMPLIFIED AIDS TO BETTER RECEPTION.

WHEN adjusting the reaction coil of a receiver to give the most satisfactory results, it must not be forgotten that several factors other than the mere number of turns on the coil will have to be taken into acount.

There is, for example, the by-pass condenser shown as C_1 in Fig. 1. If this is increased in size, it will tend to reduce the amount of reaction attained at any particular setting of the reaction condenser C_2, and will therefore have much the same effect as a reduction in the number of turns on the reaction coil.

REACTION REFINEMENTS.

Then a good deal of control can be had by varying the coupling between the tuned coil and the reaction coil; it may be found, for example, that a six-turn coil tightly coupled is about equivalent to a twelve-turn coil fixed at a greater distance. Advantage is often taken of this to make it possible to use the same reaction winding from both long and short waves; the reaction coil is large (by short-wave standards) and, while close to the long-wave winding, is removed to some little distance from the short-wave coil. This device, of course, is adopted to simplify the wave-change switching.

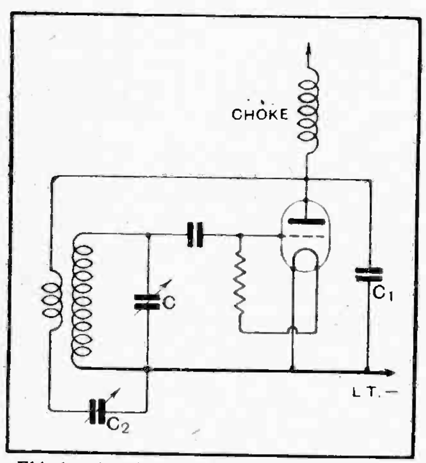


Fig. 1.—A regenerative detector grid circuit of the type discussed in the text.

Another variable factor is the voltage applied to the valve; if this is high, as it may have to be for satisfactory reception of the local station, it may be found that oscillation occurs even with the reaction condenser set to its nominal zero, although, with the lower anode voltage used for reception of more distant stations, oscillation is completely under control. The cure for this trouble, if it should arise, is the use of a reaction condenser with vanes of more or less "square-law" pattern, so that the minimum capacity of this component is low.

❖ ❖ ❖

SEMI-VARIABLE condensers of the compression type are widely used for a number of purposes; not the least of the reasons for their popularity is their cheapness. As they cost but little more than a fixed condenser of the same capacity, they may often be used in place of one of these components in cases where the use of a variable capacity is likely to confer the slightest advantage. But experience shows that compression condensers are not always used to the best advantage, possibly because amateurs do not understand fully the principles on which they are made.

COMPRESSION CONDENSERS.

All semi-variable condensers of the type under discussion are constructed on similar lines. Essentially they consist of a series of springy metal plates, interleaved with mica sheets. The metal vanes are bent in such a way that when the adjusting screw is slacked off they spring apart to the maximum possible extent, and so capacity is at a minimum. When the screw is turned in a clockwise direction it forces both vanes—or both sets of vanes—into closer contact, and thus capacity is progressively increased.

It will at once be obvious that such a construction must inevitably result in a fairly high minimum capacity. This point should always be remembered, and it is useless to expect, for example, that a 0.0005 mfd. compression condenser will tune a given coil through as wide a range of wavelengths as a condenser of the air-dielectric type. All makers give figures for minimum, as well as for maximum, capacities, and both should be borne in mind when making a choice.

Another point to remember is that each turn of the adjusting screw does not produce the same change in capacity, or anything like it. In fact, the majority of the capacity change takes place during the last couple of turns of the screws.

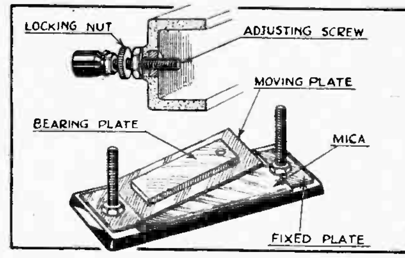


Fig. 2.—Constructional details of a two-plate semi-variable condenser, with cover removed.

Obviously, one must not conclude that something is wrong if "nothing happens" until the screw is quite near the end of its travel in the threaded guide.

Although compression condensers are hardly at their best when used for tuning purposes in circuits where adjustment is critical, it is often convenient to use them for such purposes. In such cases there is a possibility that on tightening the locking nut after making the adjustment, the screw, even if it is not turned accidentally, may be raised in its guide to a small extent, which may be sufficient to upset tuning.

Phosphor bronze, or very hard brass, is the material used in the best condensers; others, with vanes of comparatively soft brass, may tend after prolonged use to have a higher minimum capacity than the initial value. This is due to the fact that the plates do not separate to their full extent, and matters can often be put right temporarily by re-bending them.

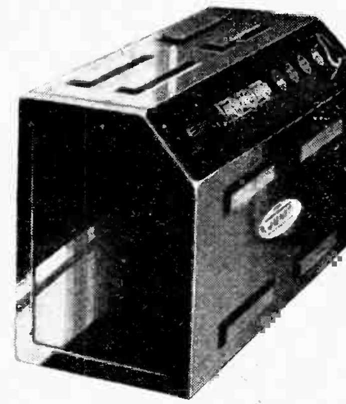
JUNIT MAINS SUPPLY FOR THE SINGLE DIAL SUPER HETERODYNE RECEIVER

In last week's "Wireless World" (Jan. 6th, page 6) the Junit 120 T.C. eliminator was given as a recommended source of mains supply for the Single Dial Superhet. Junit eliminators are outstanding for their excellent performance—they give an output well over rating—for their perfect smoothing and complete reliability. All units have one variable tapping, one fixed tapping and one S.G. tapping. All units are covered by guarantee.

Junit 120/T.C. H.T. Unit, incorporating trickle charger for 2, 4, or 6 v. accumulators; smoothed output 20 m.a. at 120 volts £5.17.6

If unobtainable from your dealer write to us direct.

Junit Manufacturing Co. Ltd.,
2, Ravenscourt Square, London, W.6. *Telephone: Riverside 0274.*



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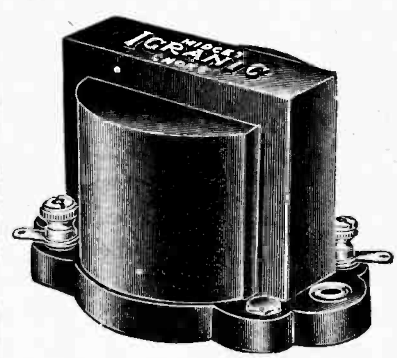


IGRANIC MIDGET L.F. CHOKE

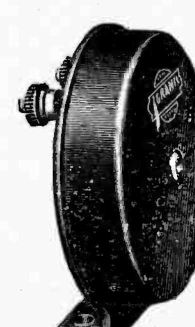
An exceptionally small choke, has a constant inductance of 20 henries up to 20 milliamps.

PRICE - - **8/6**

IGRANIC H.F. CHOKE

Definitely excludes H.F. currents. Effective up to 3000 metres

PRICE - - **4/-**



If you are unable to obtain Igranic Components locally, send to Dept. U.327, we will send C.O.D.

IGRANIC ELECTRIC CO., LTD.
149, Queen Victoria Street, LONDON.

Ultra Short Waves

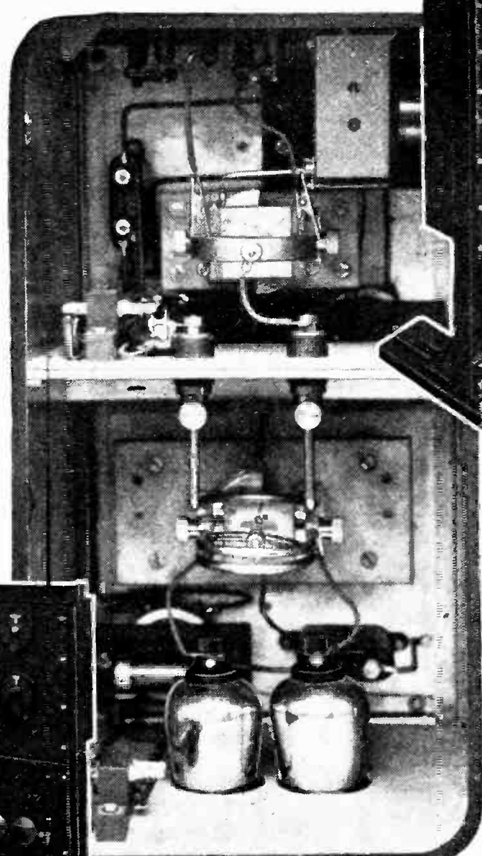
at the Telephone Show.

THE reader who omits to visit the Young People's Telephone Exhibition at the Imperial Institute, South Kensington, will miss much of genuine interest to the radio amateur. The Post Office engineers, as first announced in *The Wireless World*, are demonstrating telephony transmission and reception on ultra short waves, and on the opening day a representative of this journal was able to converse across the hall on a wavelength of only 2 metres.

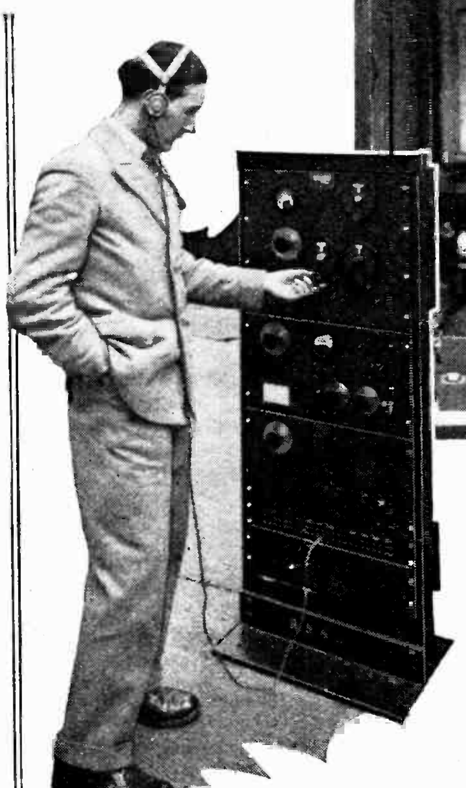
The Radio and Speech Transmission sections of the Exhibition afford ample testimony to the original and progressive methods of the Post Office Research Station at Dollis Hill, where technical innovations in the service are devised and problems of many kinds are sent for solution.

The Radio Section, which is largely devoted to ultra short wave work, includes the experimental superheterodyne receiver, containing twenty-eight valves, which may soon serve as a model for instruments supplying radio telephone links to isolated points such as islands within optical distance of the mainland. The superheterodyne receiver, the 2-metre stage of which is illustrated on this page, employs triple detection with intermediate frequencies of 15 and 1,000 metres. Under conditions where reception is likely to be conducted by inexperienced persons a super regenerative receiver of more modest design may be employed; a set of this kind is used for the demonstrations on the radio stand at the Exhibition.

Conversing on the 2-metre transmitter. The lowest picture shows the super-regenerative receiver used in the demonstrations. Note the short vertical aerial.



A "close-up" of the 2-metre stage of the experimental superheterodyne receiver on view at the Telephone Exhibition. In the upper compartment the spring connectors can be seen gripping the inductance — a half-circle copper strip.



As its name implies, the Exhibition is largely devoted to the work of the ordinary line telephone service, but one stand in particular—that dealing with speech transmission—should specially appeal to all interested in the low-frequency side of wireless work. Here are to be found instruments demonstrating the care with which the Post Office engineers approach problems connected with speech amplification and reproduction in the public telephone service and broadcasting.

Admission is free, and the Exhibition will remain open daily from 11 a.m. to 8 p.m. until January 23rd.

Nuts to Crack.

Instructive Problems and their Solution.

THE present series has been started by *The Wireless World* for the benefit of readers who like to work out little problems for themselves and be sure that the results they obtain are correct. Each week two or three wireless problems are presented, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Last week the problems 1 to 4 were given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

Problem No. 1.—**A 2-volt accumulator is used to supply filament current to a multi-valve receiver. An ammeter is inserted in one of the accumulator leads, and shows that a current of 0.8 ampere is being taken. What is the total resistance of the filament circuit?**

Answer—2.5 ohms.

By Ohm's Law we know that $I=E/R$ for any circuit in which direct current flows through a resistance. The current I is measured in amperes, the e.m.f. E in the circuit is in volts, and the resistance R is in ohms. Other ways of expressing the same relation between I, E, and R are $E=IR$ and $R=E/I$. For our present purpose, the last form will be the most suitable. Since $E=2$ volts and $I=0.8$ ampere, we have,

$$R=\frac{E}{I}=\frac{2}{0.8}=2.5 \text{ ohms.}$$

Problem No. 2.—**After the accumulator of the previous question had been fully charged, it was noticed that the current reading had increased to 1 ampere. What difference does this indicate in (a) the circuit resistance, (b) the e.m.f. of the accumulator?**

Answer—No difference. E.m.f. is now 2.5 volts.

Of course, the fact of the increased current is due solely to the greater e.m.f. of the accumulator, the circuit resistance being entirely independent of this and remaining quite unchanged. The new e.m.f. is obtained by the formula $E=IR$, in this case, 1×2.5 or 2.5 volts. This condition of affairs is, of course, only temporary, and after a very little time the accumulator e.m.f. will have fallen to its normal working value of 2 volts.

Problem No. 3.—**In order to protect the filaments from the excessive current due to the freshly charged accumulator, it is proposed to include a small variable resistance in the leads. What should be the value of this resistance, and what should be the ammeter reading?**

Answer—0.625 ohm. 0.8 amp.

Since 0.8 ampere is the normal filament current, we wish to arrange that only this amount of current shall pass through the circuit when the accumulator has its maximum voltage of 2.5, and this amount should therefore appear on the ammeter. If we call x ohms the amount of the series resistance to be included, the total resistance of the filament circuit is now $(x+2.5)$ ohms. Since by Ohm's Law $R=E/I$, we have in this case,

$$x+2.5=\frac{2.5}{0.8}=3.125$$

Therefore $x=0.625$ ohm.

Another method of finding the value of this resistance is to consider the amount of volts which we desire to lose in it, or, to use the technical term, the "potential drop" across it. Now, the filaments light normally at 2 volts, taking 0.8 ampere. If the applied e.m.f. is 2.5 volts, we shall want to use up the extra voltage, i.e., 0.5 volt, across the series resistance. But the same current must flow as before, passing also through the series resistance. Hence, if x be its value in ohms, we can substitute in the formula $R=E/I$ the values $x=0.5/0.8$, so that $x=0.625$ ohm, as before.

Problem No. 4.—**What power is consumed by the filaments when the e.m.f. of the accumulator is 2 volts and the filament current is 0.8 amp.? When the e.m.f. has its maximum value after charging, and the above series resistance is used, will the power taken by the filaments be increased? What power is dissipated in the resistance?**

Answer—1.6 watts. No increase. 0.4 watt.

In D.C. circuits, the power consumed in any resistance when measured in watts is given by the product of the number of amperes passing through the resistance and the number of volts dropped across it. In symbols, $W=I \times E$. Here $I=0.8$ and $E=2$, so that $W=1.6$.

Since the value of the series resistance was specially chosen so that the same current, 0.8 amp., should pass through the filaments at the same voltage, 2 volts, it is obvious that the power developed in the filaments has not altered.

The total power drawn from the accumulator will, however, be increased by the power dissipated in the series resistance. To find this latter, we apply the formula $W=IE$. Since in this case the potential drop is 0.5 volt, we have $W=0.8 \times 0.5=0.4$ watt.

It may be of interest to remark that the total power used in the circuit is the sum of that taken by the filaments and that expended in the resistance, i.e., $1.6+0.4=2.0$ watts. This, of course, is equal to the figure obtained by multiplying the accumulator volts (2.5) by the amperes taken (0.8)—a useful check.

NEXT SET OF PROBLEMS.

Problem No. 5.—**The H.T. current for a multi-valve set is supplied by a dry battery of 120 volts. A milliammeter placed in the negative lead indicates that a steady current of 8 milliamps. is passing. What is the D.C. resistance of the H.T. circuit?**

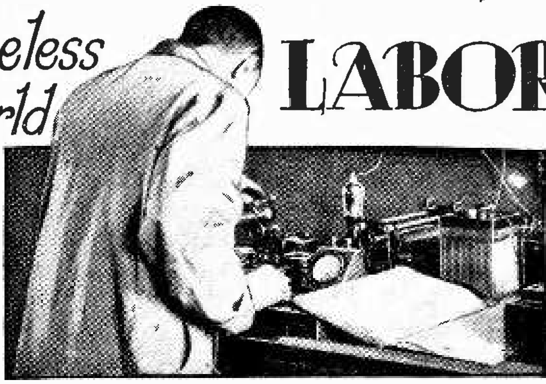
Problem No. 6.—**What amount of power is consumed in the H.T. circuit of the above example?**

Problem No. 7.—**After a period of use, it was noticed that the milliammeter reading had fallen to 6.5 mA. If we assume that the resistance of the circuit remains constant, what is now the voltage of the battery, and what is the power taken?**

Problem No. 8.—**If a 2-volt accumulator supplies 0.85 watt to the filament circuit, what is the L.T. current taken?**

NUTCRACKER.

Wireless World



LABORATORY TESTS

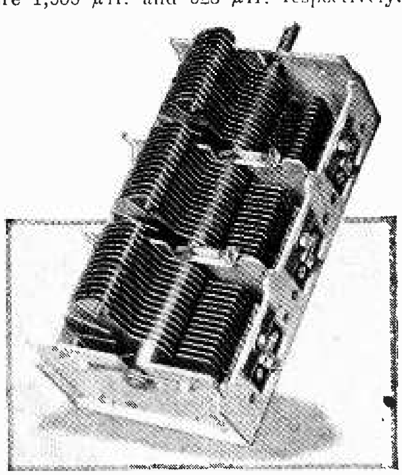
Review of New Radio Products.

RADIOPHONE CONDENSER FOR SINGLE-DIAL SUPERHETS.

With the normal type of gang-condenser the only method by which the oscillator circuit can be kept in step with the other tuned stages in the set is by the aid of padding condensers. The arrangement, though satisfactory in practice, is not, strictly speaking, scientific, since these padding condensers are introduced to compensate for deficiencies in the design of the oscillator condenser. In America special ganged units have been developed for this purpose, but hitherto no British-made counterpart was available.

The first condenser unit designed especially for this purpose has just been introduced by British Radiophone, Ltd., Aldwych House, Aldwych, London, W.C.2. It differs from the other models of this type in one particular only; the first condenser has its stator vanes cut away, which, in addition to reducing the capacity of this section, imparts to it the correct law for perfect tracking with the other sections in the unit. However, the various coils must have suitable inductance values.

The figures provided by the makers are as follows: For the medium waveband the tuning coils in the pre-selector circuit should be 157 μH. each, while the oscillator coil has a value of 126.5 μH. The corresponding coils for the long wave band are 1,900 μH. and 925 μH. respectively.



New Radiophone Superhet three-gang unit with special tracking vanes in the oscillator condenser.

In addition, a condenser of 0.00175 mfds. is required in series with the oscillator tuning condenser on the long waveband only. This is quite easily arranged when wiring up the wavechange switch.

The above inductance values are suitable for use with an I.F. amplifier adjusted to 110 k.c.

The circuits are brought into step with the main tuning condensers set to the position of minimum capacity and the adjustments made at a wavelength of 198 metres by manipulating the trimming condensers only.

These special superhet condensers cost 2s. more than the corresponding models of the normal type, the three-gang sample illustrated being priced at 30s. This does not include a cover, the price of which is 3s. 6d.

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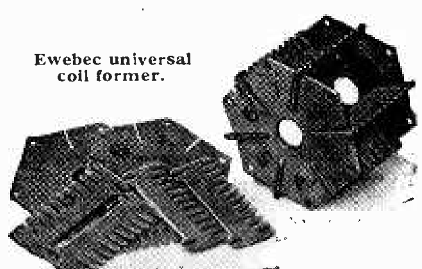
EWEBEC COIL FORMER.

Made by the Evington Electric and Radio Service, 5, Beckingham Road, Leicester, the Ewebec coil former should go a long way to simplify the constructional work of the experimenter and set designer.



Ewebec universal coil former.

It is made of thin impregnated material $\frac{1}{8}$in. thick but exceedingly tough, and is supplied in sections to be assembled by the user according to the type of coil required.

The fins can be assembled either with the slots outside, in which form a long-wave sectionalised coil can be wound, or with the flat side out for winding a single-layer coil. The overall diameter is $2\frac{3}{8}$in., and the length between end-cheeks is $1\frac{7}{8}$in., Each fin has nine slots measuring $\frac{1}{16}$in. wide and allowing a winding depth of $\frac{1}{4}$in. Quite efficient coils can be wound on these formers, as the turns will be well air-spaced, since the minimum of material is employed.

Two-range coils can be built up by joining two formers end-to-end or band-pass coils assembled with magnetic coupling by suitably spacing two coil formers. Many useful suggestions are given in the makers' literature for the application of these formers, all of which we agree are quite practicable The price of the former is 1s. 3d.

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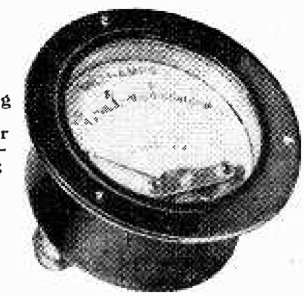
CENTRAL MANUFACTURING CO.'S MILLIAMMETER.

A milliammeter of the dead-beat moving coil type has been sent in by the Central Manufacturing Company, Crown Works, Walsall, with a view to it being found suitable for use as a kickmeter, as



Central Manufacturing Co.'s 0–50 milliammeter with a dead-beat moving coil movement.

discussed in *The Wireless World* dated August 12th last. It is an unusual experience to find a component too good for the purpose suggested, but this particular meter is quite a high grade instrument, and far more suitable for accurate measurement of current than for the other rôle suggested.

On test we find the meter to be exceedingly accurate; the small errors are of the order the thickness of the pointer only, which is exceptionally good considering the price is but 24s.

This firm make a range of small-size spring-controlled moving iron milliammeters, styled the type F.12, costing 7s. 6d. each, which would seem to be well suited for use as kickmeters. They have spear head pointers painted black, and the light background of the dial enables the slightest movement to be readily discerned.

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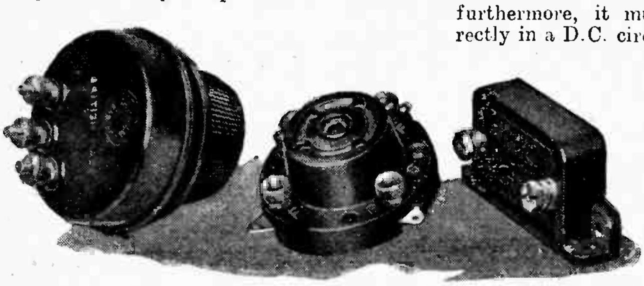
GRAHAM FARISH COMPONENTS.

A new inexpensive valve holder styled the "Snap" model is a recent addition to the range of components made by Graham Farish, Ltd., Bromley, Kent. They are available in 4- and 5-pin types, the prices being 6d. and 8d. each respectively.

The body is a moulded bakelite shell with hollowed-out centre so that the contact springs are surrounded by air. They touch the bakelite only at the anchorage point where the terminals pass through. There is a 4-pin anti-microphonic valve holder costing 9d.

The range of fixed mica condensers now include a 0.005-mfd. size at the very reasonable price of 1s.

A compact potentiometer volume control with a nominal value of 0.5 megohm will make a very satisfactory control for a gramophone pick-up. The resistance is


Selection of Graham Farish components comprising snap valve holder, volume control and fixed condenser.

a strip of impregnated material, and to relieve the element of wear, contact is made by a rocking disc. The measured resistance of our sample, which we found quite satisfactory in use, is 0.45 megohm.

The volume control is housed in a brown bakelite moulding, and the price is 3s. 6d.

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IGRANIC POTENTIAL DIVIDER.

This is a wire-wound resistance having a total value of 15,000 ohms. It is wound on a porcelain tube 1in. in diameter and 6in. long, the end connections and the tappings being made by means of small metal clips.

The resistance is divided into eight equal parts of 1,875 ohms each, but, as the clips are removable, it is quite a simple matter to vary the position of the tappings to give any desired voltage, or resistance, as the case may be.

The new potential divider will carry up to 35 mA.; it is easy to mount, and, offering such a large variety of tapping points, should find a ready appeal among experimenters and set designers.

The makers are the Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.4, and the price is 5s. 6d.


Igranic open type potential divider.

NEW T.C.C. ELECTROLYTIC CONDENSERS.

A new aqueous-type electrolytic condenser constructed in tubular form and intended for manufacturers' use has been introduced by the Telegraph Condenser Co., Ltd., Wales Farm Road, North Acton, London, W.3. This pattern is for single hole fixing, has a capacity of 8 mfds., and is suitable for working potentials up to 440 volts D.C.

Since this type of condenser is polarised, it cannot be used in A.C. circuits, and, furthermore, it must be connected correctly in a D.C. circuit. In a normal case there is little likelihood of reversed connections being made, for the aluminium case, which is the negative pole, will be clamped to a metal chassis.

A modified type is available for the use of home constructors. This is for baseboard mounting, and has the positive terminal located at the top, while the copper container serves as the negative pole. Two types are made in this style, the one having a capacity of 8 mfds., with a working potential of 460 volts D.C., while the other is rated at 10 mfds. and is suitable for use


Aqueous-type T.C.C. electrolytic condensers.

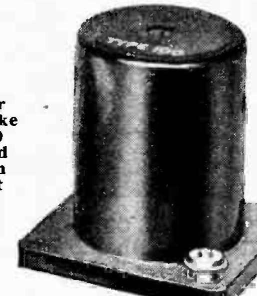
in circuits where the potential does not exceed 400 volts D.C. The prices are 12s. 6d. and 10s. respectively.

Tests have been made with some samples, and in all cases we found them entirely satisfactory. The leakage current varied slightly between specimens, the average figure being about 0.6 mA. at 400 volts with those models rated to withstand 440 volts D.C. After first switching on some time elapses before the leakage current falls to this figure. The initial current is somewhat difficult to determine, since it is obscured by the charging current. However, within a few seconds it falls to a few mA., and then, at a slower rate, to about 1mA. A period of some fifteen to twenty minutes elapses before the leakage current falls to its steady value, which is governed, of course, by the operating potential.

The electrolytic condenser offers a large capacity at a high operating voltage in a very compact form, a matter of considerable importance where the size of the set is scaled down to the minimum. They possess the quality of self-sealing in the event of a momentary voltage overload, and are thus indestructible electrically.

DUBILIER H.F. CHOKE.
Type 100.

This particular model is intended for use in superheterodyne receivers where an H.F. choke of high inductance is required for the filter in the anode circuit of the second detector valve. The measured inductance of the choke is 119 millihenrys,


Dubilier H.F. choke type 100 designed for use in superhet circuits.

and its self-capacity 7.2 m.mfds. These values assure that the resonant frequency of the choke, when included in a normal circuit, will be lower than that of a 110 k.c. intermediate amplifier.

The choke is suitable, also, for use in a normal straight circuit, since the inductance is not too high for this purpose, so it can be regarded, therefore, as an exceedingly useful general purpose component, and the price is 4s. 6d.

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

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Catalogues Received.

Runbaken Magneto Co., Ltd., 280, Deansgate, Manchester.—Descriptive leaflet dealing with a new three-range pocket meter.

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Burne-Jones and Co., Ltd., 296, Borough High Street, London, S.E.1.—Illustrated leaflets describing the Magnum range of receivers and new season's components; also a booklet dealing with the "Stenode Radiostat."

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Manufacturers' Accessories Co. (1928), Ltd., 85, Great Eastern Street, London, E.C.2.—Catalogue No. 122, dealing with radio and electrical equipment listed for the coming season.

o o o o

Peto-Scott Co., Ltd., 77, City Road, London, E.C.1.—Complete radio catalogue, giving a full description of their current range of receivers, accessories and components.

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Sydney S. Bird and Sons, Ltd., Cyldon Works, Snaresfield Road, Enfield, Middlesex.—Illustrated catalogue of Cyldon condensers; of special interest is the new range of very small capacity trimming condensers mounted on porcelain bases.

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A. J. Dew and Co., Ltd., 32-34, Rathbone Place, Oxford Street, London, W.1. —312-page catalogue illustrating and describing the range of proprietary receivers, components and accessories handled by this well-known firm of wholesalers.

Readers' Problems.

These columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.

Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found elsewhere in this issue.

Metallised H.F. Valves.

A READER who has just reconstructed his mains-operated receiver finds that the H.F. stage, which was originally quite stable, now shows signs of uncontrollable self-oscillation. No alterations have been made to this part of the set beyond the fitting of a new H.F. valve, which is of the same type as formerly used, but having a metallised bulb. He asks whether this instability could be prevented by earthing the metal coating directly, but is unwilling to adopt this course, as it would result in short-circuiting the bias resistance in the cathode lead. Some other form of automatic bias would therefore be necessary.

The effect noticed by our correspondent is probably attributable to the relatively high capacity that exists between anode and cathode of metallised valves; this property is only likely to give rise to trouble when an appreciable radio-frequency impedance is included in the cathode lead. We think it likely that the by-pass condenser that is, no doubt, shunted across the bias resistance is of a type not entirely suited for H.F. work, and that the trouble will disappear if it is replaced by a non-inductive condenser.

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An Apparent Fault.

SEVERAL correspondents have asked for help in tracing what seems to them to be an elusive fault, which takes the form of an apparent leakage of current across the H.T. bus-bars of a mains-operated set. This leakage is sometimes noticed when making a preliminary test of a newly built receiver after having disconnected the rectifying and smoothing equipment.

The idea of making tests of this nature is commendable, but we think that in several cases our readers have forgotten that in most modern mains-operated sets a potentiometer (fixed or variable) is provided for feeding the screening grid circuits of the H.F. valves. This potentiometer is permanently connected between the H.T. positive and negative terminals of the set, and so, when a test is made between these points, there will always be a conducting path, although one of relatively high resistance. Before making the test, therefore, one should remember to disconnect the potentiometer.

It should also be remembered that high-capacity condensers, however good they may be, have never an infinitely high internal resistance. The greater their capacity, the greater will be the current leakage through them. It seems possible that in some cases readers who have been making tests of the nature in question with sensitive apparatus have been misled by this small and inevitable leakage.

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Variable-mu Battery Valves.

AFTER reading the description of the new Cossor variable-mu battery valves (in our issue of December 30th), a reader asks for information as to how adjustable grid bias for valves of this type could be arranged in a battery-operated receiver with two H.F. stages. It is proposed to use a 16-volt bias battery, at present connected in the grid circuit of the output valve, for controlling the H.F. stages as well.

We recommend that matters should be arranged on the lines suggested in Fig. 1, which show that a potentiometer is shunted across the bias battery. In order to prevent wastage of current while the set is out of use, a switch is connected in series; this may conveniently be combined with the main on-off switch.

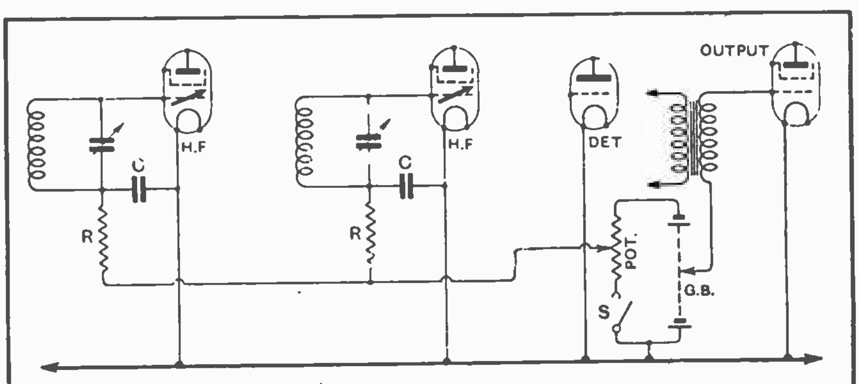

Fig. 1.—Providing full control of grid bias voltage for variable-mu battery valves. To avoid accidental wastage of current, it is a good plan to combine the switch S with the main on-off switch.

It will be noted that the grid circuits are decoupled by condensers (C), and resistances (R). The former may have almost any value, provided it is large, while the latter may be of about 10.000 ohms; again, there is considerable latitude, but inductively wound resistances are to be avoided when a band-pass filter is employed.

Another reader asks whether, for the purposes of bias control, a wire-wound resistance of 25.000 ohms (actually a Wearite product, as reviewed in the issue already referred to) might be used in place of one of 50,000 ohms, as originally recommended. The answer is that this resistance is not too low for the purpose, as it will not draw more than about half a milliampere from a bias battery of 16 volts.

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Free Bias and R.C.C.

A READER, who is apparently quite familiar with the usual methods of obtaining automatic grid bias in an L.F. amplifier when transformer coupling is employed, seems quite at a loss to know what to do now that he has changed over to resistance coupling. Actually, there is no basic difference in the methods of obtaining automatic negative voltage for an amplifier grid, whatever the system of coupling employed; the simple rule to remember on making a change is that the grid return lead should be joined to the same point.

In the case of a resistance-coupled amplifier, the conductive grid circuit is completed through the leak, and so the low-potential end of this component should be joined to the point to which the transformer secondary was originally connected.

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Mains Aerials.

IN its simplest form, a so-called mains aerial consists of nothing more than a connection between one side of the supply system and the normal aerial terminal of the set. A condenser must be interposed in order to prevent the flow of mains current.

The precise value of this blocking condenser is the subject of a question raised by a reader. We are afraid that it is not possible to say that any particular capacity will be best in all cases, but an average value is 0.0003 mfd. A smaller condenser—say, 0.0001 mfd.—is occasionally desirable, in order to minimise the introduction of hum.

Working Voltages of Condensers.

PAPER condensers, of the kind used in smoothing and decoupling circuits, tend to become expensive when they are designed to withstand high working voltages, and so it is natural that when planning a receiver every attempt is made to use these "high test" condensers only in those positions where they are strictly necessary.

It will be fairly obvious that in grid bias circuits there is never any need to legislate for high voltages, as the maximum bias applied to any valve is most unlikely to exceed 100 volts or so, even in a 500-volt "super power" amplifier. This applies to all grid circuit by-pass condensers. Uncertainty generally arises with regard to decoupling and anode by-pass condensers, and a correspondent raises the question whether a condenser that is isolated from the source of H.T. supply by a decoupling resistance of high value need be chosen with a view to withstanding the full voltage.

In such cases everything depends on the design of the receiver, and the matter can best be made clear by taking as an example the output end of a typical mains-operated receiver such as that shown in Fig. 2. Referring to this diagram, it will at once be appreciated that the condensers C and C_1 have to withstand the full voltage of the rectifier, and in particular that a full margin of safety should be allowed with respect to C. The condenser C_2 (loud speaker feed) will also be subjected to the full rectified output, less a small drop in voltage in the feed choke.

Now for C_3, which in effect is connected across the H.T. supply *via* the resistance R, assumed to have a value of many thousands of ohms. The valve with which it is associated is of the indirectly heated type, as are presumably all preceding valves in the receiver, and so it should be realised that, for a considerable space of time after switching on, these valves will not be passing any anode current at all, and so, again, full voltage will be applied through the resistance to the condenser in question. Admittedly, however, the results of a breakdown will not be serious, due to the limiting action of the resistance, and it is quite usual in the interests of economy to use, in positions such as this, condensers which have a relatively low test voltage. If provision be made for delaying the application of H.T. voltage until such time as indirectly heated valves have warmed up to do their work properly, the risk of breakdown is greatly reduced, and no objections could be raised, even on academic grounds, against the use of a "low-voltage test" condenser as C_3.

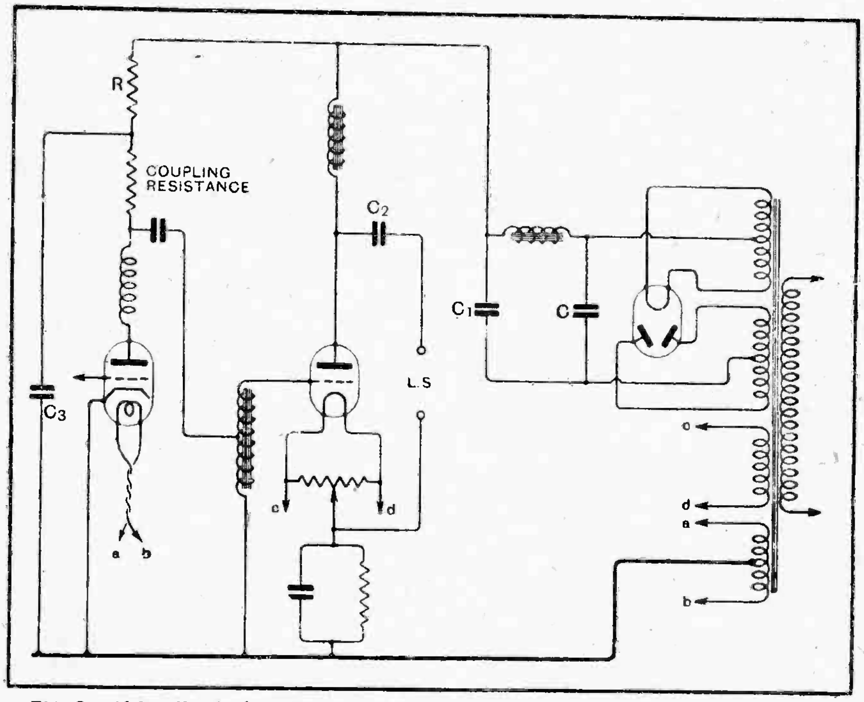

Fig. 2.—Although the by-pass condenser C_3 is isolated from the source of H.T. supply by resistance R, and thus receives some protection from surges, it has to withstand the full H.T. voltage until the indirectly heated valve becomes warm.

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Smaller Grid Condensers.

A READER, who has made the experiment of short-circuiting the grid circuit of his mains-operated set, has found that as a result mains hum is reduced almost to vanishing point. Consequently, he assumes quite logically that "hum" potentials are being picked up in this circuit.

After reading an article entitled "A Cure for Detector Damping" in our issue of December 16th, it occurs to him that the principle of using an abnormally small detector-grid condenser, as suggested in that article, might possibly confer greater freedom from background noises, and he asks whether it would be worth while going to the trouble of fitting a small semi-variable condenser in this position.

It is fair to assume that the change suggested should help in achieving the desired result, and in this particular case the experiment is one which is worth while trying.

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Avoiding Voltage Rise.

A CORRESPONDENT who has just purchased an eliminator is somewhat puzzled by the instructions issued by the manufacturers, which contain the statement that the filament circuit of the receiver should be switched on before the mains supply to the eliminator. When switching off, it is recommended that the H.T. supply should be interrupted before the filament circuit is broken.

Although the precautions suggested may often be ignored with impunity, the advice given in the makers' pamphlet is sound. By doing as suggested, the valves will begin to draw anode current from the eliminator as soon as it is switched on, and so the risk of a momentary rise in H.T. voltage, which might bring about a condenser breakdown, is avoided.

With regard to switching off, the same principle still applies. By reversing the recommended procedure, and by breaking the filament circuit before the H.T. circuit, the same voltage rise would take place.

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Matching Dissimilar Coils.

IT is asked whether it is essential that matched coils for use in a receiver with ganged tuning should be of similar physical dimensions. This question arises in connection with a proposal to build a band-pass input filter with coils having exceptionally low losses, but to retain the existing H.F. coupling coil, which is heavily damped by a grid circuit detector, and so there would obviously be little advantage in replacing it by a low-loss winding, even if space for one could be found in the receiver.

If one has enough patience—or access to comparatively elaborate apparatus—it is possible to match, with regard to inductance values, a series of coils of widely different dimensions. Provided that the inductances of all are similar, the inevitable differences that will exist with regard to self-capacity can be balanced out by trimmers.

In the absence of facilities for making true inductance measurements, our reader might adopt the method suggested for matching a frame aerial to a compact coil, which was described at length in the "Hints and Tips" section of our issue for December 2nd. A series of approximations, on the "unders and overs" principle, must generally be made before the necessary degree of accuracy is obtained. Actual adjustment of inductance is made by adding or removing turns.

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

"The Receiver of the Future."

IN our issue of December 16th, 1931, reference was made to Europe's wavelength difficulties and the general problem of selectivity, and we pointed out that if the present overlapping of stations were allowed to continue, existing sets of simple type would become more and more unsatisfactory, and that some solution of the problem was an urgent necessity. It was explained that if sets are designed where the tuning of the high-frequency side is sufficiently sharp to pick out from any one transmission a band of frequencies narrow enough to avoid interference with adjacent stations, then it was probable that the quality with present-day receivers of the normal type would be poor and the idealistic transmissions of the B.B.C. wasted in consequence.

A New Hope for Selectivity.

We explained that recent investigations did, however, offer a line of research which might eventually provide a solution of the difficulty, yet at the same time enabling us to make the full use of the frequency range of broadcasting, even though overlapping with adjacent stations took place. A great deal of interest centred around the proposals of Dr. Robinson, put forward in connection with his stenode receiver, and his claims have served to revive interest in the investigation of certain aspects of the problem of selectivity.

The Wireless World has, naturally, kept well on the track of these developments, and readers will have read with interest the articles contributed by Mr. F. M. Colebrook on "Selectivity and Tone Correction." These articles go to show that selectivity in pre-detector circuits can be pushed to a point where quality is thoroughly bad and speech almost unintelligible, and yet by correction in the L.F. amplifier the frequencies sacrificed in attaining selectivity can be brought back and quality restored. Mr. P. W. Willans, some years ago, proposed the use of L.F. correction to compensate for loss of high notes due to reaction. What is, however, of the greatest interest is that, as claimed by Dr. Robinson and explained by Mr. Colebrook in his recent articles, in performing this operation interference from sidebands of adjacent stations which overlap the station to which the receiver is tuned are not necessarily restored in the amplifier. The constant heterodyne whistle, although not eliminated in this process, can easily be removed. The keenest interest has been shown in the attitude of *The Wireless World* towards this problem, and we think that we can fairly claim to have been the only publication in this country to recognise the importance of these processes as a means of attaining a degree of selectivity greater than has hitherto been possible with circuits of equivalent types.

It is not sufficient to deal in theory only with this subject, and investigators in *The Wireless World* laboratory have been concentrating, in conjunction with Mr. Colebrook, on the development of a broadcast receiver incorporating these principles. The general scheme offers wide opportunities for future development of receivers, and we have no doubt that, following on our lead, many experimenters will get busy on the subject, which offers unrivalled opportunities for intelligent investigation.

A Practical Receiver.

It has always been the policy of *The Wireless World* to release new information to readers as quickly as possible, and in consequence we take this opportunity of announcing the early publication of a broadcast receiver of outstanding interest to the experimenter, which we have developed along the lines indicated above

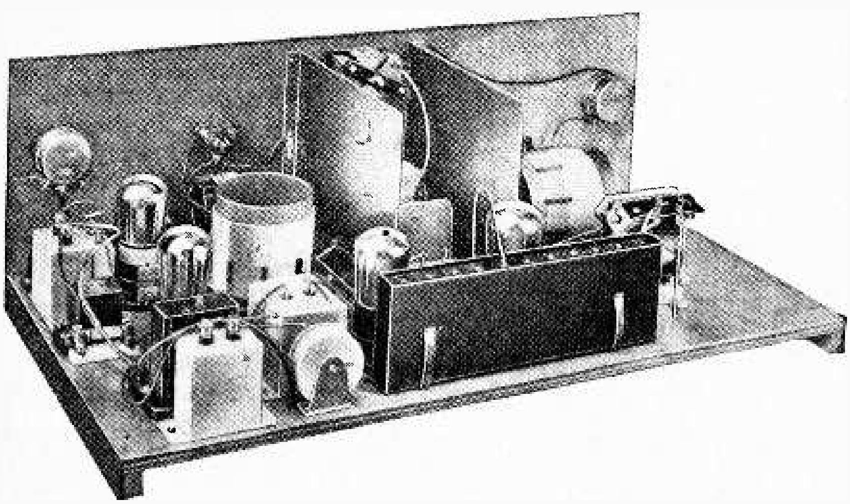
An experimental model of the new set is illustrated on this page, and the final design to be described is at present under construction, with certain minor modifications intended to simplify operation of the controls.

The set employs three valves and an additional valve for tone correction, and although no H.F. amplification is used in this model, the selectivity and sensitivity are of a distinctly higher order than is normally obtainable from any set of ordinary type employing an H.F. stage before the detector.

We are extremely pleased to be able to publish in this issue, under "Correspondence," a letter from Mr. P. K. Turner, which arrives most opportunely to add further support to *The Wireless World* view of the importance of this system. Mr. Turner, unknown to us, has been working along parallel lines. We are inviting Mr. P. K. Turner to cooperate with us in further constructional articles along these lines and hope to have the benefit of his valuable assistance.

It is interesting to note that Mr. Turner has come up against the same difficulties which have been the cause of delay on our part in putting out the design, but we believe that we have now overcome most of these troubles.

Mr. Turner gives, as his view, that the practical results in all cases entirely bear out the theory explained by Mr. Colebrook, and the performance of experimental sets he describes as "miles ahead of anything else I have heard for combined selectivity and quality, and in my opinion, this is undoubtedly the system of the future."



A view of the experimental receiver discussed on this page. Early publication will be given to a constructional design on these lines.

Another Electricity-supply Joke.

REALLY, some electricity-supply authorities are incorrigible! Only a month ago we were impelled to comment on the preposterous attitude of the Faversham Town Council in deciding that all electricity used for radio apparatus must be paid for at the lighting rate. Close on the heels of this absurdity comes the information that the County Borough of Grimsby Corporation Electricity Department have circulated consumers requesting the supply of information on a postcard as to whether a receiving set operated on the electricity supply mains is in use or not, and the sequel to the collection of this information is understood to be a pending notification to consumers that wherever wireless instruments are connected to the supply, an additional charge is to be made in electricity accounts.

It is not surprising that Grimsby consumers have risen as one man to oppose this demand, and, although we have not as yet seen any statement on the part of the electricity authorities there attempting to justify their action, we are entirely on the side of the indignant consumers, for we cannot conceive that there could be any justification for this action. It is, in our view, a scandal that any public service should be permitted to make petty regulations of this nature to annoy and antagonise those whose business it is for them to serve.

Last month we urged that supply companies should get together and agree on conditions of supply, even though for the time being it might be difficult to standardise charges. The action of the Grimsby authorities comes, we consider, under the heading of "Conditions of Supply." Electricity, for whatever purpose it is used, should be charged for at the same rate, except where, perhaps, it is justifiable under long-standing regulations for which authority has been given for a higher rate to be charged for electricity used for illumination purposes.

It seems unnecessary to make any further comment on the action of the Grimsby Corporation. Let us hope that the regulation will be killed by ridicule and those responsible for having proposed the regulation should be well satisfied to have had their little joke.

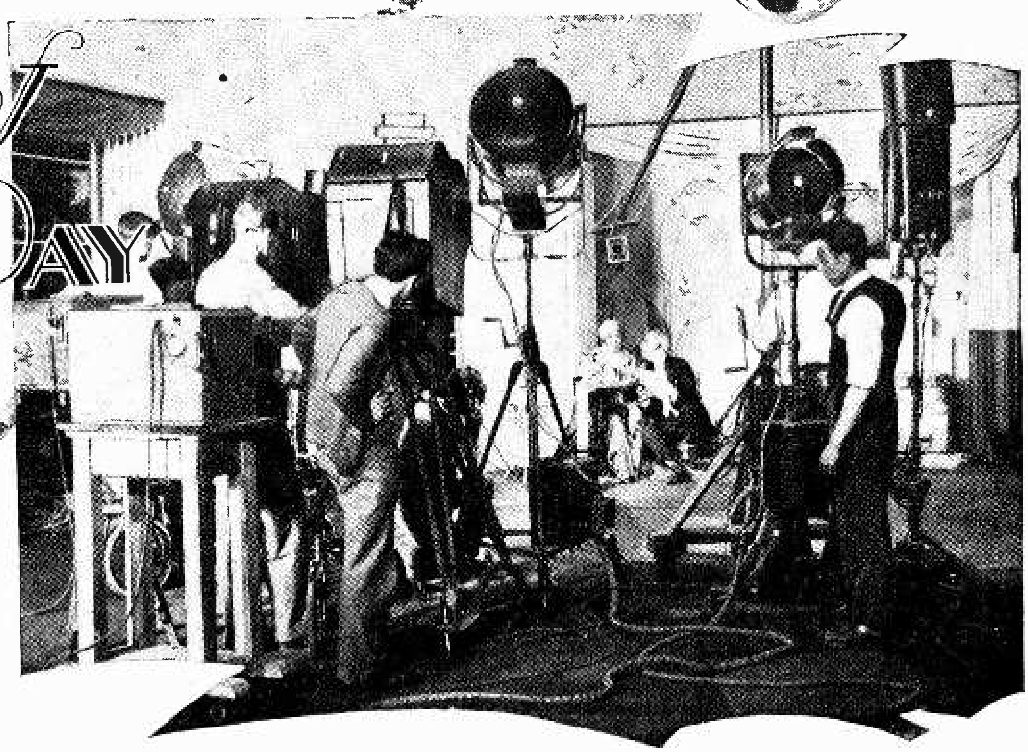
Discussion on Selectivity.

WE note, with great interest, that at the Wireless Section meeting of the Institution of Electrical Engineers, on February 24th next, an informal discussion is to take place on "Selectivity." This discussion will be opened by Prof. C. L. Fortescue, O.B.E., M.A.

Provided that the atmosphere of this meeting is not too restrained, and that those who have been closely investigating problems of selectivity, particularly in the light of recent progress, will come prepared to give the meeting the benefit of their views and experiences, we anticipate that this meeting should prove to be one of the most important associated with the history of the Wireless Section of the I.E.E.

Prof. Fortescue, it may be recalled, has taken the keenest interest in the subject for a considerable time past, and his name has been associated with recent discussions in our sister journal, *The Wireless Engineer*, on the problem

SOUND FILMS of TO-DAY



By DALLAS BOWER.

I.—The "Aural Camera" in Talking Picture Production.

IS it generally realised that the sound-film, or talking motion picture, became a commercial undertaking only as a result of the rapid advance in broadcast engineering? If broadcasting had not brought about continual improvement in radio telephony transmission and reception, it is doubtful whether the modern "talkie" would by now be a highly popular form of entertainment. Technically, the sound-film, both in the process of recording sound and in its reproduction, is closely allied with broadcasting. The amplifiers and microphones used in recording, the loud speakers and power amplifiers used for reproduction, are in a large measure the direct result of steady progress in broadcasting technique.

To explain how a sound-film is actually made is the purpose of the present series of articles, particular attention being given to the sound department. Before we can discuss methods of "shooting" on the studio floor, sound editing and other fascinating details, we must enquire briefly into the initial requirements of a sound-film system.

A means is required whereby an event in sound may be stored, to be released as a replica at some future date. This is the fundamental requirement of a sound system. The aural camera must perform the same function as the visual camera, but in the medium of sound instead of sight. It must be capable of storing any sound, and of supplying a replica substantially true to the real sound at the time of storage.

The Vitaphone system—the first workable on a commercial basis—utilised the storage of sound on wax, or what was really no more than an elaborate gramophone record. For various reasons, the foremost being ease of handling and transport, the disc is becoming obsolete and all large-scale films now have their sound recorded on film.

The Two Methods.

All the major systems, such as Western, RCA, Visatone, and Tobis, use the film method. There are two distinct ways of photographing the sound; variable density and variable area. Technical descriptions of both of these methods have been given in this journal, and it would be redundant to discuss them again in any detail.

Variable density tracks are more difficult to process and edit than variable area, and, of the two, variable area is more simple and flexible in handling. By far the most important matter for our immediate consideration is the limited area available on the film for the sound photograph. This very small area imposes a restriction which we must needs understand before we can fully appreciate the niceties and difficulties of

SOUND FILM RECORDING.

LAYOUTS AND WIRING SYSTEMS.

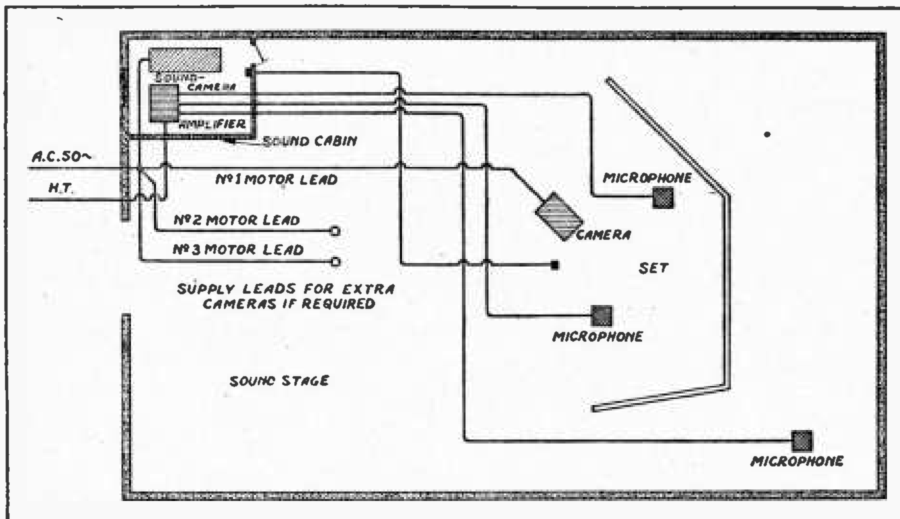
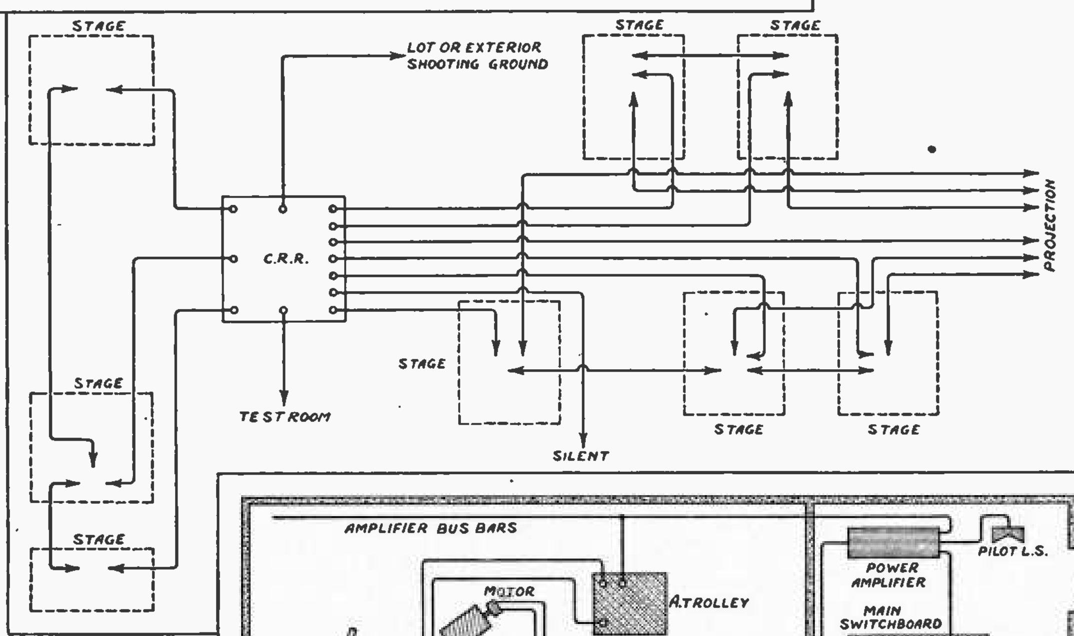


Fig. 1.—The layout of a self-contained recording system.

Fig. 2 (below) shows the wiring arrangement used in the central recording room system at the British International Studios, Elstree.



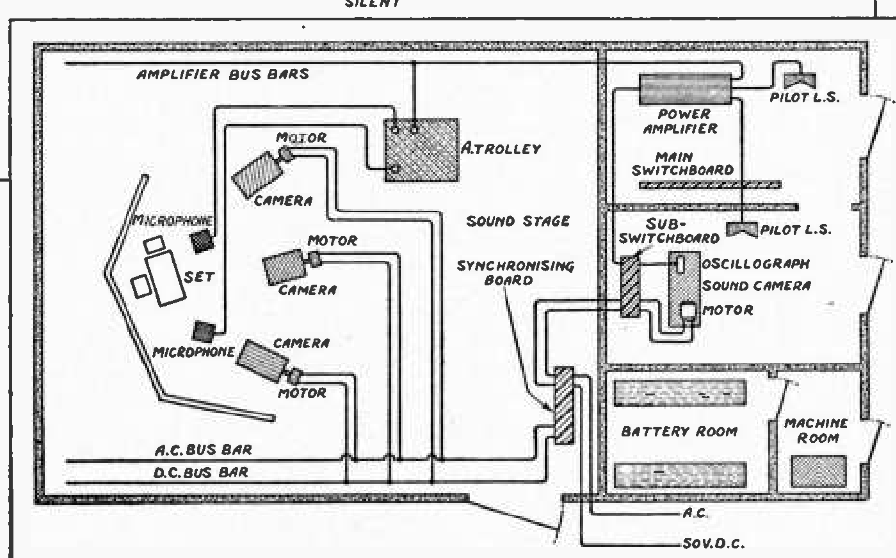


Fig. 3.—Schematic layout of the British Visatone system (Stoll-Marconi) as used in Stoll studios, the sound cameras and amplifiers being in a room next to the set.

Sound Films of To-day.—

recording. To ensure its success, the exploiters of the original sound-films—the large American producing organisations—deemed it essential that the sound photograph be on the same film as the visual photograph. Two films would be clumsy and expensive; moreover, it was desired to keep down the costs entailed by the exhibitor. Two films would mean additional projection machinery and a host of new complications in the actual operating of the projectors in the cinema.

On the sound recording side "talkie" production offers even greater, problems than those associated with broadcasting. In this new series of articles the author, who has himself recorded many British films, describes the practical difficulties which have to be tackled afresh with each new production.

With the single film arrangement, existing projectors could be adapted to the new needs of a photoelectric cell with its accompanying exciter lamp and optical system. Consequently, the single film became standardised and the size of the sound track became uniform in order that the sound tracks of any recording system could be applicable to any projectors. The area for the sound track was obtained by cutting off a small portion of the left side of the picture, a process which, of course, altered the shape of the picture. Also—and this is the vital matter—it left only two twenty-fifths of an inch, or eighty mils, for the track. A full-sized standard film measures 35 mm. across from outer edge to outer edge. We have only eighty mils of that distance in which we may photograph the sound.

The effect of this is seriously to limit the total volume range over which any recording system will work. The actual range is approximately a third less than that of modern broadcasting, and approximately two-thirds less than the total volume range of the ear.

The projection apparatus in the cinemas is likewise limited, as it is designed to handle no more volume than would be necessary when worked with the single film arrangement.

We should be much better off had we a separate film for the sound photograph with as much distance as we could obtain between the sprocket holes of a standard 35 mm. film. Range would be considerably increased, and recording made much simpler. Unfortunately, these idealistic conditions are not likely to be introduced for a long time, if ever, as they imply alteration to all projection apparatus and would thus cost a great deal of money. The so-called wide film (75 mm.) would give us a slightly larger track, but the advantages to be obtained are small compared with a full-width separate film. The wide film, however, would necessitate the displacement of nearly all existing cinema machinery of every description. It may be that through such a revolution sound will be given its own film again. We say "again," because a large amount of original experimental work was carried out with wide tracks, and the Poulsen-Petersen system made some of the first sound-films with wide tracks to be shown in this country in the early days of the art.

The negative sound track and negative picture are, in most cases, taken on separate films. They only become "married" on the same film when they are printed in the laboratory. Such a copy of print is called a married or synchronised print to distinguish it from sound and picture positives, which are on two separate films, printed from the original negative independently of each other, and which can be projected only on a special machine.

Obviously it is very necessary that the speeds of the sound and picture cameras should be exactly the same, otherwise we could not obtain synchronisation. The speed in practice is ninety feet a minute. Although the visual camera speed must not alter appreciably, very special precaution has to be taken to prevent even minute variations of speed in the aural camera. A slight alteration of speed—faster or slower than normal—immediately alters pitch, which is so easily recognisable in music that a "wow" or wobble in a music track makes it quite unusable. To hear a "wow"

A typical shot in which three cameras are used. Note the microphone position.

Sound Films of To-day.—
in a sustained chord by an orchestra suggests that the players are dropping a quarter of a tone below the true pitch many times a second.

Electrical System.

The electrical apparatus needed to equip a film studio for recording can be elaborate or simple according to the type of films the studio produces. A large modern studio producing "feature" length films needs a fairly elaborate plant in order to cope with a diversity of material and to ensure complete freedom from breakdowns. Suspension of work due to a breakdown can cost as much as two pounds a minute if the production is on a large scale.

The first requirement of the electrical system is a microphone and an amplifier. Some news-reel recording equipments consist of no more than two microphone channels, a battery-operated amplifier and a sound-camera forming part of the visual camera. Tone quality is not of the first order in these smaller equipments, and it is not strictly necessary that it should be. For studio work, however, separate sound-cameras are needed to give the widest possible range of flexibility, in allowing the editor as much scope as possible with the "mounting" of the tracks, and to give the greatest mechanical freedom to the visual camera so that it may move about.

In the RCA system a complete sound unit housed in a booth is used for each "floor" or stage. For example, if a studio has three floors enabling three productions to "shoot" simultaneously, each floor will have its own self-contained unit. In the sound-booth will be the sound-camera, the voltage and power amplifier, and the recordist's control gains, with the necessary switch gear for controlling the apparatus, including the motors driving the visual cameras synchronously with the sound-camera.

In a very large studio the use of a complete unit for each floor is somewhat costly, so we find in the British International Studios at Elstree—the largest in the British Isles—the central recording room system. Each floor has a booth in which are the recordist's controls for the microphone circuits, and an amplifier with a monitoring circuit. This amplifier feeds a line to a central power amplifier room, which in turn feeds an adjoining room housing the sound-cameras. The recordist is in telephone communication with his sound-camera operator in the central recording room. He can be told the percentage of his modulation by the operator in addition to using the visual indication by a meter on his amplifier.

The chief asset of this arrangement is economy. With a complete unit for each floor, studios with six floors will need six sound-cameras. In the central recording room system four sound-cameras will be adequate for all six floors, the reason being that it is extremely unlikely that six productions would all be shooting at one and the same time.

At least two of the six will be rehearsing or "setting-up" while the other four are shooting. When the two productions which have been setting-up are ready, another two will have finished their latest scene and will be rehearsing for the next. Consequently, two sound-cameras will now be available to switch over to the other productions.

The central recording room method is of no advantage to any but the largest studios, where all floors are nearly always occupied with a production. Its fundamental disadvantage is that the recordist is separated from his sound-camera; indeed, he no longer has an individual camera such as would be the case were his equipment self-contained on the floor, for the output from his line will be given to any sound-camera which happens to be available when needed.

The great advantage of the RCA self-contained equipment from the production point of view is that the sound-camera is under the immediate control of the recordist, allowing him to observe the modulation taking place on his sound-track in an extremely simple and efficient manner.

Fig. 1 shows the layout of a self-contained system, while Fig. 2 gives the layout of a central recording room arrangement. In small studios, the sound-camera and amplifiers may be in adjacent rooms to the floor, the recordist's controls and an initial amplifier being on a trolley or in a booth on the floor itself.

This method, which is very satisfactory, is used in the Visatone (Stoll-Marconi) system. The recordist has a portable trolley on which are his microphone gain controls and an amplifier. This little vehicle can be pushed to any part of the floor, so that the recordist can always be in full view of the "set." We shall see later how particularly useful this is in bringing about the very intimate co-operation necessary between all departments for the best overall technical work on a film. Fig. 3 shows the layout of a typical Visatone installation.

(To be continued.)

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A.R.R.L. Frequency Tests.

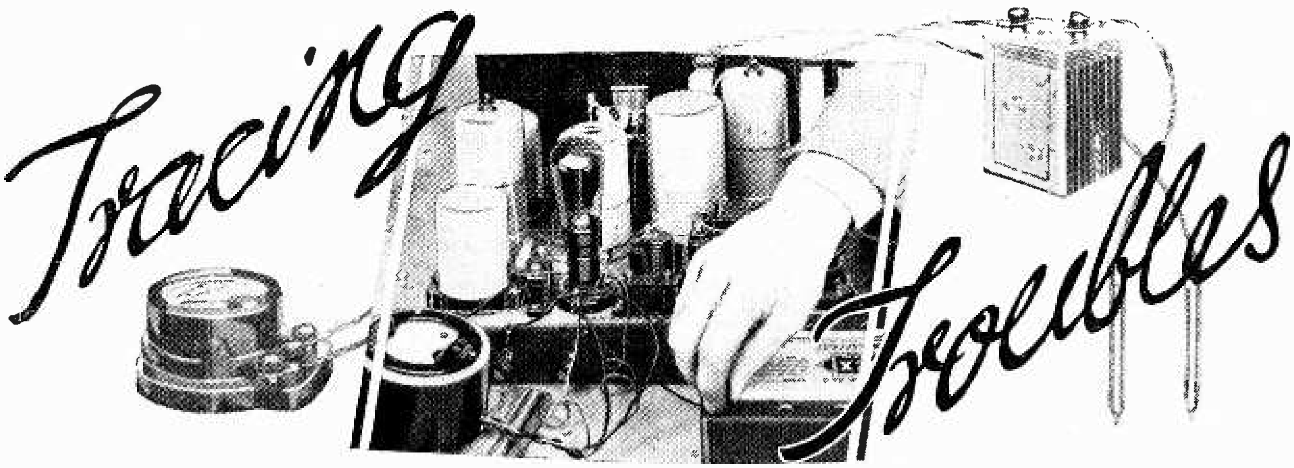
The National Frequency Measuring Contest promoted by the American Radio Relay League on October 24th and 31st of last year proved the efficiency of modern amateurs, as 144 of those who took part won certificates by measuring frequencies with an average accuracy of 99.90 per cent. or better.

Sixteen selected stations in various parts of the United States transmitted between 9 p.m. and 11 p.m. E.S.T. on both days (0200-0400 G.M.T. of the succeeding days), on constant but unknown frequencies in the 3.5 and 7.0 mC. wavebands, and these were carefully measured by the Government Monitoring Stations of the Radio Division, U.S. Department of Commerce.

Four amateur stations attained an accuracy of 99.99 or more in their measurements, and among the successful competitors were G5BY and G6PF.

Perhaps the most creditable performance was that of Mr. H. L. O'Heffernan, G5BY, who, despite the fact that the signal strength seldom exceeded R3, and fading was very bad, managed to make five measurements at his station in Croydon on a frequency meter of his own design, construction, and calibration, which proved to have an accuracy of 99.984 per cent. (not 99.934 as inadvertently printed in our issue of January 13th), thereby tieing for the eighth place among the 144 winners of certificates and foremost of all competitors outside North America.

G6PF, Mr. L. Parfitt, of Abertillery, was also among those whose accuracy reached 99.97 per cent., while the highest points were obtained by W2BP, Mr. B. Phelps, of Hicksville, Long Island, N.Y., with 99.999 per cent. in nine measurements, and VE2AP, Mr. J. C. Stadler, of Westmount, P.Q., Canada, with an accuracy exceeding 99.99 per cent. in four measurements.



By M. G. SCROGGIE, B.Sc., A.M.I.E.E.

No. 2.—Anode Current Tests.

ASSUMING that the amateur has collected the small amount of testing equipment referred to in the first article, the author now outlines some practical methods of tracing receiver troubles to their source.

MOST of the ills to which a broadcast receiver is heir may be grouped under these four headings: (1) Complete absence of reception. (2) Weak reception, including loss of selectivity. (3) Distortion. (4) Noises. To put our ideas on a practical basis we shall consider first of all a battery-driven receiver of normal type, leaving the special faults of other types of apparatus until later. It is also assumed that the set has given satisfactory results at one time, and has since then become faulty. Inherent faults in design or construction are therefore excluded.

In making the tests to be described, particularly those for which it is necessary to have the current on (from batteries or power unit), in the interests of economy in valves and components, and possibly funeral expenses, care should be taken to avoid making contact with things that should be left alone. Make a habit of discharging large condensers after having turned off the power; use insulated prods for voltmeter connections, and when making connection to, say, the anode pin of a valve, do not simultaneously touch the filament or grid pin. Take special care with metallised valves, as a metal wire or rod touching them and a screen or chassis at the same time may short-circuit something.

The first thing is invariably to check all batteries, H.T., L.T., and G.B., bearing in mind the precautions detailed in the preceding article with reference to the use of voltmeters, to ensure that the measurements are made when the batteries are delivering neither greatly more nor greatly less than their normal current. In measuring accumulator voltages it is essential to use a really accurate voltmeter, as a few per cent. is all the difference between nearly "full" and nearly "empty." An accumulator which is almost completely discharged gives nearly full voltage when measured by a high-resistance voltmeter; a good idea as to its condition is obtainable by noting the difference between open-circuit voltage (with only voltmeter connected) and normal discharge voltage. The makers of the accumulator are always willing to give advice with regard to this. Grid batteries are not usually required to supply any current, and may serve their purpose well long after they have become useless for giving current, and a low-resistance voltmeter would then give a misleadingly low reading; nevertheless, when a grid battery shows considerably less than its nominal voltage on a reasonably good meter it is time to throw it away, for it is liable to be noisy or to fail altogether and put the valve in danger of excessive current.

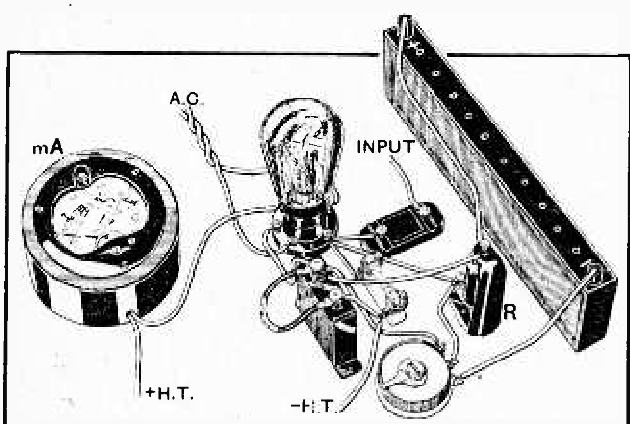
The most informative general test to make under complaints (1)-(3)—and occasionally (4) also—is to measure the anode current to each valve. The screen currents of S.G. and pentode valves are, of course, included in this part of the investigation. The simplest method is to connect the milliammeter in the positive H.T. lead or leads, removing all valves except the one under test. This is not always an entirely reliable method, as, if there are any decoupling or grid bias resistors common to more than one valve, the feed to one is increased by removing the others. In cases of doubt it is instructive to add up the separate currents and see if they are equal to the total when all valves are in position. Mains-driven receivers are not cases of doubt for the impedance of the power unit invariably makes this method of test inadmissible. An alternative is to use the valve adapter described in the preceding article, and again illustrated in detail here (which enables the milliammeter connection to be inserted at the valve anode socket), or to detach the top terminal lead, as the case may be. Take

Tracing Troubles.—

great care to see that all the valve pin connections are making good contact. Even this method is open to possible error in certain circumstances, if the addition of the milliammeter leads at this point of high signal potential is sufficient to cause inaudible oscillation, for the anode current then bears no relation to the normal value. This effect generally betrays its presence by fluctuation of the anode current as the leads are handled or moved about.

It is Better to Over-bias than Under-bias.

Unless running cost is no object, a dry battery-driven receiver should be organised so that as much as possible of the total anode current goes to the power valve, the others being kept on rather short commons, not, of course, ridiculously so, but except for power-grid detection, which is rather a luxury when only dry batteries are used, it is seldom desirable to exceed 1 mA. per valve. High readings should therefore be investigated, as the cause may be a definite fault, such as a break in the grid circuit (usually accompanied by hum, instability, distortion, etc.), or the voltages may be unsuitable. Even the power valve may take too much current by being under-biased, or by a broken grid circuit. It is better to over-bias than under-bias, for, apart from the



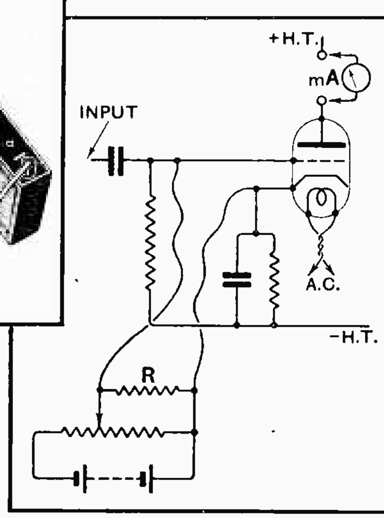


Fig. 1.—Pictorial and circuit diagrams showing a typical valve stage of which the actual grid potential is to be measured. The resistance R is made equal to the resistance of the voltmeter which will replace it in certain circumstances.

question of economy in batteries and valves, anode bend distortion is less execrable than that produced by running into grid current.

A total absence of either screen or anode current *may* mean a dud valve, but before coming to this conclusion test for voltage between anode and filament. If it is there, remove the valve and test the continuity of the filament by trying to measure the voltage of a battery through it. If the filament is still there, conduct a little independent test on the valve alone by running the filament direct from the L.T. battery and trying to get current through the anode, and screen, if any, by applying H.T., the grid being strapped straight to the filament, or as a last resource to the anode. If the result is little or no current, and other valves similarly tested give proper indications (this as a test of the testing equipment) it is safe to regard the valve as of no further use for the purpose for which it was intended, but only as a possible candidate for replacement by the magnanimous manufacturer. A valve may still have a fair amount of emission and yet be below par, enough to cause weakness or distortion. Reference must be made to the published characteristics in judging whether or not this is the case. If the shortage of current be traced to a lack of volts, or incorrect volts, at anode, filament, or grid, it is a simple matter to test back to find at what point between the valve and the source of current the connection ceases to exist.

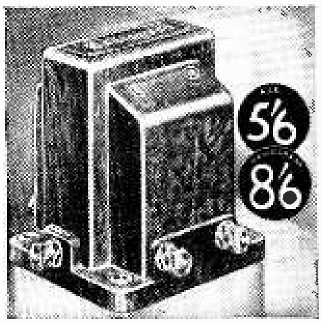
Measuring Actual Grid Potential.

Reference was made last week to the difficulty of measuring accurately the bias voltage which is actually reaching the grid of the valve, due to the fact that the connection of even a high-resistance voltmeter alters the circuit. The most reliable method is to put a milliammeter in the *anode* circuit, and connect the voltmeter from negative L.T. to the actual grid pin of the valve (to avoid possible error due to a faulty valve-holder). It is very important to make sure that no signals are being received and no oscillation of any sort is taking place; if necessary, disconnect the grid from the coupling condenser or other source of signal, so long as the actual bias circuit is not interfered with. If the milliammeter reading is not altered by the presence of the voltmeter, the reading of the latter is dependable. If this is not so, or if no separate voltmeter is available, connect a source of voltage in place of the voltmeter and adjust it until it produces no change in the anode current. A grid battery giving steps of $1\frac{1}{2}$ volts is satisfactory for rough measurements; if no tapping can be applied which does not affect the anode current the voltage lies between those which raise it and lower it. For exact tests one must use some sort of potentiometer, the circuit being as in Fig. 1. If no separate voltmeter is available, a resistance equal to that of the voltmeter must be connected in its place during the grid test, and then the combination meter (which has just been used as a milliammeter for testing anode current) afterwards substituted for this resistance in order to measure the actual voltage which exists at the grid. Remember that improperly marked bias batteries have been known, so do not take them for granted.

If loud speaker performance is weak (and probably thin in tone) or non-existent, and there is no clue in the steady anode-current readings, set the controls to give what should be ear-shattering reception of the local station, and examine the meter again. If the power-

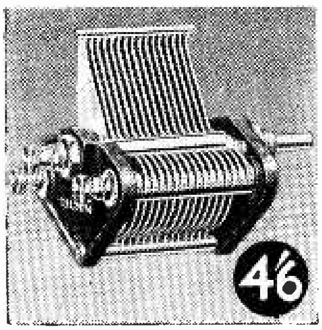
TELSEN

100% BRITISH RADIO COMPONENTS

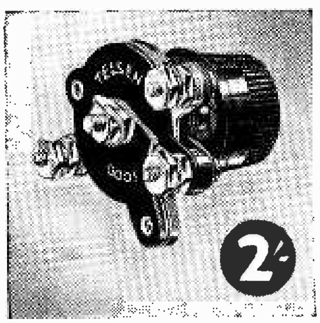


L.F. TRANSFORMERS.

Ace, ratios 3-1 and 5-1	5/6
Radiogrand, ratios 3-1 and 5-1	8/6
Radiogrand, ratio 7-1	12/6
Radiogrand, 1.75-1	12/6

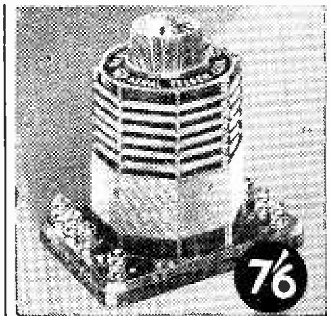


VARIABLE CONDENSER.



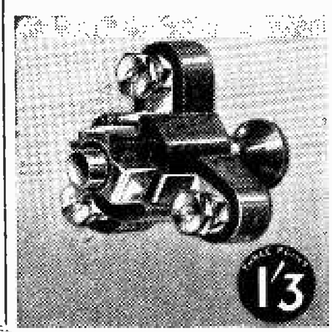
BAKELITE DIELECTRIC CONDENSERS
Differential Condenser — Cap. ·0003, ·00015, ·0001, 2/-. Reaction Condenser —Cap. ·0003, ·00015, ·0001, 2/-. ·00075, ·0005, 2/6. Tuning Condenser—Cap. ·0005, ·0003, 2/-.

Output Transformers -	12/6
H.F. Chokes - -	from 2/-
Output Chokes - „	8/-
Power Grid Chokes -	8/-
L.F. Coupling Chokes -	5/-
Slow Motion Dial - -	2/6
Fixed Condensers	from 6d.
Pre-set Condenser - -	1/6
Spaghetti Resistances	from 6d.
Loud Speaker Chassis	from 5/6
Fuse Holder - - -	6d.
Grid Leak Holder - -	6d.



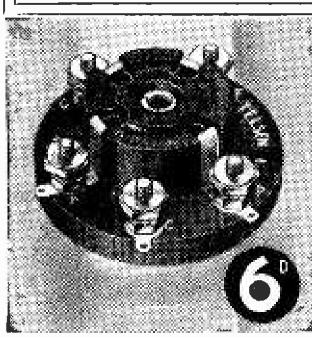
DUAL-RANGE AERIAL COIL with variable series condenser, 7/6. H.F. Transformer and Aerial Coil, 5/6.

BINOCULAR H.F. CHOKE



PUSH-PULL SWITCHES
(Prov. Pat. No. 14125/31).

Two-point	1/-
Three-point	1/3
Four-point (2 pole)	1/6



VALVE HOLDERS (Prov. Pat. No. 20286/30). The Telsen four- and five-pin valve-holders embody patent metal spring contacts, which are designed to provide the most efficient contact with split and non-split valve legs, and are extended in one piece to form soldering tags. Low capacity and self-locating.

Telsen 4-pin Valve Holder .. Price 6d.
Telsen 5-pin Valve Holder .. Price 8d.

GRID-LEAKS. Telsen Grid-leaks are absolutely silent and non-microphonic, and practically unbreakable. They cannot be burnt out and are unaffected by atmospheric changes. Telsen Grid-leaks are not wire wound and therefore there are no capacity effects. Their value is not affected by variation in the applied voltage. Made in values from ¼-5 megohms.

Advt. of The Telsen Electric Co., Ltd., Aston, Birmingham.

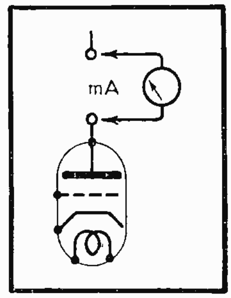
CVS—126

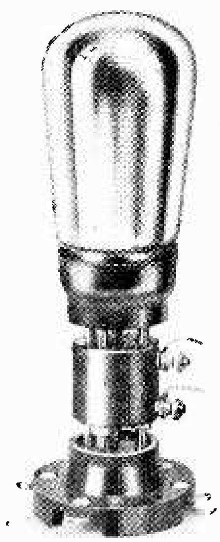
Radio Data Charts. For the keen amateur. By post, 4/10

Tracing Troubles.—

valve current is dancing about, which shows that there is a powerful signal there which is not getting through in the form of sound from the speaker, there is probably a breakdown in the speaker, output transformer, or output choke, or an absence of field current if a moving-coil speaker. Similar signs of activity in earlier valves, followed by repose in the others, may be taken to mean the short-circuit or other silencing of some component in between. A short-circuit is *sometimes* further pointed to by excessive H.T. current, and is accompanied by generally weak or zero reproduction, or, if it takes the form of a partial short-circuit of an inter-valve, output, or loud speaker winding, the tone is high-pitched. An open circuit, or break, can give audible reception only through stray capacity, and if the fault is in the audio or post-detector part of the receiver the tone is extremely high, but if in the radio or pre-detector part the reproduction is much less affected, particularly in tone.

Investigation of distortion by anode current is a subject in itself. It is erroneous to suppose that fluctuation of anode current necessarily indicates distortion. A moving-iron or thermal indicator would show a fluctuation of anode current even under theoretically perfect operating conditions, and with valves as we have them a certain amount of pointer kick, even of a moving-coil meter, is inevitable if appreciable output is to be obtained, but excessive needle-swinging may be taken to mean gross overloading (if the sound from the loud speaker warrants that conclusion) or faulty operating conditions—battery voltages—or loss of valve emission. The amount of pointer kick manifested by a meter varies enormously for a given amount of distortion, according to the construction of the instrument. Some swing about quite violently when the actual distortion is tolerable, while others sluggishly refuse to recognise anything that is not already painfully obvious to the ear. One can judge to some extent from appearance which is likely to be the case; a light pointer with a small coil is more likely to kick than one of large inertia. Also it should hardly be necessary to point out that the same instrument will display more animation when run near full-scale than when the reading is low.





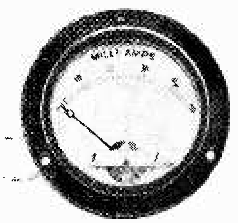


Fig. 2.—To save the breaking of anode feed leads —a valve-holder adaptor with terminals for the connection of an anode milli-ammeter is a valuable component.

If intermittent scratching, rustling, or crackling noises are present, or intermittent reception, the anode current to each valve should be watched closely (no transmission being tuned in) to observe a corresponding fluctuation, indicating an intermittent contact, short-circuit, or valve fault, which may exist in almost any component. This test helps to show which valve circuit is responsible. An incipient breakdown of an intervalve transformer usually takes this form, and valve-holders, resistors, and grid leaks, wire-wound and otherwise, are other common cases.

So many faults can be traced, or at least suspected, by the anode-current test that it is given first. When this fails to clear up the trouble entirely it is necessary to apply others. These will be dealt with in the next article.

"THE WIRELESS WORLD"

Information Bureau.

CONDITIONS OF THE NEW SERVICE.

(1) THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

(2) Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Tudor Street, E.C.4, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

(3) The fee of 5s. covers the reply to any wireless technical difficulty, but in special cases, where the enquiry may involve a considerable amount of investigation, an increased fee may be necessary. In such cases a special quotation will be made.

(4) Questions should be clearly written and concisely worded in order to avoid delay. Where enquiries relate to trouble experienced in receivers built to specifications in *The Wireless World* a complete account should be given of the trouble, and especially the symptoms.

(5) Where reference is made to published articles or descriptions of apparatus, the title of the article, the date of publication in *The Wireless World*, and the page reference number should be given, in order to facilitate reply.

(6) Full circuit diagrams, constructional details of apparatus, or values of components for home-designed receivers cannot normally be supplied, but circuit diagrams sent in with queries will be checked and criticised.

(7) Particular makes of components cannot, in general, be recommended, but advice will be given as to the suitability of an individual component for a particular purpose specified by the enquirer.

Nuts to Crack

Instructive Problems and their Solution.

THE present series has been started by *The Wireless World* for the benefit of readers who like to work out little problems for themselves and be sure that the results they obtain are correct. Each week two or three wireless problems are presented, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Last week problems 5 to 8 were given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

Problem No. 5.—**The H.T. current for a multi-valve set is supplied by a dry battery of 120 volts. A milliammeter placed in the negative lead indicates that a steady current of 8 milliamps. is passing. What is the D.C. resistance of the H.T. circuit?**

Answer—15,000 *ohms.*

The comparatively small currents which flow in the H.T. circuits of a receiver are conveniently measured in milliamperes, the prefix "milli" meaning the "one-thousandth part," so that one milliamp. is 0.001 ampere. Similarly, the microampere is a millionth part of an ampere, or 0.000001 ampere. The whole object of these units is for convenience in expression; when, however, we have any calculations to make in which they are involved, it is better to express them in terms of the fundamental unit of current, the ampere. In applying Ohm's Law it is always advisable to express the quantities dealt with in terms of the fundamental units, amperes, volts, and ohms, since the formula $E=IR$ holds for these denominations.

In the present case we should require to express the H.T. current in amperes; it is, of course, 0.008 ampere. The resistance of the circuit is then readily found from the formula

$$R=\frac{E}{I}=\frac{120}{0.008}=\frac{120,000}{8}=15,000 \text{ ohms.}$$

oooo

Problem No. 6.—**What amount of power is consumed in the H.T. circuit of the above example?**

Answer—0.96 *watt.*

Since the power in watts is given by the equation $W=E\times I$, we have very simply,

$$W=120\times 0.008=0.96 \text{ watt.}$$

It is well to notice that this formula for power applies only in the case of *direct* currents; for alternating currents the procedure is rather more complicated.

oooo

Problem No. 7.—**After a period of use it was noticed that the milliammeter reading had fallen to 6.5 mA. If we assume that the resistance of the circuit remains constant, what is now the voltage of the battery, and what is the power taken?**

Answer—97.5 *volts.* 0.634 *watt.*

Expressed in amperes, the H.T. current is now 0.0065 amp., while the circuit resistance is, as found above, 15,000 ohms. The battery voltage will, therefore, be that required to pass 0.0065 ampere through 15,000 ohms. Applying the formula $E=IR$, we have

$$E=0.0065\times 15,000$$
$$=97.5 \text{ volts.}$$

The D.C. power is, as usual, given by $W=IE$. Here,

$$W=0.0065\times 97.5$$
$$=0.634 \text{ watt (approx.)}$$

oooo

Problem No. 8.—**If a 2-volt accumulator supplies 0.85 watt to the filament circuit, what is the L.T. current taken?**

Answer—0.425 *ampere.*

We may rewrite the equation $W=IE$ in the equivalent form $I=\frac{W}{E}$, in which, as usual, E and I are in volts and amperes, while W is in watts. In the present case, therefore,

$$I=\frac{0.85}{2}=0.425 \text{ ampere.}$$

NEXT WEEK'S PROBLEMS.

Problem No. 9.—**Three resistances of 10 ohms, 5 ohms, and 4 ohms are placed (a) in series, (b) in parallel. What is their effective value in each case?**

Problem No. 10.—**What resistance should be placed in shunt with a milliammeter of 5 ohms resistance in order that the total resistance of the combination may be 0.5 ohm?**

Problem No. 11.—**The milliammeter with its resistance shunt is connected in the H.T. circuit of a receiver. If the current as read on the milliammeter is 1.5 mA., what is the total H.T. current passing, and what is the voltage drop across the combination?**

Problem No. 12.—**If the maximum scale reading of the milliammeter is 2 mA., what is the greatest H.T. current it is possible to measure with this arrangement? Could the instrument be used to measure still greater currents?**

NUTCRACKER.

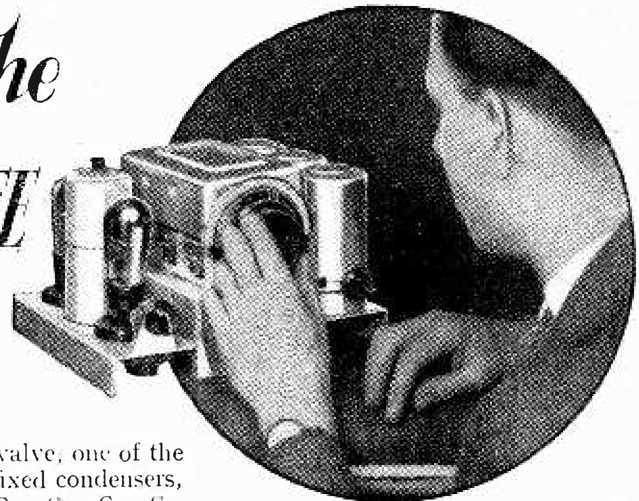
THE NEW "CALL BOOK."

The "Radio Amateur Call Book" for the winter of 1932 is now published, and copies may be obtained in Great Britain from Mr. F. T. Carter, Flat A, Gleneagle Mansions, Streatham.

Owing to the present rate of exchange with U.S.A., the price of this publication, and also that of the "A.R.R.L. Handbook," has been increased to 5s. 6d., post free.

The Lists of Amateur Transmitting Stations in all countries of the world have been carefully revised and brought up to date, and the useful list of Commercial Short-wave Stations, which occupies eight pages at the end of the book, has been re written and is as correct as is possible to make it, though Mr. Carter justly remarks "new stations and changed frequencies seem to come every few minutes."

More About the WIRELESS WORLD THREE



Hints on Tracing Faults and Some Useful Suggestions.

WITH all due modesty it may fairly be claimed that "The Wireless World Three" is one of the neatest, most compact, and most workmanlike sets that have ever been put forward for the benefit of the home constructor. It is not surprising that these receivers have been built in large numbers, and in many instances by those having no previous experience of set construction, or, at best, whose activities have previously been confined exclusively to making up the simplest form of detector L.F. apparatus. It is mainly for the benefit of those without experience of H.F. sets that these notes are published.

In the event of a constructor having inadvertently made a wrong connection, or having been unfortunate enough to obtain a defective valve or other component, the best way of finding the fault, if a cursory search is not immediately fruitful, is to make point-to-point and stage-by-stage tests. The latter are particularly valuable when dealing with a straightforward set such as that with which we are now concerned, as, by adopting a logical procedure, it is possible in a few minutes to decide definitely whether failure to get proper results is to be ascribed to the H.F., detector, or output stages.

As a start, the detector valve, and all components directly associated with it, may be tested by removing the H.F. valve and connecting the aerial to its loose anode lead. At the same time a pair of headphones should be connected across the anode resistance R_2, the output valve also being removed. Modified in this way, the receiver should function as a simple regenerative detector set, and may be expected to receive signals at fair distances, but not at any great volume. If it does not, it is logical to suspect that the trouble lies in the detector valve, one of the fixed condensers, C_3, C_4, C_7, C_9, C_{10}, in the tuning coil assembly L_3, or possibly in the H.F. choke.

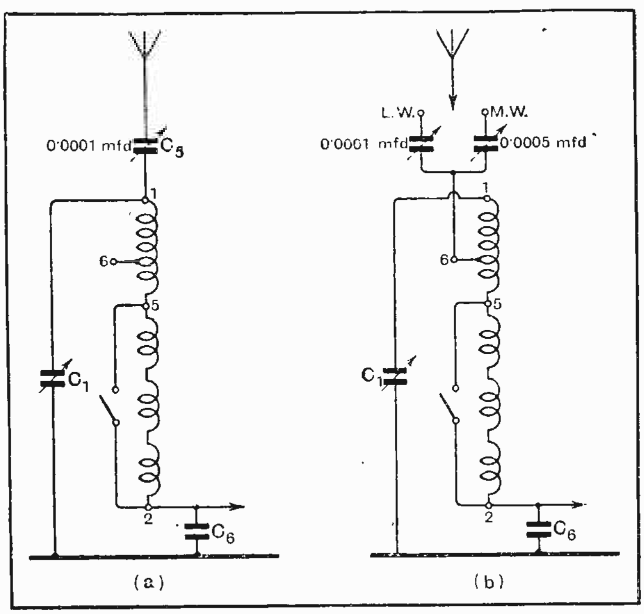


Fig. 1.—Alternative methods of connecting the aerial input circuit. With the second arrangement, the circuit is "trimmed" for each waveband by semi-variable series condensers.

Assuming the detector to be in order, the output stage may be tested by removing the phones and replacing the P.2 valve. This alteration should, of course, result in a great increase in signal strength. If everything, so far, is found to be in order, it will be known definitely that the H.F. stage is to blame.

With regard to this stage, a fault may be localised by joining the band-pass filter in place of the detector grid coil. This is done very simply in the following way: Disconnect the lead between the potentiometer (R_1) slider and the H.F. grid; also remove the existing connection between C_8 and C_7. Now make a new connection between the potentiometer slider and the free terminal on C_8.

Modified in this way, both elements of the filter circuit will be in operation; if these parts of the set are in order, a powerful near-by transmission should be receivable at good volume, but it should be noted that reaction control will no longer be operative, and so high sensitivity is not to be expected.

It is sometimes found—particularly when a long aerial of high capacity is used—that the ganged tuning adjustment does not hold good on switching over from the medium- to the long-wave band. In bad cases a powerful long-wave station may come in at two condenser settings, well spaced on the dial. This must be taken as an indication that the difference in the proportions of aerial capacity trans-

More About the Wireless World Three.—
ferred to the tuned circuit on either wave band is so considerable that the first circuit is appreciably out of tune with the other two; in order to avoid the need for constant "retrimming," the circuit may be modified in either of the ways suggested in Fig. 1. The first alteration shown in Diagram (*a*) is the simplest, and necessitates the substitution of a semi-variable condenser of 0.0001 mfd. in place of the existing C_3. At the same time the normal connection between this condenser and terminal No. 6 of L_1 must be changed over to terminal No. 1. This alteration will ensure the transference of the same proportion of aerial capacity—however large this may be—on either waveband.

Another and rather more elaborate scheme for overcoming the same difficulty is shown in Fig. 1 (*b*). This involves the fitting of a couple of well-insulated aerial sockets and of an extra semi-variable feed condenser of 0.0001 mfd.; when receiving on long waves the aerial should be transferred to the socket marked "L.W.," so that it may be connected to the set through this small capacity. Whichever of these plans may be adopted, it is advisable to set the built-in trimming condenser across C_1 at minimum, and to make any necessary trimming adjustments by means of the semi-variable condensers.

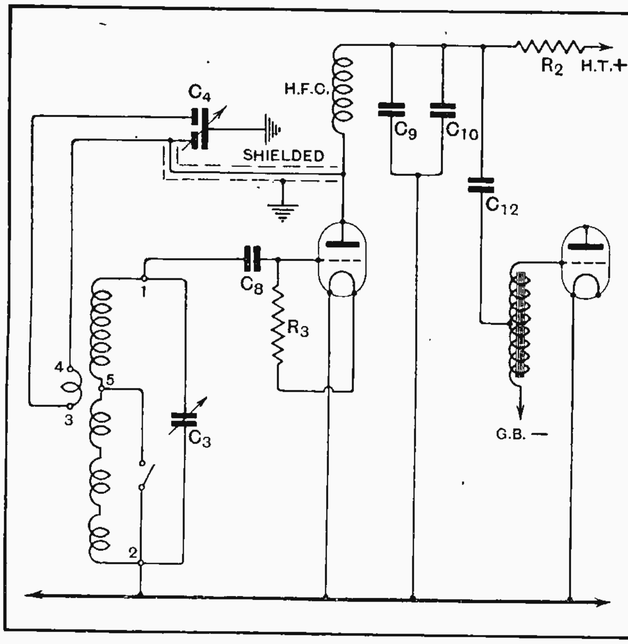
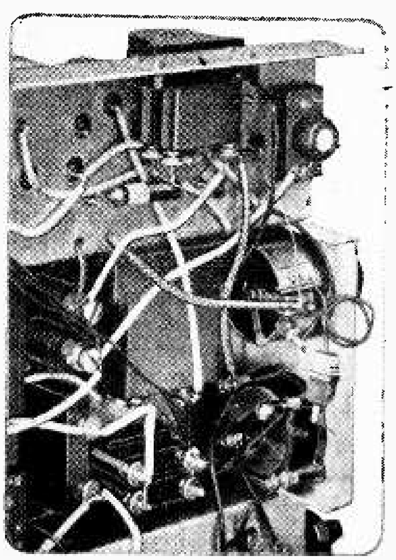


Fig. 2.—Modified reaction control circuit.

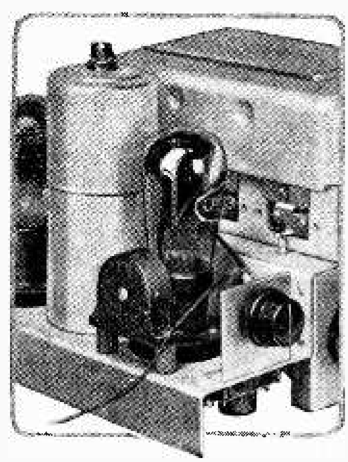

Alteration of wiring after modifying the reaction circuit. Note screened leads.

Normally, any tendency towards H.F. instability can be checked by reduction of screening grid voltage, but if it is found that an excessive reduction must be made in order to attain stability, it is worth while using a screened connecting lead (with the screening earthed) between the centre terminal of the volume control potentiometer and the H.F. grid.

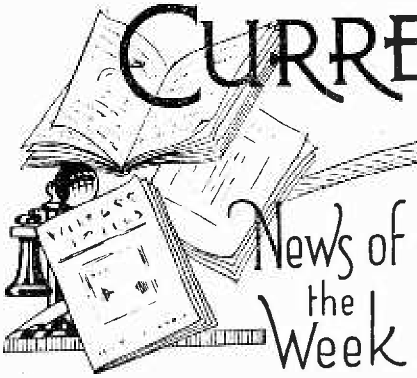
If reaction control is not entirely consistent, and particularly if it tends to become ineffective over the majority of the long-wave band and at the lower end of the medium band, it is well worth while introducing the circuit modifications shown in Fig. 2. An extra H.F. choke will be needed; a Telsen component is especially convenient for the purpose, as it may conveniently be mounted on ½in. distance pieces alongside the detector valve holder, in the manner shown in the accompanying illustration. The insulating bush for the differential reaction condenser will no longer be needed, as the rotor must be joined directly to the earthed metal chassis. It should be noted that the lead between the anode of the detector valve and the differential condenser must in almost every case be shielded, and, when the alteration in question is made, it will almost invariably be necessary also to shield the H.F. grid connecting wire, which has already been mentioned.

The reader may be reminded that screened H.F. connecting leads of low capacity are easily made by passing a length of fine wire—say No. 30—through a length of sleeving, which, in turn, is enclosed in loosely-fitting metallic braiding, or, if this is not available, in a wrapping of tinfoil.

As a result of altering the reaction circuit, the two fixed condensers C_9 and C_{10} will become spare, but they may be joined in parallel, and interposed between the low potential end of the H.F. choke and earth, as shown in Fig. 2.


Mounting of an extra H.F. choke.

All this is written with particular reference to the battery model, but many of the suggestions put forward are equally applicable to the A.C. mains-operated version of "The Wireless World Three," which is of similar design. For example, either receiver may benefit, in certain circumstances, by the alterations suggested in Fig. 1. Finally, a word of warning against the risks of short-circuits to the metal work may be given.



CURRENT TOPICS

News of the Week

Should Dealers Tell?

IT is understood that a scheme is being considered whereby radio dealers should provide the Post Office with the names of persons buying wireless sets or parts, the object being to simplify the task of tracking "pirates."

An interesting announcement may be expected.

oooo

Polyglot Programmes from 5SW?

OUGHT 5SW to transmit in the various languages and dialects of the British Empire? The question is suggested by the fact that the Colonial short-wave station in Paris now sends messages of goodwill to the French colonies in African and Asiatic dialects for the benefit of its coloured listeners.

The Chelmsford station might begin with a Children's Hour in Hindustani or Afrikaans.

oooo

Tell the Post Office.

A MACCLESFIELD listener has learnt the lesson that it is dangerous to take the law into one's own hands even in the case of an oscillating neighbour. He was fined £1 for cutting down the offending aerial, the magistrate remarking that the correct thing to do in cases of local oscillation was to inform the Post Office.

oooo

Trade Licences for Dealers?

A DEPUTATION representing various radio trade associations has discussed with the Post Office authorities whether some agreement could be reached to prevent cases of hardship which might arise out of the system under which every set sent out on approval must be covered by a wireless licence. We understand that the Post Office will shortly announce its decision concerning certain of the proposals made.

oooo

We Mustn't Complain!

"I CAN vouch for it that the tramcars interfere with wireless reception. But I do not complain, because I think transport is of more importance than wireless."—A correspondent in a Newcastle paper.

And food is more important than silence, as the man said of the humming Gorgonzola

Bradford v. Nottingham.

BRADFORD'S claim to have set up a record in the matter of wireless licences remains undisputed. In twelve months the increase has amounted to 33¼ per cent.

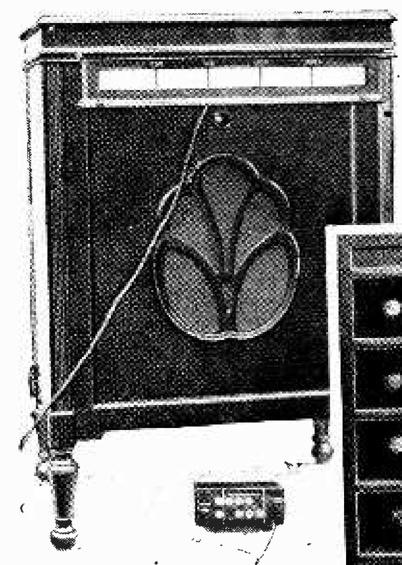
A Nottingham correspondent states that his city runs Bradford very close, the licences in the district having increased by over 31 per cent., from 42,433 at the end of 1930, to 55,623 at the end of 1931. Perhaps (he writes) this is an even more outstanding feat than that of Bradford, for, in proportion to the city's population, the total is much higher. It amounts to about one-fifth of the population of 27,000, while Bradford's is less than one-sixth of a population of about 286,000.

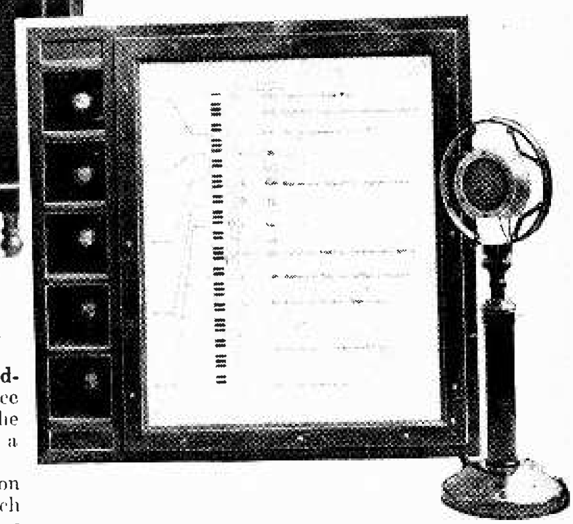
oooo

At the Telephone Show.

SPEECH and music phenomena are being cleverly demonstrated at the Young People's Telephone Exhibition in the Imperial Institute, South Kensington. In the Speech Transmission section is a special electric gramophone in which, by means of knob-controlled frequency filters, certain bands of frequencies can be excluded at will. While the results are amusing one hopes that they will also prove instructive to broadcast listeners who hear the voice of the old set at home when the illuminated panel is showing a cut off below 300 cycles.

In the device illustrated on the right five neon lamps, which glow at certain frequencies, show the acoustic peculiarities of the human voice.





LESSONS IN SOUND. Two demonstration devices at the Young People's Telephone Exhibition, which remains open till Saturday next.

Licence Lag in Germany.

GERMAN licence figures have not yet touched the four million mark. A Berlin correspondent reports that there were 3,980,852 registered listeners on January 1st, an increase of 471,000 in twelve months. But under the new regulations regarding free licences for invalids and the unemployed which came into force during the past year, some 280,000 listeners of the total are not paying for their licences, so that the actual increase in paying listeners is only some 200,000 for the whole year. The total number of British listeners is thus much higher than the German. Germans pay 24 marks a year for their licence. This can be paid in monthly instalments of 2 marks.

oooo

The Latest in Switches.

"JAMES B. WILKES . . . was alleged to have *nine switches* and a wireless set working off the mains without a meter."—*The Times*.

These switches want watching.

oooo

A Radio Paradise.

TRISTAN DA CUNHA—said to be the world's loneliest island—may shortly have a radio meteorological station. Wireless operators of H.M.S. *Carlisle*, which recently called at Tristan, report that a two days' test revealed that stations all over the world can be heard at this Pacific outpost.

The islanders have a communal broadcast receiver which has been operated and maintained by the Rev. A. G. Partridge, who is now returning to Cape Town after three years' stay on the island. We hope that the inhabitants have now sufficiently mastered receiver technique to ensure them good reception during their padre's absence.

oooo

Wireless for the Princess.

THE latest addition to Princess Elizabeth's famous model cottage, which is to be presented to her by the people of Wales, is a miniature wireless set "guaranteed to get foreign stations."

The New "Poste Parisien."

THE once-famous "Petit Parisien" broadcasting station will blossom forth under the title "Poste Parisien" next month with a power in the neighbourhood of 30 kW. The new transmitter, now under construction at Molières, in the Chevreuse Valley, is rapidly approaching completion, and, according to our Paris correspondent, must be out of the contractors' hands by February 11th.

The aerials are slung between two masts, each nearly 600ft. in height, and in appearance the station closely resembles the new *Radio Paris* at St. Remy-l'Honore.

oooo

More Power from Langenberg.

LANGENBERG'S new 60-kW. transmitter is making its presence known in Western Europe. The old 17 kW. transmitter is being retained as a stand-by, but by the end of the present month it is expected that all programmes for the *Westdeutsche Rundfunk* will go out on high power.

oooo

A Black Spot?

A SOUTH London listener troubled with oscillation in the neighbourhood writes to his local newspaper in these terms: "I am just wondering whether there can be a dirtier place (in a "wireless" sense) in Bermondsey (or anywhere else) than round about Hamilton Square."

oooo

"The Gramophone Girl."

NOT all listeners agree with the recent Austrian verdict against women announcers. After a girl had announced the "His Master's Voice" programme from Radio Paris on Sunday, January 10th, hundreds of listeners wrote or telephoned in appreciation. Her identity is to remain secret for the present; she is known as "The Gramophone Girl."

oooo

Adverts. from Athlone.

THOSE who wince at the thought of the British ether glutted with sponsored programmes must fortify themselves in readiness for the transmissions from the new high-power station in the Irish Free State. It is understood that many advertising interests are attracted by the possibility of using this 100 kW. transmitter for appeals to the British public.

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The Radio Patents Pool.

THE British radio-gramophone industry should benefit by the decision of six of the leading wireless manufacturing companies to pool all their patents appertaining to radio-gramophones. The parties concerned are the Gramophone Company, Electrical Research Products (controlled by the Western Electric Co.), Marconi's, Columbia, British Thomson-Houston, and Standard Telephones.

It is felt that under the new agreement manufacturers will be able to go ahead with large-scale production without fear of legal actions, provided that they obtain a licence from the pool.

Aircraft Radio Pioneer.

AIR COMMODORE L. F. BLANDY, C.B., D.S.O., who has been appointed deputy general manager of Marconi's Wireless Telegraph Co., Ltd., is well known for the prominent part he has played in aircraft radio development during and after the War. He has been responsible for building up the entire wireless organisation of the post-War Air Force and also the ground wireless branch of British civil aviation.

In addition he has represented the claims of aircraft wireless at a large number of international conferences.

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Honour for Professor E. V. Appleton.

BRITISH amateurs will unite with us in congratulating Professor E. V. Appleton on his election to the Vice-Presidency of the American Institute of Radio Engineers for 1932. In bestowing such an honour, America's foremost scientific radio organisation pays a happy tribute to British wireless research so worthily represented by the Wheatstone Professor of Physics at King's College, London.

Dr. Appleton, who has been a frequent contributor to *The Wireless World*, has specialised in research concerning the Heaviside Layer and its effect on radio signals, particularly in the production of "wireless echoes." In 1929 he was awarded the Morris Liebmann Memorial Prize of the Institute for the most important contribution to wireless progress during that year.

PROFESSOR E. V. APPLETON, the noted research worker, who has been elected Vice-President of the American Institute of Radio Engineers.

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More Power from Heilsberg?

HEILSBERG, the 75 kW. German station which is heard at great strength in this country, may shortly increase its power to 100 kW. The maximum possible power is 150 kW.

End of the World?

MADAME FRAYA, a famous French clairvoyante, has startled the lay Press with the announcement that 1932 will see the end of all "electrical parasites." She refuses to discuss details.

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Radio Census Surprises.

FEAR on the part of radio-users that they would be taxed if they disclosed the existence of their sets is held to be the reason for the astonishing American census discovery that Young County, Texas, possesses not one radio receiver, although it boasts 599 families.

The census returns for the whole of America shows that Yellowstone National Park County, Montana, possesses the highest number of radio sets per head of population. The percentage is 90.9, which sounds imposing until one learns that the whole county contains only eleven families.

Apart from freak returns, such as those quoted, the highest proportion of sets to families is shown in the wealthy suburbs of large cities like New York, Newark, Chicago, Boston, Pittsburgh, and Milwaukee, where 60 to 80 per cent. of the families counted "confessed" ownership of radio sets.

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America's Broadcast "Clean-up."

THE New Year found exactly 608 broadcasting stations under licence in the United States, a rather substantial decrease from the peak figure of 733 when the Federal Radio Commission came into being five years ago, writes our Washington correspondent.

Led by Major-Gen. S. McK. Saltzman, its chairman, the Commission during 1931 embarked upon a "clean-up" of the broadcast wavelengths to free them of the technically inefficient and those deemed unable to meet their obligations of public service. It is freely predicted that many other doubtful stations will also be wiped off the map before next Christmas.

Among the more notorious cases of suspension were those of KGEF, Los Angeles, operated by the militant "free speech" pastor, the Rev. Robert P. Shuler; the station of the goat-gland specialist, Dr. J. R. Brinkley, who is now building a 75 kW. station just over the Mexican border; and WMAY, St. Louis, described as a "church station," which used another station's transmitter and used phantom call letters.

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Jewish Broadcasting.

SUBSCRIPTIONS are being asked for by the leading Jewish organisations in Germany for the establishment of a broadcasting station entirely devoted to the interests of Jews.

Until all the money is collected no decision can be made regarding cost and power of the station, but, according to a correspondent, it is earnestly hoped that the transmitter will be working in time to greet the Jewish New Year.

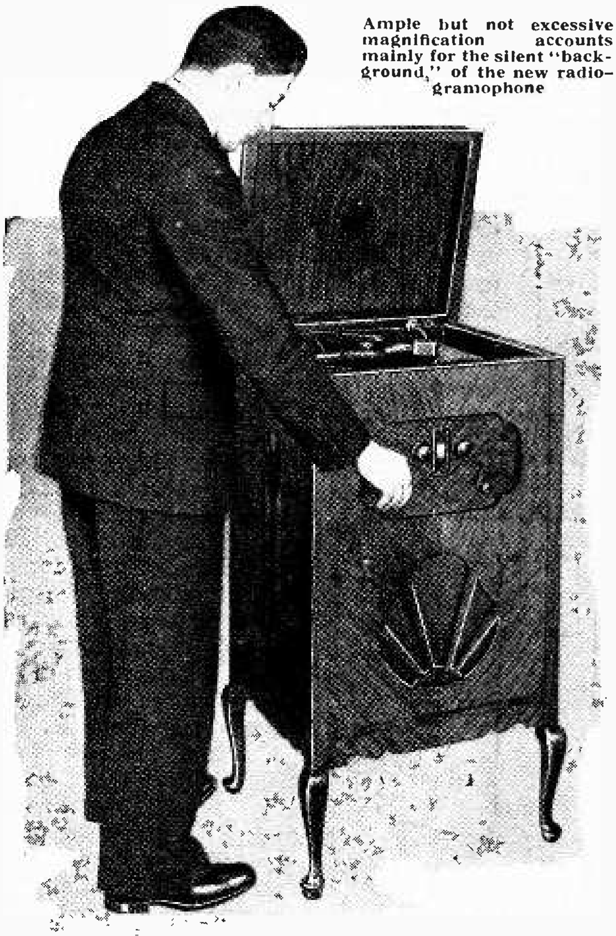
Wireless World POWER RADIO-GRAM

To be Described in Next Week's Issue.

SUPERLATIVE quality and an abundant output of undistorted volume were the first considerations in the design of this instrument, which is the first completely self-contained A.C. radio-gramophone to be described constructionally in *The Wireless World.*

Though intended primarily for local-station reception, the new radio-gramophone has a sufficient reserve of sensitivity to operate satisfactorily where receiving conditions are usually poor, and ample selectivity is ensured by a simple and inexpensive type of input filter. Even those who are not interested in gramophone reproduction will find points in the "radio" side of the set.

An undistorted output of nearly six watts is provided, and, of course, the receiver is entirely mains operated. Power-grid detection and resistance-capacity-coupled L.F. amplification are features of the circuit, which, considering its ambitious nature, is exceptionally free of complications.



Ample but not excessive magnification accounts mainly for the silent "background," of the new radio-gramophone

All subsidiary apparatus, including gramophone motor, turntable, pick-up, and loud speaker, are mounted in an upright cabinet, and all constructional difficulties have been overcome.

LIST OF PARTS.

After the particular make of component used in the original model, a list of other suitable products is given in many instances.

1 **Double-ganged condenser,** 0.0005 mfd., with built-in trimmer, complete with escutcheon and knob. **(Williams & Moffatt, Type C.A. 2-gang R.S.)**
(Burton, Cyldon, Formo, J.B., Lotus, Ormond, Polar, Utility).

1 **Variable condenser,** 40 mmfds. **(Magnum Baseboard Neutralising Condenser)**
(Bulgin, Burton, Igranic, J.B.).

1 **Variable condenser,** bakelite dielectric, 0.0005 mfd. **(Burton)**
(Graham Farish, Ready Radio, Telsen, Utility).

1 **Three-point switch** **(Telsen)**

1 **On-off switch** **(Telsen)**
(Benjamin, Bulgin, Claude Lyons, Colvern, Igranic, Junit, Lotus, Ormond, Red Diamond, Sovereign, W.B., Wearite).

1 **Semi-variable condenser,** 0.0003 mfd. **(Ormond)**

1 **Semi-variable condenser,** 0.001 mfd. **(Ormond)**
(Faradex, Formo, Graham Farish, Polar, R.I., Sovereign, Telsen).

4 **Valve-holders,** 5-pin **(Lotus:** rigid type with terminals**)**
(Benjamin, Burton, Clix, Graham Farish, Junit, Telsen, Wearite).

1 **Fixed condenser,** 0.01 mfd., mica dielectric **(T.C.C. Type 34)**
(Dubilier, Graham Farish).

1 **Fixed condenser,** 0.05 mfd., mica dielectric **(T.C.C. Type 34)**
(Dubilier).

3 **Fixed condensers,** dry electrolytic, 2 mfds., 100 volts working **(T.C.C. electrolytic Type 54)**

3 **Fixed condensers,** 1 mfds 1,500 volts D.C. test **(Dubilier Type L.S.C.)**
1 ,, ,, 2 ,, 1,000 ,, ,, ,, (,, ,, **L.S.A.)**
2 ,, ,, 2 ,, 500 ,, ,, ,, **(Telsen)**
(Formo, Hydra, Lissen, Peak, T.C.C.).

1 **Fixed condenser,** 0.0001 mfd. **(Telsen)**
1 ,, ,, 0.0005 mfd. **(Telsen)**
(Dubilier, Formo, Graham Farish, Igranic, Lissen, Sovereign, T.C.C.).

1 **H.F. choke** **(Lewcos: Midget type)**
(British General, Bulgin, Burton, Climax, Igranic, Kinva, Lissen, Telsen, Varley, Watmel, Wearite).

2 **Resistances,** 100 ohms, 1 watt **(Dubilier: Metallised)**
1 ,, 500 ,, 3 ,, ,, ,,
1 ,, 500 ,, 1 ,, ,, ,,
2 ,, 1,500 ,, 1 ,, ,, ,,
1 ,, 10,000 ,, 3 ,, ,, ,,
1 ,, 30,000 ,, 2 ,, ,, ,,
1 ,, 50,000 ,, 3 ,, ,, ,,
2 ,, 50,000 ,, 2 ,, ,, ,,
(Bulgin, Claude Lyons, Colvern, Ferranti, Loewe, Sovereign, T.C.C.).

2 **Resistances,** grid leak type, 100,000 ohms, 1 watt **(Dubilier: Metallised)**
1 ,, 5,000 ,, 1 ,, ,, ,,
2 ,, 250,000 ,, 1 ,, ,, ,,
(Ediswan, Graham Farish, Loewe).

1 **Thermal delay switch** **(Bulgin: Type A)**
(Varley).

1 **Filament potentiometer,** 30 ohms **(Claude Lyons: "Humdinger")**
(Varley).

1 **Volume control potentiometer,** 0.5 megohm **(R.I., Unigrad)**
(Igranic, Claude Lyons, Rothermel).

1 **L.F. choke,** 25 henrys, 30 mA. **(R.I., Type D.Y.25)**

1 **L.F. choke,** 20 henrys, 100 mA. **(Varley, D.P.12)**
(Bayliss, Birmingham Sound Reproducers, Challis, Climax, Clarke's "Atlas," Chester, Ferranti, Heayberd, Parmeko, Regentone, Savage, Tannoy).

1 **Power transformer** **(Varley, Type E.P.24)**
(or made to order by Bayliss, Birmingham Sound Reproducers, Chester Bros., Climax, Challis, Parmeko, Rich & Bundy, Savage, Tannoy).

1 **Dial lamp bracket and 6-volt lamp** **(Bulgin, Type D7)**

2 **Fuses,** 500 milliamperes **(Microfuses, Ltd.)**
(Belling-Lee, Bulgin).

2 **Ribbed coil formers,** $2\frac{1}{4}$ in. dia., 3 in. long **(Becol)**
(Redfern).

2 **lengths screened sleeving** **(Goltone)**
(Lewcos).

ACCESSORIES USED.

Valves: Cossor 41 M.H.L., Cossor 41 M.P., Mazda P.P.5/400, Cossor 460 B.U.

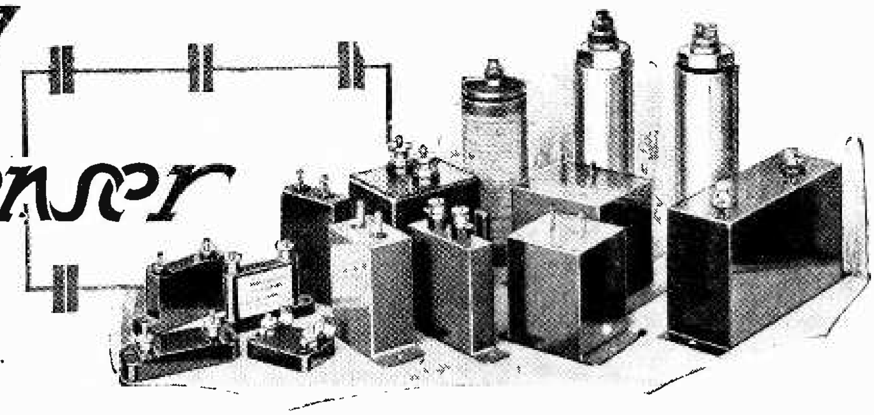
1 **Gramophone motor** **(Garrard Type 202)**

1 **Pick-up** **(Marconiphone)**

1 **Loud speaker,** moving coil, energised type, Model 148; $10\frac{3}{4}$ in., 2,500 ohm field **(Magnavox)**

1 **Cabinet** **(Kabilok)**

The Fixed Condenser



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

What It Is and What It Does.

THE modern circuit diagram, especially if it shows the circuit of a mains receiver, simply bristles with innumerable repetitions of the conventional symbol "⫩," which means "condenser." Copious inscriptions are usually found below the diagram, giving among other data, the capacities that each of the many condensers is to have. The highest and lowest values normally found are 0.0001 mfd. and 4 mfd.; the largest condenser, therefore, being forty thousand times greater than the smallest. The purpose of this article is to discuss not only the considerations that guide the designer of the set in choosing for each purpose the correct capacity from this enormous range, but also the more fundamental reason for including them at all.

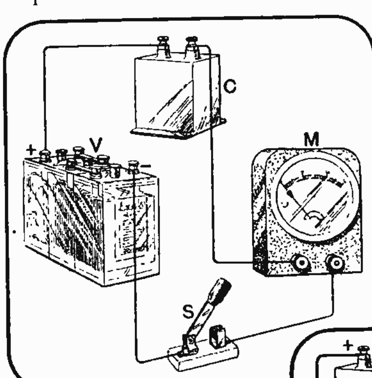


Fig. 1.—Circuit for observing the charging-current of a condenser C. On closing S the meter M will show a momentary deflection, returning immediately to zero. The source of current supply is the accumulator V.

Before this point can be tackled it is necessary to outline the properties of a condenser, so that we can see what its behaviour is likely to be in any circuit in which we happen to take an interest. In essence, all condensers, no matter what their size or how uninformative their exterior form, are like that familiar object, the tuning condenser. They all consist of two plates, or two sets of interleaved plates, carefully insulated from one another. In the case of the tuning condenser, the insulation is quite obviously provided by the air space between the plates; in the case of the fixed condenser, the "works" of which are tidily enclosed in a neat box, the insulation consists either of mica or of waxed paper.

The fact that the two sets of plates—one set, of course, is connected to each terminal—are insulated from one another suggests at once that no current can flow from one set (or terminal) to the other, and this, in turn, might make one think that the condenser might just as well be left out altogether, on the grounds that if no current flows through it it cannot possibly have any effect on the set. But anyone who tries to work his set after removing all the condensers from it will promptly realise that there is a very large flaw somewhere in this reasoning.

The Charging Process.

Although it is true that a current cannot flow continuously through the insulating material that separates the two sets of plates in a condenser, the fact remains that a momentary current can flow into the condenser, thereby charging it up. If, for example, a condenser is connected in a circuit such as that of Fig. 1, it will be found that on closing the switch S the meter M shows a deflection for a moment, returning almost immediately to zero. Before closing the switch the two terminals of the condenser were at the same potential; after closing it, since one is connected to one terminal of the battery and one to the other, there must exist between them a potential-difference equal to the voltage of the battery. The current that flowed for an instant on closing S represented the movement of electricity necessary to charge the condenser to this voltage; when the charging process was complete, and the final voltage was reached, the current naturally stopped, the insulating material between the plates preventing any continuous flow of current. The amount of electricity that has to flow before the condenser is charged depends upon the "capacity" of the condenser; the larger this is the greater, in exact

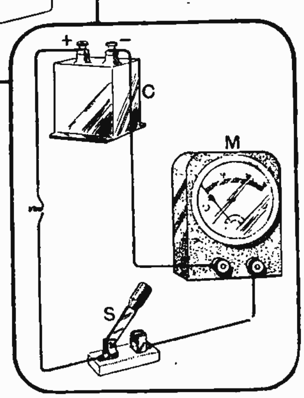


Fig. 2.—On removing the battery V of Fig. 1 and closing the circuit again by the switch S, the electricity that flowed into the condenser in charging it will flow out again, giving a second momentary deflection of M, but in the opposite direction.

proportion, will be the amount of electricity needed to "fill it up."

It will be seen from this that a condenser acts as a kind of reservoir for electricity; some current has flowed into it on closing S, but has not yet, in our assumed experiment, flowed out again. If now we remove the battery, joining up together the loose ends of wire thus freed, as in Fig. 2, and then close the switch again, we shall see a second momentary deflection of the meter—but this time the pointer will move in the opposite direction. Before the switch was closed in this batteryless continuation of our experiment the condenser was still charged, its terminals still maintaining a potential difference equal to the voltage of the battery. As soon as the switch is closed there is a conducting path between these terminals, and a current flows round the circuit in exactly the same way as if a battery, and not merely a charged condenser, were the driving force. The current lasts only for an instant, because the condenser does not contain the chemical materials which, in a battery, maintain by their own destruction the voltage across the terminals. The condenser can therefore only return through the circuit the amount of electricity that, in using the arrangement of Fig. 1, was stored in it by the battery. This once used up, the condenser is "dead," and the current ceases.

CONFRONTED with a bewildering number of fixed condensers in any modern receiver, the newcomer to wireless may be forgiven for asking whether they are all necessary, and if so, why. This article, which puts condenser theory in simple terms, will be followed by another giving reasons for the inclusion of each condenser and for the capacity assigned to it.

Now let us mount our battery on a gramophone turntable and arrange two contact-plates, as indicated in Fig. 3, which are connected to the two terminals of the battery, and which make contact with the rest of the circuit through two metal "brushes," shown connected to the two leads. If now we close the switch a momentary current due to the charging of the condenser will flow just as in the case of the first circuit discussed. Holding the switch down with one hand we now turn the turntable through half a revolution, so that the battery is put into circuit with its polarity reversed. The result of this reversal is that the negative pole of the battery is now connected to that terminal of the condenser which, owing to the charge acquired before the turn-table was moved, is positive, the positive terminal of the battery being simultaneously connected to the negative terminal of the condenser. The tendency of the condenser to discharge is now assisted by the battery; a double quantity of electricity therefore flows, being made up of the discharge current of the condenser, immediately followed by a charging current charging it the other way round. This double current will flow afresh every time the turn-table is rotated far enough to reverse the direction of the connections of the battery in the circuit.

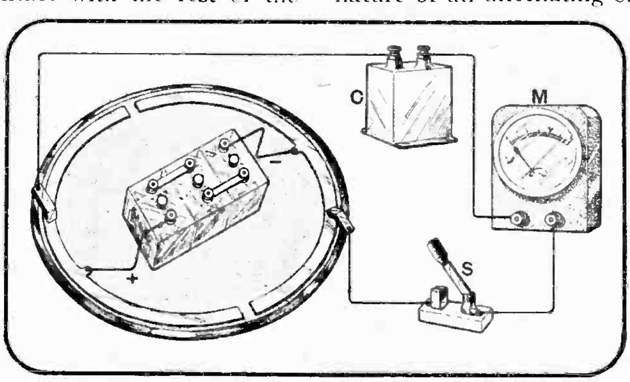


Fig. 3—The battery is now mounted on a turntable with metal contact pieces, and is connected to the circuit by way of brushes rubbing on the metal. The behaviour of this circuit leads directly to an elucidation of the behaviour of a condenser to alternating currents.

Now, one step more. Suppose the turn-table to be set spinning by its motor at such a rate that the momentary current has not quite ceased to flow before the connections are reversed. The meter will then show a deflection all the time, moving first to the right and then to the left as the direction of the current in the circuit changes. If now we replace this meter by one of a type which always deflects in the same direction, no matter which way the current flows, and spin the turn-table so fast that the pointer of the meter cannot flicker fast enough to keep up with the rise and fall of the current, we shall have visible evidence of a current flowing, apparently continuously, in a circuit which is broken by the insulating material between the two sets of plates of the condenser.

But we know, from the way that we have had to run together a series of momentary impulses flowing in alternate directions, that current is not really flowing *through* the condenser, but is passing in and out of it so continuously that the net effect, taken over any appreciable period of time, is practically the same as though the insulating material were allowing quite a heavy current to pass.

Alternating Current and the Condenser.

The battery rotated on a turn-table is a clumsy conception, but it is useful as giving a clear notion of the nature of an alternating current. In a wireless receiver we have to deal with signals picked up by the aerial (radio-frequency currents) and also with the other currents, which are the electrical equivalents of music or speech (audio-frequency currents). Both audio- and radio-frequency currents are sub-divisions of the larger class of alternating currents, the distinguishing feature of which is that they reverse their direction of flow at extremely frequent intervals in much the same way as the current set up in a circuit in which the motive power is a battery being whirled rapidly round on a turntable in the manner described. Just as a persistent current can be passed "through" a condenser in the circuit of Fig. 3, the alternating currents that occur in a receiver, and are derived from the wave picked up by the aerial, can pass "through" the condensers in the set.

The mechanism of their passage is still, of course, the rapid charge and discharge of the condenser, for no electrons can pass from one plate to the other, but the

The Fixed Condenser.—

effect in practice is as though they passed through the condenser as they might through a resistance.

Anyone who has alternating current mains can confirm this by connecting a lamp and a large condenser (4 mfd., for example) in series across the mains, as in Fig. 4. The writer has just done this, using a 40-watt lamp; it lit very conclusively, though not at full brilliance. This shows, first, that the alternating current was passing "through" the condenser, and secondly, that the condenser offered some obstruction to its passage.

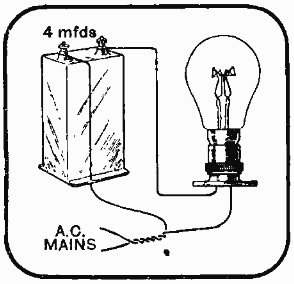


Fig. 4.—If a lamp and condenser are connected in series across alternating current mains, the lamp will light with a brilliance depending on the capacity of the condenser.

A repetition of this experiment with a 2 mfd. condenser gave a similar result, but the lamp lighted with much less brilliance, while with a 1 mfd. condenser the glow from the lamp could barely be distinguished in a darkened room. This comparison makes it quite clear that the larger the capacity of a condenser the more readily it allows alternating current to pass "through" it—the actual fact being that more electricity passes into it to charge it at each reversal of the current.

We have thus arrived at the conclusions that a condenser, while acting as a complete barrier to direct currents, will permit alternating current to flow through it, its opposition to the flow being less the greater the capacity of the condenser. The readiness with which alternating currents pass through a condenser is not, however, settled solely by the capacity of the condenser, but depends also on what is known as the "frequency" of the current. A reversion to Fig. 3 will help to make this clear.

The Effect of Frequency.

Suppose the turn-table were to revolve very slowly—making, say, one revolution every 20 seconds. Every 10 seconds there would be a momentary passage of current, but there would be long gaps between each pulse and the next. The average current, taken over the whole time, would be minutely small, because for most of the time no current at all would be passing.

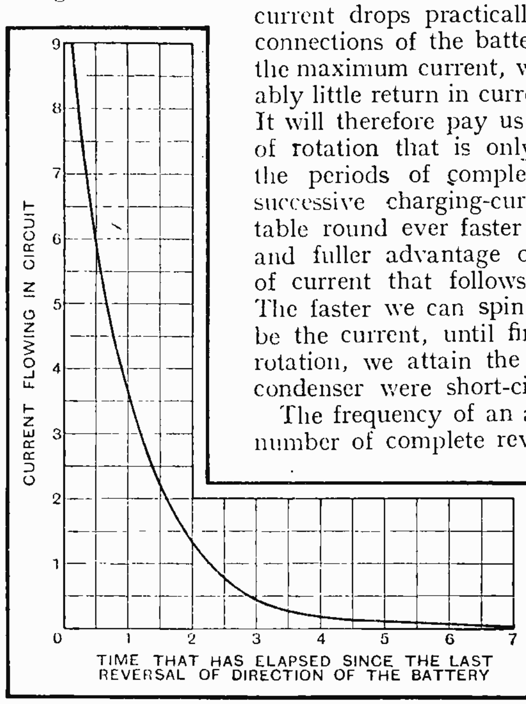


Fig. 5.—The curve shows the way in which the charging current, initially high, gradually tails off to negligible values. Though the scales are arbitrary, the shape of the curve is quite accurate.

Now imagine the turn-table speeded up to standard gramophone speed, 78 revolutions a minute, or about $2\frac{1}{2}$ turns every second. Clearly current will now be flowing for a much greater proportion of the total time. The average current will therefore be greater.

But, in imagination, if not in fact, we can speed up that turn-table still more, until eventually we arrive at such a speed that the inactive periods have vanished altogether, the current in one direction having not quite died away when the next reversal comes and a fresh burst of current comes. The average current will now be higher still, since current is flowing in one direction or the other at every moment. Is it possible to obtain a still greater current by increasing the speed of rotation? At first sight one would say not, and that if a speed had been reached at which there were no intervals in the flow no further increase in speed would make any difference.

The Meaning of Reactance.

This argument, however, overlooks the fact that during each momentary burst of current the flow is greatest at the beginning, and tails off towards the end. At the moment of reversal of the battery connections the voltage driving a current through the circuit is double that of the battery (battery voltage *plus* charged condenser voltage), but as the condenser loses its initial charge it ceases to assist the battery, and when it begins to acquire a charge in the opposite direction it actively opposes it. The first burst of current is, therefore, large, but towards the end the flow falls off, as suggested in Fig. 5.

It is clear from this curve that if we wait until the current drops practically to zero before reversing the connections of the battery, and starting off again with the maximum current, we are, in effect, getting remarkably little return in current for the extra time expended. It will therefore pay us *not* to be content with a speed of rotation that is only just high enough to cut out the periods of complete inactivity that follow each successive charging-current, but to whirl the turn-table round ever faster and faster so as to take fuller and fuller advantage of the tremendous initial burst of current that follows each reversal of the battery. The faster we can spin the turn-table the greater will be the current, until finally, with an infinite speed of rotation, we attain the current that would flow if the condenser were short-circuited out altogether.

The frequency of an alternating current is simply the number of complete reversals (from plus to minus and back again) that occurs in each second, and corresponds exactly with the number of revolutions of the turn-table in our hypothetical experiment. If the turn-table were revolving at the very high speed of 50 revolutions *per second*, or 3,000 revolutions per minute ("3,000 revs" in the language of the mechanical engineer), the alternating current generated would have a frequency of 50 cycles, and would be identical with the ordinary alternating current used for house lighting.[1]

[1] Except that it would have a positively indecent wave-form.

The Fixed Condenser.—

From what has been said it will therefore be clear that as the frequency of a current is increased the opposition offered to its flow by a condenser (known as the condenser's "reactance") will decrease. Further, it is found that the relationship is a simple one, doubling the frequency of a current resulting in halving the reactance of the condenser, or, alternatively, allowing the original value of reactance to be reached with a condenser of half the capacity.

Since, in any wireless set, we have to deal with currents of at least two very widely different groups of frequencies, we begin to find an explanation of the very different capacities chosen for different parts of the circuit. If, for example, we want to provide a path

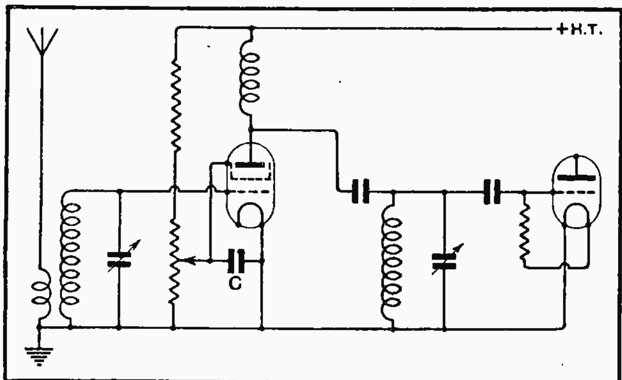


Fig. 6.—A screen-grid stage of amplification. The condenser C is used to provide as easy a path as possible for high-frequency currents passing from screen to earth. In its absence, the amplifier would be unstable.

of reactance 1,000 ohms to speech currents in the post-detector part of a set, we may choose a condenser of capacity about 3 mfds., the reactance of which is about 1,000 ohms at 50 cycles, this probably being the lowest frequency with which we expect our amplifier to have to deal. On the high-frequency side of the set, which may have to deal with wavelengths up to 2,000 metres, which is the same thing as frequencies down to 150,000 cycles, the same reactance of 1,000 ohms is provided by a condenser of capacity only 0.001 mfd. Conversely, if we had kept to the 3-mfd. condenser its reactance to this high-frequency current would be found to be no more than one-third of an ohm.

Some Practical Examples.

In their applications in a receiver, condensers are very frequently intended to act as nearly as possible as a short-circuit to currents of the frequency with which the part of the receiver concerned has to deal. They are used with this intention whenever the signal currents have to flow between points that need to be maintained at different direct-current potentials; in the absence of this necessity the condenser would be replaced by a piece of wire. A condenser used in this way is shown, as a typical example, at C in Fig. 6, which shows a screen-grid stage of high-frequency amplification.

In this circuit a voltage is applied from the battery, via the variable potentiometer, to the screen, so that the latter is left "floating" behind these resistances, and there is, in the absence of C, no easy path by which any high-frequency currents that may make their appearance in the screen circuit can flow to earth. In flowing through the only available path, the resistance, they would develop a voltage across it, with the result that high-frequency voltages would appear on the screening grid, with the probable result of making the amplifier hopelessly unstable. It is obviously not possible to connect the screen directly to the filament, for that would rob the screen of its voltage; the valve would certainly be stable enough, but would not amplify at all.

The insertion of the condenser C provides an easy path from screening grid to earth for the high-frequency currents in the screen circuit, so that they cannot develop any appreciable voltage across the low impedance that C offers to them. This ensures that the amplifier shall be stable, provided, of course, that the screening round the coils, condensers, and leads is adequate for the amplification attained. At the same time, the steady voltage derived from the high-tension supply is not interfered with, since the condenser, as we have seen, does not act as a short-circuit to direct currents; the valve, therefore, continues to amplify.

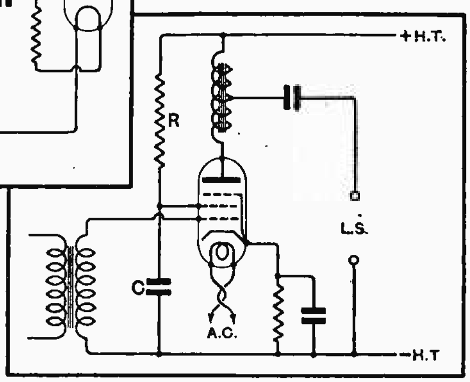


Fig. 7.—A circuit closely similar to that of Fig. 6, but this time concerned with low-frequency currents. Once again, C is inserted to provide for the signals an easy path from screen to earth.

Since the function of C is simply to provide a virtual short-circuit of signals to earth, it would appear that the largest-possible capacity should be chosen with the view of making the reactance of the condenser as low as possible. Owing to the fact that condensers of large capacity are more expensive, the designer of the set would normally choose a condenser which, on trial, proved to have a capacity large enough to ensure that the set should be stable. Alternatively, he would play for safety, and insert a 1-mfd. non-inductive condenser which, taking residual inductance and resistance into consideration as well as capacity, has about the lowest attainable total impedance (below one-third of an ohm) at the ordinary broadcast frequencies.

It will be seen, then, that, according to the point of view of the designer, capacities varying from perhaps 0.01 mfd. (equivalent to 27 ohms at 500 metres) up to 1 mfd. may be prescribed in published designs or commercial sets for this point in the circuit.

A very similar problem of short-circuiting arises at the screening grid of a pentode, the circuit of which is given in Fig. 7. The pentode shown is of the indirectly heated mains type, in which it is normal to run the anode at 250 to 300 volts, while limiting the screen voltage to 200. The voltage for the screen is taken from the main high-tension supply, but a resistance R of perhaps 10,000 ohms is interposed to drop the

The Fixed Condenser.—

working voltage to 200. In the absence of C the alternating screen current due to signals will, in passing through R, cause a voltage to develop on the screen, thereby upsetting the performance of the valve to some extent. As in the case of the screen-grid valve of Fig. 6, it is desirable to short-circuit this voltage to earth as far as possible, and, for the same reasons, a nice fat piece of copper wire is not a suitable connection for this purpose.

Once again, the inevitable condenser is used; and, as before, the larger the capacity the better. This time, however, we are concerned with a valve which is handling frequencies of a very different order from those met with in a high-frequency stage, for the pentode is concerned with musical frequencies which may be as low as 50 cycles per second. To attain a third of an ohm at this frequency the capacity required is nearly 10,000 mfd., which would cost some hundreds of pounds and would occupy nearly as much space as a small piano. In this case convenience takes precedence of perfection, and the largest reasonable size of condenser—say 4 mfds.— is generally used. The reactance of this at 50 cycles is 800 ohms, which at least reduces the impedance between screen and earth to less than a tenth of the value it would have if C were omitted; and, in practice, such a condenser is found perfectly satisfactory.

These two examples will serve as an introduction to the following instalment of this article, in which the circuit diagram of a complete receiver will be gone through, and the reason for the inclusion of each condenser, and for the capacity assigned to it, will be briefly discussed.

CLUB NEWS.

Demonstrating a Modern Superhet.

MR. J. C. G. GILBERT, who gave a lecture demonstration on the modern superheterodyne at a recent meeting of the Bec Radio Society, employed a modified version of "*The Wireless World* Super Selective Five" incorporating the Colebrook two-valve detector. The results were impressively good; with a very short indoor aerial used in a steel-girder building a large number of stations were received.

Enquiries regarding the various activities of the Society will be welcomed by the Asst. Hon. Secretary: Mr. J. C. G. Gilbert, 54, Hazelbourne Road, Balham Hill, S.W.12.

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Why They Chose Them.

"MY Receiver and Why I Chose It" was the title of a novel series of talks given by members of Slade Radio, Birmingham, at a recent meeting. Each member present was allotted a short time in which to describe his receiver, giving reasons why he selected it, and also to answer questions.

Record-breaking attendances are reported by this energetic society. Last week the members carried out a loud speaker test, in which each instrument was connected in turn to a radio and gramophone amplifier, the output being a P.M.24A. The votes revealed some interesting results.

Although all attendance records are being broken, there are still vacancies for new members, and full details of the Society, together with advance programme, can be obtained on application to the Hon. Secretary at 110, Hillaries Road, Gravelly Hill, Birmingham.

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Demonstrating Well-known Sets.

A CAMPAIGN to bring in new members has been started by the South Croydon and District Radio Society. A special feature of the forthcoming programme will be the demonstration of well-known receivers with explanatory talks on their particular points. The monthly question night and the criticism of broadcast programmes should tempt any wireless set owners in Croydon to join. For the more advanced technical lectures have been arranged.

Full particulars of the Society's activities can be obtained from the Hon. Secretary, Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

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AN EFFICIENT LOW-POWER STATION. G5JZ, owned by Mr. C. W. K. Sands at Heathfield, Sussex, has worked all Europe and parts of Africa with an input of 7 watts on the 7 megacycle waveband. In the foreground is seen the 80-metre set, then the 20-metre receiver and the 40-metre crystal-controlled transmitter, while the amplifier is partly hidden behind the operator.

A.C. Valves.

MR. PARR, of the Edison Swan Co., Ltd., recently gave a highly interesting lecture to members of the Bristol and District Radio and Television Society at the University. Mr. Parr dealt primarily with A.C. valves, giving valuable information as to the best method of using this type of valve. He later discussed various output circuits, and finally described methods of tone correction.

Hon. Secretary: Mr. G. E. Benskin, 12, Maurice Road, St. Andrew's Park, Bristol.

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The Film in the Factory.

CONDUCTED tours through a valve works and a wireless receiver works formed the subjects of a highly interesting series of films shown at the last meeting of the North Middlesex Radio Society. Mr. W. G. J. Nixon dealing with valves, and Mr. W. A. Maskell with receivers, both of the General Electric Company, were the lecturers. The valve, after a brief résumé of its history by Mr. Nixon, was followed through all its stages of manufacture from raw material to delivery van, including its various tests, one of which—the "tumbling" test—made the audience's flesh creep! Mr. Maskell then took the members through the sequence of events in the birth of a new receiver, from the first experimental hook-up, through drawing office and factory, again to the finished article. The Society was then privileged to see and hear some of the receivers in operation, including a new superheterodyne, especially designed for Empire broadcast reception in distant lands.

Hon. Secretary: Mr. M. P. Young, 40, Park View, London, N.21.

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A Good Start.

THE Gloucester and District Radio Society has just concluded a successful first half of the winter session. Meetings were resumed on January 7th, with a lecture on "Valves," by Mr. Carr, of the Edison Swan Company.

Among the subjects dealt with during the past few weeks have been "Band-pass Filters," "Fading," and "Mains Rectifiers.". During the coming months the Society will discuss "Wavemeters," "Methods of Detection," "Crystal Oscillators," and other subjects of topical interest.

Hon. Secretary: Mr. J. W. Hamilton, Upper Parting, Sandhurst, Gloucester.

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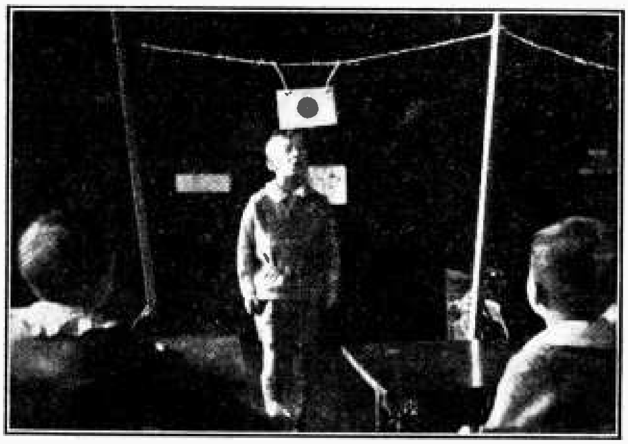
Lecture on the Westinghouse Rectifier.

IN our issue of January 6th it was stated that a lecture by the Westinghouse Brake and Saxby Signal Co., Ltd., would be given before the Derby Radio Club on January 25th, whereas the correct date should have been January 21st.

BROADCAST BREVITIES

A Musical Rumour.—Orchestral Tours?—A New Branch.—Henry Hall.—That American Concert.

By Our Special Correspondent.



Announcers are made, not born, according to German Educational authorities. This photograph, taken in a Hamburg school, shows an elocution class using a dummy microphone.

Dr. Boult's Future.

THE spotlights have been flashing upon a variety of names during the past week—Jack Payne, Henry Hall, Charles Siepmann, to quote the more prominent—and to these must now be added Adrian Boult. For the story has been current that Dr. Boult is likely to leave the B.B.C. in response to a tempting offer from America.

A European Tour?

For the sake of all musically inclined listeners, I am glad to be able to refute this rumour. It is true that, ever since his Birmingham days, Dr. Boult has been honoured with transatlantic invitations, but his reply has been in all cases the same; he prefers to remain in Europe.

There is, however, the possibility that in a year's time the B.B.C. may be able to make an exchange arrangement with the leading Continental orchestras whereby the whole of the B.B.C. Symphony Orchestra under Dr. Boult may be transferred to Berlin, Vienna, and other European cities to give a series of performances.

Visits by Continental Orchestras.

Orchestras like the Berlin State Opera and the Vienna Philharmonic would then come to this country to give an equivalent number of broadcast performances for British listeners.

The idea is still "in the air," but I believe that it will be put into practice.

Another Question.

This is rather different from the arrangement which Mr. Jack Payne might have made had he decided to remain with the B.B.C. No doubt he would have been prepared to take his band abroad, but I question whether British listeners would have relished an exchange with foreign dance bands. Symphony orchestras come under a different category.

Prince of Wales to Broadcast.

THE Prince of Wales will address the Youth of Great Britain in his broadcast from the Royal Albert Hall on Wednesday next, January 27th, when he attends a meeting organised by the National Council of Social Service. The Prince's address will be preceded by a speech by Captain E. A. Fitzroy, M.P., Speaker of the House of Commons, and this also will be broadcast.

A Famous Actress.

AN ACTRESS with an unusually clear and incisive microphone voice is Dame Sybil Thorndike, who will be heard by National listeners on Sunday next. She will plead the cause of the St. Giles Homes for British Lepers.

Henry Hall.

THE story of the London Midland and Scottish Railway Company's furniture buyer who will shortly direct the new B.B.C. Dance Band reads rather like a sensational serial. Although Mr. Henry Hall has been associated with the L.M.S. hotel bands for ten years, this has been, so to speak, only a part-time job.

When not putting dancers through their paces (he has been drummer, pianist, trumpeter, and violinist in turn), Henry Hall has been choosing tables and chairs to adorn railway hotels. (No, the average railway waiting room, I am glad to say, is not his fault.)

Good-bye to All That.

And now, one supposes, he will forget all about furniture and spend his spare time in reorchestrating popular dance numbers to give them that peculiar delicacy which listeners have always associated with the performances of the Gleneagles band. It will be interesting to see how his "sweet music," as he calls it, gets over when it becomes a regular and frequent feature of broadcasting.

Making Gramophone Records.

Meanwhile, Jack Payne, who will still bring his band to the broadcast studio from time to time, is to break fresh ground by recording for the million at popular prices.

I wonder what will happen when the B.B.C. consents to place its productions on gramophone records costing less than two shillings?

Meteors of the Talks Branch.

A SPECIAL significance attaches to Mr. Charles A. Siepmann's new appointment as Director of Talks. The old Talks Department has now been converted into a Branch and is thus, officially speaking, equal in importance to the other five Branches, viz., Administration, Accounts, Programmes, Information, and Engineering.

Now the Heads of Branches are very influential people indeed, so it becomes evident that Mr. Siepmann, in rising from the command of a sub-division of a Department (he was in charge of Educational talks) to the headship of a Branch, has ascended with a velocity that commands admiration.

Victory for Youth.

Scarcely less sensational is the elevation of Mr. Rendall to a position in which he will control the Adult Education Talks while still in the twenties. Mr. Rendall, who bears the honoured name of one of the B.B.C. Governors—Dr. Montague Rendall—has scored a victory for youth.

A Word in Season.

THE Postmaster-General has dropped one of those gentle little hints which somehow find their way into the newspapers to the effect that his pirate detector vans are now visiting the Southampton and York districts.

This is rank favouritism, and I shall not be surprised if other towns demand why they are being neglected.

"My Job."

UNDER the title "We Northerners," an attractive series of talks is being broadcast over the Northern Region by a number of North Country workpeople, who tell in their own way how they carry on their daily work. A Northwick salt worker and a Macclesfield silk weaver have already told their story. Other fixtures are: January 25th, a Yorkshire miner; February 1st, a Lakeland sheep farmer; February 8th, a Liverpool dock hand. And, to wind up, there may be a talk by a Dewsbury rag warehouseman.

Another "Offering" from America.

LISTEN in at all costs on February 15th, for on that date we are to have another concert relayed from America—this time devoted to Negro Spirituals.

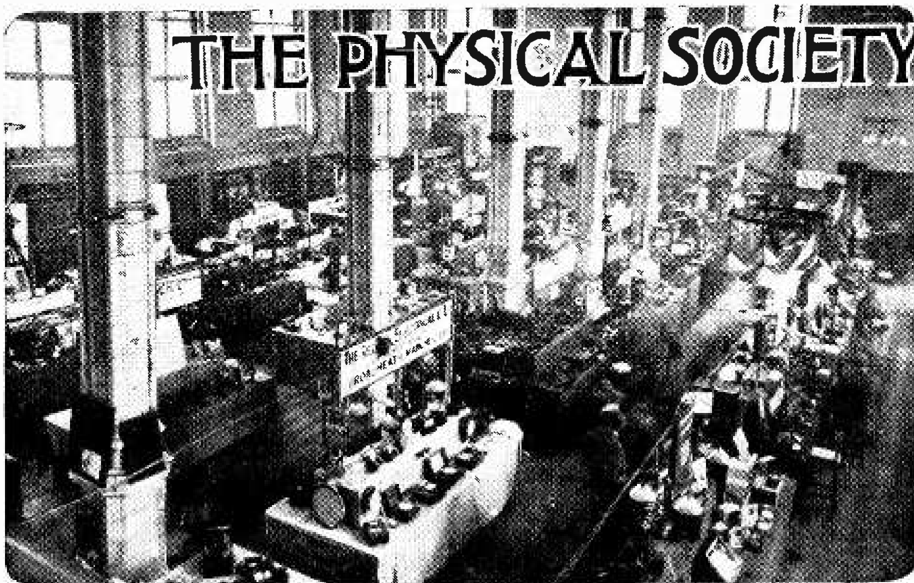
Technically speaking, last week's relay from the New York Columbia Studio was excellent, but, oh! what a programme!

In one sense this masterpiece of slickness "held" me. I did not switch off, because each turn made me feel that the next *must* be better.

Still Going Strong?

The B.B.C. could learn one lesson from the slick methods of American broadcasters. When the "Street Singer" exceeded his allotted time he was faded out in the middle of a phrase. For all I know, he may still be singing. If so, he's happy, and so am I.

THE PHYSICAL SOCIETY EXHIBITION



A section of the exhibits at the Imperial College of Science, South Kensington, London, S.W.

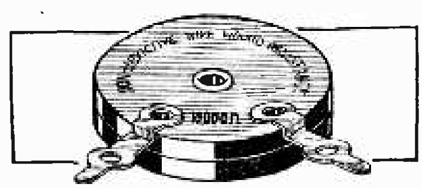
Scientific Measuring Instruments for Radio Research

A Review of the Outstanding Exhibits

TO a serious student of wireless the annual exhibition of the Physical and Optical Societies (held this year at the Imperial College of Science and Technology, South Kensington, on January 5th, 6th, and 7th) is one of the outstanding events of the season. The apparatus exhibited is representative of all the principal discoveries and advances of the past twelve months, many of which will contribute their share to the improvement of the technique of broadcast reception, if they have not already done so. The wireless exhibits can be divided roughly into three classes. 1. Components and other finished products of interest to the amateur. 2. Commercially produced measuring instruments for use in research laboratories. 3. Demonstrations of new principles and methods of measurement.

Precision Testing Equipment.

The firm of Westinghouse gave their usual comprehensive display of the applications of metal-oxide rectifiers, and, in addition to a full range of power-supply rectifiers for receiving sets, many examples of the use of small-power-consumption rectifiers in milliammeters and voltmeters were shown. These rectifiers are included in the instruments made by Messrs. Ernest Turner, Everett, Edgecumbe and Co., Ltd., and the Cambridge Instrument Co., Ltd., which were exhibited on other stands in the exhibition.



The new disc - type non-inductive resistance made by British Electric Resistance Co., Ltd. The resistance is of spirally wound fine wire.

The British Electric Resistance Co., Ltd., have introduced a neat flat-type non-inductive resistance suitable for resistance coupling, decoupling resistances, etc., in broadcast receivers. The resistance element is of the spirally wound cord type, which is in turn non-inductively wound in a disc-type moulded case approximately $1\frac{1}{2}$in. in diameter. These resistances take up remarkably little room, and can be fixed to any part of the receiver by a single screw.

As in previous years, precision measuring instruments constituted the most important feature among the radio exhibits. On the stand of Messrs. H. W. Sullivan, Ltd., were to be found many entirely new types of sub-standard wavemeters and a very neat test set for comparing the capacities of sections of commercial ganged condensers. The latest Sullivan-Griffiths wavemeter has a range of 150 to 10,000 metres and is accurate to within one part in 20,000. The conventional reaction circuit has been abandoned in favour of a screen-grid valve operating on the negative resistance portion of its characteristic. The use of this principle in conjunction with inductance standards, which are practically free from variations due to temperature and humidity, is responsible for the high order of accuracy attained. The Sullivan capacity test set for ganged condensers consists of two independently screened H.F. oscillators adjusted to give exactly the same frequency.

Testing Ganged Condensers.

Adjacent members of the ganged-condenser element are connected in parallel with the tuned circuit of each oscillator. The beat frequency between the oscillators is observed

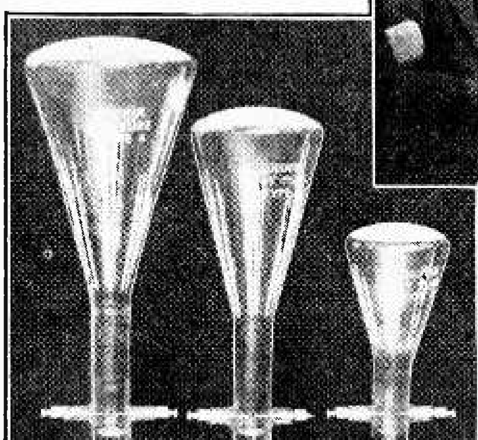
The Physical Society Exhibition.—

by means of a detector valve, and a calibrated condenser dial is used to restore the pitch of a note should there be any difference in the capacity of the condensers at any point in their range. With this instrument it is possible to detect differences of the order of 0.25 micro-mfd., and condensers up to 550 micro-mfd. can be checked.

Cathode Ray Tubes.

The cathode-ray oscillograph is a powerful weapon in all audio- and radio-frequency investigations of an advanced character. Hitherto its use has been limited owing to the difficulty of obtaining tubes on a commercial basis. It is, therefore, very gratifying to find that supplies are now available from two firms in this country. Messrs. W. Edwards and Co., 8a, Allendale Road, Denmark Hill, London, S.E.5, are handling the cathode-ray tubes developed by M. von

Considerable interest was shown in the demonstrations of cathode ray oscillographs, of which three representative examples made by Edison Swan Electric Co., Ltd., are shown below.

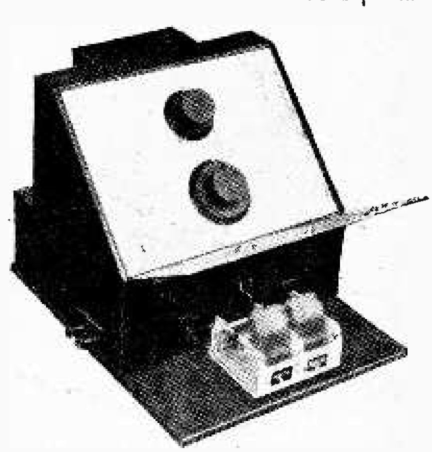


Ardenne, and the Edison Swan Electric Co., Ltd., have a range of three types of tube which are made in this country. Both these makes of tube were demonstrated. Accessories such as apparatus for providing a time base and cameras for photographing the image were on view.

Synchronous electric clocks have gained considerable ground since the last exhibition, and examples of their adaptation for time switching and domestic use were shown by Venner Time Switches, Ltd.; Ferranti, Ltd.; and Everett, Edgecumbe and Co., Ltd.

In the research and experimental section the H.M.V. exhibit is always one of the first to merit inspection. This year it makes its début under the auspices of Electric and Musical Industries, Ltd., and, in addition to demonstrations of the properties of photo-electric cells produced by this concern, comprises an interesting series of measuring instruments used in the various works testing departments. These include a gramophone motor torque tester consisting of an eddy current brake working in

conjunction with a neon lamp stroboscope, and also a portable ganged oscillator for adjusting the tuned circuits of receivers in course of production. The direct reading modulation meter, described in *The Wireless Engineer* of December, 1931, was in operation in conjunction with a Duddell oscillograph showing the percentage modulation of items from the London transmitting stations. It was interesting to note that the tuning note gave a modulation of about 30 per cent., male speech an average of 15 per cent. with peaks of 30 to 40 per cent., while a dance band gave an average value of 40 per cent. with maximum peaks of slightly over 80 per cent. An ingenious application of the new variable-mu valves was to be found in their use in an attenuator. The Marconi VMS4 has



Sullivan capacity test set for matching adjacent sections of commercially produced ganged condensers.

a characteristic in which mutual conductance varies exponentially with the grid bias. It can, therefore, be very easily calibrated to give an increase of amplification in decibel steps, which is strictly proportional to the grid bias. It is remarkably free from frequency error, and is a promising substitute for the rather complicated attenuation networks formerly employed.

In conclusion, mention should be made of the Ensign Home Talkie Projector. Making use of 16 mm. film, this projector is synchronised with a gramophone turntable running at 78 r.p.m. A considerable library of films and records is already in existence, and the quality of reproduction is of extraordinarily high standard. The whole outfit is contained in a sound-proof cabinet, and the amplifier can be used independently for the reproduction of records without the projector.

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Broadcast Gramophone Ban in Australia.

AUSTRALIA, like Germany, seems to have been suffering from a glut of gramophone broadcasts. At all events, the gramophone companies think so, for they have placed a ban on the use of records for broadcasting. The fact that, according to *Australian Wireless Weekly*, the prohibition will have a serious effect on the programme, suggests that the gramophone companies must have some grounds for their contention.

Listeners are praying that a compromise may be arrived at between the broadcasters and the gramophone interests.

McMICHAEL SUPER RANGE PORTABLE FOUR

A Well-known Portable in its Latest Form.

SINCE its introduction in 1928, the McMichael Super Range Portable Four has enjoyed a pre-eminent position among suitcase portables, or, for that matter, among battery portables of any type. When the performance of some new portable is under discussion it is not long before the question is asked: "How does it compare with the McMichael Super Range Four?"

In the matter of range the latest edition of this receiver worthily upholds the reputation of its predecessors. The finish and general workmanship are, if possible, even better, while the selectivity shows a definite advance. Under test in Central London the London National transmitter occupied a band of not more than five metres wide, while the Regional extended only from 335 to 370 metres. Even at five miles from Brookmans Park there was a clear band of forty metres (285 to 325 metres) between the two stations when making use of the directional properties of the frame.

Sensitivity on the medium broadcast band is exceptionally high for a receiver employing a frame aerial, and during a single evening's test twenty stations, in addition to those of the B.B.C., were received at good loud speaker strength. Of these, thirteen required some diminution of the volume control, or, alternatively, reaction in order to reduce the volume to a comfortable level for the average room.

The long waves provided seven stations in addition to Daventry, and the volume control could be used with advantage when receiving Radio Paris.

The circuit consists of a screen-grid H.F. amplifier followed by a leaky-grid detector and two transformer-coupled L.F. stages. Undoubtedly the outstanding feature of the circuit is the provision of automatic grid bias for the H.F. and L.F. valves. This is a feature which we should like to see more extensively employed in portable sets and other battery-operated receivers. Not only is the possibility of failure of the grid-bias battery eliminated, but, what is even more important, the bias is automatically adjusted to the H.T. voltage as the battery runs down during the normal course of its life. It will be seen from the diagram that the bias is obtained by means of a resistance inserted between H.T.– and L.T.–, a potential difference being established between the ends of this resistance by virtue of the total anode current of the receiver. The full bias voltage is applied to the last valve, and a tapping near the L.T.– end provides a proportionally lower bias for the H.F. stage and the first L.F. amplifier. The bias connections to these valves are adequately decoupled.

Decoupling is also provided for the H.T. supply to the detector valve, which is generally the most prevalent source of instability in a multi-stage set. The screen-grid potential is also taken from this point, the detector valve and its decoupling resistance functioning as a potentiometer.

Tuned-grid coupling is used between the H.F. and detector valve, the condensers in the grid and anode circuits of the screened-grid valves being ganged with an adjustable trimmer in parallel with the input circuit. Reaction is of the variable-magnetic type, with a small rotating coupling coil mounted inside the tuned-grid inductances. In the detector stage an interesting refinement is to be found in the use of a fixed-filament potentiometer for applying exactly the right positive grid bias to give the best compromise between detector efficiency and smoothness of reaction. There is little to note in the L.F. stage except that a series resistance in the grid circuit of the first L.F. amplifier and a by-pass condenser across

FEATURES.

CIRCUIT: Four valves. Screen-grid H.F., (tuned grid coupling), leaky-grid detector (with reaction), two L.F. stages (transformer coupled).

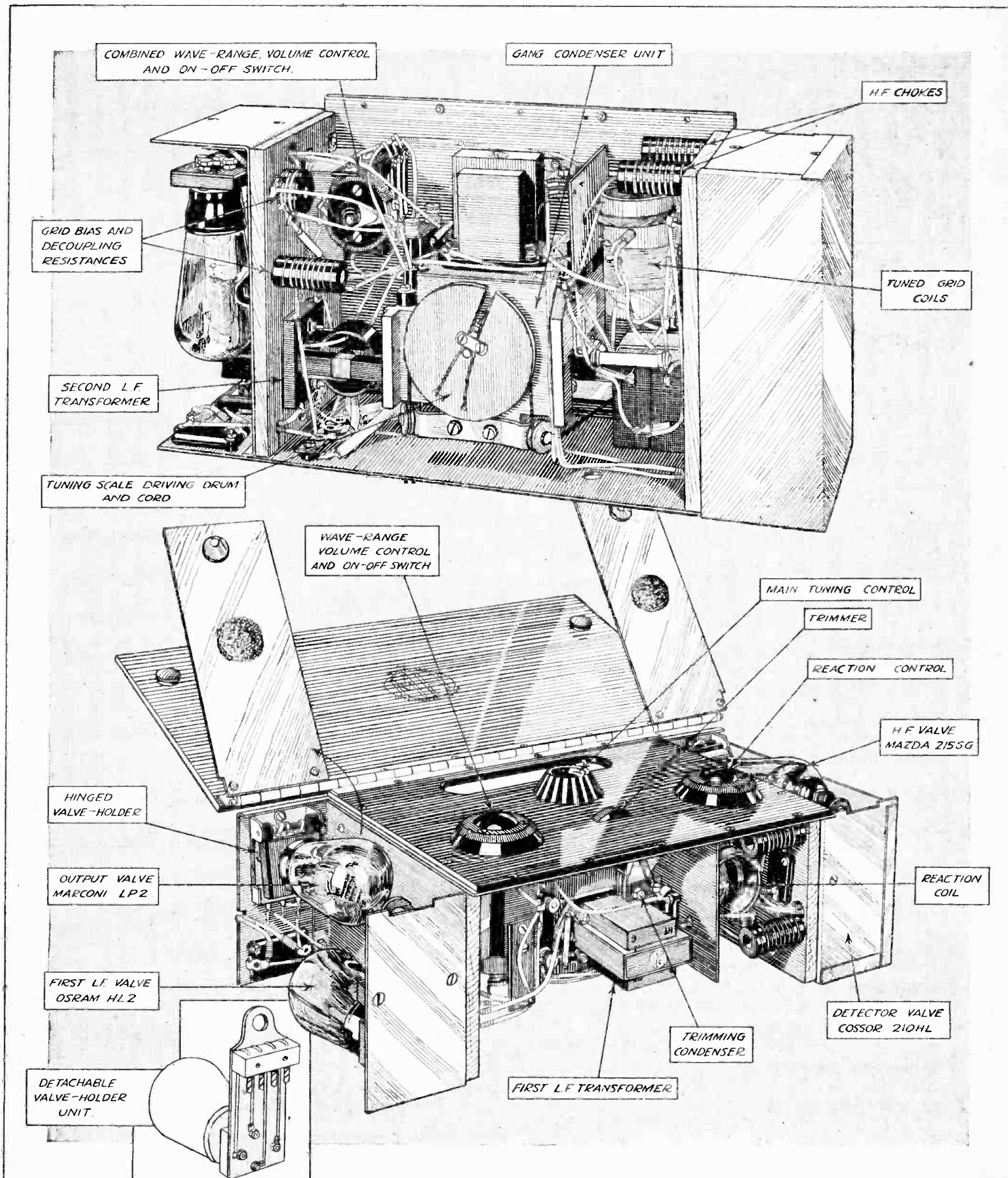
CONTROLS: (1) Main tuning control. (2) Trimming condenser. (3) Reaction. (4) Combined wave-range, volume control and on-off switch.

GENERAL: Provision for H.T. eliminator. Loud speaker tone control. Automatic grid bias.

PRICE: 22 guineas.

MAKERS: L. McMichael, Ltd., Slough, Bucks., and 179, Strand, W.C.2.

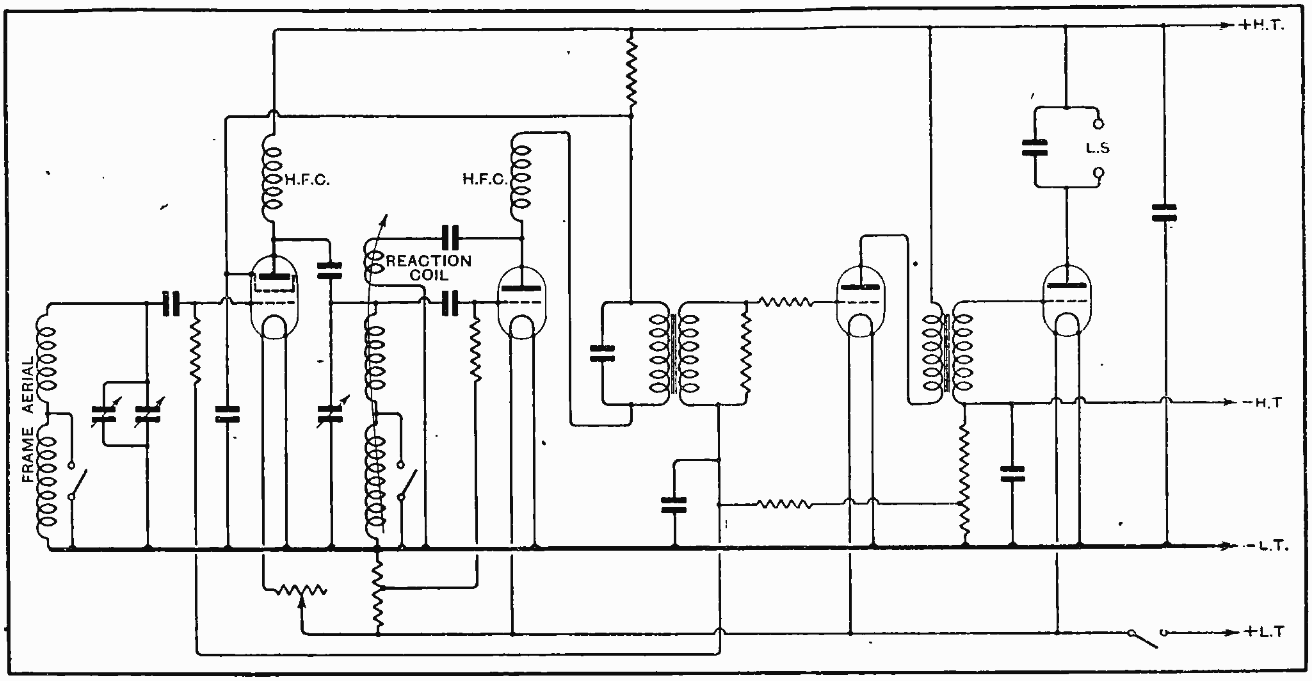
SUPER RANGE PORTABLE FOUR.



Constructional details of the chassis in the McMichael set.

McMichael Super Range Portable Four.— the loud speaker terminals are provided to keep stray H.F. current out of the loud speaker leads. This is essential as the frame aerial and loud speaker are mounted in close proximity inside the lid of the cabinet. Incidentally, the loud speaker winding is provided with two alternative tappings which give either brilliant or mellow quality by virtue of the alteration in the matching between the loud speaker and the output valve.

Structurally, the chassis is a model of neat design, and considerable ingenuity has been displayed in arranging the parts in the comparatively restricted space available. The valves are readily accessible in separate compartments on either side of the chassis. The screen-grid and output valves are mounted in hinged valve-holders, which can be tilted upwards for the removal of the valves, while the detector and first L.F. amplifier valve-holders take the form of special carriers which can be removed from the set as a complete unit.



Schematic circuit diagram of the McMichael Super Range Portable Four.

Ingenious Ganged Controls.

The tuning dial is of the horizontal type actuating a continuous cord attached to the drum of the dual tuning condenser. The latter is massively constructed with a die-cast frame and is provided with solid end vanes. The layout of controls is neat, and the main tuning control occupies the centre of the panel immediately below the horizontal scale. The trimmer is a single-vane solid dielectric condenser operated by a small knurled knob mounted edgewise and just protruding above the surface of the panel. The right-hand dial actuates the reaction-coil rotor, and the corresponding dial on the left is the combined wave-range, volume, and on-off control. The latter is a well-known McMichael feature, and consists of a divided filament rheostat, ganged to the wave-range switch. In the mid-position the cam of the wave-range switch completely disconnects the L.T. circuit, while movement to the right or left increases volume on the long or medium wavebands respectively, as the filament resistance is reduced.

Economy of H.T. Current.

The controls are smooth in operation, and reaction is free from overlap. The volume control, however, is inclined to be sluggish owing to the slight time lag in heating up the filament of the screen-grid valve. One soon becomes accustomed to the somewhat delayed response, however, and it cannot be regarded as a serious drawback.

The set is quiet in operation and is free from the background noise often associated with the long-wave range in receivers of this type.

Quality of reproduction is well maintained up to a volume level which is more than sufficient for indoor use and which leaves a considerable margin for outdoor listening conditions where more volume will probably be required.

On the score of range and selectivity and in the matter of general finish and attention to detail the McMichael Super Range Four sets a very high standard. It only remains to add that the performance is not obtained at the expense of excessive H.T.-current consumption, for the total demand on the battery when new is less than eight milliamperes.

Next Week's Set Review :—
VARLEY "SQUARE PEAK" FOUR.

Unbiased by Free Grid

Broadcasting House from Within.

ALTHOUGH the B.B.C. are not yet finally and completely installed in Broadcasting House, the place is already hedged about by red tape, and to get into the wretched place is far more difficult now than was the case a few weeks ago. At any rate, I found it so the other day, but there are more methods than one of entering a forbidden building, and, in spite of strenuous opposition at the legitimate entrances, I eventually found myself roaming at will along the multitudinous corridors of this modern mausoleum, so soon to become a human rabbit warren.

A little more *joie de vivre*.

The B.B.C. are certainly to be congratulated on their new home, but it is to be hoped that a little more *joie de vivre* will eventually be infused into the place; at present you get the impression of wandering through endless catacombs, and every time I turned a corner I half expected to come across the mummified remains of some long-forgotten performer. Already the whole place seems to be pervaded with the odour of sanctity, though I understand that there is no truth in the rumour that members of the staff will be compelled to remove their shoes before entering the Director-General's room.

One very discordant note struck me about this great temple of modernity; I refer to the heating arrangements. In a building associated with the greatest of all practical applications of electricity one would surely expect to find the most up-to-date form of electric panel heating, which has proved itself efficacious in so many modern buildings. Even if it *is* a bit expensive it ought to be used, if only for the sake of appearances; after all, you would scarcely expect to come across electric lighting in the offices of a gas company, even though the members of the staff used it in their own homes. Such incongruities are on a par with buying hair-restorer from a bald-headed barber. As it was, the heating system of Broadcasting House gave me a headache both metaphorically and physically.

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Another "Discovery."

ALL readers who are old enough to have imbibed the contents of the first number of this journal will probably recollect the regularity with which the ha-penny Press used to "discover" wireless in pre-War days. This sort of thing continued even after the striking manner in which the *Titanic* disaster brought the science to the fore. Daily newspapers are noted for this sort of thing, of course, but I really should have thought that the idea of shoving a microphone in the grid circuit of the detector or first L.F. valve of a set in order to broadcast the sound of your own voice through the house was sufficiently old to be decently buried.

Turning up my back numbers of *The Wireless World* I find that the matter was dealt with *in extenso* in the "Readers' Problems" section many years ago, and an intimation given that it had whiskers on it even then. Nevertheless, I saw in one of our leading morning journals a little while back a glowing account of this hardy annual which "a young British electrical engineer had invented." In an interview with the journal's representative the inventor gave an address at which demonstrations were being given to the public.

"A young British electrical engineer."

As I had an hour or so to spare I wended my way thither, and eventually found myself on the fringe of a gaping crowd listening to the nasal twanging of a female voice which was an insult to the thoroughly respectable portable set from which it was emanating. By following the connecting wire I eventually tracked down the wretched microphone and the presiding goddess in front of it. Her voice was, I found, one hundred per cent. "lift girl," but even so the distorting effect of the cheap and nasty instrument into which she was speaking had the effect of making her voice doubly unintelligible, if such a thing be possible. I felt genuinely sorry for her, but on offering a word of sympathy I received that "worms-of-earth" look usually reserved for persons on the vulgar side of the average post-office counter.

As for the microphone, they could have done a lot better (incidentally saving money also) by pressing into service an old horn-type loud speaker.

CORRESPONDENCE.

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

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

SELECTIVITY AND TONE CORRECTION.

Sir,—I was very glad to see the further article by F. M. Colebrook on this subject in your issue of January 6th.

Mr. Colebrook does not state whether he has tried out in practice the ideas of which he explains the theory: if he has not, he may be interested to hear of some results. During the last two years I have built three sets embodying these principles. The first was a frame aerial set with no H.F. amplification for regional stations; the other two had screen-grid stages for long-distance work on an open aerial.

In all cases the results entirely bear out the theory. The sets have an extraordinary freedom from "modulation interference"—the annoying swishing or twittering from the high notes of a neighbouring station. The carrier whistle, however, is not cut out, and if the audio-frequency equipment has a reasonable response at 9 kC one must take steps to get rid of it by a sharp-tuned filter, which is easily done. A very important advantage of such sets is that owing to the reduction of the apparent depth of modulation (due to the extreme magnification of the carrier) the detector can be made to rectify with no distortion. As a consequence, such sets if properly designed are miles ahead of anything else I have heard for combined selectivity and quality, and in my opinion this is undoubtedly the system of the future.

There are, however, certain grave difficulties in *popularising* this system at the present.

First, in order to get satisfactory sharpness of tuning on one circuit one needs a special reaction arrangement. With normal reaction circuits, a "reaction magnification" of 50 is as much as one usually gets—i.e., a 10-ohm coil has its effective resistance lowered to 0.2 ohm. Any attempt to push the reaction beyond this causes oscillation to set in with a click. This magnification is not enough, but by using special arrangements one can go much further. The reaction magnification can be pushed up to over 1,000 (i.e., a 10-ohm coil reduced to below 0.01 ohm), and oscillation sets in so gently that one can hardly tell when it occurs; and there is no backlash.

Unfortunately, it has up to now been impossible to maintain the reaction magnification constant as one searches over the waveband, and consequently whenever a new station has been found the reaction must be carefully adjusted. If it is *not* correctly adjusted the audio-frequency response will not be correct.

Again, with sets using this system it is absolutely essential that tuning shall be *dead* right. If, for example, the sharp circuit is tuned only 0.2 kC (200 cycles) off the right value, the resulting A.F. response is most weird; there is a terrific 200-cycle resonance and nothing at all below! And at 300 metres the above error is only one part in 5,000.

What all this means in practice is that the reaction adjustment needs a low-geared slow-motion control (80/1 at least) and a special circuit, and that the tuning condenser of the sharp circuit needs a "trimmer" of not more than 50 $\mu\mu$F also with a slow-motion dial on it, and there must be a meter in the rectifier anode circuit to observe the current depression.

In other words, the system is one which will give unequalled results in skilled hands, but is useless otherwise. I am now trying hard to get over these difficulties, and make sets on this principle suitable for ordinary handling. The outlook is hopeful, but the task is not easy. P. K. TURNER, M.I.E.E.

Windsor.

[The interesting letter published above should be read in conjunction with the Leader in this issue.—ED.]

CONTINUITY OF GRAMOPHONE REPRODUCTION.

Sir,—It is most unfortunate that the present design of the ordinary gramophone is almost universal. Its very popularity will be the greatest difficulty to overcome when introducing longer-playing methods.

Your correspondent who advocates larger discs and reduced speeds and who deplores the complicated record-changing devices may have overlooked one point. The largest disc possible has a very limited duration, and has to be changed by hand.

Reduced speeds require motors of precision and, consequently, more expense. The necessary torque will be greater owing to decreased value of the turntable as a flywheel. Certainly a larger turntable will assist in attaining a consistent speed.

However, why adhere to the disc method? Good results have been reported at tests of the metal magnetic thread system. Cannot it be extended further. Theoretically, I would suggest a strip of a suitable substance a number of yards in length and an inch or so wide. On it would run tracks in parallel. The strip could either take the form of an endless band, in which case the tracks will be continuous, i.e., in a spiral manner round the band; or else, at the end of the band, a notch would act as a trip and so reverse the direction of movement of the strip. It will be argued that more complicated mechanism will be involved, but still . . . STAUNTON-LAMBERT.

London, W.2.

EMPIRE BROADCASTING.

Sir,—I was pleased to read the confirmation of telegraphic Press news concerning Empire Broadcasting in your issue of November 18th, 1931, as several letters of mine have already appeared on this subject in past numbers of your periodical. It will be happy news to the many in India and the Far East, as we are now inflicted with severe heterodyning by Russia, and even Japan, so that our Bombay and Calcutta receptions are practically blotted out.

Radio Saigon 49.8 metres and Bandoeng on 15.9 metres are our standby (the former giving the Pacific news in English), and excellent reception from both is obtainable from 6 p.m. till 9 p.m. or so, when they close down. Russia covers a quarter of the dial in some cases on the long wave, and I leave it to you to imagine what we feel like in the matter. The B.B.C. is guaranteed any help they require in reception reports, if they will ask for them. I can only suggest that the wavelengths to be selected should avoid beam stations, and a difference of decimal points of metres with other broadcasting stations do not necessarily mean no interference. A loud Morse station close to broadcasting is enough to ruin all reception, and this is an experience extending over six years. "RADIOX."

India. December 7th, 1931.

INTERFERENCE.

Sir,—My recent letter re interference seems to have been rather misunderstood by your correspondent, Mr. Franklin Judge; surely the problem of interference is mainly a question of the ratio of interference to signal strength. With increased signal strength Mr. Judge would be able to scrap his H.F. stages and his aerial, and put in a band-pass filter of the type so often advocated by *The Wireless World*.

After all, the cost of a super-power transmitter is small when considered in terms of cost per head of the population which it serves, and even a little more on the licence fee would easily be off-set by the saving on the price of the receiver.

In reply to Mr. Helps, I am afraid his well-meant suggestion is not of much practical use in this case. When our motor-generator was first installed we tried two condensers in series, with the centre point earthed, using values of from 1 mfd. to 10 mfd. each side, the only result seemed to be to spread the peak of interference from about 200 metres to all over the broadcast band, without reducing the intensity to any marked extent. The power handled being about 8 amps. at 100 volts output, we find leakage a big factor, this being unavoidable on account of the spray and moisture condensation. We have also tried two lamps in series across the mains with centre point earthed (three-wire circuit), but this did not help matters much.

With regard to the cost of charging accumulators, Mr. Helps must add his rent, rates, wages, insurance to get the cost of charging accumulators when doing it for a living.

In further reference to the interference created, may we say that it is not sufficient to interfere with the reception of the local station. NUGENT C. A. GILDERS.

Romford.

Readers' Problems.

These columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.
Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found elsewhere in this issue.

Testing Procedure.

THE constructor of a three-valve battery set has found that quite a heavy blue spark is produced on making contact between the H.T. negative connecting lead and its terminal. He asks whether this is normal, and if it is not, where the fault is likely to be found.

Assuming that the L.T. battery circuit is "open," it may be pointed out that the completion of the H.T. circuit is bound to be accompanied by a surge of current, due to the charging of the by-pass condensers. If everything is in order, and if the condensers are holding their charge reasonably well, no such spark should be produced on again making the H.T. contact a few seconds later. If, on the other hand, sparks are produced at each contact, it is certain that at least a partial short-circuit exists between the H.T. negative and positive bus-bars. This "short" might be in the by-pass condensers already mentioned, but it is more likely to be found in the anode circuit of one of the valves. This is a case where a patient search must be made, preferably by a process of elimination, and with the help of some simple testing instrument.

Excessive Stray Capacity.

THE constructor of an H.F.-det.L.F. set of fairly conventional design, with band-pass input and one-knob tuning, complains of his inability to carry out the operation of ganging (by adjustment of trimming condensers) in a satisfactory manner. In whatever way the adjustment is made, it is always found that the trimmer across the tuned grid coupling circuit must always be set at minimum capacity, and there are indications that this circuit is not exactly in resonance with those of the band-pass filter. Our querist is quite sure that the coils are properly matched.

These symptoms would seem to indicate fairly definitely that there is an excessive amount of stray capacity across the coupling circuit—at any rate, there must be more capacity than can be balanced by the trimmers across the input circuits.

The difficulty might be overcome quite easily by connecting external trimming condensers across the first two circuits, but this plan has the drawback that the wave-range covered by the set may then be unduly restricted. A better plan would be to attack the trouble at its source, and to make an effort to reduce the stray capacities. A good deal might be done by rearranging the wiring, and even by using different valve holders, but probably the most certain way of bringing about the desired reduction in capacity is to "tap down" the connection from the H.F. valve anode on to the tuned grid coil.

Impatient!

A READER who has just completed the construction of a three-valve A.C. receiver, with indirectly heated valves, is now waiting for the supply mains to be connected to his home. As some delay seems likely, he raises a question as to whether it would be possible, as a temporary measure, to operate the set from batteries, and if so, how they should be connected.

Provided that batteries of suitable capacity are obtainable—and this is a matter of some importance—there is no great difficulty in connecting them to the receiver, especially if it is of relatively simple design. Assuming that all valves are of the indirectly heated type, including the output, and are all heated from the same L.T. secondary, it will only be necessary to interrupt the power supply circuits at the points marked X in Fig. 1, and to connect the batteries as shown by dotted lines. It should be noted that an extra lead between the negative terminal of the battery and the base line must be provided.

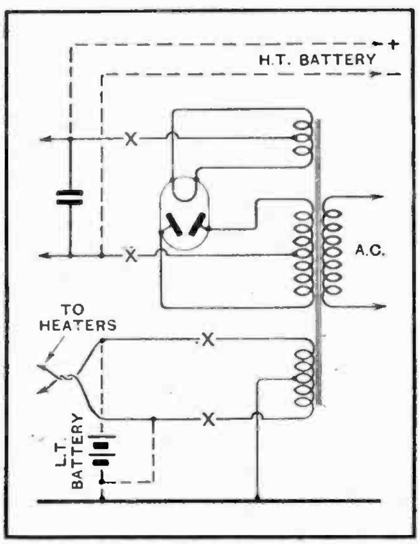

Fig. 1.—How to connect H.T. and L.T. batteries to a set designed for A.C. mains operation. Automatic bias arrangements will still operate in the normal manner. Original connections are broken at points marked X.

It should not be forgotten that if the output valve is intended to be heated from a separate secondary on the power transformer, this simple scheme of connections will probably not be applicable without modification, as it would in most cases be responsible for the introduction of a short-circuit across the output bias resistor.

This information will also serve as a guide to those who have asked for advice regarding the procedure to be adopted in making initial tests of an A.C. receiver with the help of batteries before connecting the mains.

Extra Bias Volts.

OUTPUT valves of the battery type, when supplied with L.T. current from A.C. mains through a step-down transformer, may normally be operated with a grid bias that is slightly in excess of that usually recommended. This is due to the fact that this particular method of filament heating our "point of departure" is, in effect, the centre point of the filament, and not its negative end.

This point is raised by a correspondent, who has found by chance that the output stage of his converted battery set, which is arranged in this way, works rather better with a negative bias that is 3 volts in excess of that shown on the manufacturers' leaflet.

Grid Emission.

THE user of an A.C. mains set, with indirectly heated valves throughout, states that a distinct falling-off in general performance is observed after about half-an-hour's working. After switching off for a few minutes, the receiver may again be put into operation with quite normal results, but the same trouble again sets in after a while. Information is requested as to the probable cause of this effect.

It can be stated fairly definitely that troubles of this sort are generally due to electron emission from the grids of indirectly heated valves, which is brought about by excessive voltage across the heater. The matter is serious, as the valves will be permanently damaged if they are operated in this way.

It is possible that the power transformer is wrongly designed, with the result that an excessive voltage exists across one or more of the L.T. secondaries. Again, the trouble may be due to an incorrect connection of the mains to the primary terminals of the transformer, and this point should be carefully checked, making sure that the mains are joined up to the marked terminals corresponding with the supply voltage.

A Cure for Instability.

IN one or two cases "Band-Pass Pentode Three" receivers constructed by readers seem to be lacking in stability at the extreme lower end of the medium broadcast band. Unless the original layout is changed to such an extent that long H.F. interconnecting leads become necessary, this is a difficulty that should never arise, as screening is lavish, and no exceptional degree of H.F. amplification is aimed at in the design.

If the slightest tendency towards uncontrollable self-oscillation should be encountered, the screening grid decoupling resistance and condenser may be suspected. Care should also be taken to see that the H.F. valve screen is properly earthed; this detail was not altogether clear in the practical wiring plan. In practice, it is sufficient to join the screening case to the negative filament terminal of the H.F. valve-holder.

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Loud Speaker Matching.

MANY questions have been asked, particularly with regard to the "Super-Selective Six," as to how a moving-coil loud speaker, with a built-in output transformer of the type designed for use with triode valves, should be connected when a pentode output valve is fitted to the receiver.

The rule is that the built-in transformer should be connected through a tapped matching choke, the circuit being arranged

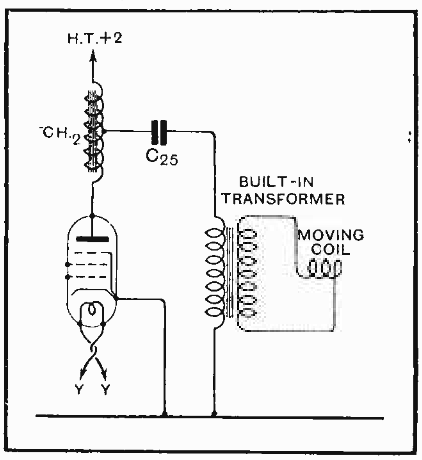

Fig. 2.—Method of connecting a moving-coil loud speaker, designed to operate with a triode, to a receiver like the "Super-Selective Six," where a pentode output valve is used.

as in Fig. 2. The feed condenser, which is necessary in order to prevent a short-circuit across the source of H.T. supply, may have a capacity of from 2 to 4 mfds.; usually the smaller value is satisfactory.

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"Single-dial Super."

Gramophone Pick-up Connections.

ALTHOUGH the single-dial superheterodyne receiver described in our issues of December 9th and 16th is a battery-operated set, it has, thanks to the use of a highly efficient type of pentode valve, a very respectable output. Consequently, the receiver can be employed quite satisfactorily with a gramophone pick-up.

In order to use the set for the reproduction of gramophone records, the pick-up may be connected as shown in Fig. 3. There are other and more complicated

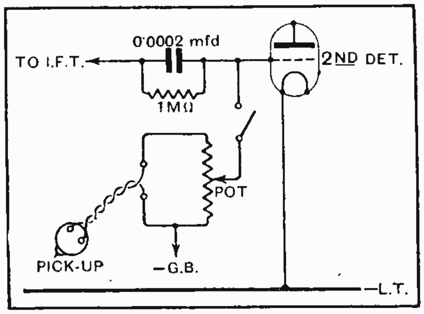

Fig. 3.—Fitting a gramophone pick-up and volume control in the second detector grid circuit of the "Single Dial Super."

schemes for changing over, but that shown is almost invariably satisfactory, in spite of the fact that the pick-up is shunted by the grid condenser. This, however, has so small a capacity that its presence will hardly ever do any harm, and so it is seldom worth while going to the trouble of fitting a change-over switch with three connections merely to isolate it from the pick-up.

Matters should preferably be so arranged that the change-over switch is mounted in close proximity to the grid terminal of the detector valve. It is a good plan to arrange some simple form of remote control for this switch, so that it need not be connected by long leads. This, by the way, is a precaution that may be observed in almost all cases when fitting a radio-gramophone change-over switch in this or any other manner.

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The "Variable-mu Three" and Smoothing.

AS a general rule, it may be taken that rectified current derived from 25-cycle A.C. mains will always need more elaborate smoothing than that of the normal and higher periodicity. This, of course, applies to the "Variable-mu Three" (*The Wireless World*, November 18th and November 25th, 1931). But this type of set enjoys a large measure of inherent immunity from "hum" troubles, and any that are likely to arise in special circumstances can generally be prevented by adding 2 or 4 mfds. of extra capacity across the smoothed output circuit (in parallel with C_{18}).

This is in answer to a reader who has a 25-cycle supply, and raises a question as to whether he would find it necessary to employ an extra series smoothing circuit. Needless to say, it will be essential for him to obtain a power transformer especially designed to operate on a 25-cycle supply circuit.

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Current-carrying Capacity.

NO longer is it safe to ask for, say, a 20,000 ohm wire-wound resistor, and blindly to assume that it is certain to carry in safety any value of anode current that is likely to be passed through it. High voltages and heavy currents must be legislated for in many modern mains-driven receivers, and a certain amount of care must be exercised in choosing resistors if constant burn-outs are to be avoided.

A case in point is that of a correspondent who intends to use a 20,000 ohm decoupling resistance of a type rated at 1 watt in the anode circuit of his power grid detector, which, it is expected, will pass about 8 milliamps. He asks whether this particular resistance will be satisfactory, or whether it would be safer to obtain a component of the so-called "power" type.

Knowing the value of current that should flow, the stability of any resistance may easily be estimated by adopting the following procedure:—

(1) Calculate voltage drop across resistor by multiplying current (in amperes or fractions) by the value of the resistor in ohms.

(2) Ascertain wattage dissipated in the resistor by multiplying voltage drop (found by previous calculation) by current flowing.

Applying this, we find that 0.008 multiplied by 20,000, equal to 160 volts, will be absorbed by the resistor mentioned by our correspondent. The wattage dissipated by it will be 160 multiplied by 0.008, equal to 1.28 watts. Thus, a 1 watt resistor would be overloaded by a considerable margin, and a component of higher current rating should be chosen.

FOREIGN BROADCAST GUIDE.

ANKARA

(Turkey).

Geographical position: 39° 57′ N.; 32° 54′E.
Approximate airline from London: 1,750 miles.

Wavelength: 1,538 m. Frequency: 195 kcs. Power: 7 kW..

Time: Eastern European (two hours in advance of G.M.T.).

Standard Daily Transmissions.

16.00 G.M.T., Oriental concert: 17.00, European concert and talks, news in the intervals. Usually closes down at 19.30.
Announcer: Man.
Interval signal: one stroke on a gong.
Call: *Allo! Allo! Ankara telsiz telefonou*, repeated in French: *Allo! Ici poste de radiodiffusion à Angora.*
Closes down with Goodnight greetings in Turkish, French and German, followed by the Turkish National Anthem

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

Editorial Comment.

The Power Radio-Gram.

THE design of a power radio-gramophone with constructional details, included in this issue, has been prepared largely as a result of special requests from a great many readers who want to build an instrument where quality of reproduction should be made the first consideration, and where, as far as radio reception is concerned, the principal interest would be in the local stations.

The tendency to-day is, perhaps, more than ever to employ two distinct types of receiver for listening. It will generally be conceded that distant listening falls considerably short of local reception in quality, on account of fading and general interference, so that, if we design a reproducer of the highest quality, the advantages so gained are largely lost in the reception of distant stations. For general listening at home, therefore, it is desirable to employ an instrument which will give first-class quality on the local stations and, in addition, on the reproduction of gramophone records.

In general, it is true to say that quality of reproduction is in proportion to the voltage available, and, consequently, in order to aim at an ideal, higher voltages are employed in this instrument than are normal for the general broadcast set, but the advantages gained are well worth while. Reasonable caution should be taken to see that a receiver of this nature is disconnected from the mains before any alteration or adjustment to the circuit is made internally, and it is most strongly recommended that in no circumstances should the receiver be switched on without first being accommodated in a cabinet for safety. Quality of reproduction is of an extremely high order, and we believe that, in putting out this design, we are meeting in every way the requirements of the "special requests." The receiver is one which should be regarded as the permanent home set and primarily a musical instrument.

Informative Advertising.

WE have recently received a number of letters from readers who ask us to draw attention to the value of technical information in advertisements. Objection is raised to the type of advertisement which merely states that a certain product is the best, without giving any reason or any suggestion as to the conditions under which the product should be used. There are, of course, many commodities offered for sale where it would generally be useless to give to the general public information of a practical nature, although, even in a number of "border line" cases, such as soap and toothpaste, there is a tendency in modern advertising to inspire confidence in the products by giving the public some idea of the composition of the material and the reasons for its beneficial action in use.

In radio advertising, especially where the medium is a paper read by intelligent users, the first thing that the prospective buyer wants to know is something about the technical specification of the product. A valve, a transformer, or a condenser, may be needed for a particular purpose, and if, when looking through advertisements, the reader finds what he wants illustrated in two or more advertisements, he is likely to choose the product where the advertisement gives most technical information as to its suitability for his purpose.

Amongst intelligent readers, we are afraid, many advertisements lose their force and effectiveness through neglect to compile them, bearing in mind the special mentality of those to whom they are addressed.

Wireless World

Power Radio-Gram

Realism on Radio and Records.

By A. L. M. SOWERBY, M.Sc., and H. F. SMITH.

A PIANO is primarily an instrument for the home; it is therefore not unreasonable to demand that an electrical reproducer for domestic use should be capable of reproducing piano music at about its original level of volume. The output stage that will do this without distress will render most music at such volume that, in an ordinary room, it has about the same level at the listener's ear as it would have if he were seated in a concert hall.

On this scale music sounds quite reasonably like the real thing, and one may accept a concert in the home as a very passable substitute for personal attendance at, say, the Queen's Hall itself. At the much lower volume customarily taken as normal for wireless signals the music may (or may not!) be free from distortion, but it can never be in any sense realistic. Experience shows that if the volume from a powerful set is slowly increased, the music becomes more and more "alive" as the level of sound rises. The limit to this steady improvement is only reached when any further loudness becomes definitely unpleasant.

For music, especially that of a full orchestra, a large output is essential if any approach to realism is desired, but such an output has a definite disadvantage in that speech becomes far too loud and rather "boomy." That, however, is the fault of the B.B.C., who insist on sending out the confidential voice of the announcer speaking quietly to his microphone at a level little below that of a crashing finale from a brass band. Fortunately, there is always the volume control.

Features of the "Power Radio-Gram."

A self-contained radio-gramophone for A.C. mains operation, in the design of which everything has been subordinated to the requirements of realistic reproduction.

Sensitivity: Adequate for good reception within the normal service area of a broadcasting station.

Selectivity: An ample margin of safety is ensured by a simple type of input filter.

Circuit details: Power-grid detector, followed by two resistance-coupled L.F. stages.

The radio-gramophone described here will deliver, without overloading, a volume which approximately fulfils the condition laid down in the opening paragraph. It is equipped, on the radio side, with sensitivity and selectivity sufficient for the reception of the local stations only, and is designed throughout for high quality of reproduction. Reference to the circuit diagram will show that low-gain resistance coupling is used in both stages, and that a band-pass filter precedes a power detector. To operate a resistance-coupled power detector a high anode voltage is essential, so that this one detail has, to a large extent, controlled the design of the set as a whole, making it desirable to use a high voltage throughout.

This naturally suggests the use of a single output valve of the 400-volt class as the simplest means of attaining the large undistorted output that is required. A Mazda PP5/400 has been chosen, and yields, at the voltages at which it is operated in the set, an output of over 4,500 milliwatts.

A modern receiver in which quality is insisted upon

Power Radio-Gram.—
must necessarily use a moving-coil loud speaker. A permanent-magnet speaker might have been chosen, but its greater cost and tendency towards lower sensitivity were against this type. After all, the necessity for energising a field winding is no disadvantage in a mains set if the power supply can be conveniently arranged. After considering the many possible methods of feeding the field, it was finally decided to energise it by placing it in series with the anode of the output valve, in which position it serves very well as an output choke, having an inductance round about 25 henrys at a normal energising current.

Allowing for a drop of 100 volts in the speaker field, the resistance of which is 2,500 ohms, the voltage required for H.T. and grid bias together is round about 540 volts. This is just outside the maximum rating for the largest standard full-wave rectifying valve; to avoid extra expense the transformer finally chosen is rated at 500-0-500 volts on the H.T. secondary, and provides, at the full load taken by the set, a total supply of just over 500 volts for all purposes.

with an amplification factor of from 15 to 20, expecting the stage-gain to be about 80 per cent. of this. A Cossor 41MP fills these requirements very nicely, having an amplification factor of 18 combined with an A.C. resistance low enough to enable it to hand on a signal of well over 30 volts without any approach to overloading.

The Intermediate L.F. Stage.

With an anode resistance of 10,000 ohms the stage-gain will be approximately 15, while a 30-volt peak output will mean a change in anode current of ± 3 milliamps. If the steady anode current is made not less than 10 milliamps. there will be an enormous margin of safety against overloading V_2 before V_3 has its full signal. With an anode resistance R_9 of 10,000 ohms and a decoupling resistance R_8 of 25,000 ohms this condition is fulfilled.

For the detector stage a valve of high amplification factor has been chosen in the interests of sensitivity. The Cossor 41MHL has an amplification factor of 52,

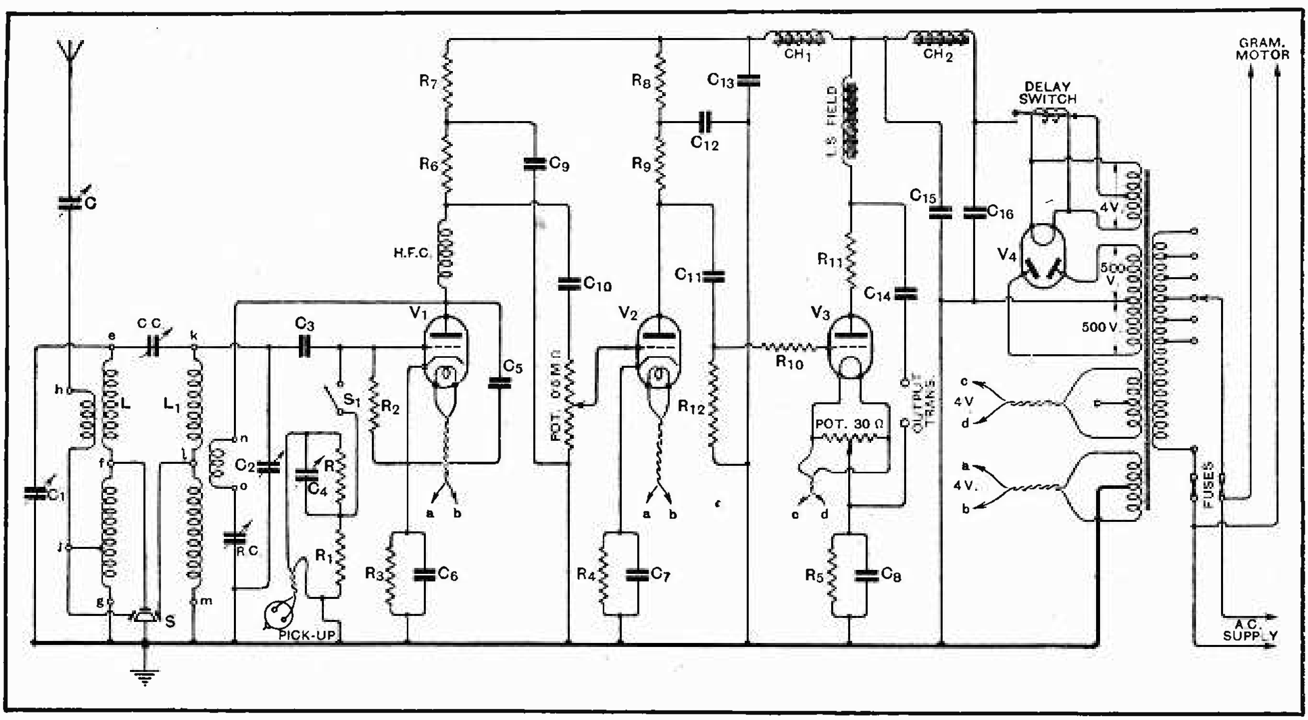


Fig. 1.—Complete circuit diagram. Values of components are: C, 0.0003 mfd.; C_1, C_2, C_5, 0.0005 mfd.; C_3, 0.0001 mfd.; C_4, 0.001 mfd.; C_6, C_7, C_8, 2 mfds. (electrolytic: 100 volts working); C_9, C_{12}, 2 mfds. (250 volts working); C_{10}, 0.01 mfd.; C_{11}, 0 05 mfd.; C_{13}, 2 mfds. (1,000 volts test); C_{14}, C_{15}, C_{16}, 4 mfds. (1,500 volts test); C.C., 40 mmfds.; R.C., 0.0005 mfd.; R, R_2, 0.25 megohm; R_1, 0·1 megohm; R_3, 750 ohms; R_4, 500 ohms; R_5, 600 ohms; R_6, 50,000 ohms; R_7, 30,000 ohms; R_8, 25,000 ohms; R_9, 10,000 ohms; R_{10}, 5,000 ohms; R_{11}, 100 ohms; R_{12}, 100,000 ohms.

The average output of a power-type grid detector may be taken as some 3 to 4 volts peak when receiving signals of normal modulation. The last valve takes, when fully loaded, a peak signal voltage of about 30 volts or a little more, to provide which the signal from the detector requires to be amplified some ten times by V_2. Allowing a reasonable margin of safety, one would therefore pick for V_2 a valve

and is run, with an anode resistance R_6 of 50,000 ohms and a decoupling resistance R_7 of 30,000 ohms, at an anode current of just over 5 milliamps. It will be noticed, in both stages, that the high anode voltage available has allowed decoupling to be exceptionally complete.

The coils specified for the band-pass filter are such as can readily be made at home by those who wish

Power Radio-Gram.—
to do so, the mounting being so arranged that screening, other than a simple flat plate of metal, is not required. To avoid difficulties due to imperfect matching of home-made coils, the dual condenser used has a rocking stator on the aerial side. Coupling between the two halves of the filter is provided by a small condenser connected between the "live" ends of the tuned circuits; such an arrangement is very far from giving constant peak separation over the whole tuning range, but serves very well when the reception of only two stations is expected. Predetection volume control is provided by the pre-set series aerial condenser and the reaction adjustment which, used in conjunction, will adequately cover the needs of regional reception with any aerial. Long-wave coils are fitted, though listeners who have a short-wave National programme available will probably omit them.

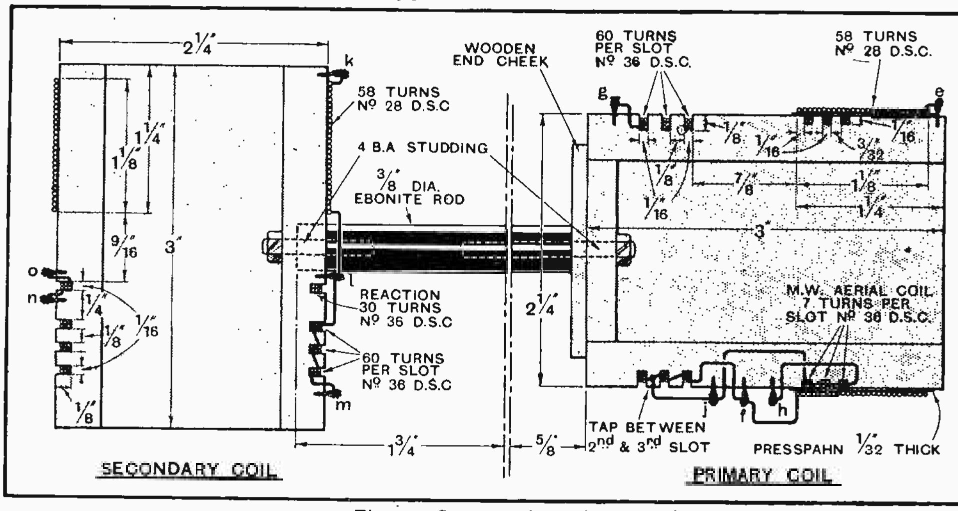
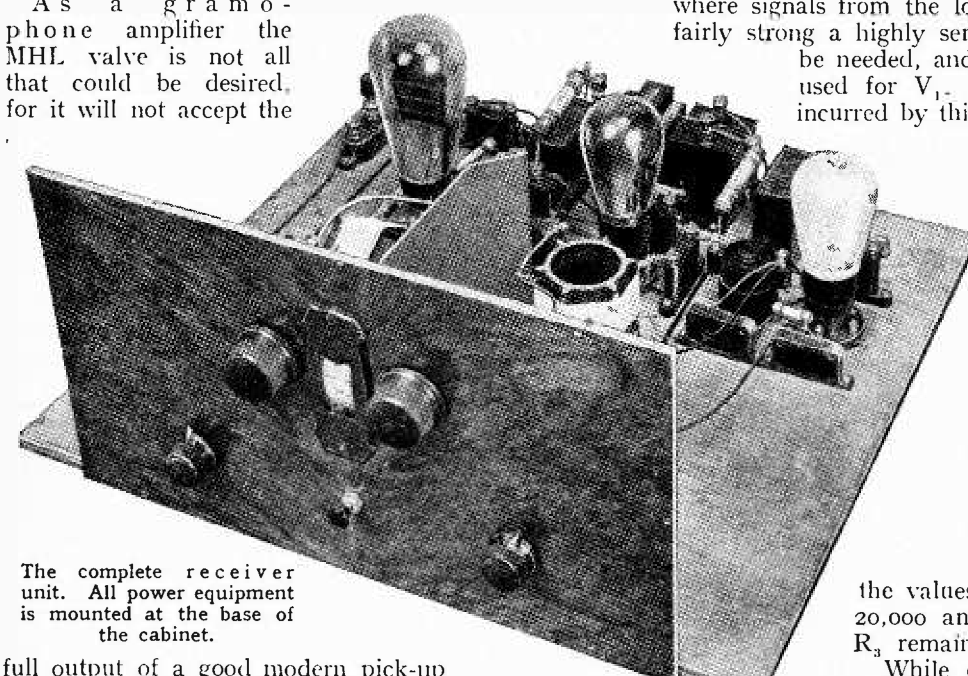


Fig. 2.—Construction of the tuning coils. Narrow strips of presspahn or similar insulating material are used to space the medium-wave tuned coil from the slot-wound aerial winding.

As a gramophone amplifier the MHL valve is not all that could be desired, for it will not accept the full output of a good modern pick-up without overloading unless precautions are taken. In the original instrument this defect is overcome by fitting a fixed potentiometer which applies only part of the output from the pick-up to the first valve. This potentiometer, made up of R and R_1 in series, allows just under one-third of the voltage developed by the pick-up to reach V_1, while the loss of high notes caused by the presence of R in series with the grid of the valve is compensated by suitable adjustment of the pre-set condenser C_4. The precise setting required for this will depend largely on the type of needle chosen; for the Burmese colour needle, with which most of the tests were made, the condenser needs to be set nearly at maximum.



The complete receiver unit. All power equipment is mounted at the base of the cabinet.

If the radio-gramophone is to be used in a situation where signals from the local station are known to be fairly strong a highly sensitive detector will no longer be needed, and a second MP valve may be used for V_1. The decrease in sensitivity incurred by this change is not great, so that unless the receiver is to be used with a very small aerial, or near the limit of the service area of the transmitter, no loss will be incurred on the radio side. As a gramophone there is a just-perceptible improvement in quality through the omission of the potential-divider across the pick-up. If this change is decided upon, the pick-up will have to be connected directly between the switch S_1 and the earth line; R, R_1, and C_1 will be discarded, while the values for R_6 and R_7 will become 20,000 and 30,000 ohms respectively, R_3 remaining unchanged.

While on the topic of permissible alterations, it may not be out of place to draw the reader's attention to the fact that an amplifier of the type here described does not depend in the least upon details of layout. Provided that resistance and condenser values are left unchanged, the circuit may therefore be adapted to a cabinet of any type desired, or, if found convenient, the amplifier may be tacked on after the detector valve

Power Radio-Gram.—

of any long-range receiver. Further, the power transformer specified will supply heater current to two or more valves if required, while if anode current for these extra valves is also taken from the same source only a trifling drop in anode voltage will result.

Reverting to the circuit diagram, there are one or two points which are worthy of mention. V_1, when used as a detector, has no bias, the grid leak R_2 being returned to the cathode. Connection of the pick-up by closing S_1 joins the grid through R_1 to the earth line, thereby applying the bias developed by the passage of the anode current through R_3. The resistance of R_2, 0.25 megohm, is too high to upset the bias appreciably, and the arrangement is very satisfactory in practice, as it makes the radio-to-gramophone switching as simple as it well could be.

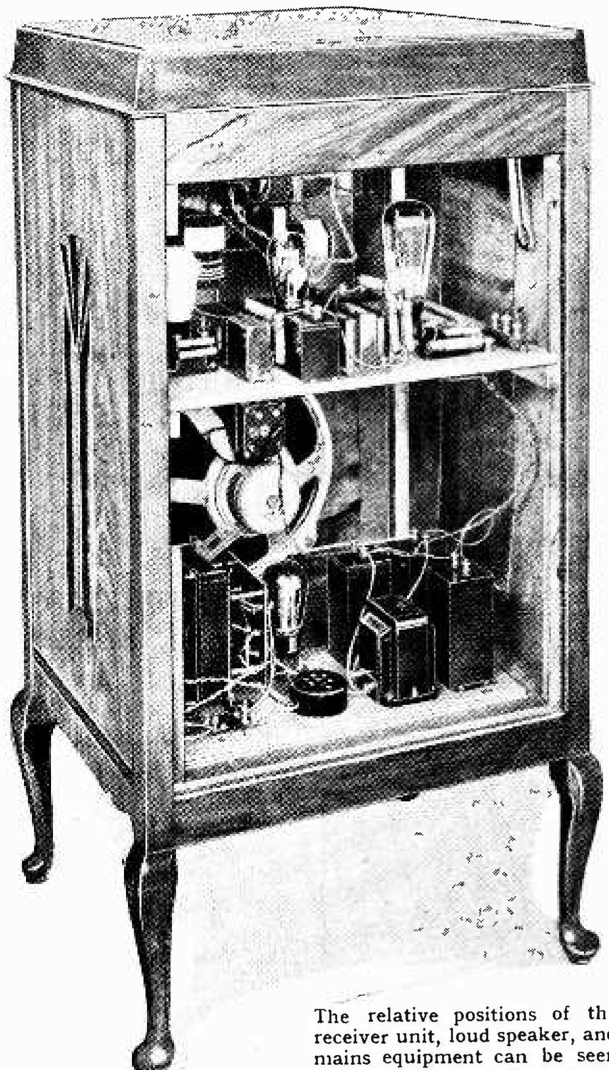
The grid potentiometer preceding V_2 is used as a volume control for both wireless and gramophone reproduction; circuit values are such that when it is adjusted quality does not alter to an extent that the ear can appreciate. This would not be true of a potentiometer across the pick-up, which would cut high notes when volume was reduced. From the wireless point of view the grid potentiometer is good practice, for it permits volume to be controlled without departing from optimum signal strength at the grid of the detector.

Safety Precautions.

R_{10} and R_{11}, having resistances of 5,000 and 100 ohms respectively, are inserted as a precaution against parasitic oscillation of the output valve. They are completely effective in the set as it stands; those who propose alterations might note that they would possibly fail to be so if the resistances were not connected direct to the valve-holder.

A Bulgin delay-action switch, thermally operated from the heater winding of the transformer, is used to switch on the anode-current supply only after the valves have warmed up. By this means it is possible to ensure that condensers whose high-potential ends are connected to the H.T. + line only through a resistance (e.g., C_9, C_{10}, C_{12}) do not at any time receive the full 500 volts. Condensers of lower voltage rating, and hence of lower price, may therefore be used; the saving thereby effected much more than pays for the switch. The reader is warned that the "economy" of using condensers of a lower voltage rating than those specified will turn out to be extremely expensive in the long run.

It is important to note that the primary of the speech transformer on the loud speaker is returned to the mid-point of the filament potentiometer; if it is taken to earth it will be found necessary to decouple the bias resistor R_3. With the circuit as shown the tiny 2-mfd. electrolytic condenser C_5 provides a sufficient bypass. In building the set it is to be noticed that this condenser, as also C_6 and C_7, must be connected with their negative terminals to the earth line. If reversed they will short-circuit their respective bias resistors.



The relative positions of the receiver unit, loud speaker, and mains equipment can be seen in this view from the rear of the cabinet.

Reaction Control.

To revert to the other end of the set, it should be made clear that a reaction control is provided mainly as a means of offsetting the loading effect of the power grid detector, and it is not intended that this control should be used for the purpose of increasing range beyond that for which the set was designed.

Those who wish to build the set will find that the list of parts, together with the photographs and drawings which accompany this instalment, will provide material enough for a start to be made; the concluding part will touch upon such constructional details as cannot readily be gathered from the various illustrations.

LIST OF PARTS.

After the particular make of component used in the original model, a list of other suitable products is given in many instances.

1 **Double-ganged condenser,** 0.0005 mfd., with built-in trimmer, complete with escutcheon and knob. **(Williams & Moffatt, Type C.A. 2-gang R.S.)**
(Burton, Cyldon, Formo, J.B., Lotus, Ormond, Polar, Utility).

1 **Variable condenser,** 40 mmfds. **(Magnum Baseboard Neutralising Condenser)**
(Bulgin, Burton, Igranic, J.B.).

1 **Variable condenser,** bakelite dielectric, 0.0005 mfd. **(Burton)**
(Graham Farish Ready Radio, Telsen, Utility).

Power Radio-Gram.—

1 **Three-point switch** (Telsen)
1 **On-off switch** (Telsen)
(Benjamin, Bulgin, Claude Lyons, Colvern, Igranic, Junit, Lotus, Ormond Red Diamond, Sovereign, W.B., Wearite.)
1 **Semi-variable condenser,** 0.0003 mfd. (Ormond)
1 **Semi-variable condenser,** 0.001 mfd. (Ormond)
(Faradex, Formo, Graham Farish, Polar, R.I., Sovereign, Telsen).
4 **Valve-holders,** 5-pin (Lotus: rigid type with terminals)
(Benjamin, Burton, Clix, Graham Farish, Junit, Telsen, Wearite).
1 **Fixed condenser,** 0.01 mfd., mica dielectric (T.C.C. Type 34)
(Dubilier, Graham Farish).
1 **Fixed condenser,** 0.05 mfd., mica dielectric. (T.C.C. Type 34)
(Dubilier).
3 **Fixed condensers,** dry electrolytic, 2 mfds., 100 volts working (T.C.C., electrolytic Type 54)
3 **Fixed condensers,** 4 mfds 1,500 volts D.C. test (Dubilier Type L.S.C.)
1 ,, ,, 2 ,, 1,000 ,, ,, ,, (,, ,, L.S.A.)
2 ,, ,, 2 ,, 500 ,, ,, ,, (Telsen)
(Formo, Hydra, Lissen, Peak, Sound Sales, T.C.C.).
1 **Fixed condenser,** 0.0001 mfd. (Telsen)
1 ,, ,, 0.0005 mfd. (Telsen)
(Dubilier, Formo, Graham Farish, Igranic, Lissen, Sovereign, T.C.C.).
1 **H.F. choke** (Lewcos: Midget type)
(British General, Bulgin, Burton, Climax, Igranic, Kinva, Lissen, Telsen, Varley, Watmel, Wearite).
2 **Resistances,** 100 ohms, 1 watt (Dubilier: Metallised)
1 ,, 500 ,, 3 ,, ,, ,,
1 ,, 500 ,, 1 ,, ,, ,,
2 ,, 1,500 ,, 1 ,, ,, ,,
1 ,, 10,000 ,, 3 ,, ,, ,,
1 ,, 30,000 ,, 2 ,, ,, ,,
1 ,, 50,000 ,, 3 ,, ,, ,,
2 ,, 50,000 ,, 2 ,, ,, ,,
(Bulgin, Claude Lyons, Colvern, Ferranti, Loewe, Sovereign, T.C.C.).
2 **Resistances,** grid leak type, 100,000 ohms, 1 watt (Dubilier: Metallised)
1 ,, 5,000 ,, 1 ,, ,, ,,
2 ,, 250,000 ,, 1 ,, ,, ,,
(Ediswan, Graham, Farish, Loewe).
1 **Thermal delay switch** (Bulgin: Type A)
(Varley).
1 **Filament potentiometer,** 30 ohms. (Claude Lyons: "Humdinger")
(Varley).
1 **Volume control potentiometer,** 0.5 megohm (R.I., Unigrad)
(Igranic, Claude Lyons, Rothermel).
1 **L.F. choke,** 25 henrys, 30 mA. (R.I., Type D.Y.25)
1 **L.F. choke,** 20 henrys, 100 mA. (Varley, D.P.12)
(Bayliss, Birmingham Sound Reproducers, Challis, Climax, Clarke's "Atlas," Chester, Ferranti, Heayberd, Parmeko, Regentone, Savage, Sound Sales, Tannoy, Trix).

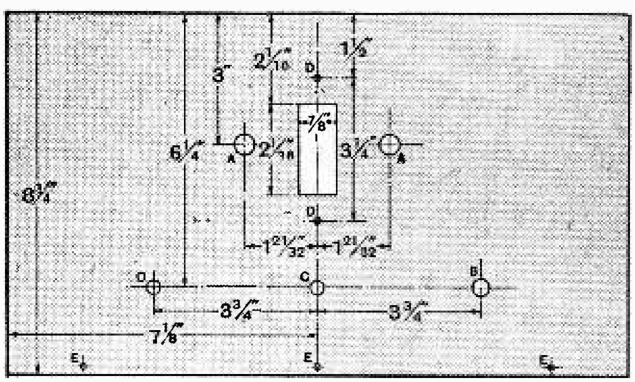


Fig. 3.—Details of the front panel, showing aperture for the "Simplicon" condenser escutcheon. Diameters of holes are: A, 7/16 in.; B, 3/8 in.; C, 5/16 in.; D, 5/32 in.; E, 1/8 in.

1 **Power transformer** (Varley, Type E.P.24)
(Bayliss, Birmingham Sound Reproducers, Chester Bros., Climax, Challis, Parmeko, Rich & Bundy, Savage, Sound Sales, Tannoy, Trix).
1 **Dial lamp bracket and 6-volt lamp** (Bulgin, Type D7)
2 **Fuses,** 500 milliamperes. (Microfuses, Ltd.)
(Belling-Lee, Bulgin).
2 **Ribbed coil formers,** 2¼ in. dia., 3 in. long (Becol)
(Redfern).
2 **lengths screened sleeving** (Goltone)
(Lewcos).

ACCESSORIES USED.

Valves: Cossor 41 M.H.L., Cossor 41 M.P., Mazda P.P.5/400, Cossor 460 B.U.
1 **Gramophone motor** (Garrard Type 202)

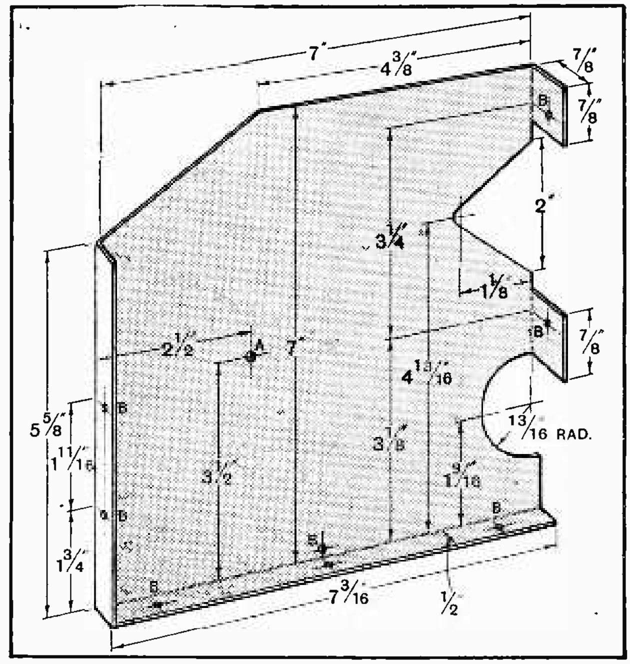


Fig. 4.—The single-plate screen, which is cut away to accommodate the tuning condenser spindle and wave-range switch. Drilling details: A, 5/32 in.; B, 1/8 in.

1 **Pick-up** (Marconiphone)
1 **Loud speaker,** moving coil, energised type, Model 143; 10¾ in., 2,500 ohm field (Magnavox)
1 **Cabinet** (Kabilok)

(To be concluded.)

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"THE WIRELESS WORLD" SINGLE DIAL SUPERHETERODYNE.

Output Transformer Ratios for Moving-coil Loud Speakers.

IN the article entitled "The Performance of the Single Dial Super" in the January 13th issue, it was stated that "the output ratio in the case of permanent-magnet loud speakers with exceedingly compact coil winding is usually of the order of 80 to 1." While this is essentially true of the majority of moving coils with small diameter windings on account of their low resistance, it does not necessarily follow that this ratio will be correct in all cases.

To take a typical example, the R. & A. type 100 moving coil has an unusually small moving coil in relation to the diameter of the diaphragm, yet its D.C. resistance is 8.5 ohms, which is more than double that of the majority of loud speakers with a coil of similar size. Consequently, the 32 to 1 transformer incorporated in the multi-ratio transformer supplied for use with this loud speaker will be approximately correct. The safest method is to ascertain the impedance of the moving coil before deciding upon the ratio of transformer to be employed. The Pen 220 requires a load of 17,500 ohms with 150 volts H.T. and 22,500 ohms with 120 volts. To calculate the transformer ratio required, divide this figure by the moving-coil impedance and take the square root.

Tracing Troubles

By
M. G. SCROGGIE,
B.Sc., A.M.I.E.E.

No. 3.—Further Tests for Battery-driven Receivers.

WE have commenced the examination of a typical battery-driven receiver by noting the current in the anode circuit of each valve, because this is the most useful and comprehensive general test for any fault which is not apparent. It usually locates, or at least gives some clue to, the trouble. Assuming, however, that the cause is still not clear, an attempt should be made to locate it by a process of elimination, and that will now be considered, dealing first with cases of interrupted or weakened reception.

The centre of a receiver circuit is the detector grid. Touch this point with the finger, either direct or through the intermediary of a piece of bare wire, and a more or less violent hum, squeal, or click indicates that any serious stoppage must be confined to the radio-frequency department. A much more satisfactory form of this test is to connect and use a gramophone pick-up. In doing so, note that unless a small negative bias is provided in the pick-up circuit to the grid the response may be seriously weakened by grid current, so this point should be taken care of. Failure to obtain a response at this point of the circuit may be followed up by transferring the test to the next L.F. valve, if any, or to the power valve, allowing, of course, for the large diminution in strength which one must expect when so much amplification is cut out. The reproduction will be rather faint with the pick-up connected direct to the power valve, even with a sensitive model. If transferring it to the input of the preceding valve does not result in a very considerable increase in strength, according to what one would expect from the design of the stage of amplification, some fault is indicated therein. Further location of an elusive fault must depend largely on the circuit arrangement. For example, an open-circuited coupling condenser in a resistance-coupled stage would prevent a powerful click from being obtained on breaking the preceding anode circuit, but would not prevent one caused by touching the following grid (or, more conclusively, connecting the grid to some point, such as positive L.T., known to be at a different potential). Each component or piece of wiring in the suspected region must be carefully examined. Examination of components anywhere and everywhere, without having previously narrowed the field, leads to great waste of time.

THIS, the third of a series dealing with simplified fault-finding, using impromptu testing equipment, discusses stage-by-stage tests leading to the location of troubles by a process of elimination. In the next instalment distortion and noises will be considered, together with some useful tests of individual components.

Overhauling the Aerial.

If the part of the chain from the detector grid onwards has been shown to contain no weak links, it is time to look at the forward, or H.F., end of the apparatus. First lean the head out of the window, or go for a walk in the garden, in order to make sure that the aerial has not been stolen. This is not so silly as it sounds; several sets have been returned to their manufacturer, at great expense, and an expert despatched to the spot, all through neglect of this simple precaution. While one is about it, a close examination, and if necessary overhaul, of the aerial may do much to restore satisfactory conditions. Especially look for bad joints, broken insulators, and leakage at the lead-in. Similarly follow the earth lead and clean connections throughout.

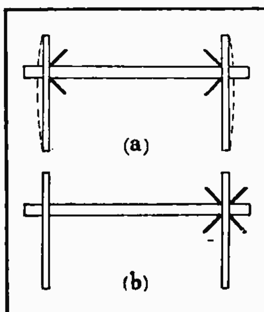
If there is no H.F. stage, presumably there will be detector reaction, and, as the detector valve has already been found to be in order, failure to oscillate is most likely to be due to a bad wave-change switch contact, or possibly to an open-circuited grid condenser. To test the latter connect in parallel with it a condenser which is known to be good. Restoration of results proves the fault. The condenser should also be tested for non-continuity, to check that it is not short-circuited.

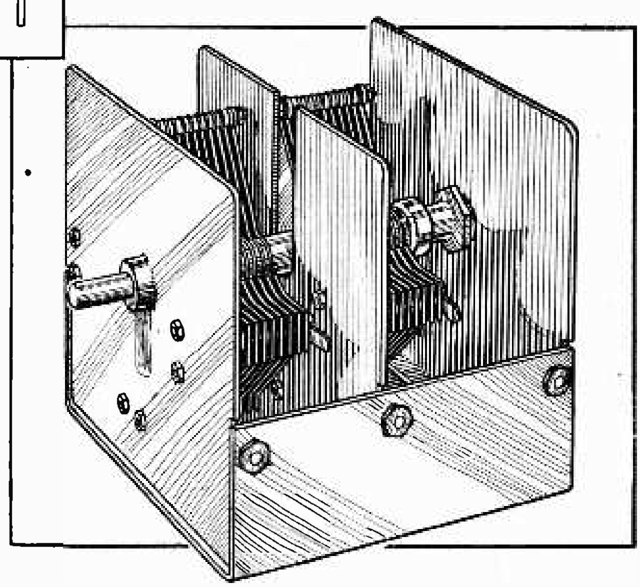
Tracing Troubles.—

It is difficult to go into detail, however, for much depends on the individual circuit and mechanical construction. The reader who has followed the outline of systematic procedure in connection with other parts of the receiver should have no difficulty in working out a systematic elimination of parts in order to locate the faulty one.

The possession of a wavemeter is not assumed for most of the tests here described, because they can be carried out with the assistance of broadcasting stations. Naturally a wavemeter is quite a considerable help for some purposes, particularly if there is not at least one station deserving the description "local," but it is by no means as indispensable as is sometimes suggested.

If oscillation is possible there is not much to go wrong in a receiver of this type, except that dirty wave-change switch contacts may spoil reception on one waveband only, which fact supplies the clue. An actual break somewhere in the aerial tuning circuit is an unlikely, but by no means impossible, eventuality. A modern receiver of this type will have band-pass aerial tuning, in which case loss both of range and selectivity will create a very strong presumption that the gang condenser has gone out of truth. For a band-pass tuner to justify the name extremely close matching is essential, and only very great mechanical excellence is capable of preserving this. Avoid condensers in which the longitudinal play of the spindle is taken up by pressure between the two end plates, but trust rather to those in which the adjustment is made at one end only, thus leaving the end plates free from any stress tending to push them apart and develop slackness of the rotor. Careful listening to results, or, much better still, observance of the strength of reception on a milliammeter in the detector anode circuit, will enable the nature of any unmatching to be judged. Broadening of the peak at one end of the scale only may be due to mistuning capable of being corrected by one of the semi-fixed trimmers. If the tuning condenser itself has suffered it is more likely that the peaks are affected at all wavelengths. The method of readjustment obviously depends on the make of condenser. Before concluding that the condenser has been treacherous, however, take a look at the coils to make sure that the formers have not shrunk or warped and that nothing has slipped.





Illustrating a method of housing a condenser spindle (a) in which longitudinal slackness is taken up between the end cheeks tending to force them apart and cause loss of adjustment. In (b) the adjustment depends on one cheek only, resulting in no stress between the cheeks. This type is particularly desirable in ganged condensers. The accompanying sketch illustrates an example where this system has been adopted.

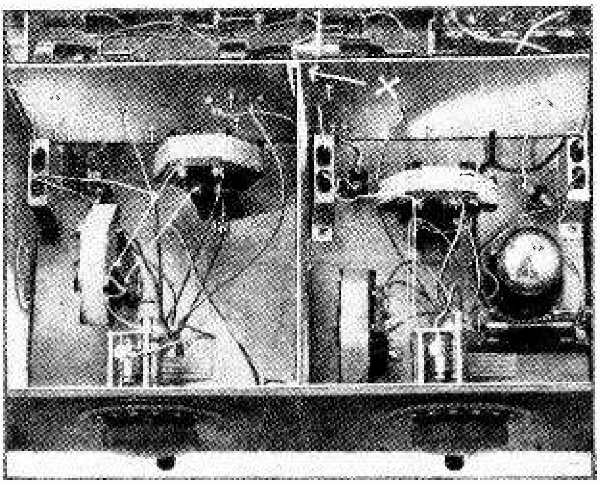
Assuming now a single H.F. stage; the general functioning of the valve has already been checked, but if tuning is very flat a possible cause is grid current, due either to deterioration of the valve itself or absence of proper negative grid bias. Failure of the valve or aerial circuit can be easily tested by transferring the aerial from its terminal to the anode terminal of the H.F. valve, leaving a plain aerial-to-detector system. The tuning of the anode circuit (now used as an aerial tuner) is spoilt as regards wavelength calibration, and perhaps oscillation, by the added capacity of the aerial, and, of course, the range and selectivity are much reduced, but it should be possible to judge whether the fault lies prior to the H.F. anode or not. Unless the aerial is a very small indoor one it is advisable to take it through a condenser of 0.0001 mfd. or thereabouts, in order to minimise its disturbing effects.

Testing Ganged Circuits.

Further investigation depends, in this case also, on circuit details, and it is hardly necessary to enumerate all the possible faults. Again, the method is to find part of the receiver which does work, and gradually add to it until the part is reached which does not function properly.

The matter of ganged tuning has already been dealt with, but if there are one or more tuned circuits which are not of the band-pass type, and if the coils and condensers are not closely screened, good use may be made of the tool described in the first instalment, which consists of an insulating rod with a metal ring at one end, about equal in diameter to that of the coils, and a disc or "spade" at the other. By bringing the ring towards a coil and in the same axis so as to couple to it, the inductance of the coil is reduced. If this *increases* strength of reception of a carefully tuned-in wave, it is clear that the circuit is tuned to too high a wavelength. On the other hand, if reception is increased by bringing the disc close to the vanes of the condenser connected to the high potential side (i.e., nearest to grid or anode) and at the same time touching it on to the other set

Tracing Troubles.—
of vanes, the circuit is tuned to too low a wavelength. This test should be made at several wavelengths and some idea gained as to the nature of the mistuning, as described in dealing with band-pass circuits.



The separate screening of complete stages which is now becoming obsolete. Should a bad contact develop at the point X the coils may become coupled by the screen, causing instability if there is amplification between the two coils.

Trimmer adjustment is effective mainly at the lower end of the tuning scale and does relatively little when the variable condenser is all in. Incorrect inductance causes mistuning all over the scale, while the symptoms of an unmatched variable condenser depend on the nature of the displacement of the condenser vanes.

If the aerial and anode (including tuned grid when parallel feed is adopted) tuning condensers are separately controlled, and there is reaction on the anode circuit, the most revealing test is to set it oscillating and try to pick up some carrier wave. Even fairly distant stations can usually be heard to some extent with an entirely inoperative aerial tuning circuit. Then swing the aerial tuning condenser. The result should be a well-defined increase in strength at a certain setting, accompanied by a sudden change of heterodyne note, which reverts to its original pitch as the condenser is rotated farther. If there is little effect the aerial tuning circuit and wave-change arrangements must be examined. Satisfactory response on the long waves, and flat or non-existent resonance on short, for example, points to imperfect contact between the parts of the switch that short out the long-wave coil, if that is the method adopted.

Much the same methods apply in the case of sets with more than one H.F. stage; moving the aerial along to one or other of the anodes localises the fault if it is of the nature of a stoppage somewhere. Wave-changing switchgear demands careful attention in the more elaborate circuits, the contacts being examined for correct opening and closing, and cleaned with fine emery paper.

Sometimes a H.F. amplifier which has been perfectly stable becomes unstable and oscillates uncontrollably when in tune. A usual cause is a bad contact in the screening system, which may actually couple the two tuning circuits instead of isolating them as is intended. That is one of the points in favour of separately screened coils instead of screening boxes or compartments, such as were commonly employed in the past.

The remaining principal ailments, distortion and noises, will be considered in the next instalment, together with some useful tests for individual components, such as those which have been extracted from a receiver on suspicion.

Nuts to Crack.

Instructive Problems and their Solution.

THE present series has been started by *The Wireless World* for the benefit of readers who like to work out little problems for themselves and be sure that the results they obtain are correct. At frequent intervals wireless problems are set, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Last week problems 9 to 12 were given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

Problem No. 9.—**Three resistances of 10 ohms, 5 ohms, and 4 ohms are placed (a) in series, (b) in parallel. What is their effective value in each case?**

Answer—19 *ohms;* 1.818 *ohms.*

For the series combination of three resistances, R_1, R_2, R_3, the equivalent or effective resistance is their sum, as is evident from the diagram in Fig. 1. Here the desired resistance is obviously 19 ohms.

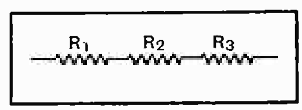


Fig. 1.—Series arrangement of resistances R_1, R_2 and R_3. The effective resistance is their sum.

If the resistances are arranged in parallel, as in Fig. 2, the value of the single resistance R which is equivalent to the combination may be found from the equation

$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3} \quad \ldots\ldots\ldots\ldots (1)$$

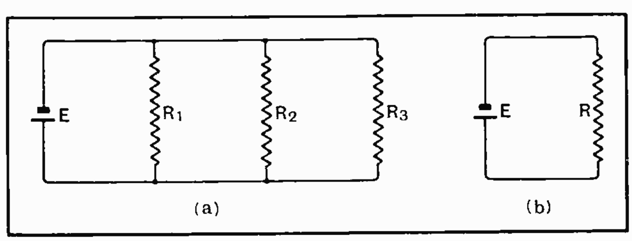


Fig. 2.—Parallel arrangement of resistances R_1, R_2 and R_3. The equivalent single resistance R may be found from the formula $\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$.

In our example,

$$\frac{1}{R}=\frac{1}{10}+\frac{1}{5}+\frac{1}{4}=\frac{11}{20} \quad \therefore \quad R=\frac{20}{11}=1.818 \text{ ohms (approx.)}$$

To show the truth of equation (1) is not difficult. If we place a source of e.m.f. E volts across the parallel combination, as shown, the same e.m.f. will, of course, operate across each member of it. By Ohm's Law, therefore, the currents taken by each resistance will be $\frac{E}{R_1}$, $\frac{E}{R_2}$ and $\frac{E}{R_3}$, and thus the total current taken will be $E\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}\right)$. But this current will be the same as that flowing through the equivalent resistance, R, if this were substituted for the parallel combination. We can therefore write,

$$\frac{E}{R}=E\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}\right)$$

and, on dividing both sides by E, we have

$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$$

the required relation.

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Problem No. 10.—**What resistance should be placed in shunt with a milliammeter of 5 ohms resistance in order that the total resistance of the combination may be 0.5 ohm?**

Answer—0.555 ohm.

If x ohms denote the value of the required resistance, by the usual formula for resistances in parallel,

$\frac{1}{x}+\frac{1}{5}=\frac{1}{0.5}$ that is $\frac{1}{x}+0.2=2.0$

therefore $\frac{1}{x}=1.8$ therefore $x=0.555$ ohms (approx.)

oooo

Problem No. 11.—**The milliammeter with its resistance shunt is connected in the H.T. circuit of a receiver. If the current as read on the milliammeter is 1.5 mA., what is the total H.T. current passing, and what is the voltage drop across the combination?**

Answer—15 milliamps. 0.0075 volt.

Since the milliammeter resistance is known to be 5 ohms, a current of 1.5 mA., or 0.0015 A., passing through it will produce a potential drop across its terminals of IR, i.e., of 0.0015×5, or 0.0075 volt, and this will be the P.D. across both the instrument and the shunt, since the two are in parallel.

Now we are given that the effective resistance of the meter and shunt is 0.5 ohm. Again applying Ohm's Law, the total H.T. current passing will be $\frac{E}{R}$, that is, $\frac{0.0075}{0.5}=0.015$ amp., or 15 milliamperes.

It is worth noticing that, for parallel combinations of resistances, the currents are inversely proportional to the resistances. In the present case we may write

$$\frac{\text{Total current}}{\text{Meter current}}=\frac{\text{Meter resistance}}{\text{Total resistance}}=\frac{5}{0.5}=\frac{10}{1}$$

Thus,

Total current $=10\times$ meter current.
$=10\times 1.5=15$ mA., as before.

oooo

Problem No. 12.—**If the maximum scale reading of the milliammeter is 2 mA., what is the greatest H.T. current it is possible to measure with this arrangement? Could the instrument be used to measure still greater currents?**

Answer—20 milliamps.

As we have seen, with the shunt of 0.555 ohms,

Total current $=10\times$ meter current
$\therefore$ Maximum total current $=10\times$ maximum meter current
$=10\times 2$ mA.,
$=20$ mA.

Still higher currents may be measured by reducing the value of the shunting resistance. This may be conveniently done by adding still other resistances in parallel to the already existing shunt, since the resultant value of a number of parallel resistances is always less than the value of any one of them.

NEXT SET OF PROBLEMS.

Problem No. 13.—**A five-valve receiver using a 2-volt filament supply (accumulator) takes 1.2 amperes of filament current. What is the total power expended in lighting the filaments? If a 40-ohm potentiometer were placed across the accumulator terminals, what would be the increase in the L.T. power consumed?**

Problem No. 14.—**What is the effective or R.M.S. value of an oscillating grid voltage whose peak values are 7 and 22 volts negative, and what is the grid bias?**

Problem No. 15.—**An L.F. alternating current of amplitude 10 milliamperes and frequency 750 cycles passes through a resistance of 50,000 ohms. What amount of power is expended in the resistance? What power would be expended if the frequency were increased to 1,000 cycles?**

NUTCRACKER.

POWER TRANSFORMER ADJUSTMENT.

IT sometimes happens that none of the primary tappings on a power transformer correspond exactly with the rated voltage of the mains supply available to the user. In such cases there is a natural uncertainty as to which terminal connection should be made.

Taking the practical case of a transformer with provision for inputs of 200, 220, 230, and 240 volts, and a supply of 210 volts, it will be seen that the 200- and 220-volt tappings differ by a similar amount from the supply voltage. It should be remembered that, if connection be made to the 200-volt terminal, it is to be expected that all the secondary voltage outputs will be slightly high, and so, to be on the safe side, it is usual to employ the 220-volt terminal. This decision will certainly be right if it is known that the mains voltage is generally rather over than under its rated value. If, however, it is found that the anode current of all the valves seems to be low (anode current measurements are the only pertinent ones in such cases that are practicable for the amateur with ordinary apparatus), a change to the 200-volt terminal would be indicated.

In any case, the matter is not one of any great importance, particularly when one is dealing with well-designed transformers, as the discrepancy in output voltage, when expressed as a percentage difference from the rated value, will not be high enough to be serious in a case like that cited as an example.

Mutual Conductance:

3·75 m.a./v.

ensures maximum efficiency in Screened Grid Stages

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THE Cossor M.S.G/L.A. A.C. Mains Screened Grid Valve has a mutual conductance ("efficiency factor") of 3.75 m a/v. under working conditions, and should therefore be used to obtain the utmost amplification from a screened grid stage. It possesses the abnormally low grid-anode capacity (of the order of .001 m.m.f.) which is an outstanding feature of all Cossor Screened Grid Valves.

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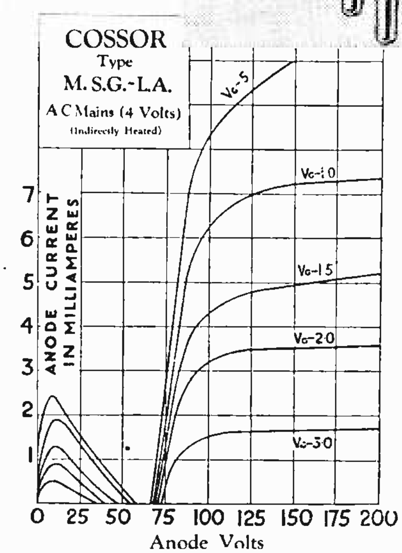

Cossor M.S.G/L.A (Indirectly Heated Cathode) Impedance 200,000; Amplification Factor 750; Mutual Conductance 3.75 m.a./v.; Normal Working Anode Volts 150; Screen Grid Volts 80. Max. Anode Volts 200. Price with Plain or Metallised Bulb.

22/6

THE

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320

CURRENT TOPICS

Events of the Week in Brief Review.

Ten 60 kW Stations ?

FROM being the most backward among European nations in regard to broadcasting, France now promises to be one of the most aggressive. The regional plan, recently issued by the military veteran, General Ferrié, provides for the establishment of no fewer than ten stations, each of 60 kW, to cover the entire country (and, incidentally, it seems to us, several other countries as well!)

We learn that the recent change of Government has merely delayed, but not overthrown, the Ferrié project, which is warmly approved by M. Guernier, the Minister of Posts and Telegraphs.

No decision is likely to be taken until after the April elections, but thereafter listeners with unselective receivers must prepare themselves for shocks.

oooo

4,329,754.

POST Office figures issued last week revealed that there were 4,329,754 receiving licences in force on December 31st, this total including 28,000 free licences for the blind. The year's increase was 909,304—an easy record, the previous best having been 544,623 in 1929.

oooo

Cheapest Radio Transmitter.

AND now comes a challenge from Warren, Ohio, where Stanley Beach, W8APM, has succeeded in establishing two-way contacts with 43 countries in the six continents of the world, using a transmitter which cost him 25 dollars. The valves are two ordinary receiving specimens.

Can anyone beat this?

oooo

"Buying British" in Budapest.

SINCE the War the English language has become "very fashionable" in Central Europe, according to a Roumanian correspondent, who records the general lament that the British stations are not more easily audible on the Continent owing to their unhappy positions on the broadcast waveband. In Budapest (he writes) it is very easy to catch such stations at Stockholm, Brussels, Oslo,—not so the British. For instance, London Regional is suppressed by Mühlacker and Graz; Daventry (5GB) by Sottens and Bucharest; North Regional by Prague, and London National by Moravska Ostrava. On the long wave Daventry National is blotted out by Moscow and Warsaw.

In registering the complaint he adds: "Listening to British stations would result in improving our knowledge of the English language. Then we should buy more English papers, read more English advertisements, and become potential buyers of British goods!"

"Old Woman," and Proud Of It.

HAWAII'S first "old woman" is Mrs. Otis Hill, the wife of a local amateur, who has received her personal station licence from the Federal Radio Commission with the call sign K6OW. The term "OW," states the American Radio Relay League, corresponds to the highly approbatory "OM," and is used to designate married women operators.

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Death Knell of Sponsored Programmes ?

THE suggestion of a forthcoming revolution in American broadcasting methods is made by Dr. Lee de Forest in "Broadcasting," the professional organ of the American broadcasting interests, which is published in Washington. Dr. de Forest asserts that 1932 may see some constructive and possibly radical step toward the betterment of American broadcasting resulting from the earnest and ever-increasing protests which its "defiled commercialism" has at last brought down upon it.

"The sad state of the radio industry to-day," Dr. de Forest says, "is more due to the miserable quality of radio programmes than to any other cause. The public simply isn't listening in—not to a degree remotely approaching that of four years ago. More receiving sets, yes—but usually unused. We have learned that the switch-off is the most valuable part of a radio set."

On the other hand, Mr. M. H. Aylesworth, president of the National Broadcasting Company, declares that, despite occasional statements to the contrary, more people are listening each day than ever before. Programme attraction is now stronger than the novelty appeal of a few years ago.

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Public Gramophone Recital in Newcastle.

AN interesting attempt will be made this evening (Wednesday) by the Newcastle-upon-Tyne Radio Society to show the general public what can really be achieved in modern electrical sound production. The City Hall has been engaged for an electrical gramophone recital, and if the event is successful further concerts may be arranged.

Three special amplifiers with a total undistorted output of 45 watts have been constructed by the Society's technical section, and for heavy orchestral pieces, use will be made of five loud speakers, four on 4ft. baffles and one on a baffle of 7ft. 3in.

Tickets at 6d. each are available from all gramophone dealers in the city. The concert begins at 7.45 p.m.

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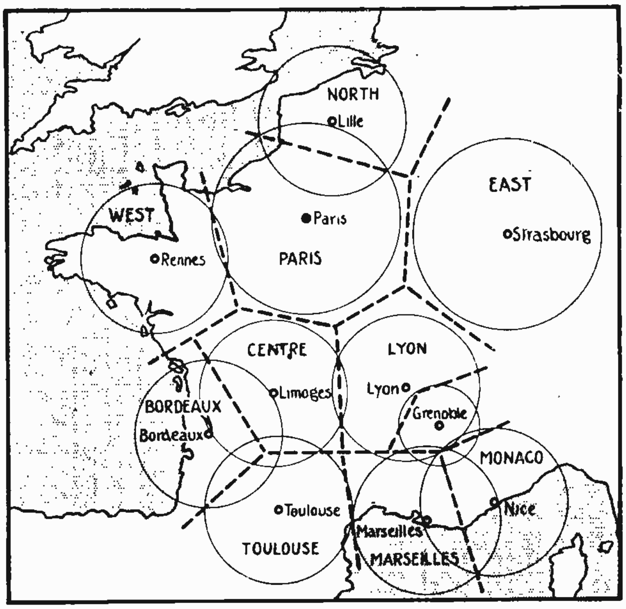
Hospital Wireless Appeal.

THE Southend-on-Sea Radio Society issues an appeal to all amateurs who have stocks of unwanted accessories and spare parts to send them to the Spare Part Stall which the Society is running at the Technical Schools, Southend, on January 30th. The proceeds will be devoted to the New General Hospital (Southend) Wireless Equipment Fund. Gifts will be gratefully received by the custodian of the stall, Mr. Walter B. Fitch, 153, Leighton Avenue, Leigh-on-Sea.



PROJECTED REGIONAL SCHEME. This is the famous Ferrié map showing the stations and service areas according to the latest French broadcasting plans. With the exception of Grenoble (20 kW.) each of the projected stations would have a power of 60 kW.

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"The Wireless World" Index and Binding Cases.

THE index for Volume XXIX, July to December, 1931, is now ready, and may be obtained from the publishers, price 4d. post free, or with binding case 3s. 1d. post free.

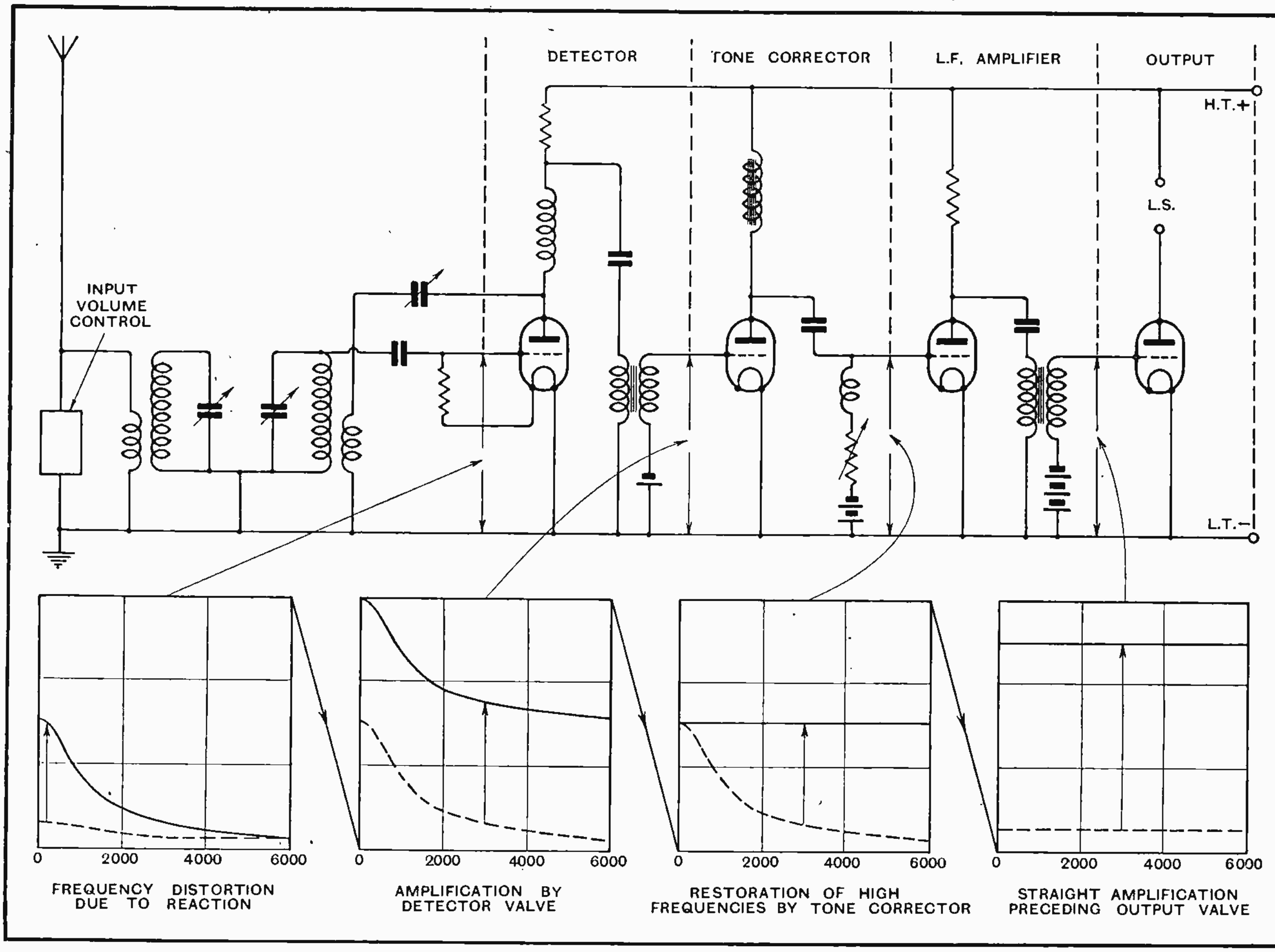
"The Receiver of the Future."

Preliminary Notes on a Design Combining Tone Correction and High Selectivity.

THERE can be little doubt that the most urgent problem confronting the designer of receiving sets at the present day is the attainment of a sufficiently high degree of selectivity without impairing quality of reproduction. So far, the band-pass filter has provided the most successful solution, but the principle of tone correction, in conjunction with critically selective reaction circuits, shows promise of providing at least equally effective results with the added advantages of simplicity and some measure of control over quality.

The theoretical aspects of tone correction in relation to selective circuits have been admirably explained by Mr. F. M. Colebrook,[1] and, as announced last week, work has now been in progress in *The Wireless World* Laboratory for some time on the practical application of these principles to receiver design.

The first set to be described will be a straightforward detector-L.F. arrangement. Adopted primarily for its simplicity in order the better to isolate the effects due to the tone corrector, this circuit has proved so sensitive in operation that it was decided to make it the subject of a complete design. The range is, in fact, quite equal to that of the average screen-grid H.F.-detector-pentode receiver, while the selectivity is decidedly better. An early experimental model gave thirty-seven stations on the medium waveband at a single sitting, while nine stations were received between London National and London Regional on a 50ft. outdoor aerial only five miles from Brookmans Park.



Schematic diagram of a selective detector-L.F. receiver showing the modification of the frequency characteristic stage by stage.

[1] *The Wireless World*, Sept. 2nd, 1931, page 228.

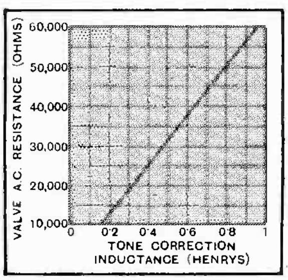
"The Receiver of the Future."—

The clue to such a remarkable performance without the use of an H.F. stage is, of course, the employment of critical reaction. To make the set safe in the hands of the average user, therefore, considerable attention has been given to the task of making reaction not only smooth and free from backlash, but also constant over the greater part of the tuning scale. Careful attention to the design of the tuning coils has made this possible, and in the final design it is possible to leave the reaction control set just below the oscillation point and to explore the waveband without any fear of causing interference to neighbours.

THE GREATEST interest was shown in the announcement in last week's issue of a receiver embodying a new method of obtaining high selectivity without sacrifice of quality. A general résumé of the factors underlying the design are given in this article. Full constructional details will appear at an early date.

It will be seen from the schematic circuit diagram that four valves are employed. At first sight this may seem an unnecessarily large number, but there is ample technical justification for four stages. Actually, there will be little difference on the score of cost from a three-valve set employing screen-grid and pentode valves, since four ordinary valves cost less than the combined price of the screen-grid and pentode valves alone.

We are forced to employ three L.F. stages, i.e., two ordinary amplifying stages, in addition to the tone corrector, owing to the rather special conditions prevailing in the detector. The high voltage magnification of the grid coil with reaction produces a very sharp and high resonance peak which will be cut off or at least curtailed if the H.F. input to the detector exceeds 0.6 or at the most 1.0 volt R.M.S. Therefore, it is necessary to include a pre-detector volume control to keep the input within this limit. Also, the effect of the high selectivity of the grid coil will be considerably to reduce the apparent modulation at all but the lowest frequencies. Thus, the average L.F. output from the detector will be lower than that given by a less selective receiver or a selective receiver employing a band-pass filter, and the subsequent L.F. amplification must be increased.



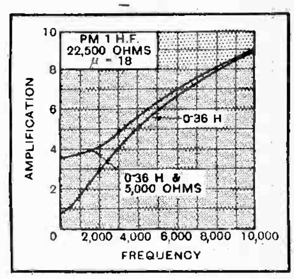
Curve showing the relation between the tone correction inductance and the valve A.C. resistance in the corrector stage.

The Tone-correction Stage.

While it is theoretically possible to obtain the requisite degree of selectivity with a single tuned circuit, in practice it is better to employ a coupled input circuit with optimum or slightly sub-optimum coupling. With this arrangement the degree of reaction required does not make impossible demands on the skill of the operator, while the stability of the circuit from the point of tuning is greatly improved.

In order to visualise the process of tone correction the history of the L.F. component of the received signal is indicated stage by stage in the circuit diagram. At the grid of the detector the modulation percentage of the low frequencies is increased relative to the high by reaction and the high selectivity of the tuned grid circuit. The detector, by virtue of its function as an L.F. amplifier and the practically straight-line amplification of the following transformer, increases the level of the L.F. output at the grid of the second valve without materially altering its form. The characteristic of the tone correction stage, on the other hand, passes on the lower frequencies in the vicinity of 50 cycles without appreciable amplification, but lifts the remainder of the curve to the horizontal. Finally, the level of the corrected L.F. response is raised by the third valve before passing to the grid of the output valve.

The design of the tone corrector stage is quite simple. Any standard L.F. choke can be used in the anode circuit; the only factor involved is that its inductance must be high compared with the tone control inductance in the grid circuit. As this will never exceed 1 henry, the average 20- or 30-henry choke will have ample inductance. The value of the tone control inductance should be so chosen that its impedance at 10,000 cycles is equal to that of the valve. In general, the inductance alone will give more correction than is required, and, since the degree of reaction may not always be the same, it is desirable to have some measure of control in the tone correction circuit to meet all conditions. This takes the form of a variable resistance in series with the choke, and has the effect of slightly increasing the amplification of the bass without appreciably affecting the amplification of the higher frequencies. If it is known that serious loss of high frequencies is taking place in the receiver, other than that due to the sharpness of tuning, it may be desirable to make the correction curve rise more steeply towards its upper extremity. This can be accomplished by connecting a fixed condenser across the choke of such a capacity that the circuit will resonate at about 15,000 cycles.



The effect of the resistance in series with the tone correction choke is to increase the output in the bass.

In the design of the receiver under discussion, however, every precaution has been taken to conserve the amplification of the upper register, and the tuned corrector arrangement is unnecessary.

The receiver in its final form is now undergoing final tests, and as soon as these are completed full constructional details and operating notes will appear in these pages.

Varley "Square Peak" Four

Long-range Four-valve A.C. Receiver with Self-contained Loud Speaker.

UNLIKE its prototype of a few years ago, the modern four-valve receiver is essentially a long-range set, for it is now customary to employ two stages as high-frequency amplifiers, since, owing to the greater efficiency of modern valves, one L.F. stage affords sufficient amplification to operate the average type of loud speaker at full volume. But the high sensitivity of this arrangement will be a doubtful attribute unless the selectivity of the set is adequate to cope with present-day conditions.

In the case of the Varley Square Peak four-valve A.C. mains receiver, the two H.F. stages are preceded by a band-pass filter, thus providing four tuned circuits, and the overall selectivity is, of course, exceptionally good. A few years ago a receiver with more than two tuned circuits was regarded with certain misgivings in view of the number of controls it introduced, but since the development of ganged condensers this objection no longer holds water, as to-day four or more tuned circuits are as tractable as one.

The tuning condensers in the set under discussion are arranged in pairs on either side of a large-diameter thumb-controlled drum dial, and each condenser is fully screened. Varley Square Peak coils are used throughout, the input filter coils being coupled by a combination of negative inductance and capacity, while the H.F. stages are transformer coupled.

From the detector stage onward the circuit is quite straightforward, consisting of a parallel-fed L.F. transformer working into a super-power three-electrode output valve capable, when fully loaded, of delivering some 2,500 milliwatts of undistorted power to the moving-coil loud speaker. One point of interest regarding the output circuit is that the field coil of the loud speaker is utilised as the smoothing choke in the H.T. supply circuit. The latter is derived from a full-wave rectifying valve.

The loud speaker is mounted on the underside of the top of the cabinet, the lid of which is hinged and when open switches on the mains supply. Apart from the novelty of the arrangement, it obviates the need for a separate control on the front. These have been reduced to the bare minimum compatible with satisfactory control of the set. There are four in all: the main tuning drum, which is of the edgewise-control pattern; a radio-to-gramophone switch incorporating also the reaction control; a wave-change switch, and the volume control.

Reaction Control.

Regeneration is obtained in a very simple manner, and consists of feeding back H.F. energy from the anode of the detector valve, *via* a small variable condenser, to the anode of the first H.F. stage. This system is applicable only where two H.F. stages are employed, and was used extensively some years ago in portable sets fitted with two H.F. stages and aperiodic coupling units. On the whole it is satisfactory, more especially in the present case, where reaction is used to a limited extent only, and it certainly simplifies the construction, since there is no need for a reaction winding on the second H.F. transformer.

The waveband switching follows accepted practice, consisting merely of short-circuiting the long-wave loading coils in the primary and secondary circuits of the H.F. transformers and also in the band-pass coils. The volume control is of the pre-detector type, as it should be in a set with two H.F. stages, to preclude overloading of the detector. It consists of a differential condenser in the aerial circuit and linked with it, and operated by the same knob, is a potentiometer, which serves as the volume control when reproducing gramophone matter.

It was noticed during the tests that, while this arrangement is perfectly satisfactory in dealing with medium

FEATURES.

GENERAL: Four-valve A.C. mains-operated receiver with built-in moving-coil loud speaker. Undistorted output 2,500 milliwatts. Station calibration.

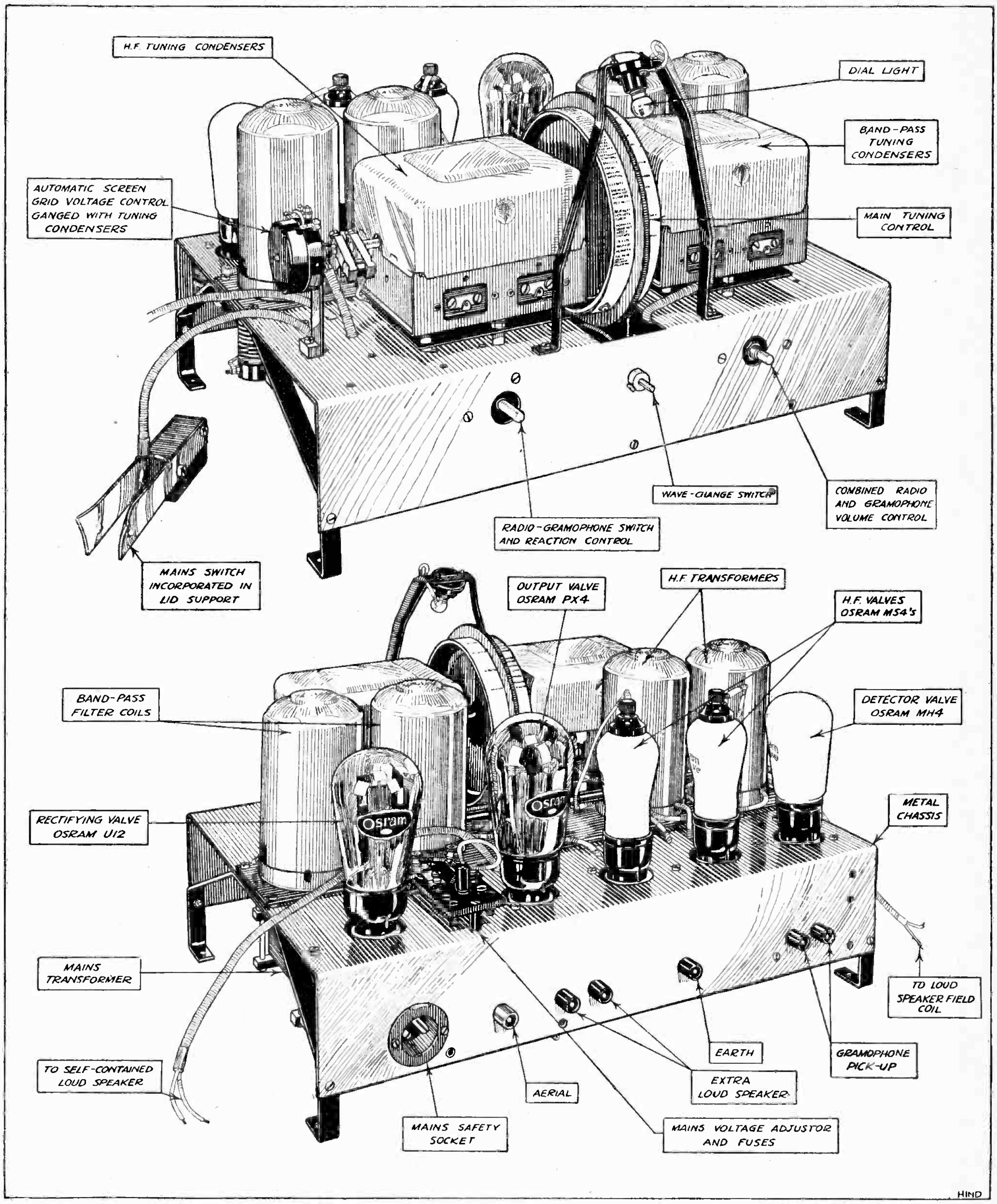
CIRCUIT: Band-pass input, two H.F. stages transformer coupled. Power-grid detection with parallel-fed transformer coupled to directly heated output valve. Provision for gramophone reproduction and extra loud speaker.

CONTROLS: Single tuning control, combined radio-gramophone and reaction control, wave-band switching and volume control.

PRICE: 29 guineas.

MAKERS: Varley, Oliver Pell Control Ltd., Kingsway House, 103, Kingsway, London, W.C.2.

COMPACT DESIGN ON METAL CHASSIS.



Mains equipment and decoupling are accommodated under the metal frame.

Varley "Square Peak" Four.—

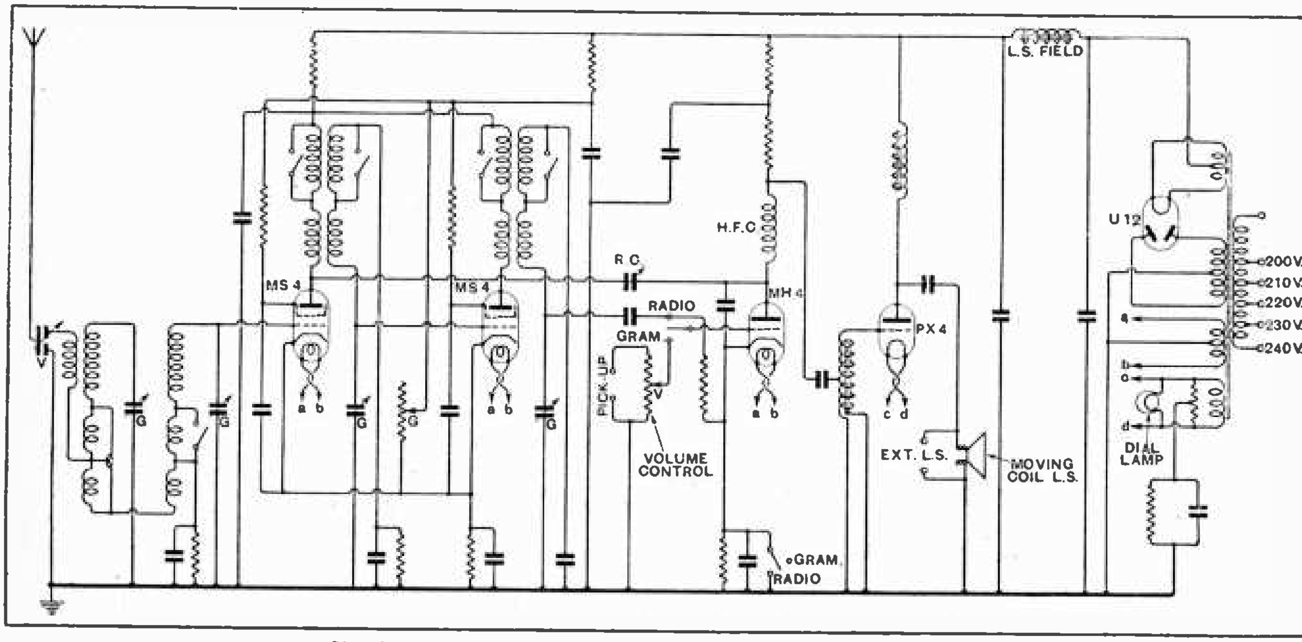
and even strong transmissions, if the received signals are overpoweringly strong, such as we experienced from Brookmans Park at a distance of twelve miles, the volume was still considerable with the control at minimum. A small condenser connected in series with the aerial lead effected an improvement, since it reduced the input to the set, but it was then found necessary to make use of the reaction control more often than hitherto when searching for some of the more distant foreign stations.

Constant Sensitivity.

However, even with quite a short aerial the sensitivity is adequate for most purposes, and all the worth-while foreign stations could be tuned in without difficulty and at good volume. A feature of some considerable interest is that the effective sensitivity of the set is well maintained over the whole tuning range and without the aid of reaction. This is achieved by mechanically coupling a variable resistance to the condensers' shaft, its function being to raise the screen potential of the H.F. valves as the upper portions of each range are explored. It is quite an ingenious arrangement, and obviates constant adjustment of the reaction, since the set can be maintained in its most sensitive state over quite a wide range without touching this control.

Owing to constant nature of the sensitivity the set is exceptionally easy to operate, and distant stations can be received with the greatest ease. The scale, which, incidentally, is illuminated, is marked with the names of seventy-five stations, fifty-eight of these being on the medium-wave band and seventeen on the long-wave band. The accommodation of so many stations is made possible by the size of the drum, the diameter of which is no less than 5¾in. British stations are identified by red lettering, while the foreign stations are marked in black.

The scale is substantially accurate and materially facilitates the identification of, and the searching for, home and foreign stations. During a single evening some thirty-five alternative programmes were tuned in on the medium-wave band, of these seven were received between the London National and the London Regional wavelengths, while the long-wave band accounted for eleven more. The selectivity is adequate for all practical purposes, the local transmissions do not spread unduly, and five programmes were tuned in below London National's wavelength. This represents an entirely satisfactory standard of performance.



Circuit details of the Varley "Square Peak" Four A.C. receiver.

Regeneration is adequate on both wavebands, but just as the set commences to oscillate on the long waves there is tendency to provoke slight motor-boating. This ceases as soon as more reaction is applied, when carrier waves are received with the same facility as on the lower range.

The position of the loud speaker does not give rise to any unnatural effect, which is due to the hinged lid acting as a deflector for the sound waves. Reproduction is good, with the bass well in evidence without overshadowing the upper register, the rendering of which is good. The same standard is maintained when reproducing gramophone records, and, although there are only two stages of amplification available, the volume is more than sufficient to fill a large room, and with the majority of gramophone pick-ups the volume control will have to be used.

On the whole, the Varley Square Peak Four is a delightful set to handle, its sensitivity and good selectivity being the two essential attributes for long-range reception, and the quality of reproduction is fully in keeping with the high standard attained by all the products of this well-known make.

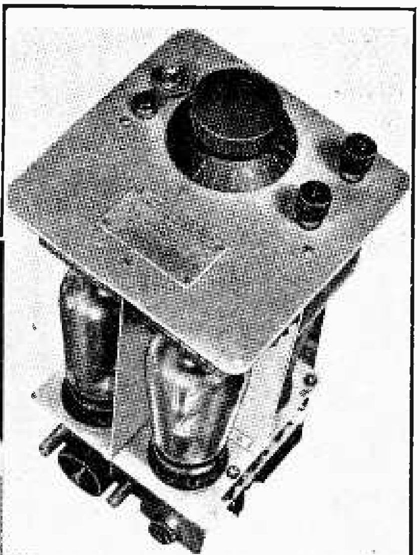
A NEW RECEIVER FOR LIGHT AEROPLANES.

A Four-valve Set with Two Screen-grid Stages Measuring 9¼ in. × 4¼ in. × 4¼ in.

READERS are already aware[1] that a special weather forecasting service for owners of light aeroplanes is being operated by the Aviation Division of the Automobile Association at Heston Aerodrome. The transmitter delivers 300 watts to the aerial, and operates on a wavelength of 833. Although the nominal range of the station is 100 miles, reports of ground reception at R9 strength have been received as far north as Newcastle.

Standard Telephones and Cables, Ltd., who were responsible for the installation of the station at Heston have now produced a special set for the reception of these transmissions. It is a remarkable example of what can be achieved in the matter of keeping down the dimensions and weight of a receiver; the dimensions are only 9¼in. × 4¼in. × 4¼in., and the weight 4 lb. 10 oz. There are four stages, and standard broadcast receiving valves are employed, as it is essential that the pilot should be in a position to obtain spares in any part of the country.

Two screen-grid H.F. stages (the first tuned and the second aperiodic) are followed by a detector and one L.F. stage. The four valves are mounted vertically in the angles of a + section screening element. Above the valves are the screened tuning coils and H.F. chokes, and below the intervalve and output transformers. The set has a tuning range of 600 to 1,000 metres, and there are only two controls—a single tuning knob and the on-off switch with which, incidentally, is incorporated a pilot light. A multiple cable connects the receiver with the battery box and also with a loud speaker unit connected with the pilot's standard voice pipe equipment.



(Above) The receiver unit removed from its metal screening case. Note the simplicity of the controls.

(Left) Interior of the pilot's cockpit in a Moth aeroplane showing the mounting of the receiver unit.

An aerial of the "fixed" type extends between the wing tips and the tail of the plane, and the whole system has been approved by the Air Ministry.

We were recently afforded an opportunity of testing the receiver under working conditions during a test flight in a Moth machine from Heston. At a distance of ten miles, although tuning was flat and there was a certain amount of overloading owing to the comparative proximity to the transmitter, the articulation and general intelligibility were excellent. Outside a range of twenty miles, however, the tuning became normal. There was no background noise from the ignition system of the engine, which was effectively screened by braided wire and special plug shields designed by Standard Telephones and Cables, Ltd.

There is little doubt that the weather service inaugurated at Heston will prove invaluable, not only to the owner-pilot, but also to motorists when on long journeys. Reports of weather conditions ahead would often help in deciding between alternative routes or stopping places for the night.

[1] *The Wireless World*, November 11th, 1931, p. 554.

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Providing a Reserve.

AMATEUR designers seem often to be in doubt as to the desirability of fitting a reaction control to their receivers, and on several occasions lately our advice has been asked on this subject.

Deservedly enough, reaction has a bad name for bringing about poor-quality reproduction, apart from interference with other wireless users. But it is often overlooked that it is the misuse, and not the use, of reaction that is responsible for these troubles; provided that the reaction control is handled intelligently, its presence can hardly do any harm, and, of course, it need only be used on those occasions where extra sensitivity is needed. Apart from the question of sensitivity, it is often useful to have some ready means of offsetting to a great extent the necessarily heavy damping that is imposed upon a tuned circuit by the modern form of grid detector.

Consequently, one is always inclined to advise the fitting of reaction control, except, perhaps, to sets with two or more H.F. stages.

WIRELESS ENCYCLOPEDIA

No. 11

Brief Definitions with Expanded Explanations.

ETHER. ***The medium which completely fills all space and permeates all matter, and by the agency of which radio waves, light, heat, etc., are conveyed through space.***

IT was Sir Oliver Lodge who once said that a deep-sea fish probably has no means of apprehending the existence of water because of its uniformity in every direction, and that our own condition in regard to the ether is very similar. We have no sense which enables us to appreciate directly that the whole of space is filled with a continuous medium; but our knowledge of the things that go on in space prove that this must be so. For instance, we know that light comes through space from the sun to the earth, and it has been proved quite conclusively that light consists of vibrations passing through space in the form of waves in a similar manner to that in which sound waves pass through air. Consequently, in space there must be something which obeys the laws of vibration and wave motion in some way, and it is this mysterious medium which is called the ether.

Although the ether is something quite apart from matter, with none of the physical properties of matter, it has some very definite properties of its own which can be likened to those possessed by a material medium such as air. It has something which is equivalent to density (mass per unit volume) and something which is equivalent to elasticity (degree of incompressibility), for waves can be transmitted through it, and these are the two physical properties which a material medium must possess to enable waves or vibrations to exist in it. The velocity at which the waves travel through the medium is determined alone by the ratio of elasticity to density and is quite independent of the frequency or number of vibrations per second. In air, at a given temperature and pressure, all sound waves travel at the same speed, no matter what the frequency or pitch. Under normal conditions the velocity of sound is about 1,100 feet per second.

The Velocity of Ether Waves.

In a similar way all ether waves travel at the same speed, which is generally referred to as "the velocity of light," being 3×10^{10} centimetres per second, or about 186,000 miles per second. (This is nearly a million times faster than sound waves travel in air. A radio wave travels completely round the earth, say at the equator, in about one seventh part of a second!)

From this known speed the equivalent ratio of elasticity to density can be calculated for ether, but as ether is not matter, the usual mechanical meanings cannot be ascribed to the terms elasticity and density; they can, however, be given meanings in terms of electromagnetism: When a condenser is charged, an electric field is set up between the plates, and energy is stored there—the ether is put into a sort of strain and tries to recover, in much the same way as a compressed spring does, and *it is this electric property of the ether that corresponds to the elasticity of matter.*

Suppose, now, that an inductive coil is connected across the charged condenser. The latter will immediately begin to discharge through the coil, setting up a current of electricity therein. By the time the condenser is fully discharged the current will have reached its maximum value, and, assuming no energy loss due to resistance, etc., the whole of the energy will have been transferred to the magnetic field associated with the current. Now the magnetic properties of the coil represent its inductance, which may be defined as that property which tends to prevent any change in the current, by virtue of the electromotive force induced in the coil when the current in changing. For these reasons inductance has very often been referred to as "electrical inertia." The magnetic field has the property of opposing any change in the value of the current; it has a sort of inertia effect. *And so the magnetic properties of the ether represent its apparent inertia or its density.* Magnetism always arises when a current flows, that is, when electrons are moving, and is therefore akin to inertia.

When a mechanical body, such as the diaphragm of a loud speaker, is vibrated at an acoustic frequency in air, sound waves are produced and travel outwards in all directions from the point of disturbance. Ether waves are produced in a similar way by the vibration of *electrons*: The high-frequency currents in a transmitting aerial really consist of enormous numbers of electrons passing up and down the aerial perhaps millions of times per second. This rapid to and fro motion of the electrons sets up electro-magnetic disturbances in the ether in the immediate vicinity of the aerial, and these disturbances are radiated outwards as ordinary wireless waves, with the velocity of light.

The fundamental idea regarding the ether is that its properties are electrical. According to the electron theory all matter consists of electric charges, positive and negative, combined in special ways, and the present trend of belief is that an electric charge itself may consist of ether in a special state. If this theory is true, then the whole of the universe must consist of nothing but ether, matter itself being ether in a special form.

One thing of definite and fundamental importance is that all etheric waves or radiations are of exactly the same nature. All of them are electromagnetic waves, their nature depending only on the frequency range within which they fall. For instance, ordinary light consists of electromagnetic waves of exactly the same nature as radio waves.

By Our Special Correspondent.

Henry Hall's Agreement.

A FUNDAMENTAL difference exists between Henry Hall's agreement with the B.B.C. and that of Jack Payne. Whereas the latter, in return for a certain regular sum from the Corporation, has engaged and paid his own performers, the newcomer will act solely as Director of the B.B.C. Dance Orchestra, the members of which will be on the same footing as other members of the B.B.C. staff.

What the B.B.C. Will Pay.

If anyone doubts whether dance-band conducting can be really lucrative, let him note that Henry Hall's salary will be £2,000 per annum, with an additional guaranteed minimum of £500 in royalties from gramophone records. Furthermore, Mr. Hall is being paid his full salary while collecting players for the new band. The initial agreement is for a period of twelve months.

I understand that the band salaries will amount to approximately £250 per week.

Fresh Talent.

I hear that only two players from Henry Hall's railway hotel bands are transferring to the B.B.C. In nearly every case the members of this orchestra will be fresh to the microphone.

We shall learn very shortly whether or not this is an advantage.

"Hot" Numbers.

It is likely that, despite his avowal not to introduce "hot" dance numbers, Henry Hall will be obliged sooner or later to yield to the undoubted public demand for this particular form of music.

Why there should be such a demand is another question, but I am inclined to believe that the answer lies in the fact that in these hard times many folk want to hit somebody or something. And if they can't make a noise themselves, they like to hear someone else doing so.

Buying a Wireless Licence.

THE purchase of a wireless licence need not be such a serious business, nor one to be shirked, as many listeners appear to think it is: and on February 2nd and 4th, Mabel Constanduros and Michael Hogan, in a new Buggins sketch, will deal with a novel side of licence-buying. In the same programme are Russell Johns, cabaret singer; Abie and Sandy, in cross-talk; and Johnson Clark, ventriloquist.

Regular Midday Programmes.

MONDAY, March 7th, should be a red-letter day in the annals of those who have the time and opportunity to listen to broadcasting when the sun is at its height. For on that date, I understand, the B.B.C. will with one sweep give the only satisfactory answer to the public claim for continuous programmes from noon onwards.

Welcome on Saturdays.

It will thenceforth be the rule at all stations to provide some sort of continuous programme—usually of light music—between 12 noon and 2.30 p.m., thus abolishing those unexplained spells of silence which lead to crossword puzzles and other evils.

The change will be appreciated most on Saturdays.

A Trip to America?

NO special significance need be attached to the rumour that two prominent members of the B.B.C. staff will shortly leave for America.

It is likely, indeed, that Mr. Noel Ashbridge may shortly cross the Atlantic, perhaps in the company of a colleague, but the trip will be more in the nature of a well-earned holiday than a vital inquisition into Yankee broadcasting methods.

Hot Air at Broadcasting House.

CHEMISTS in the Portland Place district are reporting record sales of aspirin tablets, and are hoping that their cash registers will ring still more often when the whole of the B.B.C. staff is transferred to Broadcasting House. I fear they will be disappointed.

An Explanation.

The epidemic of headaches in the new building is simply due, I am told, to the drying-out process for which the steam-heating installation is being used for the next few weeks. Blasts of hot air meet one at every turn, as I discovered some three weeks ago when paying a brief visit to a department already in residence. I left feeling that in my case the drying-out process had been thoroughly successful.

New Studios at Leeds.

UNTIL the new Leeds studios are completed the B.B.C.'s North Regional organisation is not employing brass bands, choirs, and other large combinations at its present Leeds studio. Established in 1924, this studio is too small and uncomfortable for such broadcasts, though bands and choirs have endured its discomforts many times in the past.

A Converted Meeting House.

It is anticipated that the new premises in Woodhouse Lane, Leeds, will be ready by March. Work has started on the extensive alterations to the building, which was formerly a Quaker Meeting House.

"Well-known Critics."

BUT for the appearance of such names as Herbert Farjeon, P. G. Wodehouse, Ashley Sterne and Harry Graham, I should not have suspected a leg pull in the B.B.C. announcement that the vaudeville programmes are to be the subject of week-end comments by "well-known critics." The gentlemen, however, bear the names already mentioned, so make of this announcement what you will.

These vaudeville criticisms are to begin on Saturday, February 6th.

Which Was Right?

THE newspaper comments following the broadcasting last week of Patrick Hamilton's thriller, "Rope," were illuminating. I found one journal declaring that "'Rope' Fails to Thrill," while the next one I glanced at said "Radio Thriller Raises Hair of Millions."

Take your choice.

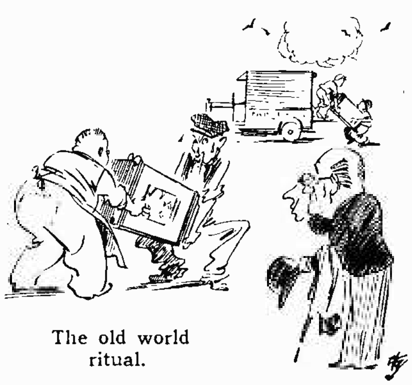
FOR RESTLESS ANNOUNCERS. Here, fresh from America, is a lapel microphone outfit, developed by the Bell Telephone Laboratories, which permits an announcer or public speaker to "ramp around the platform" while broadcasting.

Unbiased —by "FREE GRID"—

Sowing and Reaping.

I ALWAYS look forward to the first few weeks of the New Year, and I suppose most wireless enthusiasts do the same, as it is the period during which all the new components, valves, or complete sets, as the case may be, that we ordered at the Olympia Exhibition commence to arrive. Usually I count on having everything in my possession by Easter, but this year I really think that there is a likelihood of all records being broken and everything being in my possession before the days begin to lengthen noticeably.

I am strengthened in this opinion by the fact that a relative of mine, who possesses far more money than he has ever earned or deserved, actually had an expensive radio-gramophone delivered to him on Christmas Eve, less than three months after he gave the order at Olympia. It is true that it did not work, owing to the fact that, in the rush to fulfil his order, one or two important connections had been omitted. But, as I explained to the selfish fellow, who was inclined to be peeved about it, the instrument will gladly be exchanged for another in due course, and his experience is not an isolated one.



The old world ritual.

At the Olympia Show of 1930 I ordered a well-known A.C. receiver, and, in spite of the salesman's threat to deliver it in October, I received it at the end of January, 1931, which was just what I had intended, as I wanted it for a wedding present. Of course, it refused to function, but, for all that, it looked none the less "imposing" when it stood among all the other presents, and during the absence of the recipients on honeymoon I had ample time in which to return it and go through the old-world ritual of receiving and returning two others until I received the fourth and working model.

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A Hint to the P.M.G.

THE New Year has produced its usual crop of whistles and hoots from oscillating sets resulting from the following of the annual advice to "Give radio this Christmas." I suppose that a great deal of the trouble arises from unstable sets built from miscellaneous gifts of components, because, apart from the fact that, with one or two glaring exceptions, all commercial sets employing an H.F. stage are rock-stable nowadays, very few people can afford to give presents of complete receivers in these hard times. I do think, however, that a considerable proportion of the trouble comes from an attempt to "reach out" with one of the many two-valve commercial sets that are intended for local reception only. I must say that it surprises me that the much vaunted G.P.O. pirate van has not netted a few of these offenders, for surely, if the detection of a disused portable receiver stowed away in a lumber room is as easy as it is made out to be, the unearthing of oscillators should be mere child's play.

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Six Volts and a Bath.

I CAN scarcely find words adequate to express my gratification at the enormous success which followed my recent appeal in these columns for data concerning electrocution. At first information trickled in slowly and I was able to send personal letters of thanks. Later, however, the trickle increased to a stream, the stream to a torrent, and the torrent to a cataract, until finally I was swept away on a tidal wave of informative letters. I appear to have heard from everybody; a letter almost came from the warden of Sing Sing.

I am a little surprised, however, to find that a current as large as 10 amperes is used in the "hot squat," as a Hoboken informant so quaintly terms it; personally, I should have thought that such a current would have caused the unfortunate occupant of the chair to blow like a fuse, and for aught I know to the contrary he may do so.

Every picture tells a story.

Another informant suggests that death may be procured from a 6-volt accumulator by standing in a bath of water in which a wire from one battery terminal is dangling, and attaching the other terminal to a large damp pad pressed in the region of the kidneys. I fear, however, that personal experiments in this direction are impossible, as I am none too sure of the exact location of the kidneys, and unless a medical reader can oblige with a diagram suitable for inclusion in these columns I shall be compelled to advise all those whose life has been rendered unbearable by wireless problems to patronise the gas company.

If letters containing information came in a tidal wave, those *seeking* information came in a flood, and this leaves me in a dilemma, as I cannot possibly reply individually, and I am, therefore, somewhat at a loss to know how to pass on the information from those who know to those who don't. I put this point to the Editor, asking him if I could borrow two pages of "W.W." for this purpose, but he somewhat coldly drew my attention to the fact that *The Wireless World* conducted an Information Bureau.

PRACTICAL HINTS AND TIPS.

SIMPLIFIED AIDS TO BETTER RECEPTION.

D.C. "POWER PENTODE TWO." An Economical Mains Set.

DUE to the absence of rectifying equipment, a short-distance D.C. mains receiver, with a more than satisfying volume of undistorted output, can be built very cheaply. By fitting indirectly heated D.C. valves consuming 0.5 ampere, upkeep costs are also quite reasonable, but, of course, still further economies can be effected in this respect by employing the valves of even lower consumption which are now making their appearance.

A suitable circuit arrangement for a high-quality det.-L.F. D.C. mains set is shown in Fig. 1. The detector operates on the power grid principle, and is coupled to the output pentode by means of a choke. This plan, though not providing as much magnification as a transformer, is highly satisfactory for the purpose, and has the very practical advantage that it makes possible the inclusion of real power grid detection with a minimum of complication. In any D.C. set, H.T. voltage is inevitably limited to that of the mains supply, and so it becomes almost impossible to use the coupling that is normally chosen for an A.C. set. For the coupling choke CH_1, a high-inductance component, specially made for this purpose, should be chosen.

Little explanation is needed with regard to other details of the circuit. The choke CH_2 is of the conventional pentode output type, with a centre tapping, while CH_3, the smoothing choke, may have an inductance of about 20 henrys; no particular care need be taken in the choice of this component, but, if possible, it should have a reasonably low D.C. resistance.

With regard to the input tuning circuit, that shown in the diagram must be regarded more or less as a suggested scheme that is satisfactory enough for meeting the less exacting kind of requirements. It is susceptible to modification in many ways; for instance, a band-pass filter might be fitted in order that twin local transmissions could be separated without the need for applying so much reaction as to impair quality.

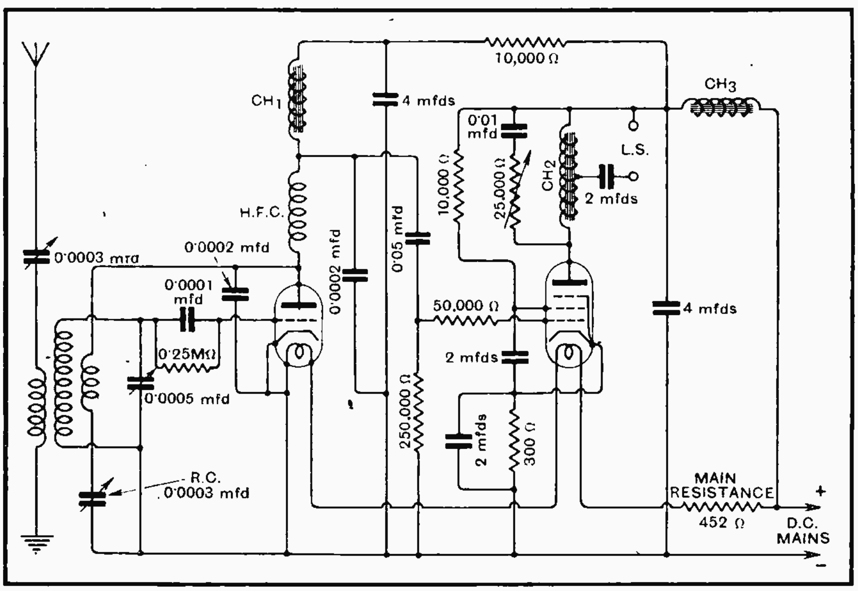

Fig. 1.—A medium-range "quality" receiver for D.C. mains feed.

A double-wound aerial-grid transformer, with no metallic connection between primary and secondary is shown; this arrangement complies with the requirement that the mains must not be directly earthed, but the alternative plan of using a more conventional "tuner" with a condenser in the earth lead is satisfactory. Values of feed resistances, etc., as shown, are estimated on the assumption that the set will be operated on a 240-volt supply. The main resistance will certainly need modification for any other voltage, but the majority of the others are less critical, and will not need any alteration unless the pressure varies considerably from that stated.

In order to avoid all possibility of short circuits, it should be noted that, strictly speaking, a large condenser should be inserted in each of the loud speaker connecting leads.

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HUM AND THE MAINS TRANSFORMER.

IT is not always realised that there is a possibility of mechanical hum arising directly from the mains transformer, and that this, and not incomplete smoothing, is sometimes the cause of this annoying accompaniment to signals. Such hum, of course, is usually due to loose transformer laminations, and the obvious remedy is to tighten up the clamping bolts.

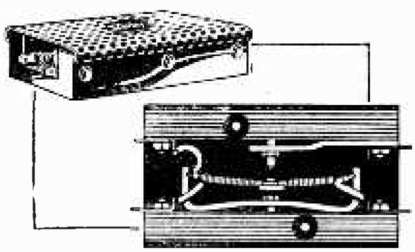
It will often be found, however, that the hum persists no matter how tightly they are clamped. It has been found that when this is the case the hum is sometimes due to the receiver chassis, or even the table upon which it is standing, acting as a sounding board. In a recent case which the writer investigated the hum was cured merely by lifting the receiver off the table and holding it in the air. Mounting the receiver upon soft felt or rubber pads reduced the hum to negligible proportions.

It was also found that when the mains transformer alone was removed from the chassis, the hum ceased; and so a cure could obviously be effected by mounting the transformer upon pads of sponge rubber or anything similar.

LABORATORY TESTS
ON NEW RADIO PRODUCTS.

VARLEY THERMAL DELAY SWITCH.

This is a delay action relay switch operating on the thermal principle, and has been designed especially for use with Osram G.U.1 mercury vapour rectifying valves. Its usefulness, however, is not



Varley delay action relay switch operating on the thermal principle

restricted to this one function, as it can be employed wherever a delay action switch of this type is required.

The heater element is wound for a 4-volt supply, and consumes one amp. of current. On test we found that with our sample a period of 80 seconds elapsed after switching on the A.C. before the relay contacts closed. The contacts opened 20 seconds after switching off. The delay action is obtained by winding the heater coil on a bi-metal strip, which expands on heating, thus closing the H.T. contacts. The final movement is rapid, and the contacts close with a snap action. When the heater has cooled sufficiently the contacts open quickly, thus preventing sparking.

The makers are Varley (Oliver Pell Control, Ltd.), 103, Kingsway, London, W.C.2, and the price is 12s. 6d.

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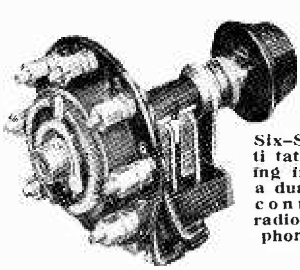
SIX-SIXTY MULTISTAT.

The Multistat is a combination of four components embodied in one unit and operated by a single control knob. It combines the functions of radio volume control, gramophone volume control, radio to gramophone switch, and on-off switch. Movement of the control knob in a counter-clockwise direction switches on



Six-Sixty Multi tat, combining in one unit a dual-volume control and radio-gramophone switch.

the receiver and gradually increases the volume, the control being achieved by means of a rheostat in the filament circuit of the first valve. Rotation from the central, or off, position in a clockwise direction changes over the circuits for gramophone reproduction and slowly brings the volume up to maximum through the medium of a potentiometer connected across the gramophone pick-up.

The unit is exceedingly easy to fix, a single hole in the panel sufficing for this purpose. Since it will replace possibly four controls, a very neat panel layout can be achieved, a feature which is the aim of every designer, whether he be an amateur or a professional.

The Multistat is very compact, and occupies a panel space of 2¼in. × 2½in.; it projects 2⅛in. behind the panel. Conversion of an existing set is quite simple, and the accompanying leaflet gives full instructions regarding the method of connecting the various terminals. It is made by the Six-Sixty Radio Co., Ltd., 17-18, Rathbone Place, Oxford Street, London, W.1, and the price is 8s. 9d.

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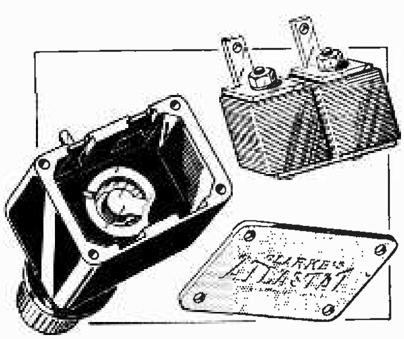
CLARKE'S "ATLASTAT."

The "Atlastat" is a potentiometer type volume control embodying a resistance element quite different from that employed generally in components of this type. The resistance is built up by interleaving layers of low conductivity mate-



Clarke's "Atlastat" fitted with a graded resistance.

rial between thin brass plates, the resistance of each couple being governed by the thickness of the material employed. This method of construction enables a graded resistance to be constructed to follow any desired law.

In the Clarke's "Atlastat" the grading is so planned that the increase in volume is even and progressive throughout. It has been condensed into quite a small compass, the overall size being 1½in. × 1¾in. × ⅜in.

The resistance has a nominal value of 100,000 ohms, and is rated to dissipate 2 watts. The makers are H. Clarke & Co. (Manchester), Ltd., Atlas Works, Old Trafford, Manchester, and the price is 8s. 6d.

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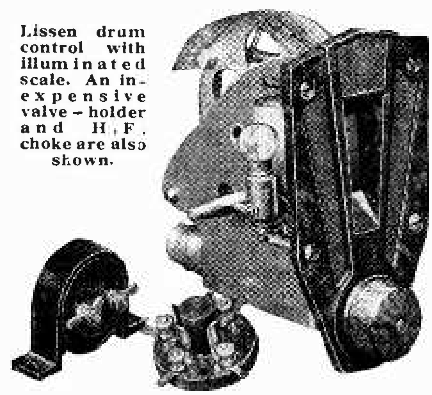
LISSEN DRUM CONTROL, H.F. CHOKE, AND VALVE-HOLDER.

The Lissen drum control is one of the most substantially made devices of its kind we have examined so far. It is assembled on a stout metal framework, has provision for attachment of condensers on both sides, and affords a reduction ratio of 5:1. There is not the slightest trace of slip even though the drum is held firmly, and the indications are that the gut driving cord would snap before slipping occurred. Thus it is possible to drive a whole chain of condensers with this control.

The engraved scale is made of trans-

Lissen drum control with illuminated scale. An inexpensive valve-holder and H.F. choke are also shown.



parent material and it is illuminated from the back by a small lamp. A handsome escutcheon plate is provided and the dial can be used with any type of condenser fitted with a ¼in. spindle. The price is 8s. 6d.

Despite its very small size, the Lissen H.F. choke shows on measurement the satisfactory inductance of 103.5 millihenrys. The winding is carried in a single slot, and as a consequence the self-capacity is somewhat higher than usual, being of the order of 20 mmfds. In a practical circuit this will be swamped by the distributed shunt capacities, so that in the majority of cases the choke will be found entirely satisfactory, and the price is but 2s.

The valve-holder can claim the distinction of being the cheapest of its kind on the market, since the price is 4½d. only. It is a four-pin model constructed on simple straightforward lines, and holds the valve perfectly rigid, at the same time making satisfactory contact to the pins.

The makers are Lissen, Ltd., Isleworth, Middlesex.

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Catalogues Received.

Igranic Electric Co., Ltd., 149, Queen Victoria Street, London.—Illustrated leaflets dealing with the full range of Igranic components.

Ferranti, Ltd., Hollinwood, Lancashire.—Publication No. Wa. 523, illustrating and describing the latest range of A.C. battery eliminators, also folder describing the Ferranti electric clocks for A.C. mains operation.

In our issue of January 6th last the general catalogue published by the East London Rubber Co. was stated to contain 108 pages, whereas actually there are some 300 pages in all. The catalogue is divided into two sections, with 192 pages devoted to wireless equipment and 108 pages to electrical fittings.

CORRESPONDENCE.

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

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

INFORMATIVE ADVERTISING.

Sir,—Is it not time that advertisers in the wireless press should realise that the section of the public to whom their advertisements are most likely to appeal, while not being composed entirely of experts, consists very largely of people who have sufficient knowledge to appreciate the kind of advertisement that offers facts, rather than a mere journalistic extravaganza?

Surely the thousands of pounds that must be spent weekly by these advertisers could be put to a better purpose than that of informing us that "Blastwell's 'Super-Thumper' loud speaker brings the mighty thunder of the organ to your fireside," or that one should install some magical apparatus which will enable one to "reach out" and "revolutionise" one's set, making it a "marvel" of sensitivity, selectivity, and every other "ivity" that a set could be!

One gets so exasperated at being told, week after week, that there is "nothing like it"—that it is "unique," "amazing," "astounding," and that even if it isn't, one can return it and have one's money back.

If one goes to buy a motor car, does one ask "Is it unique? astounding? a miracle of scientific discovery? etc., etc.?" One generally likes to know something about horse power, engine design, bodywork, and so on.

If advertisers, instead of eulogising, would say what their goods will *do*, instead of what they think of them, the purchaser would be really assisted, and the praise, if deserved, may be safely left to come from him.

Many advertisers *do* make an attempt to give some facts about their goods, notably valve manufacturers, but one would welcome a similar effort on the part of loud speaker manufacturers to show what, granting a fair amplifier, is likely to be the result of attaching a particular loud speaker thereto. In particular, some sort of curve representing the behaviour of the unit over the usual frequency band, the maximum input in watts for which the unit is designed, and the "working" impedance of the coil, would be worth more to the reader than all the grandiloquence so often encountered.

One appreciates the difficulty of getting a graphic representation of sound output, but we are nevertheless *not* given enough *working facts* about the things we are invited to buy, and it seems so unenterprising of the sellers to leave the really useful description of their apparatus to the private test departments of the various journals in which they advertise.

Cheshire. NORMAN P. SLADE.

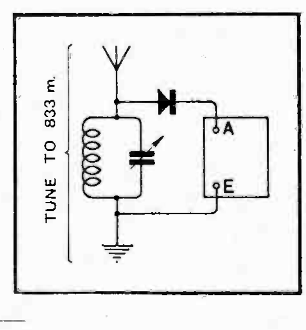
RECEPTION ON 833-METRE TRANSMISSION.

Sir,—With reference to the 833-metre transmission from Heston Aerodrome perhaps some readers would like to try the scheme of preceding their receivers by a circuit tuned to 833 metres connected through a crystal rectifier to the input terminals of their sets.

The set can be tuned to $\frac{833}{n}$ metres, e.g., 416.5, 277.7 metres, and so on.

ERNEST C. CRAVEN.

Hull.



ELECTRICITY SUPPLY.

Sir,—I should like to endorse the remarks of your correspondent regarding the poor voltage regulation of certain electricity supplies. My own supply is nominally 200 v., and during the day is mostly about 210 v., but during the evening falls to anything down to 165 v. It is not by any means a steady fall, either, but jerks up and down the whole time.

The only way to avoid large variation in reproduction from a mains set seems to be to slightly overrun the filaments and use a rectifier with a large margin of output. In my own case there is not a large change in either volume or quality between day and evening running.

My greatest trouble is a roitary A.C. to D.C. convertor. This is of the synchronous motor type, and, with the low pressure, is an awful job to get to run up to speed.

I may say that, like your correspondent, I have taken it up with the supply people, but it seems as though the small consumer is simply ignored in matters of this sort.

I hope you may be able to do something towards an improvement. F. BAYSEN.

Watford.

Sir,—Regarding variations in electric light supply, I should like to say a few words on the subject.

Here we have 220 D.C. (according to the meter!), but at the wall plug we have a different story. The supply is reasonable until 5.15, when violent fluctuations occur, and the reading of very small print becomes difficult work; the drop is 10-15 volts, sometimes more.

My neighbour has 220/50 cycles A.C., and as our consumption is rather large when compared, I fail to see why we should have to put up with such stuff known by the name of "D.C."

I sincerely hope others troubled like this will bring their particular cases forward.

I should, in closing, like to thank you for your "direct supply" of information delivered in your excellent journal.

Chiswick, W.4. D. BATTLE.

POST OFFICE WIRELESS LICENCES.

Sir,—In a recent court case wherein the tenant of a flat was prosecuted for using radio apparatus without a licence, the flat in question was one where broadcast reception could be obtained by plugging a loud speaker into a socket connected to a central receiver operated by the owners of the premises. A licence fee had been paid in respect of the receiver, but it was contended by the representative of the P.M.G. that all tenants using loud speakers must also hold a licence, since it was the person who was licensed, not the apparatus.

In the early days, when wireless was used almost exclusively for the communication of messages, the granting of a licence really constituted permission, not so much to use radio apparatus as such, but to use the ether for the purpose of communication. Further, all licensees had to be qualified persons and were sworn to secrecy of correspondence.

Now, if, in the case referred to above, this designation is still implied by the issue of a ten-shilling broadcast licence, I would like to ask:

(1) If I invite friends to my house for radio entertainment, are they liable to prosecution if they attend without having first purchased a licence? Also, am I liable if I stand outside my local dealer's shop listening to the loud speaker which he operates "fortissimo" for the benefit of the passing public?

(2) If the answer to the above question is "No," then am I or the local dealer rendered liable under the "secrecy" clause for intentionally exhibiting communicated matter to unlicensed persons?

Obviously the above designation will not do in these days, when the use of wireless with respect to broadcasting becomes one of entertainment and not one of communication. The question of "secrecy" is at once ruled out, and, as broadcasting is a national service, it merely becomes necessary to collect from those persons enjoying the entertainment the necessary contributions towards the expenses involved in its production.

The whole question centres around the word "service." Surely it would be better in the above case for the owners of the premises to be liable to the B.B.C. for the number of distribution points installed and to hire out loud speakers to those residents desiring to listen to broadcast matter? A suitable scale of charges could be arranged and the revenue paid to the B.B.C. This would allow ample scope for the owners of the premises to make a little profit to reimburse them for the service they were supplying, and would also tend to show an increased revenue to the B.B.C. The scheme might be extended to radio dealers or, better still, the Government might make use of its monopoly and, by co-operating with the B.B.C., organise a service similar to that on which the telephone service operates. Broadcasting would thus become an essential service to every inhabitant of the country, one which he can obtain as required for a very moderate fee without having to bear the initial cost of the apparatus. Of course, all these costs will eventually be defrayed by the consumer as in all trades, and also, no doubt, the Chancellor of the Exchequer will expect a little revenue from the enterprise, but all these expenses when split up into terms of "service per person per hour" resolve themselves into a very small figure. After all, one uses the telephone service but does not have to pay for the instrument. Similarly, in hotels, if one wants a bath one pays a certain fee for it (sometimes it is free), but one is not expected to bring one's own bath and pay the water rate before one is entitled to use the company's water.

Goodmayes, Essex. THOS. L. STANTON.

TONE CORRECTION AND SELECTIVITY.

Sir,—If, as appears to be the case, Mr. Colebrook's article on "Tone Correction and Selectivity" is a reply to the challenge put forward in my letter published on November 11th, 1931, it is an eminently satisfactory one, for it demonstrates—much more clearly than I could have done—the truth of my own contention, namely, that, in a difficult world like ours, where 9-kc. spacing of broadcast stations is the best we can get, the endeavour to obtain an audio frequency response up to 10 kc. is a piece of unpractical idealism, likely to end in a heterodyne headache.

Mr. Colebrook's demonstration of the soundness of tone correction in cases where a much less idealistic frequency response is aimed at likewise entirely confirms my own position, for my objection to tone correction (as against band-pass) is confined solely to its extension to cover conditions which, unfortunately, do not exist

Tone correction, within the limits imposed upon us by an overcrowded ether, can, indeed, be beneficial; whereas its rival, band pass, in its usual form, is altogether impracticable. Though such a fearful heresy may make the paper itself burst into flames, I am prepared to repeat it. The maintenance of band-pass characteristics reasonably close to the beautifully symmetrical curves which one gazes at with loving admiration is a task not unworthy of our finest instrument makers, and is certainly outside the scope of ordinary commercial gang condensers.

This, of course, does not refer to superheterodynes, where the band-pass circuits are fixed, but to those in which the whole broadcast gamut is covered by variable condenser tuning.

The response curves relating to such receivers are based on the assumption that the tuned circuits are matched within a few k.c., and makers of wavemeters would like to know how to keep even one circuit within the necessary limits without heavy cost. Besides, for a good reason, wavemeters are usually supplied with several carefully picked valves, a practice which has not yet spread to the field of ordinary receivers. This is really no cause for alarm, because the actual performance of receivers, if it were shown on paper, would be almost always far worse than it should be theoretically, and nobody worries about it very much. Nevertheless, the superhet and/or tone correction can be made to cope reasonably well with existing conditions. But I am sure that something will have to be done about it from the transmitting end before long. M. G. SCROGGIE.

Edinburgh.

EXTENSION LOUD SPEAKERS.

Sir,—I notice in the Editorial of Jan. 13th issue of *The Wireless World* you mention that you cannot recollect any set having provision for an additional loud speaker which can be made to operate independently of the speaker incorporated in the set.

May I point out that the Pye Twintriples—for use on A.C. mains, D.C. mains, or for battery operation, have always had this provision, as you will see, for example, from page five of the enclosed book of instructions for the model for use on D.C. mains. PYE RADIO, Ltd.

London, W.1. E. A. Lever.

[Other letters have been received regarding this point in the design of the Pye Twintriple.—Ed.]

TRANSMITTERS' NOTES.

INTERNATIONAL GOODWILL TESTS.

Through the courtesy of Mr. H. L. O'Heffernan (G5BY) we are able to give further particulars of the tests to be carried out in February and March under the auspices of the A.R.R.L. with the main object of ascertaining the variations in signal strength on different wavelengths, especially the 20-metre and 40-metre wavebands, at various ranges during the twenty-four hours, and also to explore the possibilities of other wavelengths.

Nature of Tests.

As an example of the proposed procedure, we give the programme mapped out by a well-known station in Chicago.

For the first three days of each period, beginning on February 21st and March 11th respectively, the American station W9GV, operated by Dr. C. E. Sceleth and Mr. E. H. Conklin, will listen for two hours and then transmit continuously "Test de W9GV" for four hours on 20 metres and 40 metres simultaneously, followed again by two hours' listening and four hours' transmission throughout the day. The first listening period on February 21st and March 11th will begin at 03.00 G.M.T., on February 22nd and March 12th at 07.00, and on February 23rd and March 13th at 05.00.

The last three days of each period will be devoted to general intercommunication, in which new contacts may be made with those stations heard during the listening intervals.

The transmission on both 20 and 40 metres will be operated by a Tape transmitting device, and as both transmitters have repeatedly worked all continents, they should easily be picked up in Great Britain. Mr. O'Heffernan, whose address is 2, Chepstow Road, Croydon, will be glad to receive reports on any reception of W9GV, which he will forward to Dr. C. E. Sceleth.

Unfortunate Clash of Dates.

It is, perhaps, unlucky for British transmitters that the dates fixed by the A.R.R.L. for these International Goodwill Tests clash with those already fixed by the Executive Council of the R.S.G.B. and B.E.R.U. for the British Empire Contest and R.S.G.B. tests; they cannot, therefore, agree to close down British stations for silent periods of listening on February 21st or on March 11th and 12th, when the R.S.G.B. 3.5 mC. tests will be in operation.

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BRITISH EMPIRE AMATEUR RADIO CONTEST, 1932.

The next B.E.R.U. Contest is fixed for the four week-ends in February beginning at 12.00 G.M.T. on February 6th, 13th, 20th, and 27th, and ending at 24.00 G.M.T. on the following days. For this contest the Empire is divided into twelve groups: 1, British Isles; 2, Canada, Newfoundland, and Nova Scotia; 3, West Indies; 4, South Africa; 5, Kenya, Uganda, and Tanganyika; 6, Egypt and the Sudan; 7, Iraq; 8, India, Burma, and Ceylon; 9, Malaya; 10, Hong Kong; 11, New Zealand; 12, Australia; while British stations not actually in the British Empire may compete in their nearest group.

Any licensed wavelength may be used, and one point is counted for each 1,000 miles (or part of 1,000 miles) for each station worked; if the same station is worked on different wavebands, points are scored for each, a maximum of ten contacts being allowed on each waveband with stations in any one group.

Full particulars may be obtained from the Secretary, Radio Society of Great Britain, 53, Victoria Street, London, S.W.1, or from District B.E.R.U. Representatives.

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NEW FRENCH WIRELESS SOCIETY.

It is proposed to form a new society of amateur transmitters in France, under the title of "Association des Radio-Emetteurs Officiels Français," or A.R.E.O.F., for which the active membership will be confined to those whose stations are licensed by the French postal authorities and to operators on ships, military stations, and broadcasting stations.

From the information at present available it is not clear whether this new association is intended to supersede the existing "Reseau des Emetteurs Français" or if it represents a sort of inner brotherhood comprising the pick of French transmitters, excluding and discouraging those whose stations are not licensed, but we understand that at a recent conference of French amateurs the number of votes recorded by unlicensed transmitters was considered excessive, and that a society representing only duly authorised amateurs was deemed necessary.

Readers' Problems.

These columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.

Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found elsewhere in this issue.

The Pen.220A Valve.

SEVERAL questions have been received with regard to the use of the Pen.220A valve, a recently introduced pentode of the high-efficiency type with a very large output, in recent *Wireless World* receivers, and particularly in the "Band-Pass Pentode Three."

It may be recalled that this valve, though just within the range of practical politics where dry batteries are employed, is at its best when a set is fed from an eliminator, or at any rate from H.T. accumulators. With 150 volts applied to both anode and screen, the total current passed amounts to some 21 milliamperes, and the valve works best with a load impedance o some 8,000 ohms.

With regard to the "Band-Pass Pentode Three," it is suggested that, to allow the use of this valve, the output circuit should be altered in the manner shown in Fig. 1. An output choke of the centre-tapped type, designed for use with ordinary pentodes, will give satisfactory results, but more accurate matching may be attained in some cases by the use of a choke with a number of tappings.

It will be observed that a by-pass condenser is suggested for the pentode screen circuit, as it is assumed that an eliminator will be used, and also that the values of the tone-correcting devices are considerably different from those commonly specified for high-efficiency pentodes having a smaller power output.

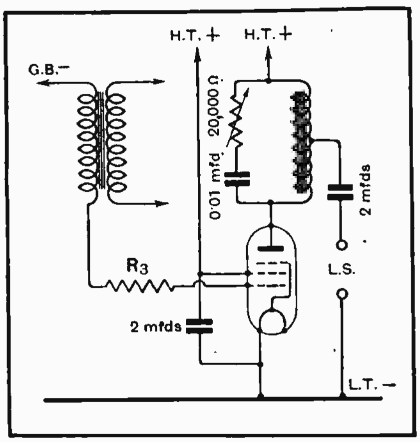

Fig. 1.—Output stage arrangement for a PEN. 220A valve.

Although this diagram shows a scheme of connections that are particularly applicable to the "Band-Pass Pentode Three," the same method may be adopted when fitting the new valve to such receivers as the "Single Dial Super."

Screened Grid Wires.

A GOOD deal of attention has lately been focused on the use of screened connecting wires in H.F. circuits, as a prevention of undesirable inter-action. It has been pointed out that, however careful one may be, leads of this type will inevitably have a fairly high capacity, and that they are likely to introduce dielectric losses, which may or may not be tolerated, depending upon the method of screening the wires, and also on the position that they occupy in the circuit.

A reader asks what would be the effect of this inevitable increase in capacity if he were to fit a screened lead some 6in. in length as a connection to the grid terminal of his H.F. valve; the associated H.F. stage at present tends to become unstable at certain settings of the ganged tuning condenser.

As the screen must be earthed, it will be realised that the extra capacity of the lead in question will be additive to that at present existing across the tuned grid circuit. In all probability its capacity will not exceed some 10 mmfds., and this value might be reduced appreciably. In any case, it is unlikely to be so great that it cannot be compensated for by an altered setting of the trimming condenser across the circuit.

Another question on a similar subject relates to the additon of capacity likely to be brought about by using screened leads for wiring up a "top-end" filter coupling condenser. Here our correspondent falls into the error of thinking that the capacity of the leads would be additive to that of the coupling condenser. If this were so there would be no point in fitting screened leads; actually, of course, the capacity of each wire to earth is added to that of the associated component filter circuit.

Screening Filter Coils.

AS the great majority of the coils used in band-pass filters are totally enclosed in metal cases, a belief seems to have grown up that complete screening is essential to the successful operation of these devices. In a way, it is, for example, it is impossible to calculate the extent of coupling necessary to bring about a given peak separation—or broadness of tuning—if there exists any appreciable amount of stray coupling, of which the magnitude is not known, and, consequently, cannot be taken into account.

But when the method of filter coupling is such that its value can be adjusted by trial and error, we can tolerate quite a lot of stray coupling: obviously, however, this must not be so great as to produce at any part of the tuning range a greater peak separation than is needed.

All this arises from the letter of a correspondent, who intends to use coils that are considerably larger than those customarily specified for band-pass filters. He is unwilling to enclose his coils completely in screening boxes, both from considerations of bulk and expense, and also because he fears that their effectiveness would be decreased by doing so.

Provided that he is able to recognise the symptoms of excessive stray coupling, and is prepared to take the necessary measures to counteract them, there is no basic reason why a satisfactory filter circuit should not be made up with partially screened coils; it should be made quite clear, however, that it is much easier to attain success when complete screening is provided.

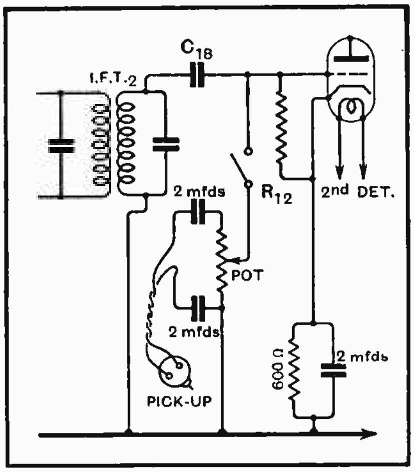

Fig. 2.—Complete isolation for the pick-up is desirable in a D.C. mains set. This arrangement is applicable to the D.C. "Super-Selective Five."

The D.C. Superheterodyne.

IT is asked whether it would be possible, when fitting a gramophone pick-up to the D.C. model of the "Super-Selective Five," to obtain automatic bias without undue complications, and also whether complete isolation between the pick-up and the mains can be arranged.

The alterations necessary in order to meet these requirements are shown in Fig. 2. It will be seen that the pick-up is isolated by means of two large condensers, and that a bias resistor is included in the cathode circuit of the second detector valve. In order that this valve may work without bias when carrying out its normal function of rectification, it will be necessary to rearrange the connections of the grid leak (R_{12}) as shown. This resistance must no longer be connected across the grid condenser, or negative bias will always be applied to the valve, irrespective of which function it is performing.

Pick-up Potentiometer.

A POTENTIOMETER resistance of more than 250,000 ohms is hardly ever necessary or desirable for use as a pick-up volume control. This point arises in connection with a letter from a querist who complains that, finding severe overloading was taking place when the pick-up was directly connected, he interposed a 1-megohm potentiometer. When set for reproduction of normal intensity, this addition produced an annoying "whistle."

Before purchasing a potentiometer, the pamphlets that are generally issued by pick-up manufacturers should be studied, and any recommendations made with regard to its ohmic value should be observed. Some pick-ups work well in conjunction with a volume control potentiometer of as little as 25,000 ohms.

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A "Standard" Addition.

REQUESTS are constantly being received for information as to the most satisfactory way of improving the selectivity of somewhat out-of-date receivers, of which the capabilities in this direction are no longer sufficient to cope with modern needs.

So far as sets with one or two H.F. stages and with single-tuned aerial input circuits are concerned, our standard reply is to recommend the fitting of some form of two-circuit aerial tuner. This advice may not be highly original, but if extensive and costly alterations are to be avoided there can be little doubt that the fitting of a two-circuit tuner will have the desired results in the great majority of cases. The only difficulty is that there will be another circuit to tune, but this should present no difficulty at all, especially when the operation of the receiver in its original condition has been thoroughly mastered.

Of the many possible ways of adding an extra tuned circuit, that shown in Fig. 3 is almost always the most convenient to put into practical execution. It is applicable to almost every type of receiver with "aperiodic" aerial coupling, whether of the auto-transformer or double-wound transformer type, and is only likely to introduce complications when the set itself is of that rather unsatisfactory type which tends to become unstable when aerial loading is reduced.

All the additional apparatus and connections that will be necessary are shown to the left of the dotted line representing the screen. Several types of commercial coil assembly are suitable for the purpose, and in some cases the use of a screened coil will be considered to be more satisfactory than the use of a screening plate. For the coupling condenser (CC) a maximum capacity of 0.0001 mfd. will always be enough, and in some cases a considerably lower value may be desirable, especially if the aerial was originally tightly coupled to the grid coil.

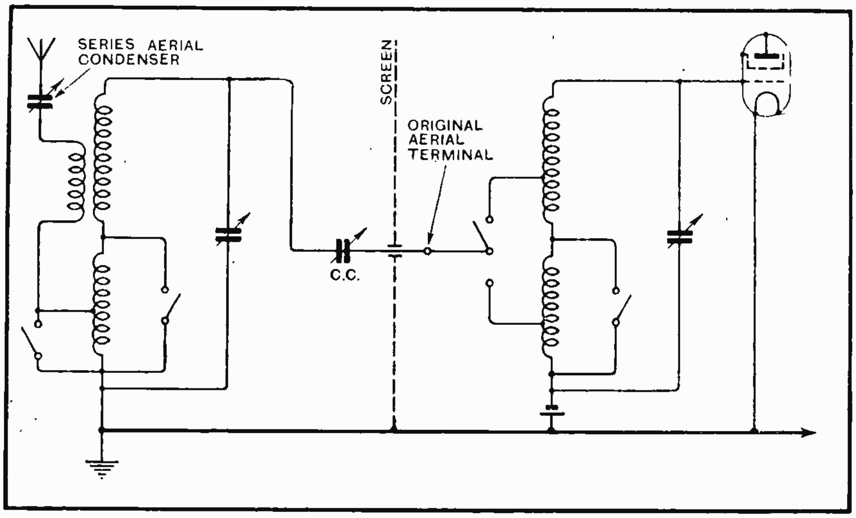

Fig. 3.—A simple form of two-circuit tuner, for use in conjunction with an existing receiver having one or more H.F. stages.

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Filter Adjustments.

A READER quotes a statement published in this journal some time ago, to the effect that the tuning peaks of a band-pass filter may be separated by between one and two degrees on the condenser dial. This applies to the medium waveband. He goes on to ask whether a similar separation would be correct for long broadcast waveband, and adds that his ganged tuning condenser has a 0-180-degree scale.

In theory, at any rate, a one- or two-degree separation would be insufficient on the long waveband, and, to attain an academically correct band width, the tuning peaks should be, very roughly, eight degrees apart on our reader's condenser. Actually, the dial readings for a nine-kilocycle separation will depend on such things as the design of the condensers and the frequency range covered by the set on the long-wave side.

In practice, it is most inconvenient to have such broad tuning as this, and we are generally quite satisfied if the peaks are some two or three degrees apart, or if signals are of appreciably the same strength while the condenser vanes are rotated by this amount.

Extra H.T. Volts.

MOST of the commercial power transformers of a year or two ago were fitted with H.T. secondaries delivering a voltage that would, by modern standards, be considered distinctly low. For example, the type of transformer intended for use with a full-wave rectifying valve generally had a centre-tapped H.T. secondary delivering from 120 to 150 volts across each half of the winding. Taking the latter figures, this means that a total voltage of 300 would exist across the extreme ends of the H.T. secondary, and a reader who has a transformer of this type asks whether it would be practicable to increase his H.T. voltage by substituting a half-wave rectifying valve rated at 300 volts.

Although the answer to the basic problem contained in this question is "Yes," we fear that it must be qualified by several "ifs" and "buts." In the first place, the transformer was probably designed to deliver quite a small current, and its voltage may fall appreciably when supplying a modern receiver. Again, there is the question of smoothing; that included in the receiver or eliminator may be incapable of dealing satisfactorily with the output of a half-wave rectifier. However, this difficulty is by no means insuperable, and if the manufacturers of the transformer in question can assure our reader that it is capable of delivering sufficient current, at the same time maintaining almost its full-rated voltage, he might well proceed with his project. A half-wave rectifier is often highly satisfactory.

FOREIGN BROADCAST GUIDE.

MOSCOW
(Imeni Stalina)
(U.S.S.R.).

Geographical position: 55° 45′ N.; 37° 37′ 12″ E.

Approximate airline from London: 1,555 miles.

Wavelength: 424.3 m. Frequency: 707 kcs. Power: 100 kW.*

Time: *Three hours* in advance of Greenwich Mean Time.

Standard Daily Transmissions.

05,00 G.M.T. onwards, short talks, educational lectures and news until 10.00; 17.30, light concert or entertainment; 20.00, main evening programme; 20.55, time signal and chimes (Midnight) from Spassky Tower, Kremlin; 21.00, weather and review of day's news. Occasionally relays Leningrad and other provincial studios.

Announcers: man and woman.

Opening signal: *L'Internationale* (gramophone record).

Call: *Slooshaitje* (twice). *Radio Stancia Imeni Moskva Stalina.*

Closes down towards midnight (G.M.T.) with *L'Internationale* and goodnight greetings: *Dasveedanja; spakoiny notchi.*

* *The power will shortly be increased to 300 kW.*