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CONTENTS

EDITORIAL COMMENT

The Art of Listening

Advantages of Indirect Reception

ONCE again broadcast listeners and, in particular, the musicians amongst them, have provoked a discussion on the comparative merits of direct and indirect listening, in the concert hall itself, or through the medium of a broadcast receiver.

On this occasion it is *The Times* which provides the forum, and that eminent musician, Sir Walford Davies, who has endeared himself to all wireless listeners, is responsible for what must be regarded, amongst all the rest, as the most provocative contribution to the discussion.

Disregarding all the limitations, such as frequency response and monaural reception, of which broadcasting engineers are so painfully conscious, Sir Walford boldly states: "Personally I have never in my life enjoyed Beethoven more in any concert room here or abroad than I have enjoyed him 'electrically reproduced' recently."

We suggest that one of the reasons why a musician can claim to get more enjoyment out of electrically reproduced music than from direct listening may be attributable to the fact that in the concert hall it is difficult to give full attention to the music without being distracted by the sense of sight and by the little interferences and interruptions to absorption in the music which go on all round. In listening through the medium of the broadcast receiver it is possible to suppress all extraneous noises and interruptions and, if necessary, put out the lights as well, to remove the disturbing influence of the sense of sight.

If we weigh in the balance the advantages of broadcast listening against the disadvantages, we think it quite likely that even a jury composed entirely of musicians might give a verdict in favour of broadcast reception, for the reason that, great as are the merits of direct listening from such points of view as quality and the ability to locate sound because we are listening binaurally, the advantages on the side of listening without any distracting noises are greater.

Faults to Correct

There are two important considerations which militate against satisfactory listening through the medium of a broadcast receiver. The first is that we are still in the position that an enormous proportion of the listeners employ sets which are incapable of reproducing music at a high standard of faithfulness. Secondly, the art of listening has been very poorly developed. Undivided attention is rarely given to a musical broadcast; yet what should we think if in a concert hall the audience provided themselves with novels to read meanwhile, or engaged in conversation with their neighbours?

Fortunately, the remedy for both these objections to our present standard of listening is in the hands of the listener himself; he must learn to understand his set and to judge whether its performance is doing justice to the original transmission, and he must acquire the art of listening before he can begin to judge the relative merits of direct and indirect performance. All this surely leads us to the view that the public should be educated to an appreciation of the capabilities of the modern high quality receiver, and once more we would recommend that the radio industry should install high grade broadcast receivers in suitable places throughout the country for public listening.

Delayed Diode A.V.C.

Selecting the Best Operating Conditions

By W. T. COCKING

THE various methods by which automatic volume control can be achieved are by now fairly well understood, and it is generally realised that if the initial sensitivity of the receiver is not to be reduced the control should be delayed—that is, it should be inoperative until the signal input exceeds a certain predetermined value. Although there is no mystery about the manner in which circuits of this type function, there are so many different arrangements with which A.V.C. can be obtained that a choice is sometimes difficult. Moreover, having selected the system which is to be used, the problem of choosing the best operating conditions still remains.

The delayed diode A.V.C. circuit is attractive on account of its simplicity, and, although it may not be the best in all circumstances for A.C. operated sets, it remains probably the only entirely satisfactory arrangement which can be used in D.C. mains and battery-operated receivers on account of the limitation in the supply voltage in these cases. For the moment, therefore, let us confine our attention to this system and examine its characteristics in some detail, particularly with regard to the determination of the correct delay voltage.

In Fig. 1 will be seen the fundamental circuit of the delayed diode A.V.C. system in which the valve is shown as a simple duo-diode type, although it may equally well be one of the combination duo-diode-triode or duo-diode-pentode types, or even two separate triodes connected as diodes or two Westectors. The H.F. or I.F. input is applied from the tuned circuit to the diode anode A1, the cathode connection being completed through the load resistance R1. In this circuit, therefore, normal signal rectification takes place, and the L.F. voltages are developed across R1 and transferred through the H.F. filter and manual volume control to the next valve. The H.F. input is also applied through the small condenser C1 to the other diode anode A2, which is connected to the cathode through the resistances R3 and R4. R3 is the diode load resistance, and usually has a value in the neighbourhood of 0.5 MΩ, while R4, with R5, forms part of a potentiometer across the H.T. supply. The cathode, therefore, is biased positively with respect to the earth line, and, as a result, the anode A2 is biased negatively with respect to its cathode.

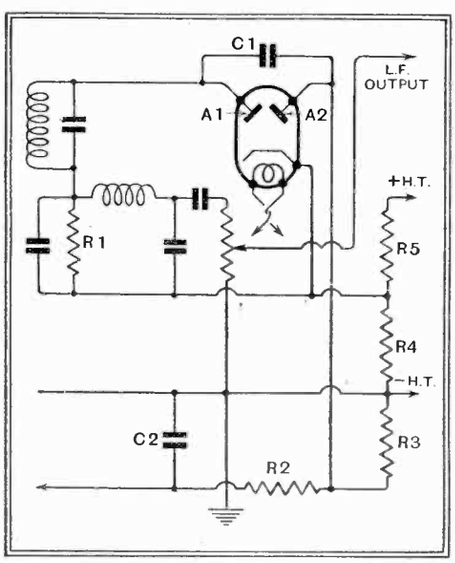
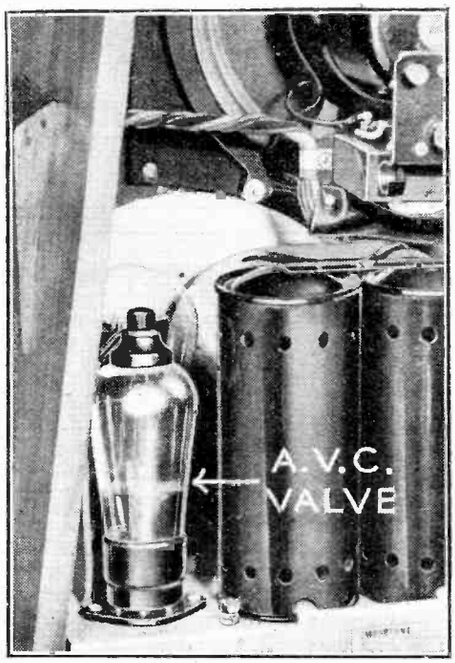


Fig. 1.—The fundamental circuit of the delayed diode A.V.C. system. The control grids of the H.F. valves derive their bias through the resistance R2.



The double-diode valve is usually of the duo-diode-triode type, and in addition to acting as the second detector and providing delayed A.V.C. it gives a first stage of L.F. amplification. The illustration is from the Ferranti Gloria superheterodyne.

The success or otherwise of the A.V.C. system depends very largely upon the amount of this bias, which is usually known as the delay voltage. Until the signal input to the anode A2 exceeds the delay voltage no rectification occurs in this circuit, and A.V.C. is inoperative. Obviously, therefore, the delay voltage should equal the detector input obtained from the weakest signal it is desired to receive. On the other hand, if A.V.C. is to be so effective that on the strongest signal the output to the ear is not appreciably louder, the detector input must not rise to more than twice the small input figure, for this corresponds to a change of output of only 6 DB. For this result to be achieved the delay voltage must be equal to the maximum bias required by the H.F. or I.F. stages, and this, in turn, will depend upon the type of H.F. valves employed and upon the number of controlled stages.

A little thought will soon show that in the general case this will lead to the detector being operated at a very large signal input, and this will mean the use of many H.F. stages and but little L.F. amplification. Whether or not this is satisfactory will depend upon many factors, of which cost is by no means unimportant.

Choosing the Delay Voltage

To put the question upon a practical basis, let us consider the choice of delay voltage for a two H.F. receiver, and let us assume that we wish A.V.C. to commence when the input to the first H.F. valve is 1 millivolt, and that the output must not rise by more than 6 DB when the input is 5 volts. These figures for input correspond roughly to the reception of a moderately strong foreign station and the local station respectively. For an output ratio of 2-1, or 6 DB, therefore, the input will vary in the ratio 5,000-1, or 74 DB.

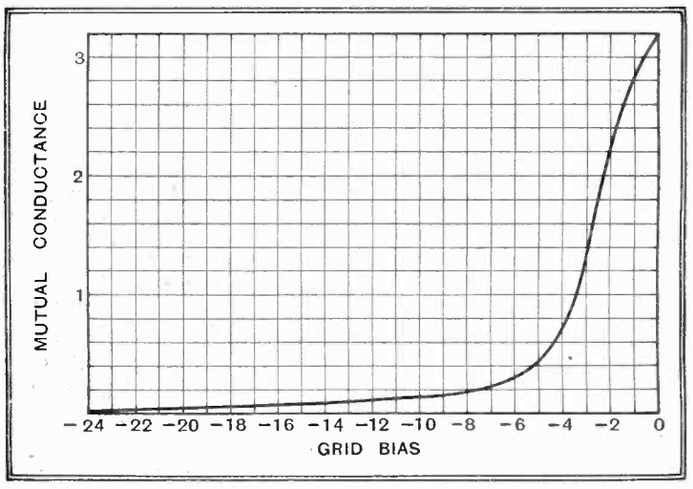


Fig. 2.—The mutual conductance of the V.P.4 valve for any bias voltage can be read off from this curve.

Let us suppose that we are using Mullard V.P.4 type H.F. pentodes with an anode supply of 200 volts, and the screens held at 100 volts, the initial bias being −1.5 volts. The curve of mutual conductance with grid bias is shown in Fig. 2. Now in

Delayed Diode A.V.C.—

the majority of practical cases, an H.F. valve is operated with a load impedance of quite small value compared with its internal A.C. resistance, and the stage gain is then equal to the product of the mutual conductance and the load impedance when both are expressed in suitable units. Since the amplification per stage is proportional to the mutual conductance, therefore, we can for our present purposes ignore it and work directly in terms of mutual conductance. As it is much easier to work in terms of decibels than voltage ratios, let us convert the curve of Fig. 2 into one showing the drop in amplification resulting from the application of grid bias to a single valve. This is shown in Fig. 3 for one stage, curve A, and for two stages, curve B, and from this we can directly determine the bias required.

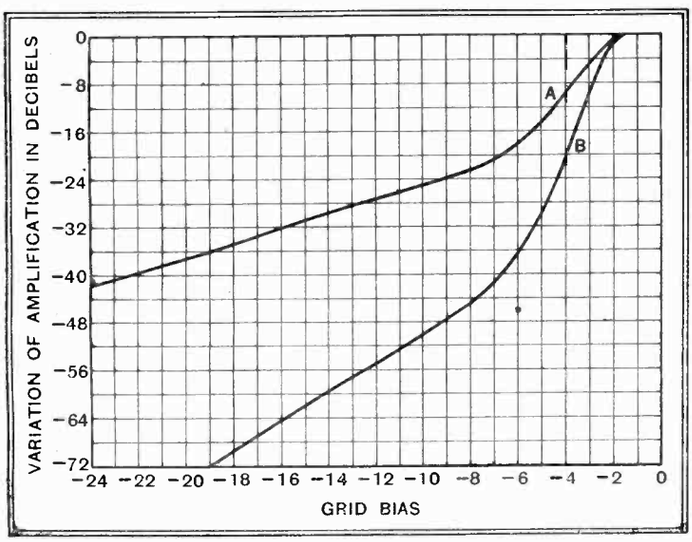


Fig. 3.—The variation of amplification with bias for one (A) and two (B) H.F. stages is shown here.

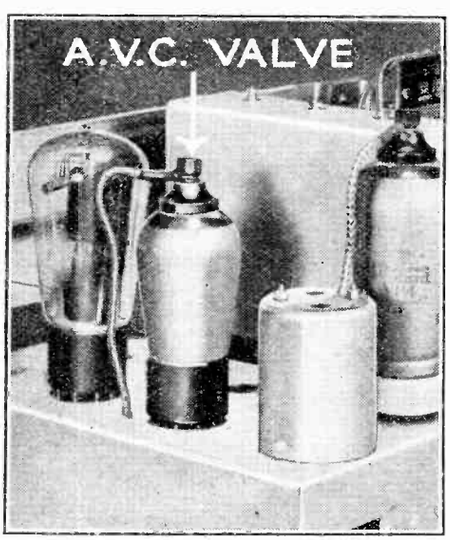
Since the signal input varies by 74 DB, and we permit an output variation of 6 DB, the amplification must vary by the difference, or 68 DB. Curve B of Fig. 3 shows that with two controlled stages the amplification drops 68 DB when the bias is – 17.5 volts as compared with the initial bias of – 1.5 volts. If we assume that this latter is fixed, and does not change with the H.F. valves' anode current, we need a change of bias of 16 volts. This will not be the case when the H.F. valves' bias is derived from a cathode resistance, and then some 17 to 17.5 volts A.V.C. bias will be needed.

The H.F. and L.F. Stages

For a bias change of 16 volts the delay voltage must equal the bias voltage and also be 16 volts. The A.V.C. system will then come into action when the detector input is 16 volts peak, assuming 100 per cent. rectification efficiency, and will be 32 volts peak when the output has risen by 6 DB and the input to the first valve by 74 DB. The rectification efficiency, however, is, in practice, more nearly 85 per cent. than 100 per cent., so that the actual maximum and minimum figures for the detector input will be nearer 37.6 and 18.8 volts peak, or, say, 38 and 19 volts. From the data given it is quite easy to plot the A.V.C. curve of the set, and this is shown in Fig. 4; it is usually unnecessary to do so, however.

The design of the A.V.C. circuit itself thus involves no difficulty; we have now to see, however, how these detector operating conditions will fit in with the rest of the receiver. In the first place, we see that on the weakest worth-while signal, on which A.V.C. just begins to operate, we have a detector input of 19 volts peak. This gives us a D.C. potential across the detector load (R1 of Fig. 1) of about 16 volts, and for 80 per cent. modulation we shall have an L.F. potential of 12.8 volts peak. This is just sufficient slightly to overload a normal pentode-type output valve with resistance-capacity coupling, but if we wish to use a triode we shall have to use a low-gain L.F. stage preceding it, for a transformer coupling does not fit nicely after a diode. In the L.F. circuits, therefore, there is no special difficulty provided that we use a pentode output valve.

Let us now consider the H.F. circuits. The detector input for a strong signal is 38 volts peak, but during 80 per cent. modulation it will rise to a maximum of about 68 volts. The preceding H.F. or I.F. stage, therefore, must be designed to give this output without distortion. When using an ordinary variable-mu valve such an output can hardly be obtained without distortion when the valve is biased for local reception, and the stage preceding the diode cannot, therefore, be controlled. This, in turn, involves the use of three H.F. stages, for it would not be possible to obtain the requisite range of control with only a single controlled stage. With an H.F. pentode, however, it should be just possible to obtain the necessary output without distortion, so that we can then control the stage preceding the diode and so save an H.F. amplifier, unless this should be needed for amplification purposes. The intervalve coupling is not without importance, however, for in the foregoing it has been assumed that it is of the single tuned circuit type. If a band-pass filter be used, as in many superheterodynes, the valve preceding the detector must be designed to give a distortionless output of at least twice the maximum detector input required, or, in this case, 136 volts peak. This obviously leads to serious difficulties with this method of A.V.C.



In the duo-diode-triode valve, often employed to give delayed diode A.V.C., the terminal on the top of the bulb is for the triode control grid. (Ekco Model 74 Superheterodyne.)

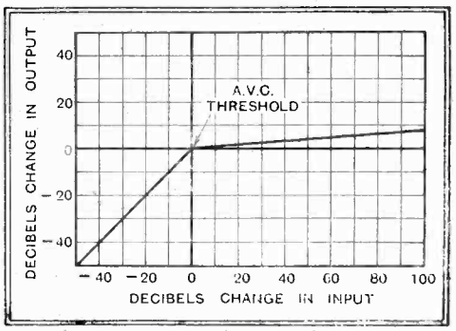


Fig. 4.—The A.V.C. curve for the conditions laid down in the text takes the form illustrated. For signals stronger than the delay voltage, a change of input of 100 D.B. affects the output by only 9 D.B.

H.F. Stage Gain

Let us now see whether we can obtain from two stages the degree of amplification which has hitherto been implicitly assumed. The minimum detector input is 19 volts peak, or 13.4 volts R.M.S., and the input to the first valve is 1 millivolt. The amplification required, therefore, is 13,400 times, so that the stage gain of each valve must be 116 times for a total of two H.F. stages. Now the amplification per stage is roughly equal to the mutual conductance in mA/V. multiplied by the load impedance of the valve in thousands of ohms. The mutual conductance at minimum bias is 2.4 mA/V., so for a stage gain of 116 times the load resistance must be 48,400 ohms, or, say, 50,000 ohms. This is by no means an abnormally high figure, for even air-cored coils of the small screened type rarely have a dynamic resistance lower than this.

In theory, therefore, there is no difficulty in meeting the requirements which we have assumed. In practice, however, we may find it difficult to obtain the requisite H.F. amplification. It is a common experience that two H.F. stages with air-cored coils are unstable unless the anode connections to the coils are tapped well down, or unless unusually effective screening is adopted. It is a matter of considerable difficulty to obtain an amplification

Delayed Diode A.V.C.—

per stage as great as 116 times when two stages are employed without meeting instability problems. It is by no means difficult to obtain this amplification from a single stage, but with two stages it is another story.

It is usually more satisfactory, therefore, to adopt an A.V.C. circuit which does not call for such a large detector input, for then we can use a smaller degree of H.F. amplification and make up for the reduced sensitivity by increasing the L.F. amplification, and in the long run this will often prove the cheaper course. In the case of a superheterodyne, however, this does not necessarily apply, for it is by no means impossible to obtain an amplification much greater than 116 times from a single I.F. stage, and the remaining amplification may be given by the first detector or an H.F. stage. Since the amplification in the different stages is obtained at different frequencies, instability problems rarely arise.

Battery and D.C. Sets

In the case of battery and D.C. mains sets there is no real alternative to the delayed diode A.V.C. system for the reason that other methods require a source of voltage additional to the normal H.T. supply for their operation, and this is not usually obtainable in a convenient manner. In an A.C. set additional voltages present little difficulty, and we can employ amplified delayed A.V.C. or delayed square law A.V.C.

It should be pointed out, however, that the difficulties attendant upon the use of delayed diode A.V.C. are greatly reduced if the circuit is designed to give a lesser degree of perfection. If no account be taken of the local station, and the system be designed to give a substantially level output on the weakest to the strongest of distant stations, it will still counteract fading, and a much smaller delay voltage can be used with a consequent reduction in the normal detector input. This will ease the design of the H.F. circuits and permit a more normal value of L.F. amplification to be used. In order to permit undistorted local reception, however, a local-distance switch must be fitted.

There is, however, a modification of delayed diode A.V.C. which considerably reduces the difficulties attendant upon its use. This is when the control is not confined to the pre-detector stages, but is arranged to operate also upon a variable-mu L.F. valve. It is then unnecessary to restrict the detector input variations to a 2-1 ratio to obtain good A.V.C., and a very much wider range is permissible. This in turn means that a lower delay voltage can be used with less detector input.

It will be seen, therefore, that the delayed diode A.V.C. system is not necessarily the best, but it has been selected here for description because it is the fundamental circuit upon which most other methods are based, and because the methods of design which have been adopted are capable of simple extension to cover many other circuits. It is hoped to deal with these other arrangements in a further article.

DISTANT RECEPTION NOTES

Progress on American 500 kW. Station

WORK on WLW's new 500-kilowatt transmitter at Cincinnati, Ohio, is, I hear, proceeding rapidly. The great 800-foot mast which is to form the vertical aerial is now nearly completed, and it is being used at times for tests with the old transmitter. Since American stations continue to come in well, any reader who is using his set in the small hours may find it worth while to tune to 428.3 metres (700 kilocycles) in search of WLW. During the last twelve months transatlantic stations with wavelengths above about 350 metres have not been too well received, but if history repeats itself stations on higher wavelengths should be well heard during the coming autumn and winter.

During the present month the new 20-kilowatt Lisbon transmitter is due to come into action. Tests may begin at any time now, and the wavelength will probably be that of the present Lisbon station, 282.2 metres (1,063 kilocycles). This will be a Government station, the first of a chain to serve the whole of Portugal. The Lisbon programmes will be relayed for the Portuguese Colonies as heretofore by the short-wave transmitter CT1AA on 31.25 metres. There is a possibility that the aerial power of the short-wave station may be increased to some extent.

Beromünster is showing extraordinary strength at the present time, and I have frequently obtained reception from this station at full loud-speaker strength during daylight hours. Other "daylight" stations on the medium waves are Brussels No. 1 and No. 2, Langenburg, Hilversum (Huizen programmes), Prague, Leipzig, Breslau, Poste Parisien, Fécamp, Trieste, with occasionally Strasbourg, Rome and Heilsberg.

Oslo is now usually quite clear of interference, though both the Eiffel Tower and Warsaw are occasionally jammed. There is a small amount of fading on the medium waveband, particularly amongst stations with wavelengths above 450 metres.

Heterodyne interference is not serious at the present time on the medium waveband. The only important stations that have been at all affected are Bari, Turin, and Florence. With the increase in all-round field strength that must occur during the next few weeks rather more heterodynes are to be expected, and it is quite possible that on this account the number of stations receivable free from interference may be smaller during the darker months than it was during the summer—a complete reversal of the old ideas about long-distance wireless reception!

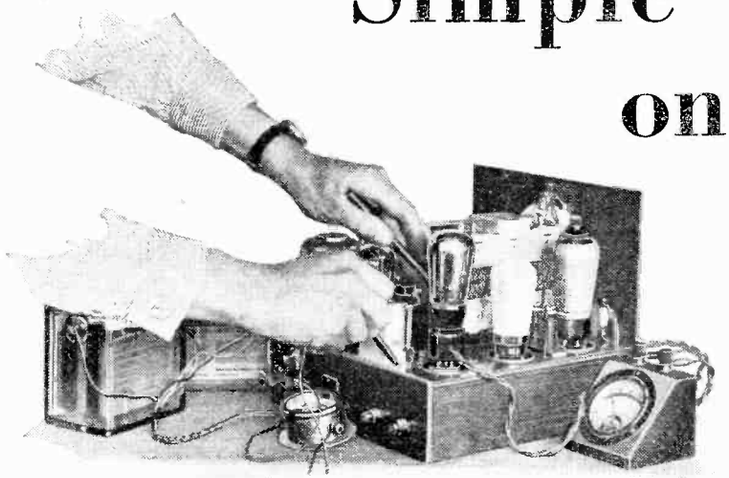
I am still at a complete loss to account for the behaviour of Brno. For perhaps half a dozen months on end we hear absolutely nothing of this station, and then comes a night when Brno is received as strongly and as well as, say, Toulouse. One could understand it if the station were heard fairly well on some nights and very well on others, but the sudden change from complete silence to very big signal strength is puzzling. It is interesting to note that the other big Czechoslovakian station, Bratislava, is also remarkable for intermittent reception. In this case, though, the "good" nights are much more frequent, and I do sometimes hear the station rather feebly.

Motala is now amongst the best of the long-wave stations, other excellent transmissions being Oslo, Luxembourg, Zeesen, and Radio-Paris. In addition to those mentioned as providing daylight reception, the pick of the medium-wave stations are Toulouse, Milan, Göteborg, Nürnberg and Katowice.

D. EXER

MODERN MODES IN AMERICA. This scene at KYW, the broadcasting station in the heart of the great Chicago Exposition, typifies the modern trend in studio fittings and furniture. The announcer's desk is close to the Control window.

Simple Measurements on Receivers and Components



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

MANY practical tests on receivers are suggested in this article, which should be read in conjunction with the contribution on the same subject which appeared in last week's issue

Finding Faults and Checking Voltages

WHEN the construction of a new receiver is completed it is always advisable to test the circuits before the high-tension voltages are applied to the valves, for an unexpected short circuit can account for a considerable amount of damage in a fraction of a second. This applies more to battery-operated sets and D.C. mains sets than to mains-operated A.C. receivers. One reason is that the filaments of D.C. valves are more delicate than the heater elements of A.C. indirectly heated valves, the fusing current being smaller for the former. The other, and perhaps more important, reason is that a short-circuited H.T. battery, or D.C. mains, gives a far greater current than that obtained from an A.C. eliminator when the output terminals are short-circuited. This is because the internal resistance of an A.C. eliminator and its associated smoothing circuits is comparatively high, and acts as an effective current limiter.

Damage to valve filaments occurs if the high-tension supply is short-circuited in such a way that the current passes through the valve filaments. In the case of a battery-operated set the negative H.T. terminal is connected to the negative end of the filaments, and therefore if the positive H.T. terminal should accidentally make contact with the wire joining the positive ends of the filaments, the short-circuit current would pass through the latter and burn them out, should the L.T. current be switched off. This is made clear by Fig. 1, in which the dotted line connection represents the unwanted path between H.T.+ and L.T.+, which may be due to an error in wiring, a fault in an intervalve component, or an unsuspected contact between a positive H.T. lead and a positive L.T. lead. The arrows indicate the path of the short-circuit current. With the L.T. circuit closed, the short-circuit current would pass mostly through the accumulator, and the valves would probably not suffer. But the H.T. battery would.

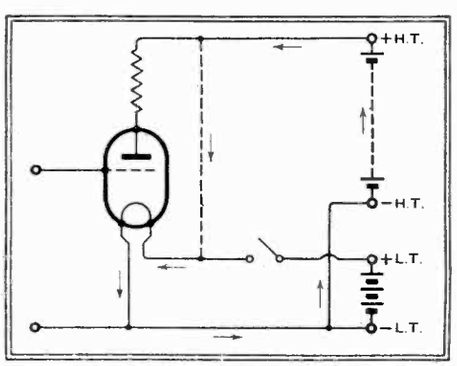


Fig. 1.—How an accidental short circuit between H.T. + and L.T. + leads may result in a burnt-out filament.

It would be interesting to know how many unfortunate ones have had all their valves burnt out through this particular fault! The short-circuit current from an A.C. eliminator would most likely not be sufficiently large to burn out several valve filaments, connected in parallel as they are in an ordinary receiver.

Testing for Short Circuits

In a battery-operated set one does not find a potential divider connected between H.T.+ and H.T.− for the purpose of obtaining an intermediate voltage for screen potentials of H.F. valves; the necessary voltage is taken from a tapping on the H.T. battery. Consequently, the only current coming from the battery under normal conditions is the sum of the anode currents of all valves, from the main positive terminal, and the screen currents of S.G. or variable-mu valves from a tapping point. *These currents can only flow when the filaments are heated* So, with the filament battery disconnected altogether, one of the first tests to make is to ascertain that no current flows in the H.T. circuits. The correct procedure is to connect a *voltmeter* (or the highest *voltage* range of a composite instrument) in the negative lead from the H.T. battery, with all valves in their sockets, as shown in Fig. 2, which is a skeleton diagram giving the normal conducting circuits between the H.T. battery and the electrodes of the valves. A milliammeter could be used instead of a voltmeter if a few thousand ohms resistance is connected in series for protective purposes, as explained in Part I of this article.

If the meter gives a reading there is something wrong, and the seat of the trouble must be searched for systematically by a process of elimination. The fault may be in the wiring or in one of the intervalve components; but it is just possible that there may be an internal short circuit in one of the valves themselves. To test for the latter the valves must be withdrawn from their sockets one at a time, and if the meter reading disappears when one of the valves is taken out of its holder, that particular valve is at fault and must be discarded.

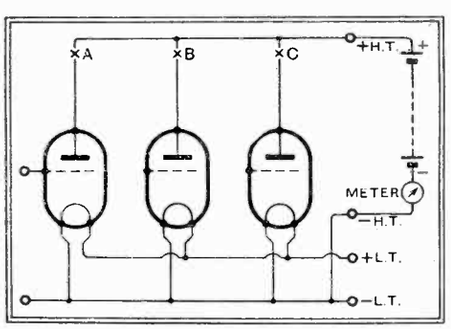


Fig. 2.—Skeleton diagram of a receiver, showing the normal conducting circuits between the H.T. battery and the electrodes of the valves.

If the meter continues to read after all the valves have been removed, there is a short circuit somewhere in the wiring, and the next step is to locate it. The meter should be removed from the negative H.T. lead and connected in turn in the branch leads to the individual anode circuits of the valves, the safety resistance always being included when a milliammeter is used. The correct places are where these leads branch off from the

Simple Measurements on Receivers

main H.T. busbar, as marked at A, B, and C in Fig. 2: that is, between the H.T. supply lead and the corresponding components in each anode circuit. Temporary disconnections will have to be made to include the meter. The valves need not be replaced during this test.

If current is found to flow in one of these anode circuits, the discovery of the fault is near at hand, and there are several likely spots to search. Among possible causes are: (*a*) A faulty decoupling condenser (see Fig. 3); (*b*) electrical connection between primary and secondary windings of an intervalve transformer, or between primary winding and an earthed core; (*c*) a faulty blocking condenser used in conjunction with a parallel-fed transformer or a tuned-grid high-frequency coupling; (*d*) a faulty reaction condenser. The path of the short-circuit current is indicated in each case by the heavy lines in Fig. 3. If all these components are in order, it is possible that a short circuit may exist in the corresponding valve holder itself. However, the process of elimination is continued until the fault is found.

Should the individual anode circuits and the screen-grid circuit prove to be in order, there must be a direct connection somewhere between the positive H.T. busbar and "earth." Examine carefully for wires which may have got bent out of position and come into contact with another wire or the metal chassis. The voltmeter should finally be connected across the loud speaker terminals to ascertain that no direct current flows there.

The same tests can be applied to an A.C. receiver, but it must be remembered that there will most likely be at least one potential divider circuit, which must be opened temporarily during the tests, and *the heaters must be switched off*. The A.C. eliminator should not be used for supplying the testing voltage because, if there is a short circuit in the set, the rectifying valve will be damaged. It is better to use a battery of a few volts connected between the H.T. positive and negative terminals of the set. If the eliminator is built in with the set a temporary disconnection can be made.

Checking Voltages in a Receiver

When it has been ascertained beyond all doubt that there are no faults in the circuits of the receiver, the H.T. and L.T. voltages can be applied with safety. Of course, where grid bias voltages are obtained from a battery, it is essential to see that the latter, after having been tested with the voltmeter, is connected into the circuit before the H.T. and L.T. voltages are applied. If it is a battery-operated set, the voltage of the H.T. battery should also be checked with the voltmeter, but the accumulator supplying the filaments can be relied upon to give the correct voltage if it is in good condition and has been recently charged.

Where the H.T. supply is obtained from an A.C. eliminator the checking of the voltage at the terminals is not so straightforward. There are two main reasons for this, the first being that, owing to the internal resistance of the eliminator, the voltage depends to a large extent on the current supplied to the set, unless a neon stabiliser is connected across the terminals. So the voltage of the eliminator must be measured when it is supplying the normal current. Now, an ordinary voltmeter usually consumes several milliamperes; in fact, it may take as much current as the complete set; and so, if an attempt is made to measure the voltage when the set is being supplied with current, an extra load is put on the eliminator and a false reading is obtained. An electrostatic voltmeter, which takes no current, or a very high-resistance voltmeter would, of course, give satisfactory readings.

To obtain the actual operating voltage of the eliminator with the use of an ordinary voltmeter, the best procedure is to obtain a regulation curve of terminal volts, plotted against output current, and this involves the use of a separate milliammeter, and requires some means of varying the output current. A device for the latter purpose can conveniently be improvised by using the power output valve of the set; it can be made to take different anode currents by varying the grid bias obtained from a battery. The circuit arrangement of Fig. 4 (a) shows clearly how the calibration is made. The milliammeter must be connected on the eliminator side of the voltmeter so as to register the sum of the currents taken by the valve and the voltmeter. The lowest current reading would be that obtained without connection being made to the valve anode, being the current taken by the voltmeter alone; then other readings are taken with the valve in circuit and with various negative voltages applied to the grid. When changing the tapping point on the bias battery, it is absolutely essential to switch off the H.T. first, otherwise the valve will take excessive current in the anode circuit as soon as the grid is disconnected from the battery, and damage may result. The curve obtained will be more or less a straight line, as in Fig. 4 (b), so only three or four points need be found. With this regulation curve available the

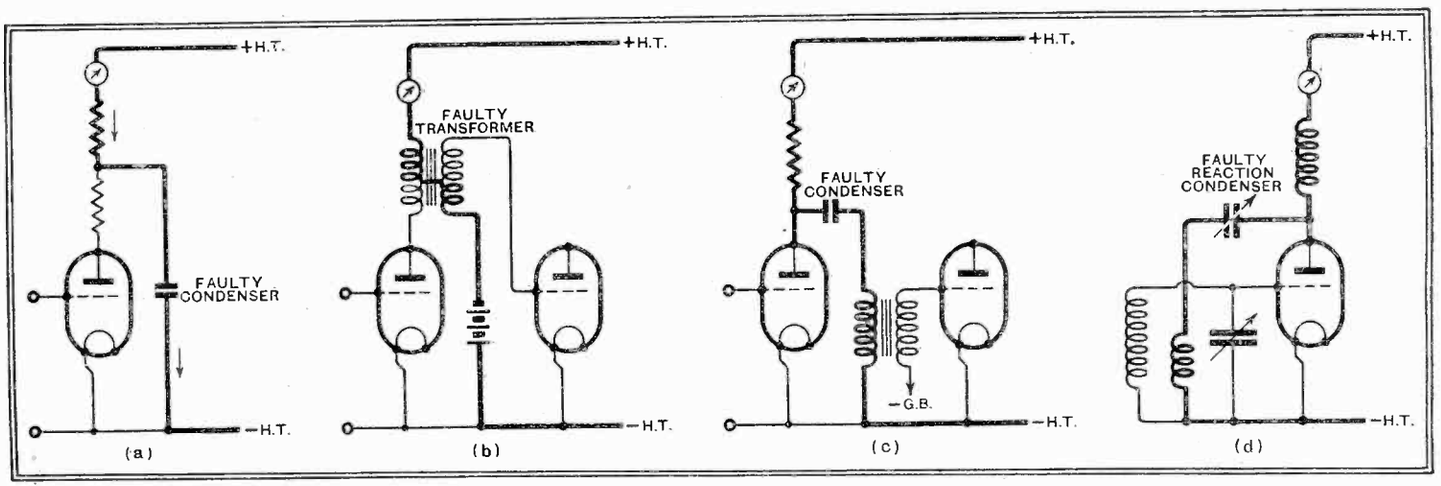


Fig. 3.—Diagram showing how some faulty components are responsible for short circuit or leakage currents. The paths taken by these currents are indicated by the heavy lines.

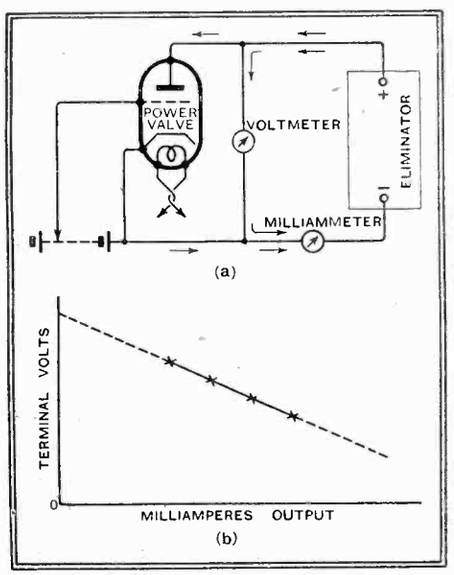


Fig. 4.—(a) How the regulation curve of an eliminator can be found by using a power valve as the variable part of the load. (b) The form of the regulation curve.

Simple Measurements on Receivers

eliminator voltage is known for any output current.

The correct anode current of each valve in the set can be computed fairly closely from the characteristics of the valves used, and these currents are usually stated in constructional articles on specific receivers. So the total current to be supplied by the H.T. battery or eliminator is easily estimated. It is impossible to measure directly the voltages at the anodes, grids, and screens of valves with an ordinary voltmeter, because the resistance of the latter is usually smaller than the resistances of the components in the circuits leading to various electrodes. But if each valve is found to take an anode current approximately equal to the estimated value, it is usually safe to assume that the operating voltages are correct.

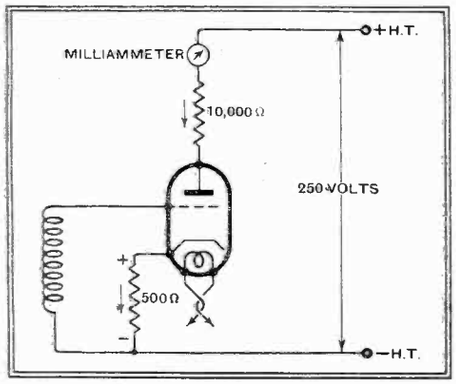


Fig. 5.—Illustrating the example given in the text of finding the anode potential and grid bias voltage.

The first test to make when the supply voltages are applied to the set is to see that the total H.T. current taken is approximately correct, by connecting the milliammeter in one of the leads from the H.T. battery or eliminator. An excessive current may indicate little or no bias voltage at the grid of one of the more powerful valves, such as the output valve. In this event the set must be switched off immediately, and investigations made by examining grid circuits. A bad fault is usually easy to find.

Checking Anode Current

It is more usual to find that the total anode current differs from the normal value by a few per cent. only, but if the discrepancy is greater than 25 or 30 per cent. it is worth while checking the currents in the individual anode circuits, to discover which one is incorrect. Naturally the power valve takes the greatest current and should be checked first. Excessive anode current almost certainly indicates a wrong grid bias voltage, and if the set is provided with "automatic" bias the particular bias resistance must be suspected. To ascertain if this is the seat of the trouble the correct bias voltage could be obtained temporarily from a battery. If the anode current is then correct the trouble has been located, the automatic bias resistance being too low; maybe part or all of it is short-circuited. A faulty decoupling condenser would have this effect!

Another very feasible cause of excessive anode current is the breakdown of the blocking condenser used in choke-capacity or resistance-capacity coupling between the grid of the valve in question and the anode of the previous valve. A breakdown of this condenser results in a high positive potential being applied to the grid of the valve; this state of affairs is very serious, because the grid and anode are now virtually in parallel and carry the greatest current the valve is capable of passing. In these circumstances the cathode would be very quickly ruined.

Insufficient anode current would either mean excessive negative grid bias or low emission of the valve filament (or cathode). If the anode current does not increase appreciably when the grid bias is reduced in value it can be assumed that the valve cathode is incapable of giving greater emission. There may be one of two reasons for this: (a) either the filament or heater voltage is below normal, or (b) the valve is getting old and the emission falling off. The cure in either case is obvious.

Finding Anode and Grid Voltages

The actual voltage between the anode and cathode of a valve can only be measured directly with an electrostatic voltmeter, a rather costly instrument; but if the resistance of the external anode circuit is known the current can be measured with a milliammeter and the voltage calculated. In the same way grid bias voltage obtained from a resistance in the cathode circuit can be found.

Let us take as an example an A.C. indirectly heated valve, with 10,000 ohms in the anode circuit and 500 ohms in the cathode lead, as in Fig. 5. The milliammeter is connected either in the cathode lead or the anode lead for a triode. Suppose that the current is found to be 6 milliamperes, and that the eliminator gives 250 volts at the terminals. The voltage drop in the anode resistance is $0.006 \times 10{,}000 = 60$ volts, and in the 500 ohm bias resistance it is $0.006 \times 500 = 3$ volts. The total voltage drop in the external resistances is therefore 63, and so the voltage between the anode and cathode of the valve is $250 - 63 = 187$ volts. The cathode is 3 volts positive with respect to the grid, and so the grid bias is -3 volts.

In the case of a screen-grid valve the bias resistance carries the sum of the anode and screen currents, so in finding the grid bias the milliammeter must be connected in the cathode lead. To find the anode-to-cathode voltage, calculate separately the voltage drop in the anode resistance and in the bias resistance from the individual currents measured in each. Subtracting the sum of these voltages from the eliminator voltage gives the anode potential with respect to the cathode.

The few examples that have been given here should serve to show how useful one or two meters can be. All the tests described for a newly constructed receiver can equally well be applied to one already in use, and faults may be traced with a minimum of trouble and expense. Many other uses will suggest themselves, not only in tracing faults, etc., but in connection with the operation of the receiver. For instance, a milliammeter in the detector anode circuit enables accurate tuning to be effected visually; and a milliammeter in the anode circuit of any L.F. amplifier valve or the output valve enables one to detect overloading.

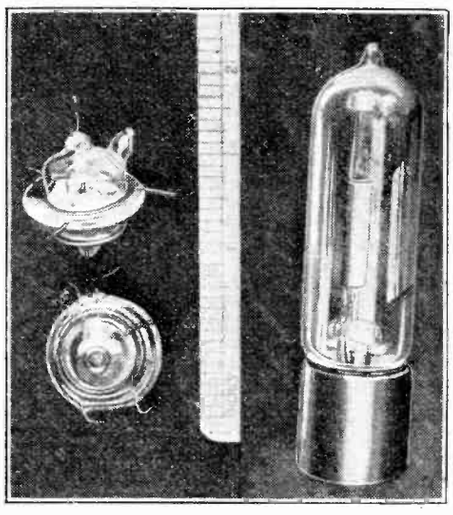
Short Wave Valves

Development of Minute Types

NEW work on the development of valves for use at wavelengths below one metre has recently been described in America.

Disregarding the generally accepted idea that to get oscillations and amplification at lower wavelengths required trick circuits with conventional valves, it was decided instead to remake the valves and use them with conventional circuits. This has now been done experimentally; to make valves work at wavelengths ten times as low as present valves, the dimensions of the valves were reduced by a factor of ten. Reducing the physical dimensions did not change the characteristics, but the inter-electrode capacities were reduced and the limiting wavelength could be taken down much lower. Designers have been successful in making valves which oscillate beautifully at 100 centimetres in well-known circuits and which oscillate without difficulty, though with less power, at 40 centimetres.

Not only will these valves oscillate—they will amplify. Thus at 100 centimetres a stage gain of about 4 with a screen grid valve is not difficult.



Two of the new valves (approximately actual size) are shown on the left. The valve on the right is a Weco peanut for comparison.

It sounds simple to reduce the dimensions of a valve by a factor of ten, but the problems are many. According to one correspondent the point has not been reached where these diminutive valves can be made in quantity. The tolerances between elements are so small that slight changes in geometry produce large changes in electrical characteristics. But good progress has been made: new valves working well at one metre and less have been made—and television seems nearer. For it is certain that television must go on the ultra-short wavelengths, certainly of the order of 5 metres.

News of the Week

Current Events in Brief Review

There's a Reason

NO fewer than 30,000 Austrian wireless users have refused to pay radio licence fees for "political reasons."

Here and There

THE Berlin Radio Show, which was open for twelve days, attracted 210,000 visitors—a figure which is considered disappointing in view of the fact that two extra days were allowed, together with a special "Popular Day" with an admission charge of only 6d.

The Olympia Radio Show in London was visited by 225,000 persons in nine days.

More Listeners in Ireland

OVER 5,000 additional wireless licences were issued in the Irish Free State up to the end of July, and the total number is now 36,228.

Medical Radio Code

A CODE of words which should completely cover the needs of medical diagnosis and treatment by wireless will be contained in Volume II of the new International Code of Signals for Shipping which is to come into use on January 1st, 1934.

THE ORIGINAL 2LO. Marconi House, Strand, a London landmark for twenty-one years, photographed last week-end during the Marconi Company's removal to Electra House, Victoria Embankment.

B.A. Studies Television

TELEVISION experiments by the Marconi Company are a feature of this year's British Association meeting which opened at Leicester on Wednesday last, September 6th. Demonstrations are being given of television images on a screen 4ft. square. Fifty line images are shown with a repetition frequency of approximately fifteen per second.

A Necessary Accomplishment

THE view that everyone should have a working knowledge of wireless is supported by the French Minister of National Education, who dwells on the importance of wireless in the school. All teachers and others in authority, he declares, should be capable of assembling and maintaining a simple radio receiver.

Should Club Members Specialise ?

AN interesting scheme is being adopted by the Thornton Heath Radio Society. During the coming winter each member will make himself thoroughly familiar with a particular phase of radio reception. This should be a great assistance in enabling members to help each other to the best advantage.

B.B.C. : What Hungary Thinks

HUNGARIAN listeners have just registered their preferences in regard to the programme material of the various European countries. The countries are given in this order: Austria, Italy, Germany, Poland, France, Rumania, and Great Britain.

Anti-fire Radio

THE forest fire menace has been tackled by radio methods in the Marseilles district. On the wooded heights near the coast seven wireless transmitters have been installed, and during the hot season they are manned by sentinels, ready to communicate immediately with the Marseilles Fire Brigade on the outbreak of fire.

Another French High Power Station

"A FORMIDABLE instrument for radiating French Southern thought throughout the world" is the description applied to the new Toulouse-Pyrenees broadcasting station now nearing completion near Murat on a plateau some 700 feet above sea level. Its power will be 120 kW. The station, which is the property of the State, is not welcomed by the adherents of Radio Toulouse, who declare that the newcomer is quite unnecessary.

Short Waves from Bandoeng

MR. J. F. W. DE KORT (call sign PK1WK) of Bandoeng, Dutch East Indies, is transmitting on a wavelength of 49.42 metres. His schedule is as follows:—9.30 till 11.30 a.m.; 12.30 to 1.30 p.m.; and 11.45 p.m. to 12.15 a.m.

"Ultra Shorts" from Yacht

ULTRA-SHORT wave transmissions from a yacht cruising in the Solent will be undertaken by Mr. S. G. Morgan (G6SM) on Sunday next, September 10th. It is expected that transmissions will last from 10 a.m. to 6 p.m., and during this period an attempt will be made to keep in continuous touch with G5BY and G5NN located on Beachy Head.

Reports will be welcomed by G6SM at 3, High Street, Croydon.

Sir John Cass Institute

COURSES in electricity and magnetism are included in the curriculum of the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C., which resumes classes on Monday, September 25th. Students will be enrolled during the preceding week.

The science courses, which include the electrical studies, are held from 6 to 10 p.m., and full facilities are provided in well equipped laboratories for special investigations and research.

2LO "Closes Down"

MONDAY last, September 4th, saw the final closure of what was originally London's first broadcasting station. Marconi House, Strand, which was London's principal radio landmark before the war, has been vacated by the staff of the Marconi Company, who now occupy a section of Electra House, Victoria Embankment.

Marconi House, originally an hotel, was one of the first buildings in London to carry wireless masts, and it was the obvious choice in 1922 when the British Broadcasting Company sought a transmitter site in the heart of the capital. The original 1½ kW transmitter was housed near the roof, and had a remarkably good service area until superseded by a new transmitter on the roof of an Oxford Street store.

During the war Marconi House was an important receiving base for enemy wireless propaganda, and was also used for wireless research, particularly in the development of the thermionic valve.

Clubs and the Tax

THE new wireless tax is having a bad reception in France, and all kinds of pleas are being put forward by various interests in the hope that the Government may be induced, in special cases, to remit the fee. The radio clubs are especially vocal. They are championed by Dr. Fobeau de Courmelles, President of the National Federation of Radio Clubs.

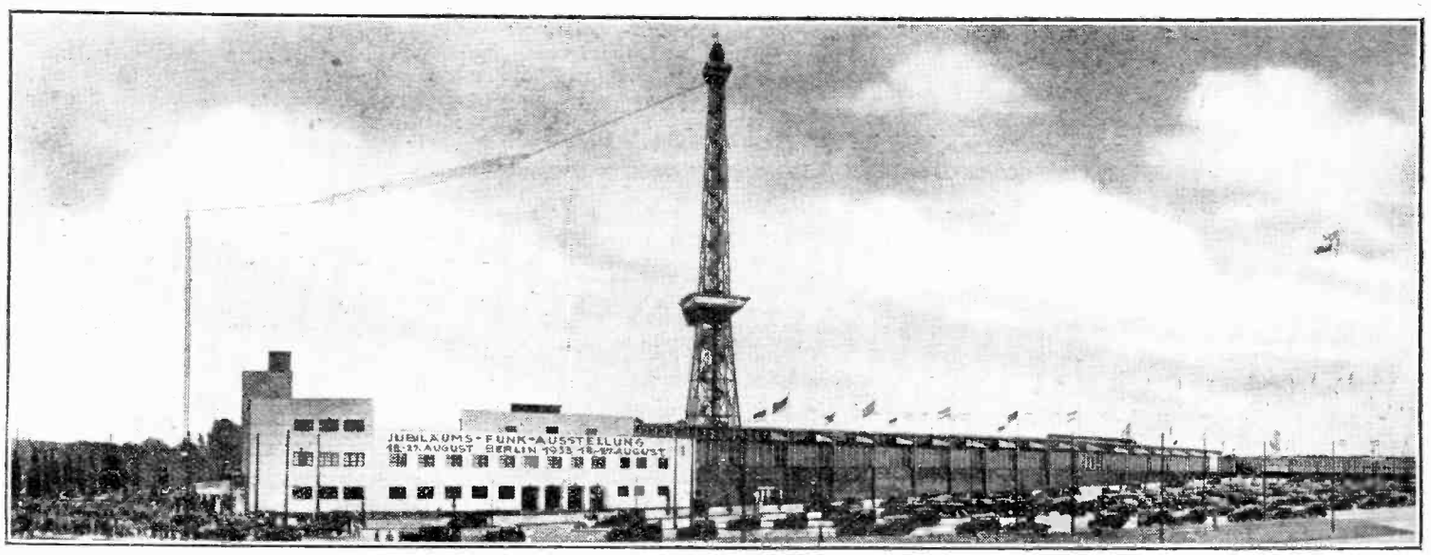
The clubs, he points out, use their sets, not for broadcast reception, but purely for experiments and instruction to their members. The members, it is claimed, act as "benevolent recruiting sergeants for radio," increasing the number of licence holders as well as burning out numerous valves for the benefit of the tax collector. (In France there is a special duty on valves.)

Marchese Marconi's private laboratory in the throes of removal last Saturday. Micro-wave apparatus had to be handled with special care.

"Ultra Shorts" in the Transvaal

THE Transvaal is developing an interest in the ultra-short waves, and we learn from a correspondent at Witbank that the amateurs in that area are arranging a series of tests.

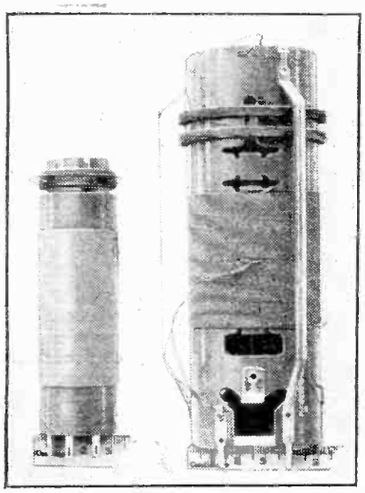
There has been a considerable revival of radio interest in South Africa on account of the reliability of the B.B.C. short-wave service.



The Berlin Radio Show

A Review of the Exhibits

THE German Radio Show, which has just been held in Berlin, has received greater publicity and probably provoked more interest than any previous Berlin Radio Exhibition, partly for the reason that this year broadcasting has taken such an important position in political and Government affairs. The general appearance of the Exhibition this year has undergone



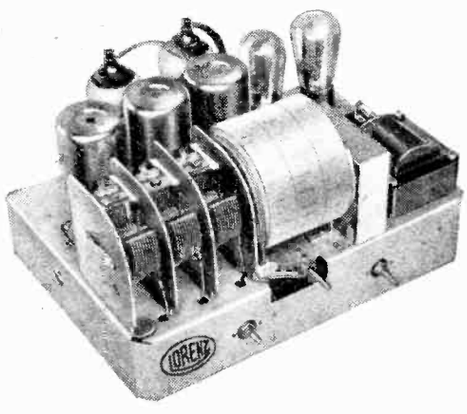
Examples of the new coil assemblies as generally used in the new German broadcast receivers.

a definite outward change indicative of the importance which the German Government now attaches to broadcasting as a means of propaganda. We are, however, not concerned here with the political aspects, and must confine our attention to a review of the technical progress which the exhibits at the Show revealed.

The set manufacturer has had the advantage of new valves of types similar to the new valves in this country to assist him in his designs, and the result is increased range and selectivity of receivers, a large number of superhets, including those employing only a few valves, and automatic volume control in all the more important models.

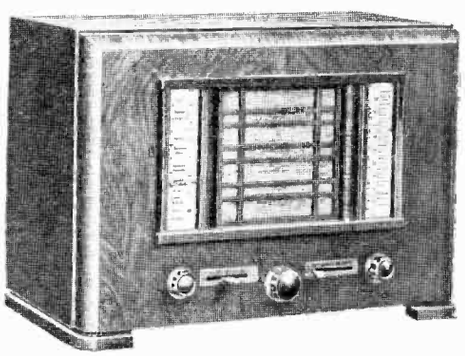
THIS YEAR'S radio show in Berlin was described as a Jubilee since it represented the 10th consecutive Exhibition since Broadcasting began. In the German receivers the greatest ingenuity is displayed in tuning arrangements and other mechanical devices rather than in originality of actual circuits employed. Although not of real technical interest, the introduction of the People's receiver was perhaps the most spectacular feature of the show.

In view of the need for increased selectivity, practically all receivers have employed coils of high efficiency, and the solid dielectric type of condenser which was popular in Germany in previous years has been replaced by well-built air dielectric condensers. The coils are almost invariably built in cylindrical form with stranded Litz wire. This improvement in tuning circuits has resulted in the appearance of even simple two-valve sets with tuning scales calibrated in station names.



Tuning drum rotatable through 360 degrees in the Lorenz three-circuit receiver.

The German receivers this year are notable for the variety of types of tuning dials, nearly all with station names, and mostly indicating these clearly with illuminated scales. The scales are of very varied construction. One firm, Lange, has two vertical scales, one on each side of the loud speaker; the left-hand scale gives the long-wave station names, and the right-hand those of the 200-600-metre band and the short-wave stations. Another firm, Lorenz, employs a very large drum scale with the station names in three zones side by side; this scale rotates through 360°. The firm

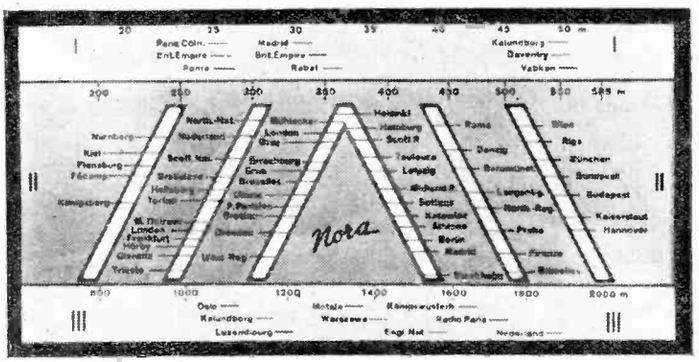


Arrangement of two scales on either side of the loud speaker (Lange).

Dr. Dietz and Ritter uses a pointer situated in front of the scale. Another divides the whole scale into several separate parts, and these three-wave zones are so arranged that only the correct one lights up. Siemens have developed a particularly original tuning device, the "Area" scale. In this there is a transparent band divided into various parts corresponding to the various German station groups and the groups of foreign transmitters. By means of a knob the wanted zone is adjusted behind the spy window. In this way the listener can always find the stations belonging to one locality grouped together. The scale also contains a zone in which all the stations are combined.

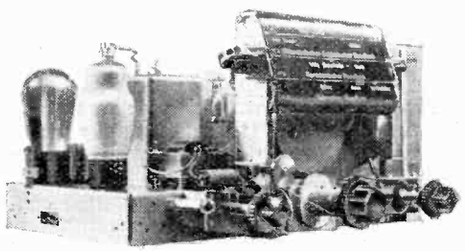
The Berlin Radio Show.—

Scale illumination is so arranged to-day in all German receivers that the lamp can be easily changed. In all new German receivers the chassis are made of steel throughout. In many cases, in the effort to simplify tuning the wave scales are arranged in the sloping-deck fashion at the top of the receiver. The number of knobs has been kept as low as possible; knobs fulfilling the same kind of functions are often placed on a common spindle. Almost everywhere it has been arranged that only the appropriate parts of the wave scale light up. Examples of chassis are seen in the illustrations.



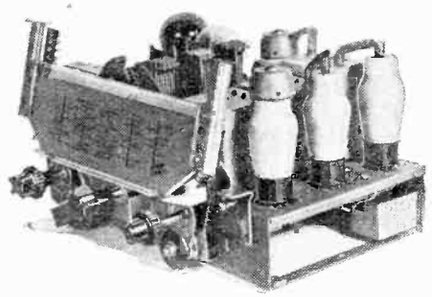
Another tuning scale for three wave ranges (Nora).

A great deal has been heard about the



"Areas" (geographical) scale in Siemens chassis.

People's receiver. A first order for these was for 100,000; before the Show 30,000 of these were sold; and by the end of the first few days of the Show another order for 100,000 had to be placed. This receiver is built in three different types—one for D.C., one for A.C., and one for battery supply. Both the mains types have two valves, a screen grid, and a pentode of 3 watts output. The battery receiver has three valves and employs a Class "B" output stage. The



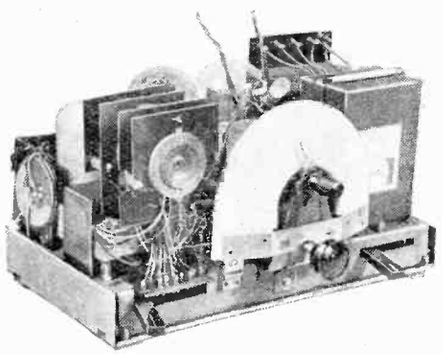
Chassis of a big superhet.

A.C. receiver is in a bakelite case, the others in cases of wood. The chassis is similar in all the receivers; the components are the same throughout, although twenty-eight different German manufacturers build the receivers. The external appearance is also the same, whatever the firm. Every receiver has a moving-iron type of loud speaker. The wave scale in the People's receiver is not calibrated in station names or wavelengths. The receiver has three adjusting knobs—on the left the aerial coupling, in the middle the wave adjustment, on the right the reaction coupling. All the components have to be approved by the Heinrich-Hertz Institute in Berlin. The receiver gives reliable reception of the nearest high-power stations and the Deutschlandsender, and also several powerful distant stations. It has no provision for short waves.

In addition to the People's receiver, which has only one tuning circuit, the industry has built other single-circuit receivers in large numbers; almost all these have provision for short-wave reception, embody a wave-trap circuit, and, as a rule, are so built that the constants of the aerial do not affect the tuning adjustment, so that the receiver can be calibrated in wavelengths.

Simple replacement of the illuminating bulb.

The three-valve two-circuit receiver and the four-valve three-circuit receiver are still being turned out in Germany, but the selectivity has been considerably increased by the use of the new high-frequency pentodes and the low-loss tuning circuits. The two-circuit receiver is almost always provided for short-wave reception. A novelty for

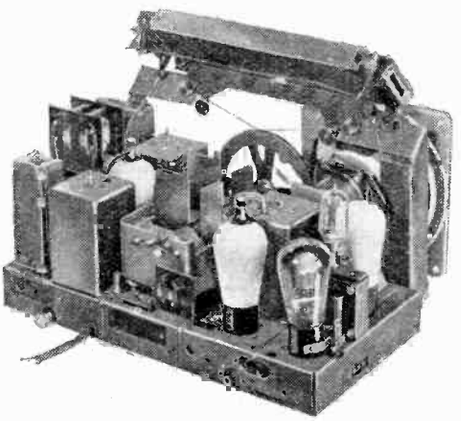


Chassis of the Telefunken two-valve receiver.

Germany, on the other hand, is the three-valve superhet. A volume control and a tone adjuster are always provided. The selectivity is obtained by varying the band filter damping. Most firms build this set to include short-wave reception.

Then comes the four-valve superhet. This has a preliminary stage with high-frequency pentode. It is worthy of note that the Stassfurter Broadcasting Company, in this and in its five-valve superhet, uses coils with iron cores in all important positions.

A mixing and A.V.C. hexode, a high-frequency pentode as preliminary valve, and



Chassis of the Telefunken three-circuit receiver with four valves.

a binode, usually containing a screen grid amplifier stage, and a six-watt output pentode are the valves used in the big superhets. These are of very high quality, and all possess a so-called interference barrage—that is, an arrangement by which the sensitivity is decreased when interference becomes too strong. This is carried out either by a change of amplification of the preliminary valve, its grid bias being regulated by a switch, or by the use of a compensation device (Stassfurter Broadcasting Company), by which the noise level is decreased without affecting the range, sensitivity, volume, or quality. In addition, all big superhets this year are provided with the A.V.C. hexode, which, together with the

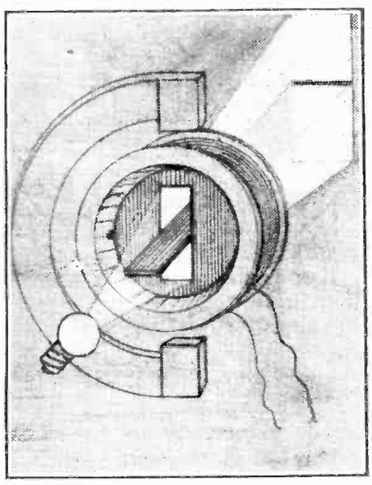
Telefunken four-valve three-circuit receiver.

binode, makes possible the compensation of fading over a very wide range of signal strength. Most big superhets possess also a "crack killer," and all superhets with five and more valves have, also, an arrangement for optical tuning. Several very different methods are employed for this: Telefunken, Siemens, and the A.E.G. use a shadow instrument; above the wave scale there is a small window with a ground glass disc illuminated by a small glow lamp. In the beam of this lamp there is a small rotatable mag-

The Berlin Radio Show.—

netic armature, which normally screens the whole beam. The armature can be moved out of its normal position by means of a coil through which the current to the loud speaker passes. At the maximum strength of signal the shadow cast on the ground glass by the armature is at its narrowest. Other firms use a glow lamp fed by the loud speaker voltage; in these lamps the length of the glow depends on the loud speaker intensity. Still other firms use a milliammeter in the anode circuit of the detector valve, the reading indicating the strength of a signal. All big superhets have a tone control and a manual volume control. A novelty in many new German receivers is the provision of a reading lamp, enabling the programme journal to be read even in a dark room.

Worthy of notice is a receiver which can be used either on D.C. or A.C. mains; for A.C. mains one rectifier valve must be inserted (Loewe).



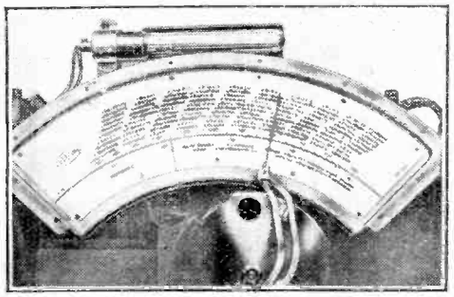
The principle of shadow tuning.

Numerous short wave adaptors have been produced this year. They are all based on the superheterodyne principle.

The battery receiver is not much in demand in Germany this year. It may be assumed, however, that even this season more battery receivers will be turned out as soon as the valve makers have produced the special valves now being developed.

The number of motor-car receivers has been added to by Telefunken. Their receiver is a four-valve superhet.

The moving-coil loud speaker rules the loud-speaker market in Germany this year. The permanent magnet type has been greatly improved.



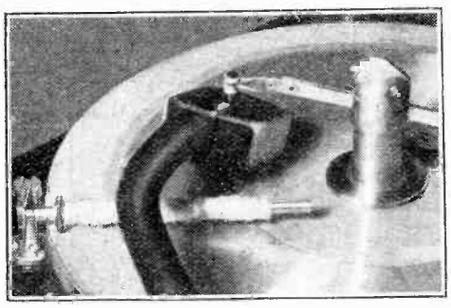
Saba Jubilee super with station names in staggered form.

The Trautonium is now officially sold by Telefunken; it has a quite new form and differs from previous models by possessing two "formant" (tone forming) circuits.

In the field of home recording of gramophone records a whole series of improve-

Telefunken motor-car receiver. Control box on the steering column. Inset: The four-valve superhet receiver.

ments have appeared. Telefunken has produced a high-grade portable instrument, in which, by the introduction of a different needle, the recording sound box can also be used to reproduce the record. Similar equipments are turned out by Grass and



An arrangement for winding up the cut shaving when recording.

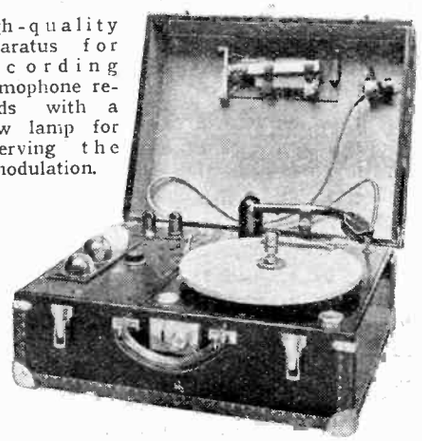
Worff and by Budich. The Telefunken apparatus is a high-quality instrument.

A notable Telefunken novelty is the provision of a small rotatable shaft passing across the record in front of the recorder; this rolls up the shaving as it is cut. Numerous new microphones are exhibited, of which the Telefunken new "amateur" microphone is a good example. A new condenser microphone has appeared by von Ardenne.

In the field of components there are not very many, but still a few, novelties.

The Gautzsch Gluelicht Company has developed a testing set which should be particularly useful in the hands of radio traders. At the top of this instrument there is a long glass window. On this there are various signs; for example, the words "Faulty," "Filament Break," "Grid Displacement," "Too little Emission," and so on. If the valve to be tested is pushed into the sockets provided and the knob pressed, the writing on the glass window becomes visible corresponding to the fault shown by the valve. The firm Bittorf and Funke shows a testing set, displaying a whole number of sockets. The firm supplies a template for every type of valve purchasable in Germany. When such a template is laid over the sockets it gives access only to those required for the testing of the particular valve. A switch is provided which shows a large number of circuit connections corresponding to the volts to be tested for. If the switch is turned from one position to another, an indication is given whether the valve displays the fault corresponding to that position of the switch.

The firm Abrahamsohn makes an instrument for the checking of valve characteristics. This has a transparent glass window divided into squares. Over this window two pointers move; one is connected to the resistance regulating the grid bias, while the other is connected to the moving coil of a meter in the anode circuit of the valve under test. The crossing point of the two pointers gives the anode current corresponding to a given grid bias. Transparent discs can be



High-quality apparatus for recording gramophone records with a glow lamp for observing the modulation.

laid on the glass window on which are marked the valve characteristics of the various valve types on the market. If the valve is a good one, the crossing point of the two pointers must agree more or less exactly with the characteristic line on the disc.

The elimination of interference takes an important place in the Exhibition. New searching equipment for tracing the origin of interference was shown, and kits containing all the various components which anyone can need in order to eliminate the disturbances.

Screened aerial down leads and their accessories have been particularly developed this year, numerous firms participating in this, including Telefunken, A.E.G., Kathrein, Lindner & Co., Pawlick, Ehrl, and others.

In next week's issue a description of the television section of the Berlin show will be included.

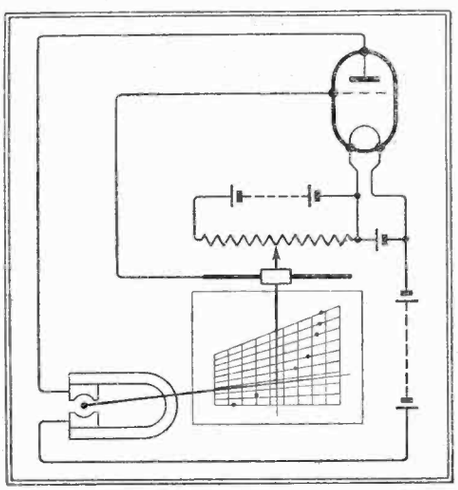
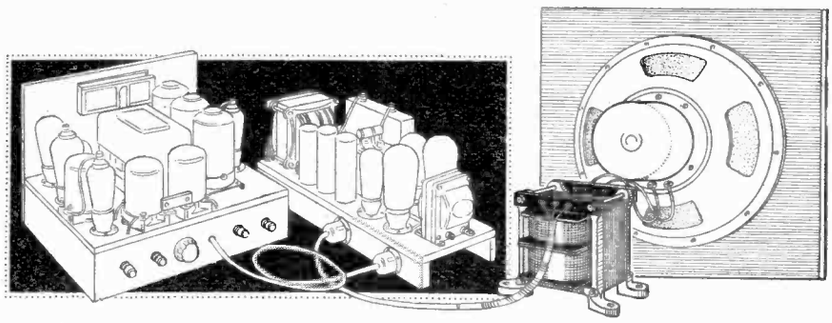


Diagram explaining the principle of an apparatus for checking the valve characteristics.

Push-Pull Output Transformers

A Special Design for the New Monodial Super



THE choice of a suitable output transformer is a matter requiring no less care than the selection of an intervalve coupling, if the best reproduction is to be obtained. The output stage is designed to work with a definite value of load impedance—in the case of the New Monodial Super it is 10,000 ohms—but it is rare to find that the loud speaker has the precise value required. The two are joined together, therefore, by means of a transformer with its ratio so chosen that the effective impedance of the speaker is altered to the necessary degree. Thus, the speaker may have an impedance of only 1 ohm and the output stage may require a load impedance of 10,000 ohms, but the use of a transformer of 100-1 ratio will result in the equivalent of a 10,000 ohms speaker with a 1-1 ratio transformer.

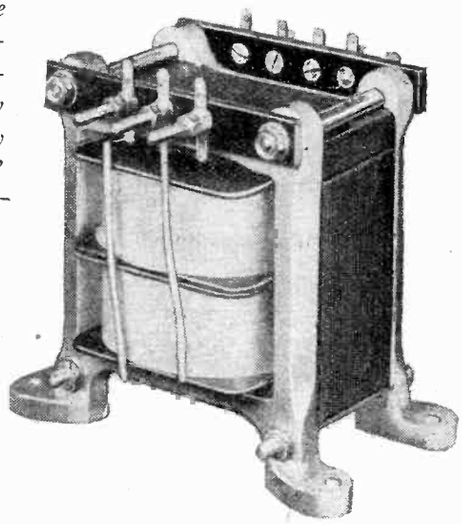
ALTHOUGH the output transformer is often neglected, it can exercise a profound effect upon the performance of a receiver in regard to the quality of reproduction. In this article, constructional details are given of a push-pull component designed especially for the "New Monodial Super."

The question of ratio does not enter into the choice of primary inductance for the transformer, and we can consider the primary as a choke in shunt with the load impedance. Since the reactance of a choke falls with decreasing frequency, it is obvious that the efficiency of transformation will fall at low frequencies. It can be shown that the loss of bass due to this is small if the choke reactance is not lower than the load impedance at the lowest frequency required, but this is not all. As the load and the primary must be considered to be in parallel, the effective load impedance of the output stage falls as the frequency decreases, with the result that the maximum undistorted output obtainable also drops. There is thus a risk of amplitude distortion arising at low frequencies through the use of an output transformer with an inadequate primary inductance.

The Transformer Primary

If this effect is to be negligible, a higher primary inductance is required than is necessary merely for the maintenance of an even response curve at low frequencies, and in general the primary reactance should not be less than twice the load impedance at the lowest frequency required. For a 10,000 ohms load and a low frequency limit of 50 cycles, this means a primary inductance of some 63 H. or more.

The next point of importance is the power rating. It is more a question of the A.C. volts developed across the primary at the lowest frequency than of actual power, however, and with a 10,000 ohms load and a 6 watts output we must allow for a maximum potential of 245 volts across the load impedance. The flux density in the core must not be allowed to exceed a certain figure if amplitude distortion is to be avoided, and it is



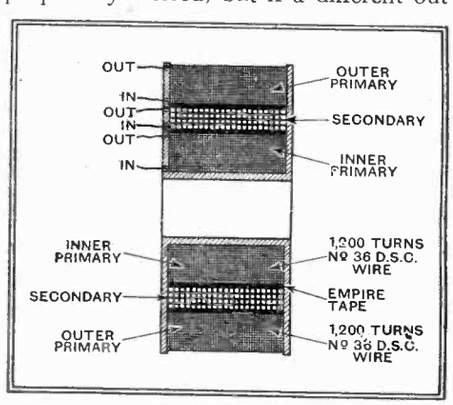
dependent upon the quantity of iron, the number of primary turns, the voltage developed across the primary, and the frequency. For a given voltage and frequency there is a minimum quantity of iron and number of turns which must be used if distortion is to be avoided.

Both primary and secondary resistances must be low if the general efficiency is to be high, and an appreciable proportion of the power delivered by the output stage is not to be lost in the transformer. In theory, maximum efficiency will be secured for a given winding space and number of turns when the secondary resistance is equal to the primary resistance divided by the square of the turns ratio. In practice, however, it is usual to make the secondary resistance rather higher than this for two reasons—because the primary resistance causes a loss of anode voltage on the output stage, and we like to keep this as small as possible, and because when a high ratio is used the secondary wire gauge demanded by theory is apt to become unwieldy. With any reasonable choice of wire gauges the resistance losses are very small.

Leakage Inductance

One of the most important points is the question of the leakage inductance, for this governs the high frequency response, and if it be large there will be a loss of high notes. For a given method of winding, the larger the primary inductance the greater the leakage, so that if we aim at perfection in the bass we run a risk of losing the upper register. Obviously, therefore, we cannot afford to make the primary any higher than is strictly necessary. The leakage inductance, however, is not governed merely by the primary inductance, but it depends very largely upon the physical disposition of the windings, and by properly interleaving the primary and secondary it may be kept at a low value. The self-capacity of the windings is fortunately of no practical importance, and a high self-capacity is beneficial rather than otherwise.

It will be seen, therefore, that the choice of an output transformer is a matter of some importance. The primary should be selected according to the output stage with which it is to be used, and the turns ratio according to both speaker and output stage. If the speaker be changed at any time the secondary winding must be appropriately altered, but if a different out-



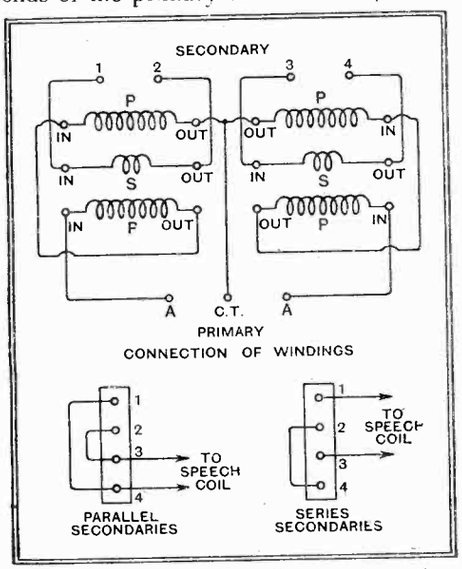
The method of winding can clearly be seen from this drawing of one of the bobbins. The other bobbin is identical save for the direction of winding.

Push-Pull Output Transformers—

put stage be employed, then it is to the primary that modifications must be made.

In designing a transformer for the New Monodial Super, another factor enters owing to the use of push-pull, for this necessitates a centre-tapped primary and a symmetrical disposition of the windings. Fortunately, however, the absence of a direct current through the primary renders the use of an air-gap in the core unnecessary, so that fewer turns and a smaller core can be used than if the transformer were for a single output valve.

The arrangement of the windings can clearly be seen from the drawings. Two identical bobbins are used, each carrying one-half of the primary and one-half of the secondary, and the total primary turns on each bobbin are 2,400. No. 36 gauge D.S.C. wire is used for the primary, and on each bobbin all windings are in the same direction. The two bobbins as a whole, however, are wound in opposite directions, so that the two extreme inner ends of the primary are for connection to



The upper portion of the diagram shows the connections between the windings and the terminals, while the lower gives the speaker connections.

the anodes of the output valves, and the two extreme outers are joined together for the centre-tap. Complete symmetry is thus readily obtainable. The secondaries are connected either in series or parallel, according to the ratio required; in the series connection the two outers are joined together, and the speaker connected to the two inner ends, but in the parallel connection the outer of one winding is joined to the inner of the other, and the outer of the latter is taken to the inner of the first, the two ends thus formed being taken to the speaker.

It is unnecessary to make any attempt at a layer winding for the primary, and it will suffice if the turns are run on as evenly as possible, so that a good surface is maintained for winding the secondary. After winding 1,200 turns a layer of Empire tape should be wrapped round it for insulation purposes, and the secondary can be put in place. Here an even layer winding is essential on account of the thickness of the wire; the turns should be run on evenly and tightly, but in spite of this there will usually be a tendency for the winding to assume a circular rather than a square shape. After the secondary is completed, therefore, the winding should be gently tapped down with a hammer and a block of wood. Another layer of Empire tape should be placed round the winding, and the outer primary section of 1,200 turns can be wound. The second bobbin should be identical with the first, save that all windings should be in the opposite direction.

During winding the formers should be mounted between stout end cheeks to prevent any tendency for the former to collapse; a small winding machine fitted with a revolution counter is a great help, but not strictly necessary. Owing to the fine gauge of wire used for the primary it is a wise plan to solder a short length of heavier wire to the ends for leading out.

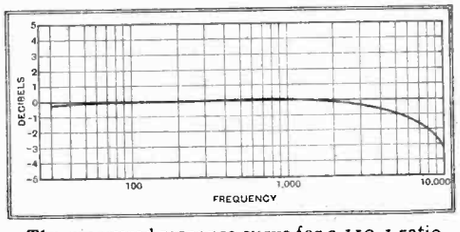
Table giving winding data for transformer secondary turns to match some leading makes of loud speakers.

Speaker.	Speech Coil Impedance.	Ratio.	Secondary Turns per Bobbin.	Wire.	Connection of two Secondary coils.
Magnavox Dual	0.8 ohm	112–1	42	No. 18 D.C.C.	Parallel
Rola Dual	1 ohm	100–1	48	No. 18 D.S.C.	Parallel
Magnavox Single	1.6 ohm	79–1	62	No. 20 D.C.C.	Parallel
Rola Single	2 ohms	70.7–1	68	No. 20 D.C.C.	Parallel
B.T.H. R.K. Senior and Ferranti M.2. and D.3	15 ohms	25.8–1	93	No. 20 D.S.C.	Series
Ferranti M.1	20 ohms	22.3–1	108	No. 22 D.S.C.	Series

Where both secondaries are normally paralleled, one-half the ratio will be obtained by joining them in series, and it will be suitable for matching a speaker of four times the normal impedance. Thus, the 70.7–1 ratio with paralleled windings for a 2-ohms speaker will give a ratio of 35.35–1 when the secondaries are connected in series and will then match an 8-ohms speaker.

The Secondary.

When the coils are completed the bobbins should be placed together and the core inserted. The "T" and "U" pieces are inserted alternatively on opposite sides in the manner of a mains transformer, and when the core is completely filled the end plates can be loosely bolted in place. The core should then be gently tapped home with a hammer, and the clamping bolts finally tightened. Small strips of insulating material carried by the ends of the clamping bolts serve for the terminal blocks, and the method of connection should be clear from the drawings.



The measured response curve for a 112-1 ratio transformer; the loss at 30 cycles is less than 0.5 DB and at 8,000 cycles it is only 2 DB.

The accompanying Table shows the number of secondary turns, the gauge of wire, its insulation, and whether the coils are to be connected in series or in parallel, for a number of loud speaker types in more common use. The component illustrated was built to have a ratio of 112-1, and gave a measured primary inductance of 69 H.; the total primary resistance was only 300 ohms, so that with push-pull valves taking 40 mA. apiece the anode voltage is reduced by some 6 volts only.

The response curve has been measured, and is illustrated here; it will be seen that it is level within 2 DB over the 50 cycles to 8,000 cycles range, and by extrapolation it can be seen that the useful frequency range is considerably greater for a drop of 5DB is probably inaudible.

The materials necessary for constructing the transformer are quite few in number, and consist of:—

100 pairs of No. 4 stampings.
2 half-size No. 4 bobbins.
1 pair of end plates with clamping bolts.
1 lb. No. 36 D.S.C. wire.
1 lb. wire for the secondary.
2 terminal strips, 4 B.A. nuts and bolts, Empire tape.

The transformer iron, bobbins, and end plates employed in constructing the experimental model were supplied by Sound Sales, who would doubtless supply the transformer completely assembled to special order.

Although designed specially for the New Monodial Super, this component may be employed with any apparatus fitted with a similar type of output stage.

NEW BOOKS

Modern Electric Clock, by Stuart F. Philpott. Sir Isaac Pitman & Sons, Ltd. 1933. Price 7s. 6d. net.

This book appears at a very opportune moment, for the adoption of frequency control in the A.C. supply systems of the leading electricity undertakings has stimulated wide interest in synchronous electric clocks. All the leading makes of this type are described and illustrated and the underlying principles fully explained. This section of the book should be of special interest to wireless users as the two subjects meet on common ground at many points.

The information contained in this manual is essentially of a practical nature and covers every type of electrically energised timepiece. It should prove of considerable value in choosing the best type of mechanism for any given purpose and as a guide in installation and maintenance work.

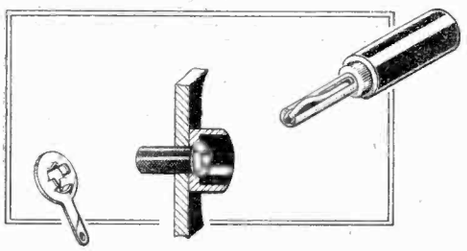
"Broadcast Advertising. The Fourth Dimension," Television Edition, by Frank A. Arnold.—A descriptive and explanatory account of advertising methods in use in connection with sponsored programmes in the United States, including sample advertising programmes. Pp. 284+xix. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., London. Price 18s. 6d.

LABORATORY TESTS

NEW RADIO PRODUCTS REVIEWED

GRIPSO SELF-LOCKING TAG AND SOCKET

OF the many new items recently introduced by the Gripso Co., 28, Victoria Street, London, S.W.1, the Self-Locking Soldering Tag is of particular interest, for it serves the dual rôle of a fixing for the socket and the media for connecting leads. The socket is passed through a clearance hole in the terminal strip, the locking washer is threaded on the back and the whole firmly fixed in position by a sharp blow with a hammer using a special hollow punch. The hole in the tag is provided with a number of serrations which grip firmly both the socket and the terminal strip.



Gripso self-locking tags and sockets, also New Midget wander plug.

Two sizes are available, one with sockets to take $\frac{1}{8}$in. plugs at 8d. per dozen sets and the other for 3/16in. plugs costing 1s. per dozen sets. Sockets with erinoid insulated heads engraved or plain and in two colours, also insulating bushes for use with metal panels are available.

With these the new Midget Wander Plug can be used. This has a solid pin slotted on one side and fitted with a strong flexible spring which ensures a good electrical contact. These plugs are for general purpose use and range in price from 1d. to 2d. each according to size. The special hollow punch and die for fixing the tags costs 1s. 6d.

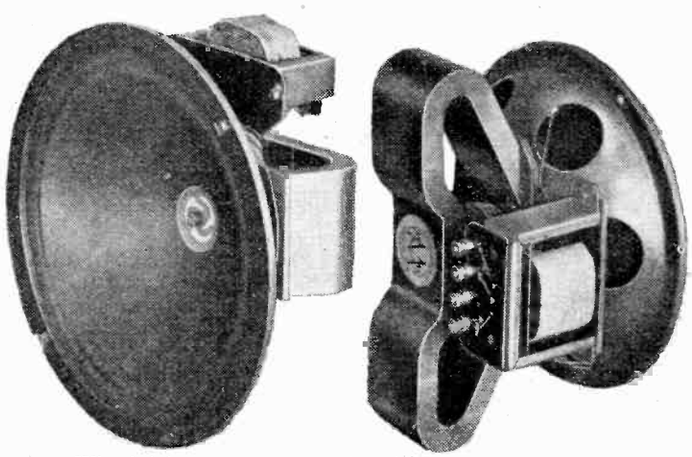
WHARFEDALE LOUD SPEAKERS

THE units submitted for test were the "Bronze" and "Golden" models. Both are notable for their rugged construction and the generous dimensions of the magnet systems. A notable feature is the method which has been adopted to ensure the exclusion of foreign matter from the air gap. Particles falling in towards the apex of the cone are stopped by a fine-mesh gauze behind the centring spider, while the back of the gap is sealed by a sponge rubber ring surrounding the centre pole-piece.

There is little to choose between the two models from the point of view of efficiency and sensitivity. As regards frequency response the "Golden" model has a better output in the bass below 100 cycles on account of its larger diaphragm, and in the extreme top its higher price is again justified. In both models there is an appreciable response at 8,000 cycles, but whereas the "Bronze" model commences to fall off at 4,000 cycles, the output of the "Golden" model is fully maintained up to 5,000 cycles. The bass resonance occurs in the "Bronze" model at 145 cycles and in the "Golden" at 120 cycles, but in neither case is it sufficiently prominent to colour the quality of reproduction. Apart from a slight increase in output in the region of 2,500-3,000 cycles the response in the middle and upper middle registers is in both cases sensibly uniform. The prevailing impression of the quality is one of brightness without too heavy a bass response. Reproduction of speech is exceptionally good.

The output transformers have interleaved and impregnated windings and are of more than usually generous design. Tappings are provided for matching to all types of output stages including Class "B."

Made by Wharfedale Wireless Works, 62, Leeds Road, Bradford, the "Bronze" model costs 39s. 6d. and the "Golden" model 63s.



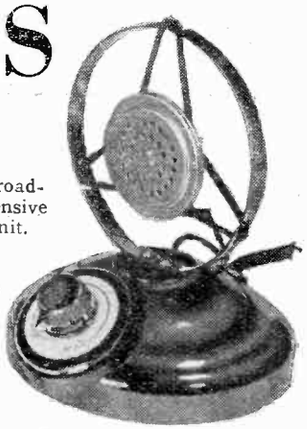
Wharfedale permanent magnet moving coil loud speakers (Left) "Golden" model. (Right) "Bronze" model.

AN INEXPENSINE MICROPHONE

THE G.E.C. Home Broadcaster is an inexpensive microphone having many uses both practical as well as entertaining. It is eminently suitable for Home Recorders, for announcing gramophone record titles at dances and at garden *fêtes*, as well as broadcasting matter of general interest at these functions, at amateur theatricals and for experimental transmitting work, to mention but a few only of its possible applications.

A normal broadcast receiver having facilities for gramophone reproduction is quite suitable for many of these occasions, the Home Broadcaster being connected by a change-over switch to the pick-up terminals so that either microphone or pick-up can readily be brought into use.

The unit is entirely self-contained, and consists of a sensitive carbon-type microphone, a volume control, an input transformer, and clips for a small torch battery; the last two mentioned being accommodated in the base. It is equipped with 25ft. of cable screened to avoid pick-up of mains hum and other extraneous electrical noises.



G.E.C. Home Broadcaster, an inexpensive microphone unit.

The specimen tested was very sensitive, showed a most satisfactory frequency response, and altogether is an ideal instrument for home and experimental use. The makers are the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, and the price is 18s. 6d.

The Radio Industry

"NEW Notes in Radio" is the title of an informative little booklet recently issued by Hartley-Turner Radio, Ltd., of Thornbury Road, Isleworth, Middlesex. It presents a good résumé of the principles underlying the design and construction of moving-coil loud speakers, with particular reference to the Hartley Turner instrument. Much useful information is given on the associated problems of field current supply, L.F. amplifiers, and matching.

◇ ◇ ◇

In addition to the various screened aerial down-leads, which are already well known, Ward & Goldstone have just introduced a metal screened earth lead. Both the three-stranded conductor and the external wire braiding are of heavy gauge, and the insulation is completely waterproof. The use of a screened earth lead is in some cases beneficial in reducing background noises, and is likely to be particularly useful when a screened aerial system with impedance-matching devices is installed.

◇ ◇ ◇

British wireless products are getting far afield. According to the Chloride Co., an Exide H.T. accumulator battery of 220 cells has just been despatched to the palace of the Dalai Lama, in the "forbidden city" of Lhasa, the capital of Tibet.

The company also announce a reduction in the prices of several types of dry-cell H.T. battery designed for certain well-known self-contained receivers.

◇ ◇ ◇

The works of the Harken Electrical Co., Ltd., have now been transferred from Walworth Road, London, S.E., to 18a, South End, Croydon. Under the managing directorship of Mr. E. Harker, recently engineer-in-chief to the Post and Telegraph Department of Ceylon, this firm specialises in radio and other apparatus for use in tropical countries.

◇ ◇ ◇

We are informed that the servicing of Atwater Kent receivers has now been taken over by the Radio Development Co., of Aldwych House, Aldwych, London, W.C.2. This company also undertake repairs to Fada and other American receivers.

◇ ◇ ◇

New Catalogues Received

Blue Spot Loud Speakers and Units: The British Blue Spot Co., Ltd., 94-96, Rosoman Street, Rosebery Avenue, London, E.C.1.

Wharfedale Loud Speakers: Wharfedale Wireless Works, 62, Leeds Road, Bradford.

Oldham "Insured Life" Accumulators: Oldham and Son, Ltd., Denton, Manchester.

Clix Connectors, Terminals, Plugs, Valveholders, etc.: Electro Linx, Ltd., 79a, Rochester Row, Westminster, London, S.W.1.

Broadcast Brevities

By Our Special Correspondent

200 Kilowatts at Droitwich

BRITISH listeners who have been perturbed by the thought that the B.B.C.'s National transmitter at Droitwich will be limited to a power of only 100 kW. will be glad to learn that the B.B.C. is very much more ambitious than the published announcements would lead one to expect.

I understand that provision will be made for a transmission power of not less than 200 kW.—sufficient to make the British transmitter a match, as it should be, for Luxembourg, hitherto the most powerful station in Western Europe.

Open-air Drama

The output stage of the great transmitter now nearing completion at the Marconi Works, Chelmsford, will contain four of the new C.A.T. valves, each rated at 50 kW.

Just now there is a real open-air drama being enacted in that Worcestershire meadow, three miles from Droitwich.

It is a fight against time and weather.

The aim is to get the lid on before the wet weather sets in. When once the building has a roof the transmitting apparatus can be installed.

Testing by March?

He would be a bold man who would prophesy that the B.B.C. will wait until midsummer, 1934, as announced before sending out test signals.

I am not bold enough to make any such prediction, for I believe that we shall hear the first signals from Droitwich by April, possibly March.

Meanwhile, the masts are ascending inch by inch, and will soon be half as high again as St. Paul's Cathedral, London.

A Lord Dunsany Play

LORD DUNSANY has written a new play especially for broadcasting. It is called "The Use of Man," and will be heard in the National programme on September 26th. The characters include human beings and the spirits of animals, birds, and insects. Listeners will no doubt recall another of Lord Dunsany's plays—"If"—which has been broadcast on two or three occasions in the past.

Don't Take This Seriously

"COUNTER Clockwise," by Moultrie Kelsall, which is to be broadcast on September 18th, is a programme designed to explode historical myths. The three myths exploded are, first, that Bruce learned his statecraft from a spider; secondly, that Burns was a haggis addict; and, thirdly, that Bonny Prince Charlie divided up his tartan apparel among the enamoured ladies of the Highlands.

I understand that, on the last occasion on which these sketches were broadcast, some listeners took them seriously, and their national pride suffered in consequence. No disparagement of these national heroes, however, is intended, and the explosions are as mythical as the myths themselves.

Think that out.

Devolution

NOT *decentralisation* but *devolution*, I am told, is the guiding principle in the new organisation which characterises the B.B.C. in all its branches from Land's End to John o' Groats.

The Organisation

The scheme can be sketched in a few words. At the head is Sir John Reith; on his left sits Admiral Sir John Carpendale, head of Administration, and on his right Colonel A. C. Dawnay, the new Controller of Output.

Under the principle of devolution this organisation is repeated in miniature, as it were, at each of the Regional headquarters. Thus we find at the Scottish Regional Mr. Melville Dinwiddie in charge; his Administrator is Mr. J. M. A. Cameron, and his Programme Director Mr. Moray McLaren; this form of organisation holds good north, east, south and west.

A Talented Musician

By the way, I am glad to hear that Mr. Hely-Hutchinson's transfer to the post of music director in the Midland Region does not mean that this extremely talented musician is lost to London audiences. I venture to predict for Mr. Hely-Hutchinson a great musical future, and many listeners will feel that the Midland Region is honoured by the appointment.

Mr. Aylmer Buesst

Mr. Aylmer Buesst, who is to become chief assistant to Dr. Boult, is an Australian who has already had a distinguished career as a conductor and will no doubt wield the baton at many broadcast concerts in the near future.

St. Leger Broadcast

A RUNNING commentary on the St. Leger will be broadcast on Wednesday next, September 13th, by Mr. R. C. Lyle, the well-known racing correspondent, whose descriptions of the Derby and other racing events are always popular with listeners, especially those backing the winner.

Hunted

NO wonder, during these dog days, the B.B.C. officials wear a hunted look. They *are* hunted, for the daily Press, robbed of so many sources of intellectual food, such as the Houses of Parliament and the Law Courts, seems to turn naturally to broadcasting for its stunts.

If an official distributes an innocuous circular encouraging lady members of the staff, if they feel so disposed, to enquire what exactly would be their position in the event of marriage, the Press sleuths manage without difficulty to turn the event into a first-class "story."

No Crèche in Portland Place

Not that very much harm is done, for the B.B.C., after its initial embarrassment, welcomes publicity and rejoices in its ability to explain an entirely well-meant effort on its part to reassure its women employees.

As one member of the staff remarked to me: "We wish to be fair all round, but even we cannot be expected to run a crèche."

Why not leave it at that?

CONTROLLER OF OUTPUT. Col. A. C. Dawnay, who assumed control of the "output" section of the B.B.C. on Monday last.

"La Bohème"

SADLER'S WELLS Theatre in Islington will be the venue of a relay in the National programme on September 19th, when Acts I and II of "La Bohème" will be broadcast. It is some time since listeners last heard a relay from this theatre, from which several performances of opera have been successfully broadcast in past years. Act I of Gounod's "Faust" will be relayed from this theatre on September 30th.

Smash and Grab

A STRONG cast will be heard in "One Good Turn——," described as a "Smash and Grab Presentation of Road House Variety," to be broadcast on September 12th (Regional) and 13th (National). The book and lyrics are by Max Kester and Ray Noble respectively, and the latter's orchestra will take part in the performance. Included in the cast are Anona Winn, Suzanne Botterell, Al Bowlly, Bobbie Comber and Claude Hulbert.

Bouquets and Broadcasting

THE dear old-fashioned habit of sending up bouquets to the stage at the end of the opera or village concert has never, for some reason, been adopted by broadcast listeners. I have never seen a queue of messenger boys with floral tributes at the back-door of Broadcasting House at the conclusion of the evening programmes.

If You Send Flowers . . .

I mention the subject only in case you should ever conceive the idea of paying tribute in this manner, possibly when you have heard Mr. Maschwitz's Eight Step Sisters. Make sure that the flowers are absolutely fresh and, if possible, encased in ice. For it has been observed that flowers in the studios are doomed to a short life. The oxygenated air will serve a *prima donna* for ten minutes, but apparently it cannot keep flowers alive for more than a day or two. *Verb. sap.*

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, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

Television

ALTHOUGH it is only recently that I turned up some of my first numbers of *The Wireless World*, this is my first letter to your paper.

I write to support the Hon. Sec. of the Halifax Wireless Club. Experimenters in the North may well ask "What is this television?" I have just dismantled a television set because it was useless to continue attempts at reception. With the transmissions from London Regional I had fairly good results, but London National is hopeless in this locality. I also feel that I was let down in connection with the Fultograph transmissions. Will television come to the same ignominious end? Possibly, unless keen experimenters all over the country, and especially in the North, are allowed a "look in."

"A YORKSHIRE PARSON."

Electricity Supply

WITH reference to your correspondent's letter on "Continuity of Electric Supply" in your issue of the 25th Aug., I append an extract which may be of some interest:—

Section 12 (2) of the Electricity (Supply) Act, 1919, states: " . . . there shall be incorporated with this Act the provisions of the Schedule to the Electric Lighting (Clauses) Act, 1899, subject to such exceptions and modifications as may be prescribed by the order constituting the joint electricity authority."

Section 30 (1) of this schedule states: "Whenever the undertakers make default in supplying energy to any owner or occupier of premises to whom they may be and are required to supply energy under the special order, they shall be liable to a penalty not exceeding 40s. for each day on which the default occurs."

From this it is clear that the supplying authority has very definite obligations.

A. K. T.

Teddington, Mddx.

Eliminating Interference

I HAVE recently visited the German Radio Exhibition and feel that all who saw it must have shared my keen interest in the demonstrations and exhibits of the German Reichspost in connection with the elimination of interference from electrical machinery.

I was particularly struck by one very simple arrangement for eliminating interference from small motors with series field windings which I find was mentioned, though without special comment, by Mr. Bernaert in his article in your issue of July 7th, 1933. I refer to the division of the field winding into two equal parts, one being placed in each supply lead. If a condenser is then placed across the brushes, it forms with the two sections of the field winding a symmetrical filtering arrangement which is stated by the German engineers to result in a substantially complete elimination of interference.

I do not know to what extent such an arrangement would be applicable to the various types of commutator motor for alternating and direct current, but as it involves a change of manufacturing practice, namely the division of the field windings into two similar sections connected one in each main lead, with the armature between them, it would appear to be a matter deserving careful investigation and decision, particularly when it is borne in mind that such motors are extremely common and give rise to a very great deal of troublesome interference.

P. W. WILLANS.

London, W.C. 2.

Double Channel B.B.C. Transmissions

RECENT research into high quality sound reproducing systems has shown that considerable improvement can be obtained by the use of a double channel reproducing system consisting of separate microphones each with its own amplifier and reproducer. In a recent test a considerable number of observers preferred a double channel system with an upper cut off at 2,800 c.p.s. to a single channel system with a 12,000 c.p.s. limit.

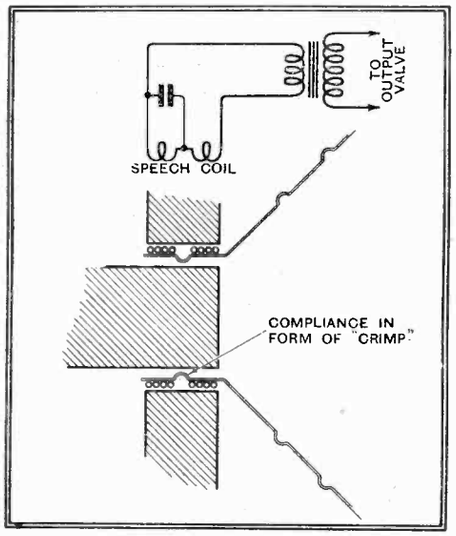
Here we have an excellent opportunity of turning the B.B.C. regional scheme to good use, and I suggest that when two or more stations are radiating the same programme, arrangements should be made to use two microphones. Listeners who were prepared to purchase the extra equipment could then avail themselves of the advantages of a double channel system without any interference with the normal purpose of either station serving listeners with single reproducers. It would be interesting to have comments upon the proposed arrangement.

Rugby. JAMES MOIR.

NEW HIGH QUALITY LOUD SPEAKER

A Moving Coil with Uniform Mechanical and Electrical Impedance

SO far, one of the most successful methods of reproducing sound over a wide range of frequencies has been to use at least two types of loud speaker—a large moving coil cone unit for the low notes and a moving coil horn or "tweeter" for the higher frequencies. Filter circuits are employed to keep out of the respective speaker units the frequencies assigned to the other, and the system is comparatively expensive and by no means easy to design or adjust.



In the Olsen moving coil loud speaker the moving coil is divided into two sections coupled by a mechanical compliance which, in conjunction with a by-pass condenser, short circuits a section of the coil at frequencies above 1,000 cycles.

At the recent I.R.E. Convention in Chicago, a new type of moving coil loud speaker was described by Dr. H. F. Olsen, of the R.C.A. and Victor Corporation. This unit, which has a frequency range from 90 to 10,000 cycles, is based on an interesting combination of electrical capacity and mechanical compliance which considerably extends the high frequency range and enables the performance of the dual unit system to be obtained from a single loud speaker.

The moving coil loud speaker of normal design consists of a coil of wire moving in a strong magnetic field and a cone diaphragm which imparts the coil vibrations to the surrounding air. At low frequencies this coil moves as a piston, but at high frequencies the mechanical impedance is so large that considerable power must be expended to move it. At the same time, the electrical impedance of the speech coil, which is made up of inductance and resistance, increases with frequency so that above 1,000 cycles the loud speaker load no longer matches the impedance of the power valve. This again results in a loss of power. In order to achieve uniform mechanical and electrical impedance over the frequency range, Dr. Olsen divides the speech coil into two sections as shown in the accompanying diagram. The two sections are coupled mechanically by a "crimp" in the paper coil former. This functions as a compliance, which is the mechanical analogy of a condenser. The section of the coil remote from the junction with the diaphragm is shunted by a capacity which by-passes the current in this section above 1,000 cycles. At the same time, the mechanical compliance is adjusted so that the shunted section of the coil remains stationary at frequencies above 1,000 cycles. Thus, only part of the coil is in use, and as the diaphragm is corrugated to reduce its effective area, the mechanical and electrical impedances at high frequencies do not rise appreciably above their normal values.

According to reports, subjective listening tests show that the high-frequency response is decidedly better than that of the present type of moving coil units, and laboratory tests have shown that the acoustic output is practically uniform up to 10,000 cycles as compared with an average cut-off at 5,000 cycles in the average moving coil unit.

IN the rush and turmoil of the recent Radio Show it is possible that many visitors overlooked the less spectacular sections of the G.P.O. exhibit. For their benefit, and also for that of readers who were unable to go to Olympia, attention may be drawn to a little-known application of anti-interference filters which was officially advocated by the technical staff in attendance. The Post Office engineers have now had so much experience in these matters that their pronouncements should carry weight.

A Barrier to Interference.

The more usual type of filter, connected in the mains feed of the receiver itself, has been discussed from various points of view. It is often completely effective, but cannot in any way mitigate the ill-effects of interfering impulses passed into the building by the electrical mains and then re-radiated to the aerial from the house wiring. Clearly, the better plan is to filter out all H.F. energy at the point where the mains enter the building; the main objection to this

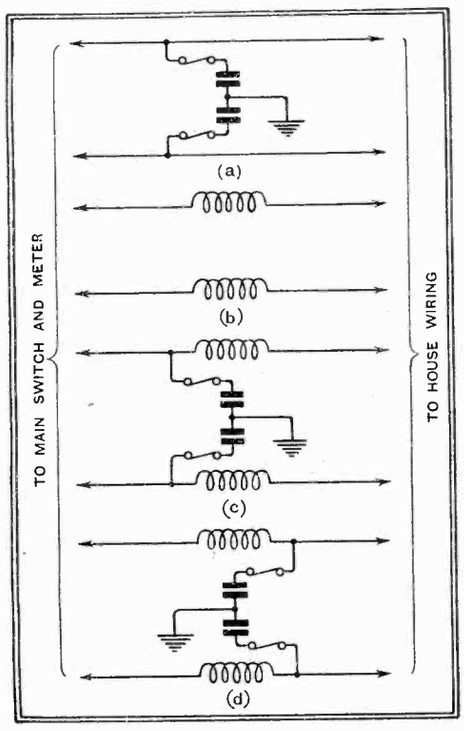


Fig. 1.—For keeping interfering impulses out of the house-wiring system: filter circuits for connection at the point of entry of the mains.

course is that the chokes which will generally be needed must be of lower resistance than those used in a receiver filter, as they have to pass much heavier currents.

Simplified Aids to Better Reception

No hard-and-fast rules were laid down as to the best type of filter for all circumstances, and it was suggested that experiments should be made with the various circuit arrangements shown in Fig. 1 (reproduced from a Post Office leaflet).

The simplest arrangement, consisting merely of two condensers joined in series across the mains input, and with the junction point earthed, does not introduce any complications. But, as already inferred, where chokes are necessary the greatest care must be taken to avoid an excessive loss of voltage, and before setting to work a rough estimation should be made of the maximum amount of current consumed for domestic purposes. In a small house, where no more than half a dozen 60-watt lamps and the wireless set are in use simultaneously, the total consumption will not exceed some 2 amps., assuming a normal voltage. It is not difficult to wind a pair of chokes with a total resistance of between 0.5 and 1 ohm, and so the loss of voltage should not exceed 2 volts, which is negligible. The Post Office suggests chokes of between 100 and 600 microhenrys inductance, and condensers of 2 mfd.

Chokes of suitable inductance, combined with a D.C. resistance low enough for most domestic installations, may be wound with No. 18 D.C.C. wire, and with a mean diameter of from 2in. to 3in. Between about 100 and 200 turns will be required, depending on the nature of the interference, etc., and the larger windings are most conveniently made up in "pancake" form. Where the load is heavy, a correspondingly heavier gauge of wire should be used for the chokes.

MOST amateurs have a high grade moving-coil D.C. voltmeter, but few feel inclined to incur the expense of buying an instrument for measuring A.C. voltages. For equal accuracy, the A.C. instrument is considerably more costly, and further, it is seldom that it becomes really necessary. It is not generally known that, without any internal alterations, and without affecting its normal use, a D.C. voltmeter may be converted for reading A.C. with very fair accuracy.

An Improvised A.C. Voltmeter

The modification shown in Fig. 2 is suggested for this purpose; assuming the meter to have a very high resistance—in the order of 1,000 ohms per volt—results will be quite satisfactory. Nothing is needed for the conversion beyond a valve holder, a low-tension battery, and practically any type of valve that may be available. It matters little if the valve has partially lost its emission, and is therefore unsuitable for normal use.

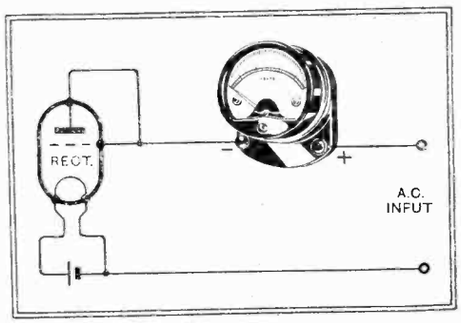


Fig. 2.—In order to read A.C. voltages on a D.C. voltmeter, a rectifier may be inserted in series.

To take a reading, the source of A.C. voltage to be measured is joined across the input terminals, and the voltage indication given by the meter is multiplied by a correction factor of 2.2 to ascertain the R.M.S. value.

An old-type Weco dry-battery valve is almost ideal for this purpose, as its filament may be heated from a single dry cell, thus overcoming the difficulty of maintaining an accumulator when the set itself is mains operated. If desired, of course, an ordinary 2-volt 0.1 amp. valve may be heated by means of two dry cells, with a series rheostat of 20 ohms.

IN an attempt to conserve anode current in Class "B" battery sets as much as possible it is quite usual to over-bias the driver valve in order to keep down the current flowing in its anode circuit to the lowest possible level. It would seem that sometimes matters are carried rather too far in this direction, with the result that distortion is produced.

Check the Driver Valve.

The purpose of this note is to point out that the operating conditions of the driver may be checked in the same way as those of a conventional output valve. A milliammeter, connected in the anode circuit, should show a steady current reading while signals are being received; violent kicks during the reproduction of loud passages will indicate overloading, and if they are in an upward direction we have an indication that the driver bias is excessive.

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 brief particulars, with the fee charged, are to be found at the foot of this page.

A.V.C. and Quality

THERE seem to be a few lingering doubts as to whether the use of automatic volume control is compatible with the highest quality of reproduction. Several correspondents have lately expressed doubts as to whether *pianissimo* and *fortissimo* passages will be rendered at their true values when A.V.C. is fitted.

We would hasten to assure them that their doubts are quite unfounded. A.V.C. is not out of place in a "quality" set; it does nothing to smooth out the normal variations in modulation, being operated solely by the average carrier-wave amplitude.

"Shorted" Volume Control

FOLLOWING conventional practice, a reader, who has built a "2-H.F." set for A.C. mains operation, is using variable-mu valves and has made provision for controlling volume by variation of grid bias.

After working well for some time, the volume control system has now failed, and, further, it is found that operation of the controlling potentiometer has no effect on the anode currents of either of the H.F. valves. Careful tests for insulation and continuity have been made with negative results, and so this reader has decided to ask our help.

As the circuits have been thoroughly tested, presumably with current switched off and possibly with valves removed, we can only think that the fault lies in one of the variable-mu valves, in which defective heater-cathode insulation has probably developed. A breakdown in the heater-cathode insulation of either valve would have the effect of short-circuiting the bias for both H.F. stages.

It is improbable that both valves have failed, and so, to detect the faulty one, we suggest that, with a meter in the common anode circuit, one of these valves should be removed while the set is working. If control of anode current can now be obtained by operation of the grid bias potentiometer, the valve removed is defective, while, if control is still unobtainable, the valve in the set will be responsible for the trouble.

Mains Periodicity

A CORRESPONDENT, who is using a metal rectifier in a voltage-doubling circuit, has noticed that the D.C. output of his H.T. supply unit is exceptionally high, and

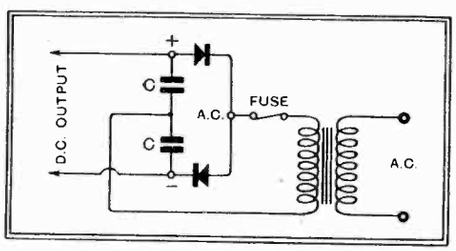


Fig. 1.—A conventional "voltage-doubler" circuit; the reservoir condensers C should be chosen with regard to the periodicity of the mains supply.

that a temperature rise takes place after a few minutes' work. He adds that his mains supply is rated at 80 cycles, and that the power transformer used is stated to be suitable for this periodicity.

It seems probable that this reader, who asks for a suggestion as to how his H.T. voltage may be reduced to a normal value, is using reservoir condensers of the usual capacity (4 mfds.) in association with his rectifier. These condensers (marked C in Fig. 1) are in series with the source of A.C. input; when current is supplied at an exceptionally high periodicity they will offer a lower reactance than at the more normal frequency of 50 cycles. According to the latest instructions issued by the makers of the Westinghouse rectifier, the standard capacity of 4 mfds. should be doubled for 25-cycle supplies, and halved for 100 cycles. These values are not critical, and we think that our correspondent might use condensers of 3 mfds. each.

Loading the Output Stage

THE prospective constructor of a modified version of the New Monodial receiver asks whether it would be possible to omit the intermediate L.F. stage, and to feed a single output valve, giving 5 watts, directly from the double-diode-pentode second detector.

This plan is not to be recommended, for the reason that it would involve the sacrifice of tone correction, which is an important feature of the set. With a tone-correcting coupling in its anode circuit, the D.D./PEN. second detector will certainly not give sufficient output without an intermediate stage, but it could be made to do so by substituting an anode load to about 20,000 ohms.

Superhet Tests

SUPERHETERODYNE receivers are not prone to H.F. instability; that is one of the attractions of the system. Nevertheless, occasions sometimes arise, just as in straight sets, where the signal-frequency H.F. stage of a superheterodyne breaks into uncontrollable self-oscillation, especially at the lower end of the waveband.

A reader whose set is behaving in this way concludes, quite rightly, that the cause of instability may most easily be localised by isolating the part of the receiver concerned. He proposes, for purposes of test, temporarily to convert the set into a simple H.F.-det. combination by inserting a pair of phones in series with the first detector anode. As the set is mains-operated, with quite a high anode voltage, it is considered desirable, in the interests of safety, to isolate the phones from the source of H.T., and our advice is sought on this point.

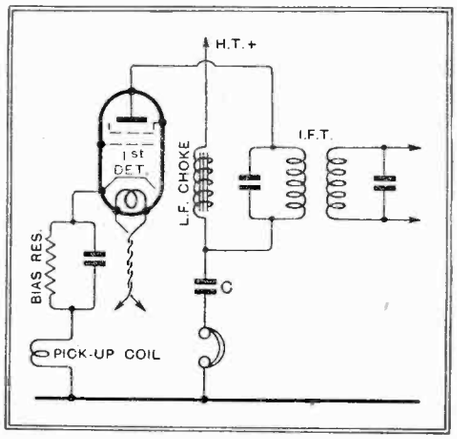


Fig. 2.—Temporary phone connections for testing a mains-operated superheterodyne.

Although one can often do it with impunity, it is risky to connect headphones directly to a mains-operated receiver, and we consider our correspondent is wise to take precautions. Failing a spare output transformer, which may be used for the purpose even if it does not give accurate matching, we suggest the use of a choke-filter arrangement, as shown diagrammatically in Fig. 2. For a choke, almost any inductive winding, such as the primary of a discarded L.F. transformer, will serve, while the condenser may have almost any capacity from 0.1 mfd. upwards; it should be rated at at least the same working voltage as the other condensers in the receiver.

When making a test of this sort it is a good plan to make sure that the oscillator valve is not functioning, as otherwise misleading effects may be introduced if the circuits associated with this valve be tuned to a frequency that will give an audible note when beating with oscillations in the signal-frequency circuits.

Oscillator Tuning

SEVERAL readers have asked whether an ordinary ganged condenser (without specially shaped plates) may be used for tuning a superheterodyne receiver.

It is possible, by the use of a padding condenser of suitable capacity in series with the oscillator section of the condenser, to obtain sufficiently good alignment of the signal-frequency and oscillator circuits without the use of a special condenser. But the reception of the long waves presents a difficulty, as the capacity of the padding condenser needed will differ from that required for the medium band. This introduces complications in waveband switching, as it will become necessary to make provision for changing over the padding condensers for each band.

For padding purposes it is generally best in such cases to use semi-variable condensers, or one of these in parallel with a fixed capacity.

The Wireless World

INFORMATION BUREAU

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.

Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, 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.

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CONTENTS

EDITORIAL COMMENT

Aerials and Earths

Importance of an Overhaul

ALL of us have a natural desire to improve the standard of reception and are prepared to devote a large amount of time, and money according to our means, in doing all that we can to perfect our receivers. In the early days of wireless reception, when the simplicity of the crystal set left comparatively little scope for improving the efficiency of the receiver beyond a certain point, we paid the greatest attention to the aerial and earth because it was on this end of the outfit that we depended for any real improvement in reception.

Why Aerials Are Neglected

To-day, with the amazing amplification which the modern valve can give, and the efficiency of our receivers, we are inclined to think that the aerial and earth do not matter. A year or so ago, when the increase in the number and power of transmitters overtook the standard of selectivity in receivers, it was common practice to shorten the aerial, reducing its efficiency as a collector, as a means of improving selectivity of the set. Now, with set selectivity vastly improved, we would be prepared to wager that there are thousands of aerials which have been left precisely as they were, in spite of the fact that a new and up-to-date selective receiver has been installed in the meantime in place of the unselective one.

Wherever circumstances and space permit, a return to a long and efficient aerial would be found worth while to-day if a selective set is in use, and an indoor aerial, or any compromise of this nature, should only be entertained as an alternative if a good outside aerial is a physical impossibility.

In three weeks Summer Time will be at an end and very probably a wet spell will set in, so that the opportunity should be taken now for a thorough overhaul of the outside aerial and earth. From every point of view it will be found well worth the time spent.

Do It Well

Whilst on the job, put up the best aerial possible in the space available and then see how much difference it is going to make to reception. The earth, too, requires the same sort of overhaul, and, above all, watch for any rubbing contacts which may give rise to crackles which we may have hitherto regarded as inevitable atmospherics. Whilst the fine weather is still with us it is an opportunity, also, to consider whether it is advisable to install a screened down lead or other refinements. It is a job easily tackled whilst the fine weather lasts, but one to be shunned on a cold and wet day.

We should take the opportunity to discourage our friends from resorting to the use of "aerial substitutes" of pocket size, which, even in these enlightened days, are still being sold in a variety of types, in spite of the fact that their very dimensions are sufficient to preclude the possibility that they could act as efficient collectors. On the other hand, indoor aerials of good type and others of special design for outdoor use, will often be found to be the next-best-thing if outside aerial facilities are restricted.

On this question of aerials we should not be selfish, that is to say, we should, in our common interest of raising the standard of reception, encourage our friends, particularly those who are not technical, to take this opportunity to overhaul the aerial system or fit an outside aerial, if possible. We shall have the satisfaction of our friends' appreciation later of the value of the advice we give them now.

The Electrostatic Loud Speaker

1. How It Works

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

IF a sufficiently high voltage were applied between the plates of a variable condenser, and the moving plates were sufficiently freely suspended, they would rotate into the maximum capacity position. In practice there is no great likelihood of our tuning dials moving round in this way when an extra powerful "atmospheric" arrives, because the friction at the bearings is so great that the voltage would spark across between the vanes long before being enough to shift them round. But the electrostatic voltmeter, which is simply a very tiny and lightly suspended variable condenser fitted with a pointer, demonstrates the truth of this principle every time it is used.

The principle, of course, is that a difference of potential or voltage between any two conductors causes them to attract one another, and, where they are free to move, to approach one another.

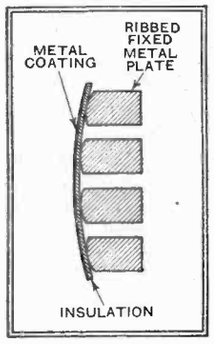


Fig. 1.—Section of the "Kyle" electrostatic loud speaker.

If the potential continually varies, the degree of attraction varies and the motion is continuous. A back-and-forward motion repeated at anything between about 16 and 16,000 times a second causes sound. Therefore, a condenser is, in principle at least, a loud speaker. Actually an ordinary paper fixed condenser may sometimes be heard to emit a faint note on being connected across the A.C. mains or other source of high alternating voltage. But generally the manufacturer has taken good care that the two strips of foil that make up the condenser are too tightly sandwiched between the waxed paper dielectric strips to vibrate at all.

Practical Considerations

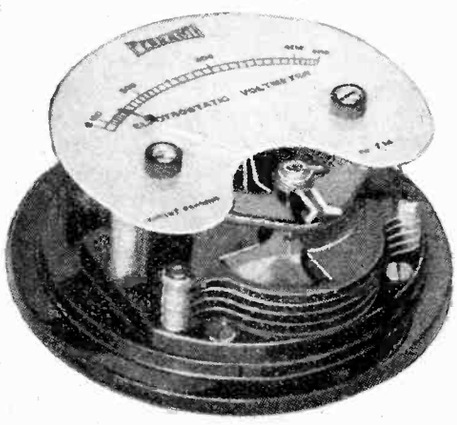
If a condenser is to be any good as a sound reproducer it should be exposed to the open air, and one at least of its two conducting elements should be reasonably free to move to and from the other. This could be done by suspending it a little distance away, with a layer of air in between. There are several disadvantages in this. The layer of air acts as a cushion, tending to damp out the motion, just as a pneumatic stop prevents a door from being slammed, however hard it is pushed. Then the force set up by a given voltage falls off very rapidly as the plates are separated even slightly. And to keep them separated at a fixed distance without solid material in between it is necessary to impede their free motion still further, either by making the plates very thick and stiff or by stretching them tightly.

The result is that the simple condenser loud speaker tends to be very inefficient and insensitive, and the object of design is to remove these objections. An example

THE amount of information which has been published about the electrostatic or condenser loud speaker is almost negligible. Being such an unknown quantity it has not yet come into general use, although it has been on the way for over fifty years. This neglect is not altogether deserved, for in some respects, particularly reproduction of the higher frequencies, it is unrivalled. Being fundamentally different from other types of loud speaker it is unfair simply to substitute it and expect the best results. The purpose of the author of this contribution will be to explain how the electrostatic loud speaker works and to give advice on its use.

of the stretched diaphragm type is that by Hans Vogt, of Ferrocart fame. He used an extremely thin moving diaphragm, stretched so tightly, close to a perforated fixed plate, that the natural frequency was above the usual audio frequency range—about 15,000 cycles per second, in fact. The perforations were intended, of course, to remove the air damping.

The Kyle loud speaker—of American



The Ferranti electrostatic voltmeter illustrates the principle of electrostatic attraction.

origin—has the effect of splitting up the total surface into a vast number of tiny diaphragms, by stretching the moving element directly on the fixed one, separated only by a thin layer of flexible insulation. Fig. 1 shows in section a small portion of this arrangement. The fixed plate is slotted and ribbed, and so shaped where it makes contact with the composite moving plate that an increase in voltage between them causes the latter to cling closer to the fixed plate and squeeze some of the air out through the slots. The reverse action takes place when the voltage relaxes.

A still closer approach to unrestricted motion is obtained in the "Primustatic" speaker, which, as it is one readily obtainable in this country, will be principally considered. Fig. 2 shows an enlarged section of it, in which the fixed plate, of perforated aluminium, is slightly curved. Behind it is a tinfoil-coated sheet of waxed paper, folded so as to form tiny triangular-sectioned air spaces behind the perforations. At the "dead" lines, in between the rows of perforations, where there is no motion, the foil paper is held in position by a special sort of hairy thread which makes very light, but adequate, contact everywhere. It is possible to use graphite-coated paper instead of metal, as a fairly high resistance does not interfere with the operation.

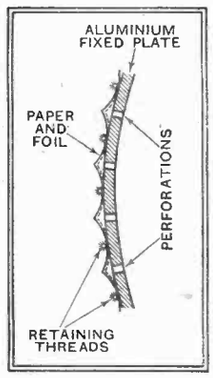


Fig. 2.—Section of the "Primustatic" loud speaker. The dotted line shows the position of the diaphragm under the force of attraction.

It will be clear that when a voltage is set up between the plates a sort of rolling action takes place, causing the line contact to spread out into a strip, as shown dotted, and air to be expelled through the perforations.

Possibilities of Distortion

As the attractive force takes place whenever a difference of voltage exists between the plates, it is obvious that they will move together during both positive and negative halves of an alternating wave. Thus, in Fig. 3, if (a) represents two complete periods of a 50-cycle supply, (b) represents the corresponding attractive force set up, and it will be seen that there are *four* complete waves. So instead of a 50-cycle note we get a 100-cycle note.

Reproduction in which every frequency is double what it ought to be is not likely to be considered satisfactory. It is interesting to note that precisely the same result is obtained in a moving-iron loud speaker or headphones in which no permanent magnetism is provided, the only

The Electrostatic Loud Speaker—

attractive force being due to the signal current. The remedy in the latter case gives us the clue to that for the electrostatic speaker defect—the provision of a steady initial force considerably larger than any due to the signal.

Fig. 3 (c) shows the combination of the high steady voltage and the alternating signal voltage, and one important feature is that it never reverses—the initial voltage being relatively large keeps it on one side of the base line throughout. Consequently the frequency-doubling effect is absent, and the attractive force closely follows the outline of the voltage, Fig. 3 (d).

The Polarising Voltage

It can be shown mathematically that not only is the distortion reduced to an unimportant quantity, but also the sensitivity is considerably increased. In practice it is not advantageous to increase the initial polarising voltage indefinitely, even if it were convenient. There would be the danger of breaking down the insulation—air or solid according to the type of construction—between the plates. Also the freedom of motion would be impaired by an excessive displacement in one direction. So the actual voltage is something of a compromise, and one is not far wrong in imposing the voltage used at the anode of the output valve. The signal voltage at this point is, of course, always substantially less. If the latter is stepped up, however, it may be necessary to increase the polarising voltage also, to make sure that it is in the correct proportion.

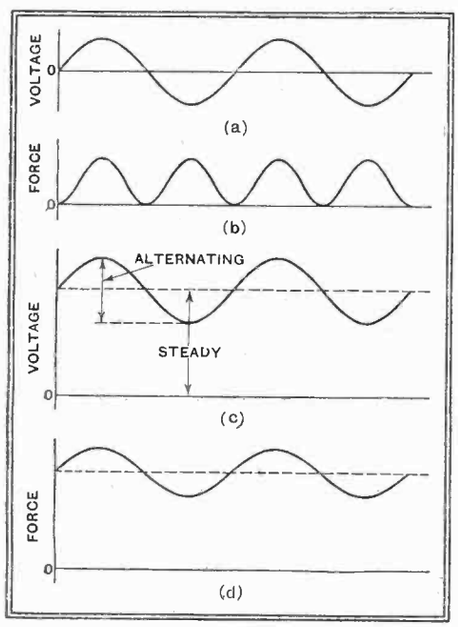
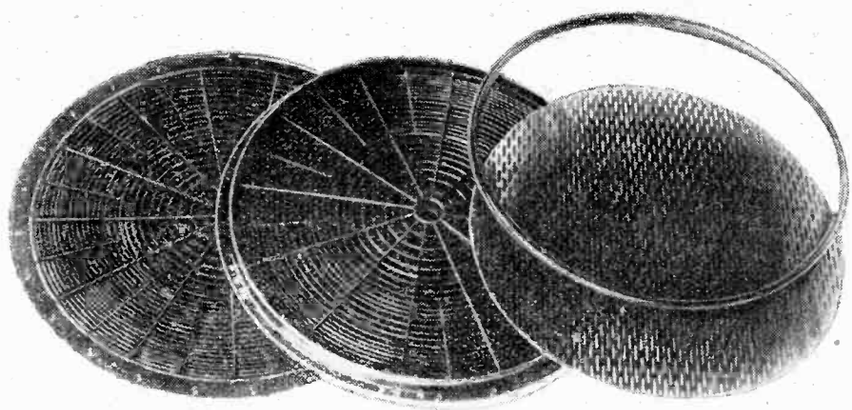


Fig. 3.—Without a polarising voltage, frequency doubling would occur in an electrostatic loud speaker.

A polarising voltage of 1,000 used to be necessary for the earlier types, which is sufficient to explain the disfavour with which they were regarded for general use, and an advantage of the Primustatic type is that about 250 volts is usually enough. So what used to be a serious drawback now seldom presents much difficulty. The loud speaker being in effect a condenser draws no current from the polarising source.

A rather more serious criticism is that the amplitude of motion is not very great, and that there is therefore difficulty in obtaining strong reproduction of the lowest frequencies. This can be got over to some extent by increasing the area of the diaphragm, which can be done as much as one pleases by adding more units in parallel.



Component parts of the Vogt stretched diaphragm loud speaker.

Lastly, on the debit side of the account there is a problem in efficiently coupling the speaker to the output valve. This matter will be gone into in detail later.

High-frequency Response

Now for the credit side. It has already been pointed out that the high note reproduction is a strong feature. There are several reasons for this. Instead of the relatively heavy and complex moving system of any of the magnetic types of speaker, which renders it difficult to get upper frequency reproduction except in the form of resonances, there is a light uniform moving diaphragm, with extremely low inertia. Moreover, this is actuated all over its surface instead of at one part, as in other types, thus avoiding the complicated modes of vibration with resulting resonances and irregularities that distinguish the latter. Further, the area of the diaphragm can be made as large as one pleases, and the focusing and "interference" effects of a small cone are avoided. It is a better sound radiator, in other words. There is practically no upper frequency limit, and therefore it is in advance of present day microphones and transmitting systems, and advantage can be taken of any improvements in the latter. But even with existing standards of transmission, so long as local interference does not impose a severe limit, it is possible to appreciate a very greatly increased clarity and faithfulness of reproduction. It is significant that for special experiments in America, where substantially uniform output of sound was required up to 14,000 cycles, a condenser reproducer was employed.

The advantage is particularly marked in speech, string tone, and sounds involving transients, such as clapping, tapping, paper rustling, and cymbals.

The construction is much simpler than that of any other type. There are no coils, magnets, or field excitation. For the same reason it is extraordinarily light, and as regards compactness it can be made into panels of very little depth—an inch or so, for example, or even less if necessary.

An electrostatic loud speaker, used alone, is far superior in naturalness and clarity of speech to a moving coil speaker particularly of the cheap sort now almost universal. But unless very large there is not enough depth to music to please most listeners, although even this deficiency can be made considerably more tolerable by the delightful distinctiveness of the instruments in the upper registers, which is variously described as brilliance, "life," and crispness. It is a great relief to get away from the thumpy whoofy reproduction that is so common, or the still commoner apology for "brilliant" tone produced by a fierce high note resonance.

The best overall reproduction is therefore given by a combination of moving coil and electrostatic speakers. To obtain a satisfactory distribution of labour between the two, or even to run an electrostatic on its own, we must consider how it behaves as a load in the valve circuit. Unless attention is given to this the results can be very bad indeed. So it will form the subject of the next part of this article.

Northern National Radio Exhibition

The Manchester Wireless Show will be held in the City Hall, Deansgate, from Wednesday, September 27th, to Saturday, October 7th, 1933.

Next week's issue will contain a plan and guide to all the Stands at the Show.

Practical HINTS and TIPS

AIDS TO BETTER RECEPTION

The Pentagrid Oscillator.

IN a few cases it may be found that the special frequency-changing valve in the New Monodial receiver fails to oscillate over the whole of the medium wave-band. Assuming that the circuits are correctly wired and that the working voltages are normal, this effect must generally be ascribed to the fact that the particular specimen of valve in use has a somewhat lower mutual conductance than usual.

Although there are several ways of correcting this trouble, probably the simplest and most satisfactory cure can be effected by shunting the reaction section of the oscillator coil assembly with a fixed condenser of 0.0001 mfd. The coil terminals across which the condenser should go are numbered 1 and 2 in the diagrams published with the description of the set.

Free Volts for A.V.C.

IT is probable that many readers have not noticed that, in the A.V.C. version of the original Monodial, a "free" supply of anode voltage for the control valve is obtained by the expedient of inserting the loud speaker field in the negative high-tension lead. This is a plan that might often be adopted when fitting a similar system of A.V.C. to existing receivers of the superheterodyne type; it is not suitable for "straight" sets, for the reason that a sufficiently high H.F. voltage is not available on the anode of the detector at the higher frequencies. The system of control is, however, useful when a straight set is employed in conjunction with a superheterodyne converter for short-wave work.

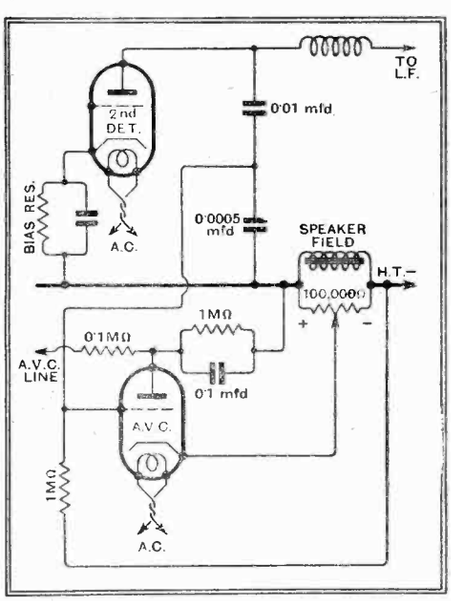


Fig. 1.—The voltage developed across the speaker field winding in the negative H.T. lead supplies the anode circuit of an A.V.C. valve; adjustment of grid voltage is made by means of a potentiometer.

The essentials of the control system are shown in Fig. 1. By adopting this form of connection, correct working voltages will be obtained for the A.V.C. valve; its anode will be positive with respect to the cathode, and its grid will be negative with respect to the same point by an extent depending on the position of the potentiometer slider. This slider is provided in order that the working voltage of the A.V.C. grid may be set to a value which gives the correct amount of "delay" action; in practice it is easily adjusted by tuning in a very weak signal and then moving the slider gradually from the positive towards the negative end until a point is reached where signal strength begins to decrease. The slider is then moved back slightly towards the positive end; this will be the final working position.

The actual voltage existing across the speaker field is comparatively unimportant; 60 volts will give results, but a higher voltage is desirable.

Capacity-coupled I.F. Filters.

FOR amateur use there is no more convenient method of coupling together two H.F. circuits than the "top-end capacity" system. As compared with methods which require adjustment of the relative positions of the coils, it presents no mechanical difficulties, and is therefore especially suitable for extemporising two-circuit tuners or filters when existing apparatus not specially designed for the purpose is to be used. Practically speaking, the only difficulties that are likely to arise are those brought about by imperfect screening and excessive minimum coupling; both have the same effect. It is therefore necessary to make sure that the coils used are properly screened, and that the coupling condenser which is joined between the high-potential ends of the circuit has a suitably low minimum capacity.

Although this system of coupling is largely used in signal-frequency circuits, it does not appear to be generally realised that it is equally applicable to the I.F. couplings of superheterodynes—this in spite of the fact that it has been so used in several well-known receivers. As compared with arrangements in which the relative positions of primary and secondary coils may be changed, the capacity-coupled filter is probably easier to adjust and is certainly more suitable for those who, in spite of limited workshop facilities, are in the habit of making their own coils.

A capacity-coupled I.F. filter is shown diagrammatically in Fig. 2. For the coupling condenser CC, a semi-variable component of 50 micro-mfds. will be amply large enough; a condenser of 0.0001 mfd. may be used, but it is sometimes desirable to reduce its minimum capacity by cutting off a part of one of the plates. The decoupling resistance R and the associated condenser C may have normal values.

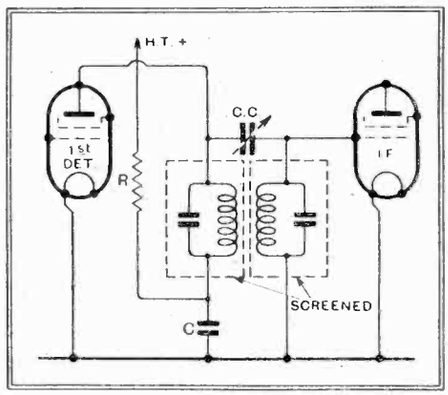


Fig. 2.—"Top-end" capacity coupling is as suitable for I.F. as for H.F. circuits.

Another Aspect of Mains Hum.

THE main reason for the universal dislike to a background of mains hum is that it impairs the artistic value of the programme, gives a constant reminder that we are hearing an artificial reproduction, and is distinctly unpleasant to listen to for long periods.

In addition to this, the existence of hum may actually have a prejudicial effect on the behaviour of the receiver. An output valve, or even a detector, which is partially loaded by hum potentials will not accept so large an input as one working under more ideal conditions.

It might be thought that if the intensity of hum be sufficiently great to load the valve to an appreciable extent the noise would be unbearably loud, but this is not always so in practice; if the hum frequency be above or below the normal band of frequencies reproduced at good strength by the loud speaker it is quite possible that it may not be audible at anything approaching its proper relative strength.

Similar remarks apply to interfering voltages produced by certain forms of man-made static, and in one case which was recently investigated it was found that the fittings of a proper mains filter, in addition to providing a quieter background, made a very obvious improvement to the sensitivity of the set. Admittedly, the detector used in this particular case was of the screen grid type, and able to deal with but a very small input without overloading, but the average detector has quite a small margin of safety.

DESIGN OF THE Detector-Oscillator

Precautions to Observe When a Single Valve is Employed to Serve the Dual Purpose

By F. R. W. STRAFFORD

THE frequency-changing device employed in all superheterodyne receivers generally presents the designer with his most difficult problem. Practically every case of failure to work or violent instability can be traced to this stage, particularly when a single valve is made to perform the dual function of providing the local oscillation, mixing it with the incoming preselected signal, and rectifying the resultant wave form to give the desired beat frequency or intermediate frequency.

The use of a separate valve for each function is often the most straightforward method of securing the optimum conditions for maximum heterodyne conversion, but the tendency of the manufacturer, as distinct from the builder of an individual set, towards reducing costs of construction and subsequent maintenance is a paramount factor in these days; and if the commercial designer can kill two scientific birds with one stone it is the course to adopt.

Bearing this in mind, the writer will attempt to elucidate the action of the detector-oscillator and describe how a single screened grid or H.F. pentode valve may successfully perform the requisite dual function if certain circuit precautions are observed.

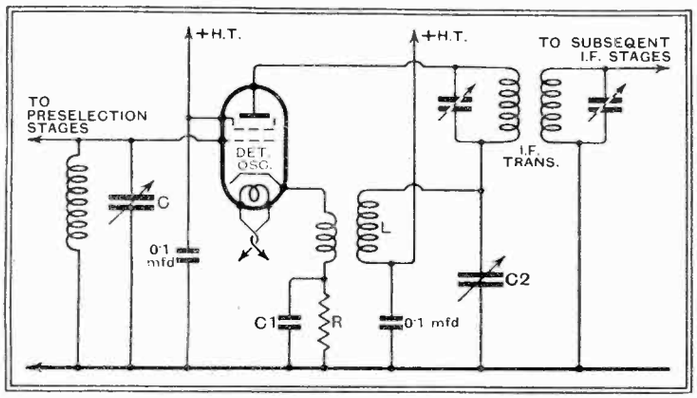


Fig. 1.—A typical detector-oscillator circuit. Condensers C, C2, are normally ganged.

Schematically, the simple detector-oscillator circuit is depicted in Fig. 1. Oscillations, the frequency of which are fixed by the LC circuit, are produced via the coupling coil in the cathode circuit, and the oscillating difference of potential set up between cathode and earth is applied to the grid, together with the signal from the preselector stage or stages.

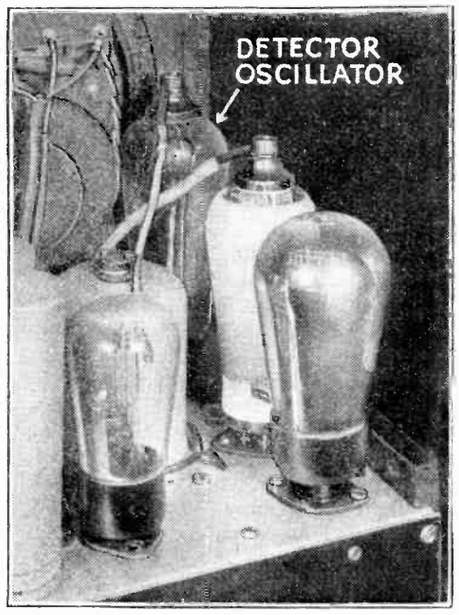
Even though oscillating, the valve is able to rectify these combined wave forms, although less efficiently than a separate detector, and the resultant intermediate frequency appears in the plate current components and sets up a resonant voltage across the intermediate frequency transformer. The apparent simplicity of the action, however, loses some of its appeal when the circuit is tried out unless great care is exercised in selecting the circuit constants.

Undesired Oscillations

It can easily be seen that, since there are two tuned circuits in the anode lead, there is every possibility of the circuit oscillating at an undesired frequency in the neighbourhood of the intermediate frequency. This often occurs—particularly when the dynamic impedance of the oscillator circuit is less than that of the intermediate frequency circuit. The condition may be cured by tapping the anode lead down the primary of the intermediate frequency transformer, thereby reducing its effective dynamic impedances as reflected into the anode circuit. Such an operation will naturally reduce the intermediate magnification, but in general practice this method of eliminating intermediate frequency oscillation will give the necessary suppression before much loss of magnification has occurred.

The desirability of employing an oscillator circuit with a high magnification has now been established from the viewpoint of stabilising the oscillation over the working frequency range. Another advantage is the reduction of oscillator harmonics transferred to the grid circuit; for it is known that when the preselection is not exceedingly high the small out-of-tune signals from a local transmitter produce a complex series of chirps by beating with these harmonics as the tuning condenser is rotated in search of stations.

Theoretically, the amplitude of the intermediate frequency is directly proportional to the product of oscillator and signal voltage, and it would therefore appear that the best operating conditions implied strong local oscillation. The assumption is, however, only true while the rectification continuously occurs on the *parabolic* portion of the anode current grid volts characteristic; when the valve has to perform the dual function of simultaneously oscillating and rectifying the conditions are altered, and the assumption no longer implies.



An H.F. pentode valve, the Mullard S.P.4, is employed in the detector-oscillator stage of the Varley "Square Peak" 4 Superhet.

Effect of Strong Oscillations

If the oscillations are too strong, first the violent grid current will damp the preselector circuit and increase also the re-radiation of oscillator voltage via the grid cathode impedance, and, secondly, the rectification efficiency will fall, since the weak signal is, in a way, demodulated by the stronger oscillation.

Fig. 2 shows the approximate relationship between oscillator voltage and intermediate frequency output for a small input signal assumed to be constant.

It can be seen that a linear action does exist until a certain strength of oscillation

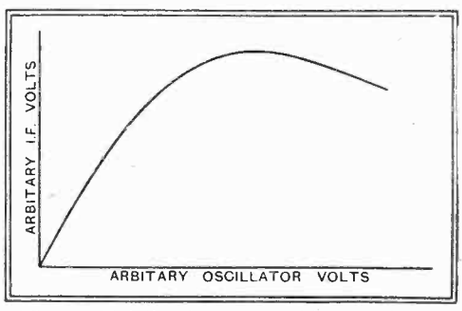


Fig. 2.—Relation between oscillator and I.F. voltage.

Design of the Detector-Oscillator—

is reached, and thereafter the rate of change rapidly decreases and finally reverses.

Experience has indicated that the best value for initial bias voltage (obtained via the cathode resistance R) and oscillator voltage between cathode and earth should be experimentally determined.

Using typical British A.C. screened grid valves or H.F. pentodes, at their normal voltage ratings, the bias resistance should be between 3,000 and 8,000 ohms, and the r.m.s. oscillator voltage across the cathode coil from 2 to 5 volts, and certainly not greater.

Effect of Coupling

The strength of oscillation is chiefly determined, for a given anode voltage, by the tightness of coupling between the reaction and oscillator coils, and the selection of suitable reaction conditions is very important. Tight coupling with few turns is better by far than loose coupling with many turns, although the mutual inductance may be the same in each case. For when the reaction turns are excessive the inductance of the winding may resonate with associated capacities and produce either spurious oscillations or "blind spots" over certain portions of the desired waveband, resulting in partial or complete loss of sensitivity. Even when few turns are used it is a good plan to wind the coil with resistance wire so that the reaction circuit losses effectively damp out any such tendencies.

In normal practice, a rough guide to the number of reaction turns required when tight coupling is used is as follows: For ordinary screen-grid valves operating at normal voltage ratings, approximately one-tenth of the oscillator coil turns, and for H.F. pentodes about one-twentieth.

When the oscillator-detector is directly connected to the aerial preselection circuits a certain amount of re-radiation of oscillator frequencies is unavoidable due to the grid cathode impedance, which is normally a capacity resistance. Great care should therefore be taken to keep any stray capacities, effectively in parallel with grid and cathode, at a minimum. Where the valve is metallised it is useful to remove the coating by scraping; or, better still, to employ the equivalent unmetallised version.

In most cases the clear valve is the better to employ, since the cathode is at H.F. potential above earth, and the metallising, which is connected to the cathode pin, will often produce queer "blind spot" effects by resonating with the reaction coil inductance.

There is still one very important function of the detector-oscillator with which it is proposed to deal. The intermediate frequency component passes through the reaction coil during its circuit from anode to cathode, and thereby sets up potentials across the grid-cathode circuit. These potentials are therefore amplified to some extent by the oscillating valve, and unless the phase is suitably adjusted the net result developed across the intermediate frequency transformer may show an appreciable loss in magnification.

By a judicious adjustment of phase, which may be carried out to a considerable degree by varying the capacity C1 across the cathode bias resistance R, the intermediate frequency may be reintroduced so that the anode circuit components are brought very nearly into phase. By this method the magnification or conversion factor of the detector oscillator stage may be increased several times. If the adjustment is carried out too far the inevitable occurs, and the stage flops into violent oscillation or squegging.

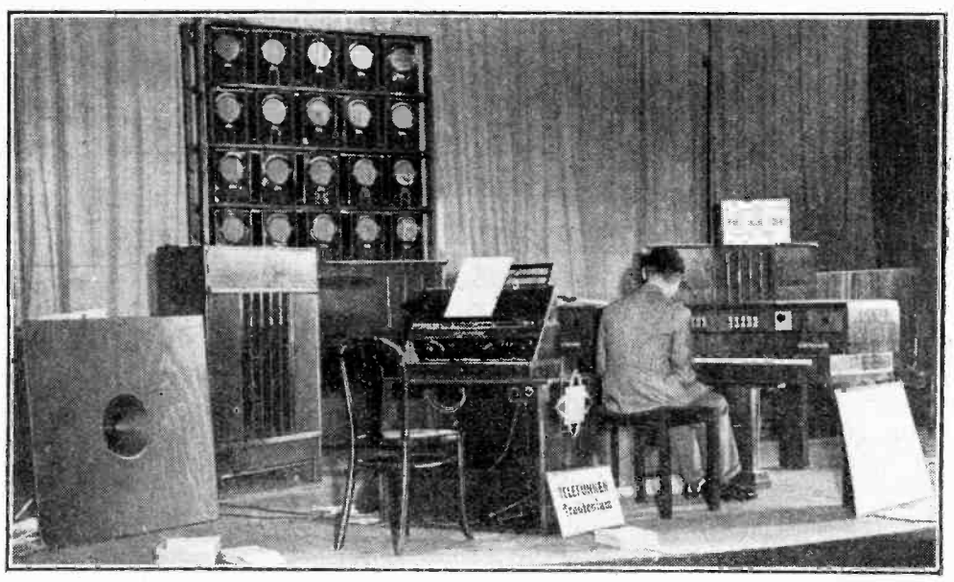
Summary

The important points in detector-oscillator design may be summarised as follows:—

(1) The use of a high magnification oscillator circuit reduces the tendency for unstable oscillation or sudden transference of oscillations to intermediate frequency.

(2) For normal screened grid or H.F. pentode valves the oscillating voltage across the cathode coil should lie between 2.0 and 5.0 volts r.m.s.

(3) The bias resistances should lie between 4,000 and 8,000 ohms, and the capacity between 0.001 and 0.005 μF. It is best to commence with some low limit of both resistance and capacity and finally adjust both for maximum stable magnification when the other circuit conditions are correct.



The Trautonium and other electrical musical instruments shown at the Berlin Exhibition. The Telefunken Company now manufactures the Trautonium to an improved design.

NEW BOOKS

Experimental Television, by A. Frederick Collins, F.R.A.S. Sir Isaac Pitman and Sons, Ltd. 313+xxii and 185 diagrams. Price 10s. 6d.

The title of this book would lead one to believe that it deals with the experimental side of television transmission or reception, but a glance at the chapter headings soon shows that it is concerned at least as much with optics and radio technique. Although they both play an important part in television they are themselves specialised subjects, and elementary descriptions of experiments with reflection, refraction, crystal detectors, and simple amplifiers are out of place in a book on television. A thorough knowledge of these subjects is undoubtedly necessary for a complete understanding of the problems of television, but there are many good text-books available which deal with them in a scientific manner.

Apart from matters of this nature, the book is by no means free from errors. On page 2 it is stated that "a molecule consists of two or more atoms," whereas, of course, molecules consisting of no more than a single atom are quite common. The errors in the circuit diagrams are too numerous to be listed here, but it should be noted that they consist chiefly of the omission of grid leaks and the connection of H.T. batteries in such a manner that they are short-circuited.

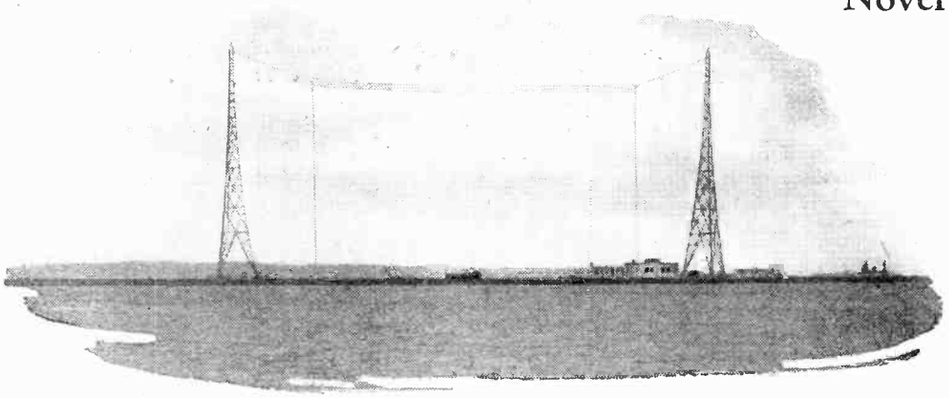
The author possesses a happy air of infallibility, and it is interesting to know that he has settled the vexed question of the exact composition of the ether! The book assumes no knowledge whatever on the part of the reader beyond the ability to read, and while this in itself may be a good point, in this case it results in a style which is reminiscent of a book for the very young.

The book is of American origin, but the English edition under review, which is well printed and bound, and free from typographical errors, is published by Sir Isaac Pitman and Sons, Ltd. W. T. C.

The Radio Trade Annual of Australia, 1933 (First Edition), compiled by the staff of "Radio Retailer of Australia" and containing a quantity of useful information concerning the progress and present position of wireless in Australia, including the general history of the industry during the past twenty years, the laws, regulations, and agreements now in force in the Commonwealth, list of national and private broadcasting stations, servicing, and technical data and other useful information. Pp. 247. Published by Australian Radio Publications, Ltd., Sydney. Price 10s. post free in Australia, or 12s. 6d. overseas.

Why Kalundborg is Loud

Novel Features in New 60 kW. Transmitter



Denmark's famous station at Kalundborg occupies a dominating site on a narrow peninsula.

APART from the remarkable strength at which it is received in this country, the new 60 kW. broadcasting station at Kalundborg is notable in several ways, not least in the method of high power assembly. It has been usual in the past to build transmitters in factory-made units. With increase in power and consequently in size of components, this unit system may tend towards a certain mechanical clumsiness, seriously modifying the layout as compared with what would be desirable from an electrical point of view. This consideration led the manufacturers, Standard Telephones and Cables, of Hendon, London, working in collaboration with the Danish Posts and Telegraphs Administration, to adopt a "cellular" system of construction, the high-power amplifying valves and interstage circuits being mounted in a line of cubicles forming part of the building.

Each cubicle, which is inset into the walls, consists of two screened cells in which are mounted the two halves of a balanced push-pull amplifier or output circuit. As a consequence, the transmitter room presents a remarkably simple appearance, in which all that can be seen of the apparatus is the front panels with their indicating dials and switches.

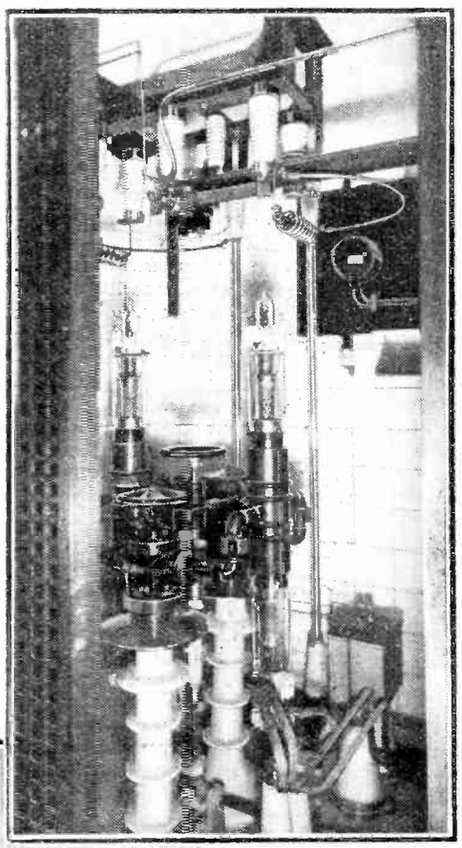
From the circuit standpoint, probably the most prominent feature is the use made of push-pull in the high-frequency stages. Only the Master Oscillator and First Separator are single valve circuits; the Second Separator, the Modulated Amplifier and the three Power Amplifiers are all of the push-pull type. Besides giving an exceptional degree of stability, the use of such balanced circuits aids in the reduction of harmonic content at the output stage, thus reducing the possibilities of interference.

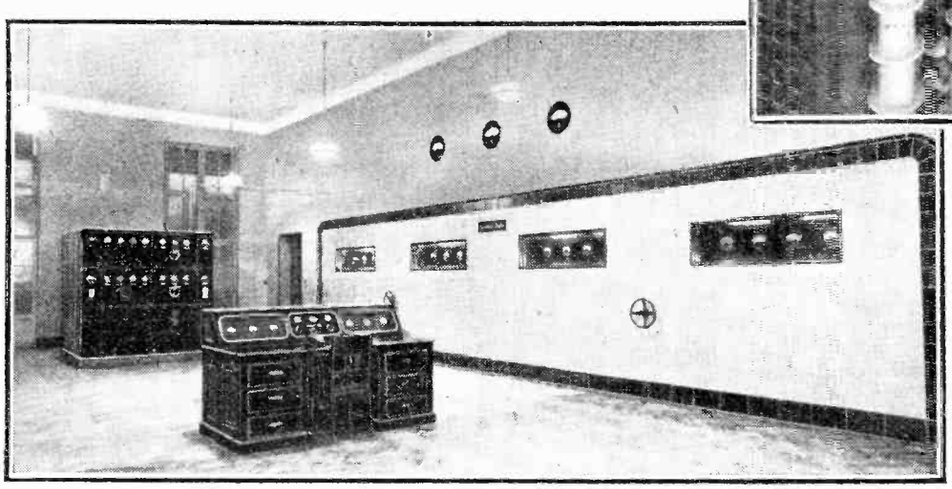
A plate supply of no less than 20,000 volts operates the two high-power stages. This handling of high power at high voltage levels means greater economy and efficiency; the valves used in the last stage are each capable of an output of 200 kilowatts with a plate supply of 25,000 volts.

The Valves

These valves, being of the double-ended type, are designed with the idea of reducing internal capacity. The filament is a system of Tungsten wires kept in tension by means of a spring, and the terminals are fitted with cooling pins so that, despite the large current to be handled—225 amps. at 25 volts—there is no necessity for air blast cooling of the filament seals. The grid terminal at the top end is also fitted with cooling pins. The water jacket, which is a fixture on the anode, is made with flexing ribs, whereby the mechanical stress of contraction and expansion, corresponding to changes in load and temperature of the water, can be taken up safely.

The anode supply for the high-power stages comes from a 20,000-volt rectifier embodying hot cathode mercury vapour valves. It was during laboratory tests with these particular valves that the interesting discovery was made of a former cause of the unreliability which has been a drawback with this type. As a consequence, it is now possible to make satisfactory rectifiers embodying this form of valve, with its extraordinarily high efficiency of the order of 99 per cent. The Kalundborg rectifier is of the three-phase, full-wave type, and is made in two units, each using six valves and giving an output of 10,000 volts, the total output of the two units in series being 20,000 volts, 12 amps. It is believed to be the largest rectifier of its type at present in regular commercial service.





(Above) Two output valves of the double-ended type, each capable of an output of 200 kilowatts at a plate voltage of 20,000. Note the cooling fins and central water jackets.

(Left) This view of the transmitting room, with its control desk, shows the unique "cellular" layout adopted by the manufacturers, Standard Telephones and Cables.

Why Kalundborg is Loud—

The Kalundborg aerial system is of the "multiple-tuned" type, and good radiation efficiency is obtained while using masts lower than the long wavelength would otherwise necessitate. Slung between the two 330ft. masts, the horizontal length of the aerial is nearly 400ft. At each end is a tuned down-lead, one of which is coupled to the transmitter through a short transmission line.

As the station receives most of its programmes from Copenhagen, an elaborate line amplifier system equipment has been necessary with all power supply taken from the station lighting mains. Mercury vapour valves are used for the H.T. supplies and copper oxide rectifiers in conjunction with ballast lamps for the filaments.

While it cannot be claimed that Kalundborg is Europe's most powerful station, it certainly earns distinction on the score of novelty, and it will be interesting to observe whether the new ideas incorporated in the design, particularly in regard to the "cellular" form of construction, become popular in the case of other and more powerful transmitters.

DISTANT RECEPTION NOTES

France's Broadcasting Problems

INTERFERENCE by heterodynes or actual jamming has been rather serious on both the medium and the long wavebands of late. Much of it is due to wavelength wandering, though some of it is caused by illicit stations or by authorised stations working on unauthorised wavelengths. This state of affairs does not augur very well for the success of the Lucerne Plan, for one might have expected that station engineers would now be doing their best to ensure correct wavelength keeping to prepare for it. Some of them will require a good deal of practice in this matter if they are to comply with the stringent rules of the Plan! Governments, too, should be setting their houses in order. It is not to be expected that a miracle will happen on January 15th, and if any country permits illicit stations within its borders to continue broadcasting at the present time there is undoubtedly trouble in the offing.

The French Government is making every effort to obtain the necessary powers to deal with the extraordinary wireless situation that exists within its borders. Bill after Bill to give the Government the power that it needs has been brought before the Chamber, but none of them so far has ever passed into an Act.

The Ferrié Plan

The Ferrié Plan is going forward, though it has been to some extent revised. In its original form it contemplated the erection of fourteen stations, mostly with output ratings of 60 kilowatts, though two or three were rated at 30 kilowatts only. In its present form the scheme allows for ten main stations, one on the long waves and nine on the medium band. The long-wave station will be Radio-Paris, whose power will soon be raised from 75 to 100 kilowatts. In addition to the Poste-Parisien, it is expected that three other high-power French stations on the medium waveband will be at work before Christmas.

The Russian interference with Huizen's transmissions (Hilversum programmes) has ceased for the moment, and it is to be hoped that no more will be heard of it. A good deal of trouble has been caused on the lower part of the medium waveband by spark signals which frequently mar transmissions on wavelengths from about 250 metres downwards. Some of the transmitters responsible are very broadly tuned, and one of them was "double-humping" badly a few evenings ago. It seems a most curious thing that spark transmissions should be allowed to take place during programme hours within the limits of the waveband dedicated to broadcasting.

The number of well-received stations has increased considerably during the last week or two. The improvement is particularly noticeable at the top of the medium waveband, where stations are usually the first to suffer from summer-time conditions and the last to return to their winter strength. Budapest is now well heard on most evenings. Vienna is improving, and will, no doubt, come in well as soon as the aerial mast is in full use. Munich is now strong, and Riga has been coming in at good loudspeaker strength.

Recommended stations on the long waveband are Motala, Luxembourg, Kalundborg, Radio-Paris, and Huizen. On the medium band the choice is very large, and the following list gives those which have been found completely reliable night after night during the week preceding the writing of these notes. Here they are: Brussels No. 1 and No. 2, Prague, Langenberg, Rome, Toulouse, Leipzig, Strasbourg, Breslau, Hilversum, Heilsberg, and Trieste. Many others were good on most nights, but just fail to obtain places in the list owing to occasional heterodyne interference.

D. EXER.

FOREIGN BROADCAST GUIDE

BUDAPEST

(Hungary).

Geographical position: 47° 30′ N.; 19° 3′ E.
Approximate air line from London: 903 miles.

Wavelength: 550 m. Frequency: 545 kc/s. Power: 18.5 kW.

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

Standard Daily Transmissions.

06.45 B.S.T., Physical exercises; 08.45 (Sun.), 09.45 (weekdays), news; 10.00, sacred service (Sun.); 12.00, carillon; then continuous broadcast until 18.30, concert; talks; 19.30, relay of opera or concert; 23.30, Cigány orchestra or dance music.

Announcers: Man and woman.

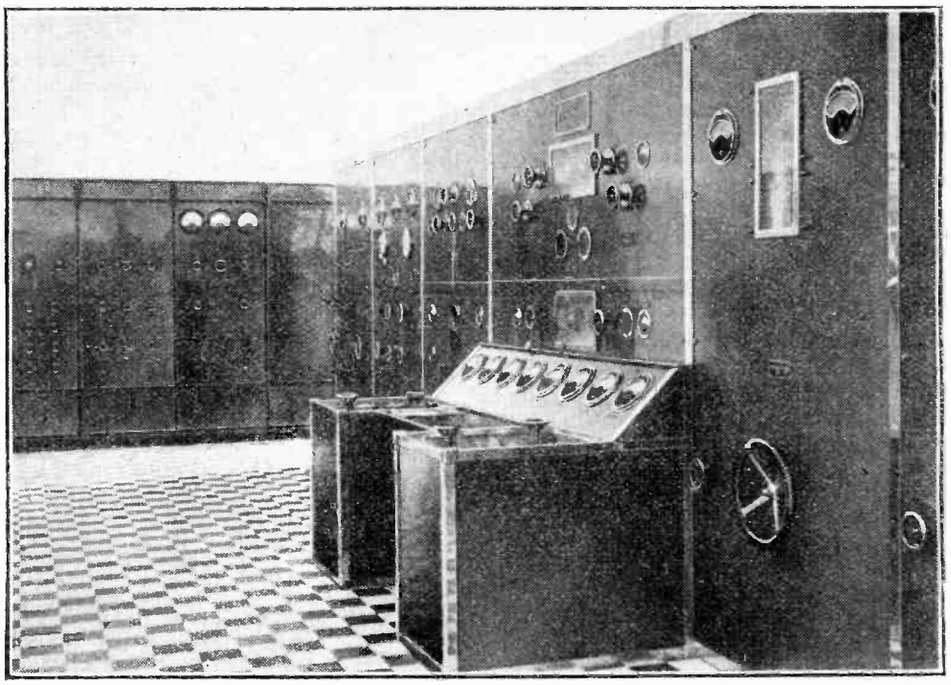
Call: *Hallo! Radio Budapest* (followed by names of relays). Details of programmes are frequently given in the French and German languages; also in English on International evenings.

Interval signal:

When plays are broadcast a gong is used at the beginning and end of each act.

Closes down with good-night greetings in several languages, occasionally followed by the Hungarian Anthem.

Relays: Miskolc, Magyarovar, Pecs—on 209.8 m. (1,429 kc/s), 1.25 kW. Budapest—Csepel, 840 m. (357.1 kc/s), 3 kW., and Nyiregyhaza, 267.4 m. (1.022 kc/s), 6.25 kW.



MARCONI BROADCAST EQUIPMENT IN FINLAND. The control desk and main transmitter of the Finnish Broadcasting station at Viipuri (Viborg), in the background can be seen the switchboard. This station broadcasts on a wavelength of 291 metres and the power is given as 13.2 kW.

News of the Week

Current Events in Brief Review

Test for Ether Searchers

ANY listener with a good receiver has an opportunity to beat the world in an interesting competition which opens on October 1st to discover the set user who can tune in the greatest number of broadcasting stations on the medium waveband between 180 and 500 metres. The stations in question must be situated at a distance of not less than 2,000 miles from the receiving point and on a separate continent.

The contest is being organised by the International DX'ers Alliance, Brighton Grove, Newcastle-upon-Tyne. The competition remains open until April 1st, 1934.

The Sultan's Own

IT is rumoured that the Sultan of Morocco will soon possess a private broadcasting station. On his recent visit to France, the Sultan ordered several receivers, including a short-wave set, and it is understood that special enquiries were made regarding transmission gear.

First Aid by Radio

ALTHOUGH car radio, so far as we are aware, has made no progress in Soviet Russia, motorists are being helped by a new system of short-wave transmitters installed at strategical points on certain main roads. These wireless "posts" are of the fool-proof type, so that any car driver in need of mechanical or medical help can get into immediate radio touch with the nearest regional listening centre to which the transmitter is permanently tuned.

Believe it or Not

THE latest radio story from Paris concerns a small boy whose schoolmaster considered that he deserved corporal punishment. The father, however, refused to take action, and on being questioned by the schoolmaster declared: "I dare not punish the lad; he is the only one in the family able to work the new wireless set."

Polytechnic Wireless Classes

THE London Polytechnic courses in Wireless and High-Frequency Engineering commence on September 25th next, enrolment dates being from September 18th to the 22nd. The courses, which are given in the evenings from 6.30 onwards, are arranged to provide a thorough training in the principles and technique of H.F. engineering, and should appeal specially to those engaged or interested in wireless, gramophone, or talking film work.

The wireless laboratory includes a complete commercial installation for telegraphy and telephony (G6RA).

Fuller particulars can be obtained on application to the Polytechnic, 307-311, Regent Street, London, W.1.

The Tell-Tale Badge

SWISS licence holders are now required to affix an official badge on their receivers to indicate payment of the necessary fee.

Kite as Aerial

A KITE flying at the height of 1,500 feet was used to support a 30-ft. aerial for ultra-short wave experiments carried out by the London chapter of the International Short-Wave Club on September 3rd. The tests were carried out on Parliament Hill, London, with a "Wireless World" Ultra Short Wave Two, and several stations were heard.

Programme Souvenirs

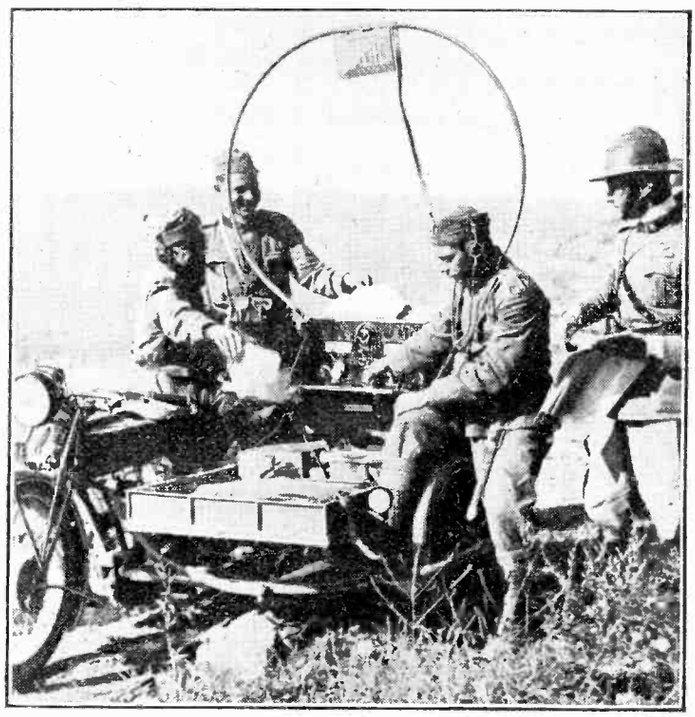
"EIAR," the Italian Broadcasting Company, has now begun the production and sale of gramophone records.

Anti-Static Laws for Germany

GERMANY is considering legislation to stop electrical interference with radio reception. We understand that a Committee is being formed to investigate all causes of man-made static and to report to the Government at the earliest possible moment.

Ban on Interference?

A TYPE of French listener who hopes to escape the new wireless tax is the man who is troubled by man-made static. Many claims have been sent in by individuals who claim exemption because the "parasites" are produced by the Postal Administration itself. The Post Office has bluntly replied in the negative, adding that a decree will be issued within six months on the subject of responsibility for interference with radio reception.



H.Q. CALLING. Battlefield instructions being communicated by a mobile field equipment during recent Italian Army manœuvres.

Boy Scouts Calling

A NEW sub-division of the American "ham" fraternity is the Boy Scouts' network, which now includes about fifty stations, the prime mover of which is H. W. Yalnell, of Helmetta, New Jersey, operator of station W2SN.

Still They Come

THAT kilowatts spell wireless licences is once more revealed in Switzerland, where, since the opening of the high-power transmitters at Söttens and Beromünster, the number of licences has increased by leaps and bounds. Last year the licence figure was 187,080. On June 1st, 1933, the figure had increased to 261,361.

The Gramophone Quota

POSTE PARISIEN has signed an agreement with the gramophone manufacturers limiting gramophone recitals to sixty hours per month, and forbidding a second broadcast of the same record without a special permit. The other French stations are expected to follow suit in the near future.

More Encouragement for German Amateurs

GERMAN short-wave amateurs are about to be granted much more liberty in their experiments. Formerly there were not more than thirty to forty German short-wave transmitters. At least 150 licences are about to be issued.

Super Pigmies in Paris

MINIATURE or "Gulliver" sets are to be a leading feature of the coming Paris Radio Salon; indeed, according to our Paris correspondent, many of the superhets will be "super pigmies." The average weight of the miniature set will not exceed ten pounds.

The main difference between the London and the Paris show will be the almost complete absence at the latter of the battery set. France is "all electric."

Trying Again

BELGIAN architects are to have another opportunity to design a "Broadcasting House" worthy of their country. It will be remembered that the recent competition failed to evoke any effort of the required standard, though the first eight of the competitors have since been awarded consolation prizes of 1,000 francs each. The closing date for the new competition is November 10th.

World Beater Set for Geneva

FACILITIES for hearing the world's broadcasting stations are considered essential for the new Palace of the League of Nations now being built at Geneva. In the Secretary-General's room a wireless receiver is to be installed operating on all wavelengths and capable of picking up any foreign station.

At the Brussels Show

OVER 100 exhibitors, occupying 275 stands, provided Brussels with its fifth annual radio show last week. According to our Brussels correspondent, the event was a triumph for the superhet. Nearly all manufacturers displayed at least one superheterodyne receiver, and all the latest features, such as automatic volume control and silent tuning, were very much in evidence.

Short wave reception has not yet captured the public imagination in Belgium, but this year several short-wave receivers were shown, and it is hoped that this heralds the popularity of this form of reception.

German sets were displayed in large numbers, notably the new People's Receiver. American receivers were also well represented, and considerable interest centred on a 16-valve example which included A.V.C., silent tuning, a Class "B" low-frequency output stage, rectifier and twin speakers, and a tuning range of 14 to 2,000 metres. British sets were well in evidence, but it is a notable fact that the Belgians are most attracted by British components and accessories, which are always assured of a good market.

Slander on the Air

THE Vienna police are still seeking the whereabouts of a mystery station at Oradea, which nightly broadcasts slanderous statements concerning well-known citizens. The transmission begins at exactly nine o'clock each evening, and a regrettable feature of the affair is that nearly all the citizens of Oradea forget the Vienna programmes in their anxiety not to miss the secret transmissions.

Television at the Berlin Show

A Review of the Year's Progress in Germany

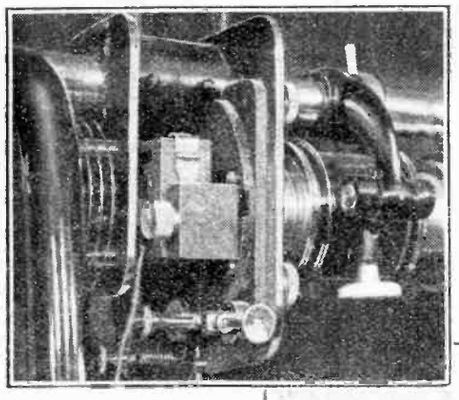
With a regular television transmission on ultra-short waves, Germany is at present taking a lead in television development in Europe. Apparatus for the reception of these transmissions is being developed by a number of manufacturers

DURING the past year, and particularly in recent months, there has been great activity in the field of television in Germany. The German Government is anxious to encourage television. Even so, the only prospect of television at present seems to be on ultra-short waves. German investigators all use twenty-five picture changes and 180 lines, with 40,000 picture elements, and thus obtain pictures far in advance of the current Post Office transmissions.

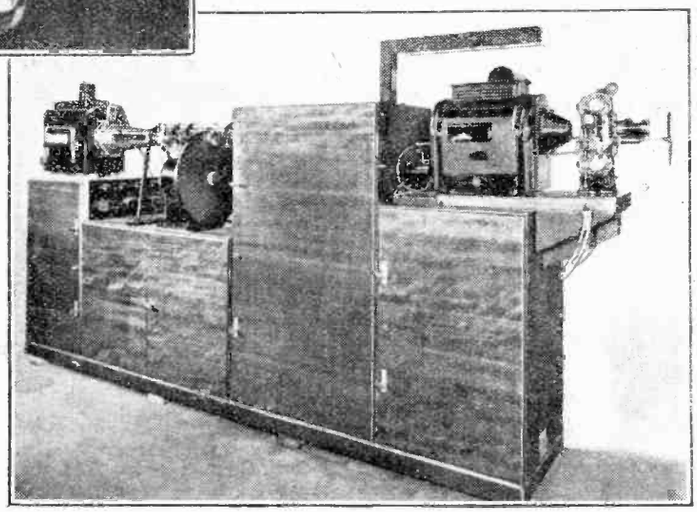
Some examples of the progress made and shown at the Berlin Exhibition will be briefly mentioned.

The Principal Exhibits

The Fernseh A.G. has been able to improve to a remarkable extent its well-known "intermediate film" process. In this system the object to be transmitted is first filmed, and the film still wet (in fact, five to ten seconds after exposure) is passed through the televisor and scanned. Formerly it was necessary to use a new film for every record; now, this is no longer necessary. A blank film in an endless band is now used. A sensitised layer is deposited on this by a special apparatus. After passing through a drying chamber the film arrives in the recording camera, where it is exposed, developed, fixed, and led to the television transmitting apparatus. Once the picture has been scanned, it is wiped out from the film by another process: a new sensitive layer is deposited on it, and the whole circle repeated. Another accomplishment of the Fernseh A.G. this year is the projection of television pictures to a size of 3 × 4 metres, by the following method. An endless band of blank film is provided with a sensitive layer in a special apparatus and is then dried. From the drying chamber the film passes to a window at which the received television picture is recorded as a negative by means of a perforated disc and a source of light modulated as to brightness. Although every separate picture element can only be illuminated for about a millionth of a second, the illumination is sufficient. The recorded picture is immediately developed and fixed and then projected as a positive picture in much the same way as an ordinary film, by a special cine projector. After passing through this projector the photographic layer is removed from the film and replaced by a new one so that the process continues without intermission.

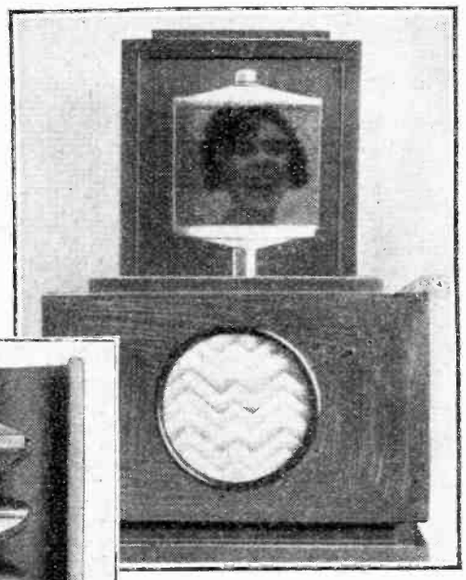


The Fernseh A.G. continuous "intermediate film" television projection receiver, with (inset) a close-up view of the Kerr cell unit which modulates the light.



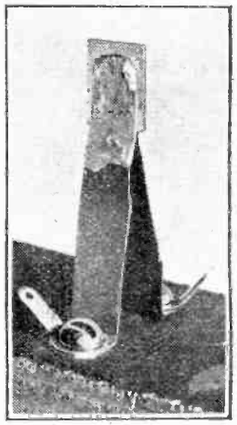
Another exhibit of the Fernseh A.G. is a new light ray scanner for the direct scanning of subjects. The novelty in this process is that the scene and persons to be transmitted are in a closed room whose inner walls are as white as possible and thus possess a high power of diffuse reflection; in this way three dimensional scenes can be transmitted without interfering shadows and with great efficiency.

The Fernseh A.G. were also showing a cathode ray television receiver and a mirror screw receiver, as developed by Te-ka-de.



The Te-ka-de mirror screw television receiver and an enlarged view of the mirror screw and motor.

As in former years, the Te-ka-de exhibited a mirror screw television receiver which is on sale and which this year also reproduces sound. A Te-ka-de novelty is a new type of Kerr cell for the control of the light ray. This Kerr cell does not consist, as usual, of a small condenser in nitro-benzole, but of a crystal through which the light passes. The crystal plate is coated on both sides with metal foil to which the modulating voltage is applied. Under the influence of this voltage the transparency is altered, linearly.



A crystal substitute for the Kerr cell. The crystal transparency varies, depending upon the potential applied across it.

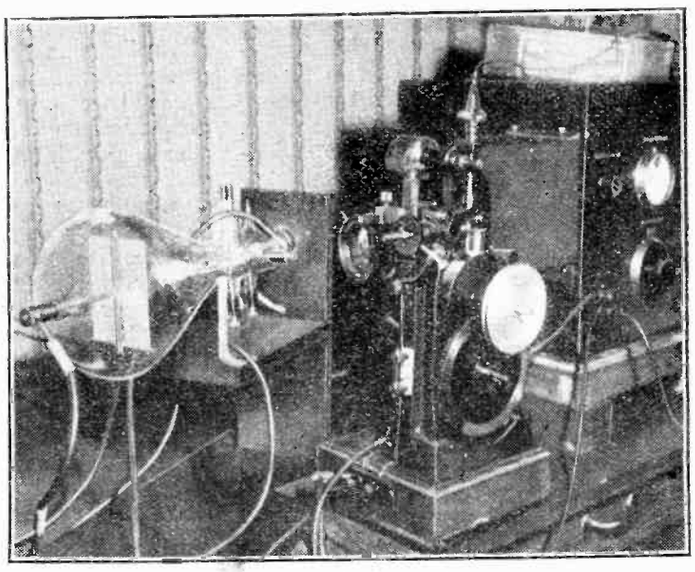
The firm of Loewe exhibited a cathode ray television receiver. The length of this cathode ray tube is 60 cm., the diameter of the fluorescent screen being about 25 cm. The lower portion of the apparatus contains the ultra-short wave receiver, the "Kipp" apparatus for controlling the tube, and a mains unit for providing the necessary voltages. The knobs on the left-hand side of the front regulate the volume for the loud speaker and the tuning of the short-wave receiver, the knobs on the right control the sharpness, and also the switching on and off of the mains

Television at the Berlin Show—

current. The pictures demonstrated were extremely good. In the Loewe aparatus both sound and picture are received on the same receiver, but are then separated by two detector valves.

Telefunken also exhibited a television receiver with cathode ray tube. This, like the Loewe apparatus, has an ultra-short wave superheterodyne receiver.

M. von Ardenne was showing his new cathode ray tube equipment, distinguished by the remarkable brightness of the light spot, so that the images can be observed on the screen in daylight or can be projected. The method used is that of "line control" (speed modulation, in which a constantly bright spot of light travels over the field of view with varying velocity).

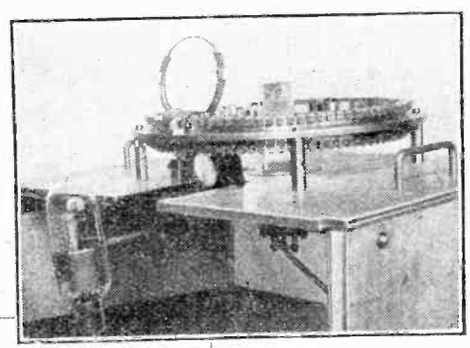


The new cathode ray tube equipment of von Ardenne, employing the principle of speed modulation.

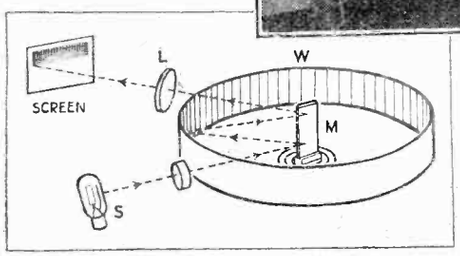
Apart from the Post Office exhibits, which also made use of cathode ray tubes, the new mirror wheel process of Mihaly should be mentioned. This employs a Weiller mirror wheel, in which, however, the mirrors are on the inner side. The mirror wheel W (see diagram) does not itself move, but inside it on its axis there is a small rotating plane mirror M, which is very light. This is driven by a small motor and kept in synchrony with the picture-changing frequency; a ray of light from a very strong source S is thrown on to this mirror, which reflects it on to the mirrors of the wheel. From here the ray is again led back to the little mirror which then projects it through a lens system on to the screen.

This extremely simple system would appear to have obvious advantages. The tiny rotating mirror only needs a very small and weak motor, which is no bigger than those used in synchronous electric clocks. As a result of this the driving and synchronising energy is extremely small, being only *a fraction of a watt* in the case of the latter. The energy can, therefore, be taken from the receiver itself, and thus the television transmitter controls the synchronism of the receiver.

As already mentioned, the mirror drum is stationary and its different mirrors, when once adjusted in the factory, need no further attention. The images thrown on the screen are sufficiently big to be viewed by a number of people from almost any position of the room. Apart from the technical advantages are the constructional ones, as the manufacturing price of this receiver is low.



The new Mihaly mirror wheel apparatus. The diagram indicates the principle of operation. With the complete receiver, which is enclosed in a cabinet, an external screen on a stand is provided and the picture is projected onto this screen from the receiver.



At the Berlin Radio Exhibition this receiver was shown working off the 7-metre television transmitter. The image consisted of 90 lines (10,000 elements), there being 90 mirrors on the drum. In this receiver the small rotating mirror was silvered on both sides, so that the rotating speed need only be half of the picture speed, i.e., 750 r.p.m., according to the British standard. The results on the 90-line receiver were pleasing, the detail being about equal to a 9 mm. home cinema outfit. The image size was about 6 by 8 inches. Synchronism was perfect, the picture being rock steady. The internal construction of the receiver can be clearly seen in the illustrations. The complete set contains the actual television portion, together with a 3-valve ultra-short wave receiver for A.C. mains.

A receiver for the new German standard of 180 lines will shortly be put into production. This model will probably employ a Kerr cell as a light source, thus giving brighter and black-and-white images.

It is interesting to note that the regular television transmission service of the German Post Office employs ultra-short waves, the picture being horizontally scanned twenty-five times a second in ninety strips, the total number of picture elements or points being 10,000.

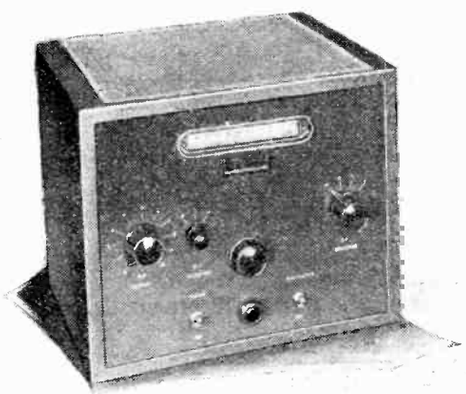
Singleton-Brown Test Oscillator

A Mains-Energised Source of Modulated H.F. for Receiver Servicing

RECENT improvements in the design and performance of receivers have called for a corresponding advance in the skill and equipment of the service man, and a test oscillator is now as essential and important an item on the test bench as the soldering iron or the multi-range meter.

The S.B. Model 2 Modulated Oscillator consists of a screen-grid dynatron R.F. oscillator with three ranges (1,500-545, 375-136, and 148-96 kc/s) modulated to a depth of approximately 70 per cent. by a triode giving three alternative frequencies of approximately 70, 500 and 4,000 cycles. The H.F. ranges and modulation frequencies are controlled by switches on the front panel, and an extra contact on the L.F. switch brings into circuit pick-up sockets which may be used to modulate the oscillator by music or standard frequency records.

The illuminated horizontal tuning scale is divided into 100 divisions and a calibration chart is screwed to the top of the metal cabinet. An attenuator resistance is also incorporated and a calibration curve of the voltage output is given. The range is from 50 microvolts to 2.5 volts R.M.S., and the output is taken from a plug and jack through a pair of screened leads. A second jack supplies a source of audio-frequency voltage for testing L.F. amplifiers.



S.B. modulated oscillator in which the A.C. power pack may be used for external testing.

The oscillator runs entirely from A.C. mains and the output from the power pack may be used for energising mains receivers in which a fault in the power supply is suspected. Plugs and sockets are provided at the back of the cabinet for this purpose and are rated as follows: L.T. 4 volts 6 amps., H.T.1 200 volts 13 mA., H.T.2 100 volts 7 mA.

The cabinet is constructed of steel and is neatly finished in brown crystalline enamel, the overall dimensions being 12in. x 10in. x 10in.

The price of the Model No. 2 illustrated is £18, and supplies may be obtained from The Singleton-Brown Radio Instrument Co., Singleton House, Compton Road, Wolverhampton. A simplified model omitting the I.F. range and with only one modulating frequency (500 cycles) is also available at £15.

UNBIASED
BY FREE GRID

Glasgolympia

YOU will no doubt be surprised to learn that, although the Scottish Radio Exhibition has been all over for a week now, I am still sojourning in the city of rivets and Red Biddy. I have, in fact, become so imbued with the spirit of Burns and Haig that I can scarcely tear myself away from the place; and at the conclusion of the show instead of returning with the caravan I risked being carted away forcibly.

The language difficulty at Glasgow has proved to be not nearly so bad as I had been led to believe. In any case, forewarned is forearmed; and I had come fully prepared to meet all difficulties in this respect, as my dentist had produced a special denture which was so arranged that it dealt automatically with the Scottish accent, and I flatter myself that my speech was indistinguishable from that of an inhabitant of the Broomielaw. I may mention that my dentist, a Cavendish Square man of considerable repute, specialises in this sort of thing, and has a considerable clientele among the London announcers, many of whom are actually Highlanders who, by the simple expedient of donning trousers and one of his special dental plates, have succeeded in passing the Oxford accent examination at Broadcasting House with flying colours.

One curious case which I encountered at the show was that of a manufacturer who made and sold automatic record changers and yet used those of another make in his radio-gramophones.

Tackling the first salesman I saw, I asked him to lead me gently by the hand and explain. I was, of course, referred to the elusive Mr. Blank, who, as at other radio shows, had gone to his interminable

At Glasgolympia.

lunch. I said I would wait, and did, and after an hour or so the people on the stand evidently realised that they had got to do something about it, with the result that a scientific-looking youth with bulging forehead and horn-rimmed glasses presented himself and proceeded to try on the old dodge inherited from the motoring industry and which is, I believe, known among the fraternity as "blinding the customer with technicalities."

Eventually he retired baffled and gave place to another young man resplendent in gent's autumn suiting whom I took to be the leading salesman. His arguments were long, wordy and unconvincing, and I was getting very impatient when sud-

Blinding him with technicalities.

denly a brilliant idea struck him. "To tell you the truth, Sir," he said, "our own record changers are so much better than those of other makers that we decided to let the public have the benefit of them as our present factory output is not sufficiently large to fulfil the needs of the public and supply our own radio-gramophones as well."

Happily I was glad to see a fine collection of chairs, making it possible to sit down at intervals and reflect upon the frailty of human nature. According to all reports, things were not so comfortable at Olympia.

The dance floor was exceedingly well patronised, and I was glad to see that the authorities had followed the lead of Olympia last year by providing dancing partners. Of these there were so many that I felt quite embarrassed with their attentions.

Arguing with the Blinkers On

AN ophthalmic surgeon, writing quite seriously to the Editor of a well-known daily, states that the cathode ray system of television reception is definitely harmful to the eyesight. Now I am more of an optimist than an optician, but, at the same time, I cannot give any credence to a medical man, however eminent in his own sphere, who supports his assertions by arguments that totter like a superannuated cab horse.

He alleges that the cathode ray system is harmful because, in his view, the picture it gives is as unsteady and as full of flicker as the early movies of thirty years ago, and causes similar eye strain.

I am not going to deny that flickering pictures tire the eyes, no matter whether they emanate from cathode ray radioscopes or early cinema projectors, but what about the pictures given by alternative methods such as the scanning disc receiver?

It seems scarcely credible that an eminent oculist should have sat in judgment upon one type of machine without seeing the results from the other; if he *had* seen the other he would have realised that the older type was not one whit less flickery.

To What Base Uses . . .

A WELL-KNOWN cabinet supplier was discussing with me the other day the relative merits of modernistic bakelite as against wood cabinets, to which latter substance he remains as faithful as the glue which he uses in his products.

I pointed out that one well-known firm was turning its attention to the production of bakelite tables and other major articles of furniture. "In fact," I added, "it is fairly certain that you and I will be buried in bakelite coffins if we live many years longer." "Not for me!" he said. "I am off at once to see my solicitor to guard against such a paradox in my will."

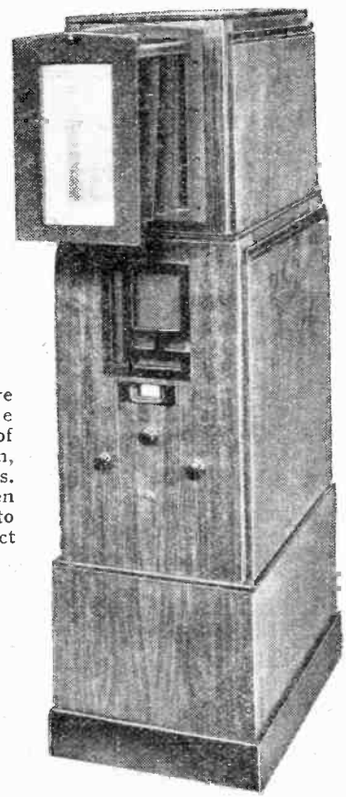
Frankly speaking, I cannot see any reason for retracting my prophecy except that in my own case, of course, not quite

Not all of me will be buried.

all of me will be buried, as I am at present considering several attractive offers from various hospitals and medical schools who want my scalp.

BUSH RADIO BAIRD Television Receiver

An Efficient Mirror-drum Televisor



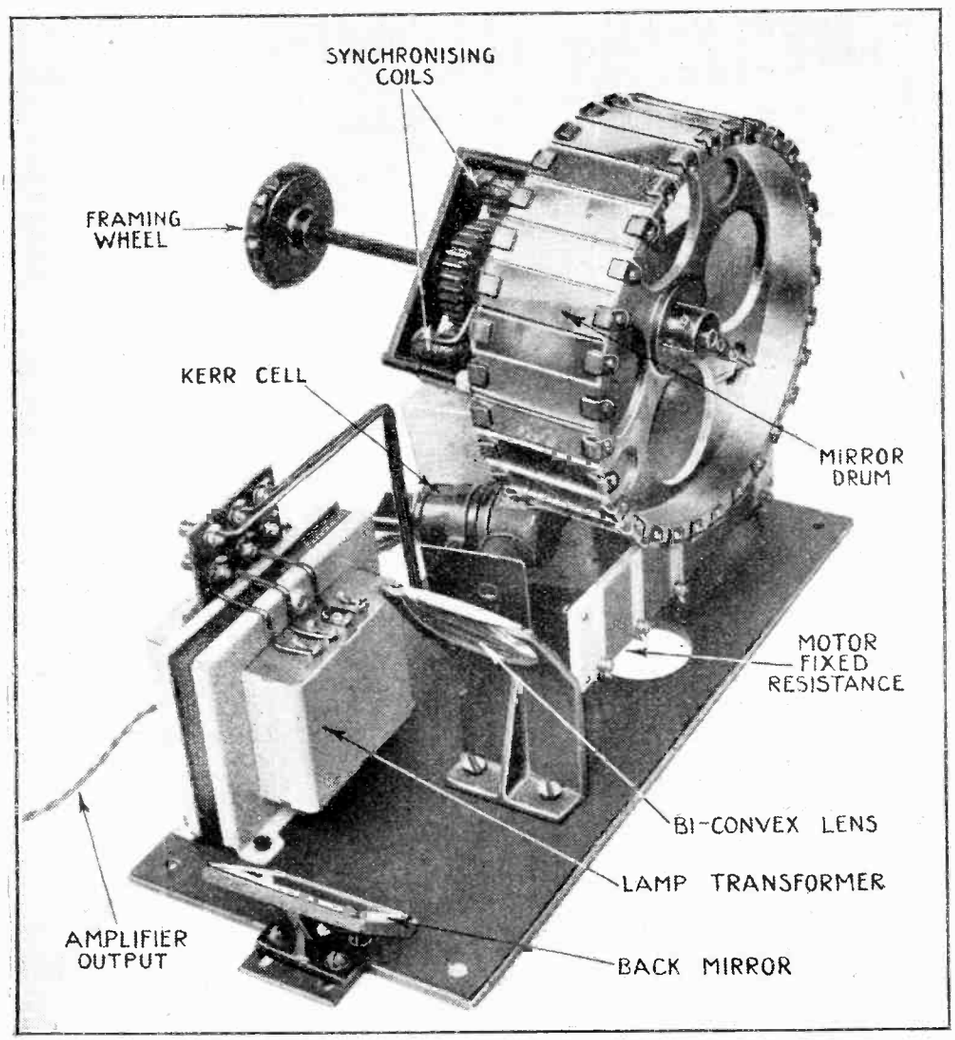
The picture covers the full area of the screen, 9×4 inches. The screen draws out to the correct position.

TELEVISION transmission and reception has not yet achieved the degree of perfection which is now found in sound broadcasting, but in spite of this, the possession of a televisor is not without interest. Comparisons between vision and sound are difficult, but it is probable that the results now obtainable from good television apparatus are comparable with those given by sound equipment in the days when the weekly broadcast transmissions from Writtle were an oustanding event.

Unlike sound broadcasting, television receivers must be designed to operate with a given system of transmission, and the transmitter and the receiver are far more closely interlinked. The present B.B.C. broadcasting is carried out on the 30-line, 12½-picture system, which means that 12½ complete pictures are transmitted each second, and that each picture is analysed by scanning it vertically 30 times. With the definition obtainable in this way it is probable that a receiver employing a mirror-drum is as satisfactory as any.

The apparatus under review is contained in a strongly built cabinet, which is similar in shape to that of a miniature grandfather clock; the lower portion contains the receiver proper, the power amplifier, and the mains equipment, while the upper part houses the purely television apparatus. The receiver is of conventional type, including H.F. amplification and resistance-capacity coupled L.F. circuits, and unusual care has been taken to avoid any loss of the upper modulation frequencies. Used for sound reproduction, therefore, the apparatus is capable of giving an exceptionally high standard of quality. Tuning coils are included for the medium waveband only, since there are no television transmissions on the long waveband. A loud speaker is fitted in order to facilitate tuning, and when the station has been found a switch permits a change over to the television equipment.

The output valve is of the 25-watt type and feeds a Baird Grid Cell which acts to convert current, or, more strictly speaking, potential variations, into variations of light intensity. An additional valve of similar type is provided for synchronising, and it is doubtless largely due to the considerable power which it supplies that such a good performance is obtainable.



The important parts of the Baird projector. The rotary mirror drum works in conjunction with an optical system of adjustable lenses and mirrors.

The Television Equipment

The Baird Grid Cell acts, as a loud speaker in sound reception, to convert the electrical impulses into a form in which they can be detected by the senses. It consists essentially of a type of Kerr cell mounted between Nicol Prisms. A 100-watt lamp is mounted at one end of the assembly, and in its passage through the prisms and cell the light is modulated by the varying electrical potentials on the plates of the Kerr cell. The cell itself is a voltage-operated device, so that at first it seems that a large power valve is unnecessary for its control. Owing to its high self-capacity, however, it must be shunted by a fairly low resistance if frequency and phase distortion are to be kept at a low value. In order to obtain the necessary voltage variations across this resistance quite a large amount of power is required.

The modulated light output of the cell falls upon the mirror drum from which it is reflected on to the viewing screen. The drum contains thirty flat mirrors, each set

Bush Radio Baird Television Receiver—

at a slightly different angle so that with the drum rotating at the correct speed and in the absence of a signal thirty vertical, parallel, and equi-spaced lines appear on the screen. This screen must be at some considerable distance from the mirror, so that to obtain a compact assembly it is arranged with bellows to pull out of the cabinet when reception is required.

The drum is driven by an electric motor, the speed of which is controlled by a variable resistance mounted on the left-hand side of the cabinet with the motor switch and the framing control. To assist in obtaining the correct speed it is fitted with a stroboscopic indicator which is viewed by the light of a neon tube operated by the 50 cycles lighting supply. With the aid of this it is a simple matter to adjust the motor speed. When the motor gathers speed the lines of the stroboscope can be seen slowly rotating, and as the correct speed is approached the apparent rotation is reduced. When the correct speed is found the stroboscope lines appear stationary.

Synchronising is carried out in the usual way. The black edging provided at the transmitter gives a series of pulses, one at the top of each scanning line. Since there are thirty lines per picture and 12½ pictures a second, there are 375 synchronising impulses a second, and in the receiver these are applied to what is virtually a small motor mounted on the main drum driving shaft. If the main driving motor increases or decreases its speed, the synchronising control operates to give a breaking or accelerating effect and to maintain constant speed.

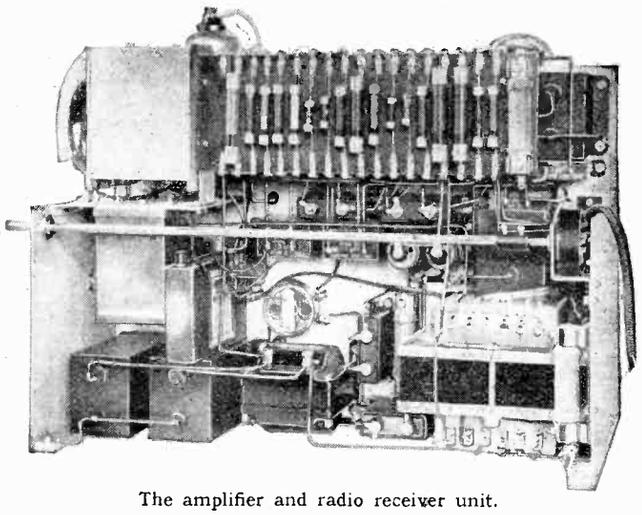
The controls comprise the normal tuning and volume adjustments, and an on-off switch mounted on the front of the cabinet, together with a control which acts to bias the Grid Cell and so regulate the average illumination of the picture. At the side of the cabinet are the purely television controls; the motor speed regulator, the framing handle, and the motor on-off switch, together with a viewing hole for the stroboscope.

Adjusting the Apparatus

In operation, the station is tuned in using the loud speaker as an indicator. The motor is started up and adjusted to its correct speed by the rheostat while watching the stroboscope. A change over from the speaker to the vision equipment is then made, and if perfect synchronism has been obtained the picture will be visible. A "flashing rain" effect indicates that the motor speed is incorrect, and an appropriate adjustment to the controlling resistance effects the necessary alteration.

When the picture appears, however, it may not be in frame; that is, it may be divided horizontally or vertically. This indicates incorrect phasing, and is adjusted by the framing control. This control operates to rotate the carcase of the motor and so moves the picture in a vertical direction. A small movement of this control, therefore, is sufficient to correct for any degree of vertical mis-framing. With most apparatus, horizontal mis-framing is more difficult to correct, and it is usually necessary to slow-up the motor momentarily so that a few pictures are slipped. The operation, therefore, requires some little skill for its successful accomplishment.

In this particular apparatus, however, the difficulty is avoided by a clever arrangement of the vertical framing control. The picture is arranged to be very slightly out of the vertical, so that rotating the carcase of the motor to produce a vertical displacement of the picture causes also a very slight sideways motion. To correct for horizontal displacement, therefore, it is necessary only to turn the framing control to a much greater degree than is necessary to compensate for vertical mis-framing. As the control is turned, the visual effect is of a number of pictures slowly moving vertically and gradually gliding sideways.



The amplifier and radio receiver unit.

Performance

The operation, therefore, is quite simple, and the performance obtainable probably represents the best that can be achieved with the present 30-line transmissions. The detail obtainable is not high, and dark objects of different degrees of illumination tend to merge together. Thus, a man's chin is quite distinct as long as his head is held upright, but it merges into his tie when he looks downwards and his chin falls into the shadow. The scanning lines are quite obvious, and give a vertical striped appearance to any white object, such as a shirt front.

In spite of these drawbacks, which are unavoidable with the present transmissions, the programme can be followed with ease provided that it does not contain too rapidly moving objects. The degree of definition is such that it is easily possible to recognise a well-known face.

The synchronising is really good, and during the half an hour's transmissions the apparatus often carries through without going out of synchronism even once. Occasional readjustment of the framing is necessary, since there is an occasional slow drift of the picture. The lapses from synchronism are apparently due more to the transmitter than to the receiver, for they invariably occur at the end of an item, when the curtain falls in the studio. Apparently this interrupts the synchronising impulses.

The apparatus is solidly built, and should give long and satisfactory service, and its adjustment does not call for any special degree of skill. The makers are Bush Radio, Ltd., of Woodger Road, Shepherd's Bush, London, W.12, and the apparatus is priced at 50 guineas complete.

The Radio Industry

WE are informed by Messrs. J. J. Eastick and Sons, of Eelex House, 118, Bunhill Row, London, E.C.1, that they are able to supply a dual-range "Hartley" coil for the pentode oscillator described in the issue of August 25th. Complete with a suitable D.P.D.T. switch, the coil assembly costs 9s. 6d., or 7s. 6d. without switch.

An attractively written brochure, entitled "A City of Sound," by E. P. Leigh-Bennett, has just been issued by the Marconiphone Company. It describes Marconi activities from the earliest experiments of Marchese Marconi to the present-day work of the factory at Hayes. Free copies will be sent to interested readers.

In our "Show Guide" number it was stated that Fuller "Sparta" batteries are intended for Q.P.P. and Class "B" receivers. The Fuller Accumulator Co. now point out that, although the "Sparta" Batteries may be used for this form of set, their "Triple Capacity" types are especially recommended for the purpose.

The Hawley Products Company of America have now established a European factory and office at 101, Walmer Road, North Kensington, London, W.10. The new firm, under the name of Hawley Products, Ltd., will manufacture loud speaker diaphragms under the original patents; diaphragms can be made in all sizes, and with different response characteristics to meet various specifications and requirements.

1933/1934 Catalogues Received.

Colvern, Ltd., Mawneys Road, Romford, Essex.—Radio List No. 12 dealing with principles, design and application of Ferrocart components. A particularly informative booklet which is obtainable free on application to Colvern, Ltd.

Varley (Oliver Pell Control, Ltd.), Kingsway House, 103, Kingsway, London, W.C.2.—A 28-page booklet illustrating and describing the new season's components, also leaflet dealing with the latest receivers and radio-gramophones.

Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.4.—New season's catalogue of Igranic devices, containing 48 pages of descriptive matter, technical data and illustrations.

Ward & Goldstone, Ltd., Frederick Road (Pendleton), Salford, 6, Lancs.—1933-1934 Radio Catalogue R/130, containing 55 pages of descriptive matter and illustrations dealing with "Goltone" components and accessories. Full techuical details are given wherever warranted for all components.

Broadcast Brevities

By Our Special Correspondent

Television and the Film Industry

LEST any novelist should be preparing a saga on the decline and fall of the film industry consequent upon the advent of television, it is worth while remarking that the film folk are losing no time in "tying up" with television in this country.

The Coming Tests

It is common knowledge, I suppose, that the new 120-line transmission tests from Broadcasting House, on the Baird and H.M.V. systems, will employ film almost exclusively.

The question arises as to whether the B.B.C. will ultimately rely entirely on celluloid entertainment in preference to the flesh-and-blood variety in the studio.

Complications

Complications are likely to occur. For instance, it is improbable that the film companies will be willing to permit their best efforts to be broadcast—a practice which will eventually mean that a costly film will dissipate half its value in the course of one evening. Again, the film companies are not likely to follow the present practice of the gramophone firms in permitting their products to be put over the ether in expectation that bigger sales will ensue.

No listener or "looker" will feel impelled to dash out and purchase a seat for the film he has just witnessed on his televisor.

By way of self-preservation, the film industry in this country will make a big effort while there is still time to link up with broadcasting.

Sir John Reith's Journey

Very shortly Sir John Reith will be crossing the Atlantic to attend the inaugural ceremony of Radio City, New York, which represents the world's greatest conglomeration of entertainment industries, banded together for mutual support and protection.

It will be interesting to note whether the Director-General, on his return, envisages a similar Palace of the Entertainment Arts in London, with Broadcasting House as the nucleus!

Mr. Melville Dinwiddie, D.S.O., O.B.E., M.C., who has been appointed the Scottish Regional Director.

Another Conflict of Interests?

This, perhaps, is sheer speculation. But those who sense the growing importance of television cannot but see that the present independence of broadcasting and the film cannot endure when television develops.

For example, television may be restricted in the early stages to brief comedies and short items of news interest; ultimately, however, the film industry may find itself in conflict with the B.B.C.

"Effects" in Gramophone Programmes

I HAVE a fancy that "Free Grid" will relish the authentic news that the B.B.C. is adding "effects" to the broadcast of full-length operas on gramophone records. When "Pagliacci" was broadcast with the full gramophone version a short time ago, the Effects Department assisted with a special Columbia record of sounds in a theatre, the tuning-up of the orchestra, and the applause of the audience.

And Why Not?

Surely this practice could be developed, particularly in relation to talks, which are so badly in need of a little tonic treatment?

Let the B.B.C. engineers take some Blattnerphone records of noises in Hyde Park so that the well-blended murmur of approval and disapproval can form a misty background to the pontifical utterances of some of our more solemn speakers. After all, the speaker himself need not be aware of this background to his remarks. Better not, perhaps, for the hoots and cat-calls which would go down very well with the army of listeners might play havoc with the composure of the professor in the studio.

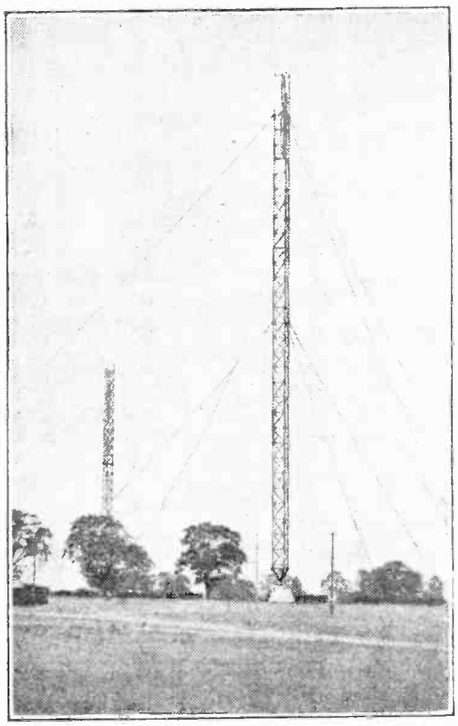
At any rate, the B.B.C. should be prepared to try anything *once*.

The Saturday "News Reel"

THE only striking innovation in the autumn talks programme is the introduction of the Saturday "news reel" after the second general news bulletin. This news reel will be based on the successful experiment of Saturday, July 1st, when news, topical talks, and relays from abroad were grouped in one continuous programme.

Blattnerphone Flashes

Beginning on October 14th, the news and talks, starting at 9 o'clock, will be incorporated in a single programme, and the first three or four minutes will be devoted to a summary of the outstanding events of the day. This will be followed by a more elaborate presentation of the details of these events, possibly by the aid of gramophone and Blattnerphone records, brief interviews with people "on the spot," and a more vivid Sports Bulletin than has been given in the past.



A DROITWICH LANDMARK IN THE MAKING. The first 250 feet of the giant masts of the new B.B.C. National transmitter in course of erection. When finished they will be over 700 feet high.

An Aside

In regard to this last, the B.B.C. remarks rather patronisingly that a number of listeners appear to be interested in no other aspect of human activities.

Big Names in the Making?

In the main the speakers are familiar names: Vernon Bartlett, Desmond MacCarthy, G. K. Chesterton, S. P. B. Mais, and Sir Walford Davies. There are, however, some new speakers, and we may legitimately hope that some hitherto mute and inglorious Miltons are about to burst upon our aspiring ears.

Symphony Concerts

THE detailed programmes for the series of symphony concerts, which begin on Wednesday, October 18th, have now been issued by the B.B.C. They will, as usual, be conducted mainly by Dr. Adrian Boult, but several famous guest conductors will also do their share.

Handel Modernised

AMONG the numbers to be performed for the first time in England are Bartok's Concerto No. 2 for pianoforte and orchestra, in which the composer will play the solo instrument; Alban Berg's "Wozzeck" and an arrangement by Arnold Schönberg of Handel's Concerto Grosso for string quartet and strings. It will be interesting to hear how Handel stands modernising, though it is difficult to imagine our old friend George Frederick in the dress of one of the ultra-moderns.

Political Talks

PERHAPS the greatest novelty in the coming season's talks will be the political addresses to be given on Thursdays at 9.20 p.m., in which the speches will not be subject to preliminary censorship.

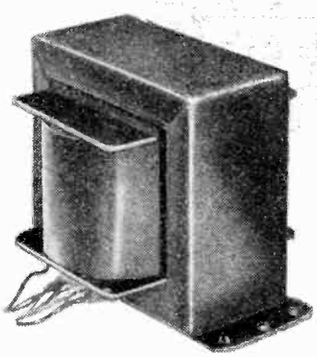
LABORATORY TESTS

NEW RADIO PRODUCTS REVIEWED

PARTRIDGE MONODIAL MAINS TRANSFORMER

PROSPECTIVE constructors of *The Wireless World* New Monodial Super may be interested to learn that a mains transformer for this set is now obtainable from N. Partridge, King's Buildings, Dean Stanley Street, London, S.W.1. The component is designed on very generous lines, for it measures 6⅞in. × 4⅜in. × 4½in. high overall, and, in view of these dimensions, it would seem desirable that slight alterations be made in the size of the baseboard for the power pack. An increase of ¾in. in the length and of ½in. in the width would provide the additional space required. Increase in the latter direction may be avoided, however, by bending one of the fixing lugs at right angles and screwing it to the side of the baseboard, but the extension in the length is far preferable to a rearrangement of the components.

The various leads are brought out through the lower cheek of the bobbin, and thus fall convenient for passing through to the underside of the baseboard and thence to their respective anchorage points. The primary winding is screened, and a separate earth lead brought out. Small tags are tied on the wires for identification. Tappings are provided on the primary for supply mains of 200, 230, and 250 volts 50 cycles A.C.



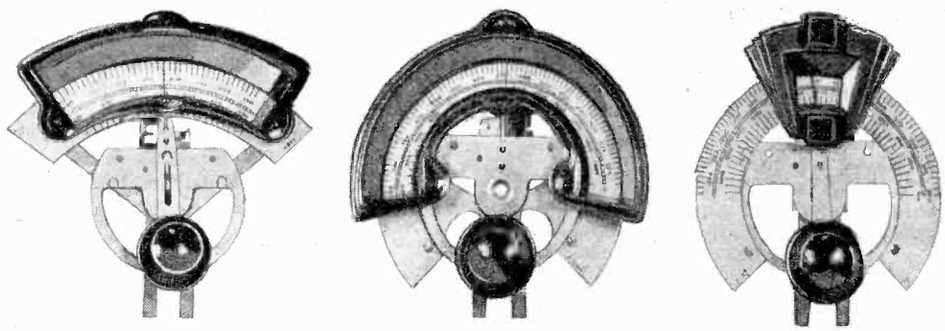
Partridge mains transformer for the New Monodial Super.

With all windings giving the specified output currents, the various voltages when measured were found to be correct for the satisfactory operation of the set. After smoothing, the H.T. supply measured 430 volts with 120 mA. flowing; the two one-amp. L.T. windings showed 4.01 volts, while the rectifier filament and the six-amp. windings were each giving 3.98 volts.

The transformer runs perfectly cool; there is no trace of mechanical hum due to looseness in the core or in the assembly; and, altogether, the component is a sound electrical job, which, at 36s., represents very good value.

NEW POLAR DIALS

THE Polar range of condenser dials now includes six models; three are full-vision type, two are disc drives, and one is a drum pattern. The four latest additions, described respectively as the Horizontal, the Arcuate, the Semi-Circular, and the Moving Scale Disc drives are calibrated in wavelengths for Polar condensers, assuming a minimum capacity of the order of 70 m-mfds., and coils of 157 microhenrys and 1,900 microhenrys for medium- and long-wave pre-selector circuits. For superheterodyne sets the oscillator coils should have inductances of 126.5 and 925 microhenrys respectively. But a plain graduated scale is provided as well, which in the Horizontal and Arcuate models is divided in 100 divisions, and in the remainder into 180 degrees. These drives are very robust, well finished, and quite free from slip or backlash. The reduction ratio is about 8 to 1, and the knob drives the pointer in the same direction as its rotation.



Polar condenser drives; illustrating the Arcuate, Semi-Circular and the Moving Scale Disc Models.

The new models can be supplied fitted with a small air-dielectric trimmer condenser giving a variation of about 50 m-mfds., its control being mounted concentric with the tuning knob. Dual lamp-holders mounted on a removable clip are fitted, and the prices are 5s. 9d. each for the three full-vision types, 4s. 6d. for the new disc model, 5s. for the plain disc pattern, and 7s. 6d. for the drum drive. Escutcheon plates of appropriate design for each model in brown bakelite, also knobs to match, are included, together with fixing screws. The trimmer condenser adds 2s. to the price of each model.

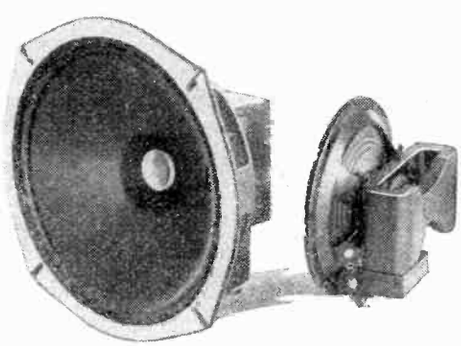
TWO SONOCHORDE REPRODUCERS

IN producing the Sonochorde de Luxe models the makers have set out to provide a chassis unit of better finish and external appearance than the average "set builder's" loud speaker. It is finished in a very attractive two-tone cellulose enamel, and the transformer is enclosed in a detachable metal cover with a rubber bush for the connecting leads.

In the mains-energised model tested the field terminals and those of the input to the transformer were, in our opinion, spaced rather too closely, but there is no reason why trouble should arise in this quarter if it is realised that special care must be taken to avoid short circuits due to stray strands of wire.

As regards sensitivity, few loud speakers we have tested in this class have given better results. The quality is well balanced and the output is exceptionally uniform from 150 to 2,000 cycles. There is a bass resonance at 130 cycles, and the output falls gradually to a cut-off at 75 cycles. Between 2,500 and 4,000 cycles the output is five or six decibels above the average level, and above 5,000 cycles it falls off rapidly. The price of the de Luxe energised model is 35s., and of the permanent magnet model 65s., or 67s. 6d. with Class "B" output transformer.

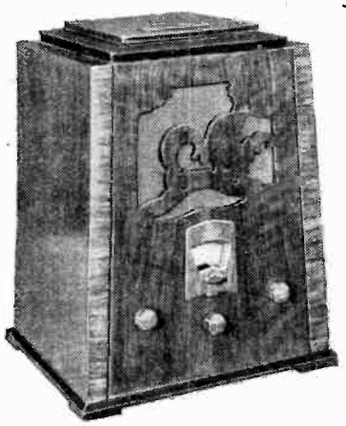
The new Sonochorde Midget has been designed for portable sets and car radio, and has a cone diameter of 4½in. In spite of its small size (the depth is 2⅝in. in the energised and 2¼in. in the P.M. type), the performance is remarkably good, and the quality is to be preferred to many moving-iron units of comparable price. The middle and top register reproduction is very similar to that of the average medium-sized moving-coil loud speaker except that the increased output in the upper middle register is somewhat higher in frequency—approximately 3,800 cycles. There is not much output below 150 cycles, but the "bass" resonance at 260 cycles serves to prevent the reproduction becoming too high pitched. On both speech and music the balance is really rather surprising, having regard to the small size of the diaphragm. Naturally the efficiency is not so high as that of units employing larger magnets and diaphragms, and for a given sound output an increase of about 4 db. in the power input is necessary above that required by the average 7in. diaphragm unit. On the other hand, the power handling capacity is good, and over one watt was applied before chattering made itself heard. The price of



Sonochorde de luxe D.C. and Midget P.M. moving-coil loud speakers.

the permanent magnet model is 21s., and of the D.C. model 17s. 6d. The latter is available with 2,500- or 6,500-ohm field, and both types may be supplied with transformers for power or pentode valves.

The makers are Sonochorde Reproducers, Ltd., 1, Willesden Lane, London, N.W.6.



Varley "SQUARE PEAK" 4 Model A.P.46

High Selectivity with an Unconventional Circuit

FEATURES. ***Type.***—*Four-stage table model superheterodyne for A.C. mains. Internal moving-coil loud speaker. Provision for pick-up and external loud speaker.* ***Circuit.***—*Signal frequency amplifier—oscillating detector with I.F. transformer—second detector—pentode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Main tuning. (2) Waverange operated by sliding escutcheon. (3) Volume. (4) Reaction in I.F. circuit.* ***Price.***—*15 guineas.* ***Makers.***—*Messrs. Varley, 103, Kingsway, London, W.C.2.*

THE four-valve superheterodyne receiver, on account of its superior selectivity, is gradually ousting the three-valve straight set from its position as the "standard" receiver of the day. The number and variety of sets of the former type shown at Olympia were sufficient indication of the trend of events in this direction.

In the Varley Model A.P.46, however, we have something more than "just another 4-valve superhet," for there are many points both in the circuit and the structural design which indicate original thought rather than mere repetition of current practice.

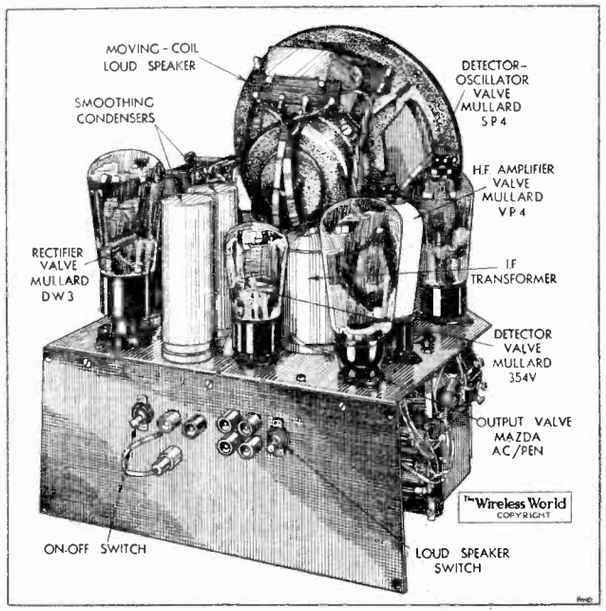
Probably the most interesting innovation is the omission of valve amplification in the I.F. stage. There is, of course, an I.F. transformer in which both windings are tuned, so that the full advantage of the superheterodyne principle from the point of view of selectivity is retained. This is further enhanced by reaction applied to the I.F. transformer from the second detector stage.

The first valve, which is usually the detector-oscillator in a 4-valve superhet, in this case is used purely as an H.F. amplifier. It is of the variable-mu pentode type, and volume is controlled in this stage by simultaneous variation of the bias and screen grid voltages. Incidentally, it is the primary of the H.F. transformer which is tuned, and this circuit is ganged with the tuned aerial circuit and with the oscillator circuit associated with the second valve. This, again, is of the H.F. pentode type and combines the functions of oscillator and first detector. It is coupled to the second detector—a triode—through the band-pass I.F. transformer. Transformer coupling is employed between the detector and the pentode output valve, and tone correction is applied across the primary of the output transformer to the moving-coil loud speaker. The external loud speaker is connected through a condenser across the output transformer primary, and is therefore suitable for high impedance loud speakers as well as moving-coils fitted with a suitable transformer.

The controls consist of main tuning, volume, reaction on the I.F. circuits and waverange. The latter is controlled by switch mechanism attached to the moulded escutcheon plate which slides up or down, thus exposing the appropriate scale and station calibrations. It is interesting to note that the makers are already supplying tuning dials with stations distributed according to the Lucerne agreement, which comes into force in January next.

At the back of the chassis, in addition to the usual sockets for aerial and earth, pick-up, mains aerial and external loud speaker, there are two tumbler switches. One is connected in the mains supply circuit and the other disconnects the loud speaker in the set when it is desired to use the exterior loud speaker only.

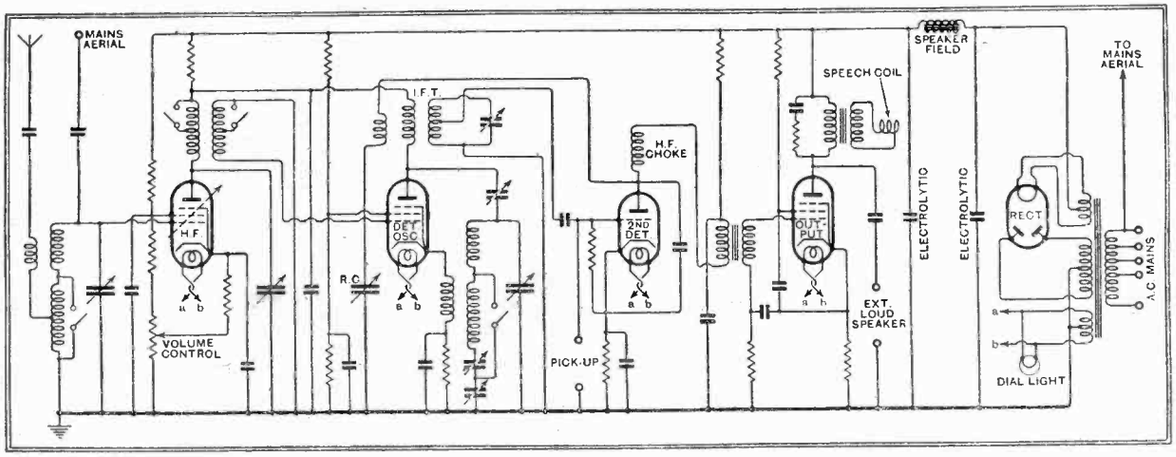
The performance of this set amply justifies the deviation from convention in the circuit arrangement. Whistles due to second channel interference are considerably reduced by the signal frequency stage, and the four tuned circuits in conjunction with the reaction in the I.F. circuits give a high degree of selectivity. Zeesen on long waves is easily tuned in free from Daventry and Radio Paris, while, in Central London, on medium waves, only two channels are lost, on either side of the Brookmans Park National and Regional stations. The performance as regards selectivity seems to be equal to that of the average four-stage superhet, without having to resort to the use of reaction, which may be kept in reserve for exceptional receiving conditions.



The moving-coil loud speaker and chassis form a single unit in the Varley A.P.46 receiver.

Quality of reproduction is bright, with an adequate foundation of bass, and transients are noticeably good. Mains hum is negligible.

To summarise, in the Varley A.P.46 we have a receiver at a reasonable price which is original in design and capable of a performance in range and selectivity which is above the average for a superheterodyne of four stages. The only criticism we have to make is that there is room for improvement in the mechanical rigidity of the chassis; but this is of concern more to the service engineer than the user.



An unconventional feature of the circuit is the omission of valve amplification in the I.F. stage. The selectivity of the I.F. circuits is supplemented by reaction from the second detector.

Next Week's Set Review

H.M.V. SUPERHET CONCERT SEVEN Model 467

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 brief particulars, with the fee charged, are to be found at the foot of this page.

Condensers in H.F. Circuits

EVER since non-inductive by-pass condensers appeared, it has been consistently advocated that they should be employed in all H.F. circuits in preference to those of the older type. To ensure that by-pass and decoupling condensers shall be entirely effective in such circuits, it is strongly recommended that attention should be paid to this point.

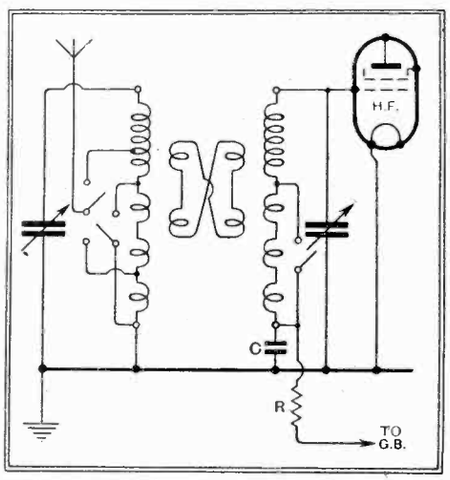


Fig. 1.—The by-pass condenser C is effectively in series with the secondary tuned circuit, and if this condenser has appreciable inductance, the matching of the secondary coil will be affected.

A correspondent, who realises that it would be fatal to employ an inductive condenser in such a position that it would be common to the two component circuits of a band-pass filter, nevertheless seems to think that an old type of condenser might be used satisfactorily for decoupling the H.F. grid circuit of the Modern Battery Four (*Wireless World*, August 11th). This condenser is not common to both filter circuits, and so it is argued that, even if it be slightly inductive, filter coupling will not be affected.

All this is true enough, but our correspondent has overlooked the fact that the condenser in question is in series with the second tuned circuit, and therefore, if it happens to have an appreciable inductance, it will upset the matching of the two coils. Any inductance in the condenser will be additive to that of the secondary winding; this is made clear in Fig. 1.

Gilding the Lily

IT has been asked whether it would be worth while going to the trouble of fitting a band-pass input circuit for the New Monodial superheterodyne; a second reader words his question rather differently by asking whether the quality of the receiver would be improved by such an addition.

Although it cannot be denied that an additional tuned circuit is bound to lead to increased immunity from second-channel interference, the benefits to be derived from such an addition are not considered to be sufficient to warrant the extra complication and cost involved. So far as quality is concerned, no improvement would result from this addition, as the loss of side bands which inevitably takes place in a single-tuned input circuit was taken into account in the design of the tone-correction system.

Car Sets Afloat

IT has occurred to a reader that one of the recently introduced motor car sets would be almost ideal for installation on board his cabin cruiser, where space is at a premium. The engine is fitted with 12-volt electrical system and a large battery. We are asked to say whether any unsuspected difficulties are likely to arise in operating the set, and, indeed, to criticise the proposal in general.

Although we have not yet had any personal experience of the use of car sets for this purpose, we can see no reason why they should not be entirely satisfactory for motor boats or motor yachts, provided that a suitable converter or battery be fitted. It is understood that these specialised receivers are installed on board many motor cruisers in America.

Limitations of Multiple Valves

THE user of a "straight" H.F.-det-L.F. three-valve set asks whether it would be satisfactory to replace the present detector valve by a double-diode-triode, and, with the help of this valve, to obtain automatic volume control without loss of sensitivity and without adding to the number of valves in the receiver.

Although these new valves provide an excellent solution of the problem of adding A.V.C. to a "2-H.F." set, we fear that our present querist may be dissatisfied if he makes the proposed alterations. All "1-H.F." sets depend largely on reaction for their sensitivity, but this invaluable aid to long-distance reception must be forfeited if one of the new valves be fitted.

A.V.C. Without Alteration

ANOTHER query dealing with the addition of A.V.C. to an existing receiver comes from a reader who wishes to fit an "amplified and delayed" automatic control to his "2-H.F." A.C. receiver without making any internal alterations. It is stipulated that the control valve shall be entirely mains-operated.

Were it not for this latter stipulation, we would suggest the A.V.C. unit described in *The Wireless World* of March 31st. The threshold value of signal strength at which the control exercised by this unit comes into operation may be adjusted to any desired extent; further, the system is an "amplified" one, as the control valve acts as a D.C. amplifier of voltage changes appearing on the anode of the detector valve. Although not impossible, it would be difficult to arrange the unit for "all-mains" feed, but our correspondent might like to effect a compromise by supplying the anode of the valve from the mains through a separate rectifier, a battery being used for grid bias purposes.

True Selectivity

PROBABLY the most common question propounded to the Information Department deals with the improvement of selectivity of existing receivers. In replying to such questions, it is comparatively easy to suggest methods whereby the signal input from the aerial, or the H.F. magnification of the set, may be reduced, and thus an apparent improvement in selectivity be obtained. But this improvement will always be at the expense of sensitivity; none of the popular "losser" methods can do anything towards improving the true selectivity of a receiver.

This can only be done by improving the "goodness" of the tuned circuits in the set or by adding to their number. The first alternative is generally impracticable, but the second can generally be put into effect by adding an external tuned aerial circuit to receivers which do not already include a band-pass input.

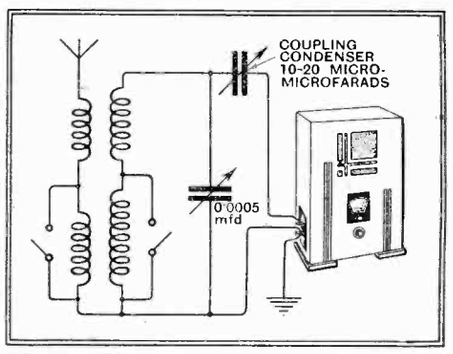


Fig. 2.—The most practical method of adding an extra tuned circuit, and thereby improving true selectivity.

Accordingly, this is the plan that is usually recommended, and for the benefit of several readers who have written on the subject, the circuit diagram of a satisfactory arrangement is reproduced in Fig. 2. The necessary apparatus is, of course, mounted externally to the receiver, and may be accommodated in a small box. Any reasonably effective standard coil assembly may be used, and particular care should be taken to see that the coupling condenser has a really small minimum capacity. It is worth while mentioning that the new iron-cored tuning coils are suitable for this purpose, and also that the addition of a separate aerial tuner may necessitate the need for "reganging" the original input circuit of the receiver.

The Wireless World INFORMATION BUREAU

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.

Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, 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.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Car Radio

The Rumours of Official Restrictions

INTEREST in car radio is undoubtedly increasing in this country and it looks as if, in the course of the next few months, a large number of sets will be fitted both on new models of cars and existing types. All sorts of rumours have been current as to what may be the official attitude towards car radio, and it has been suggested that the Ministry of Transport or the Home Secretary will prohibit the use of wireless whilst cars are travelling on the road.

It is not unnatural that some alarm should be felt by those wireless manufacturers who are at present interesting themselves in the development of car radio at the idea of restrictions of this kind, because the public are not likely to spend money if there is any likelihood of a ban being put on the use of the sets at an early date.

Wireless on motor cars is not by any means a new idea; portable sets have been carried for years past, and sets built in as permanent fittings on a car have also been known in this country almost since the days that broadcasting started. It is only recently, however, that the possibilities of a really compact and efficient set have made the idea generally attractive for privately owned cars.

The officials of the Ministry of Transport and the Home Office have, naturally, had to look into the question of car radio from the point of view of accident risks on the road, and consider whether special regulations ought to be issued governing the use of car wireless. Consultations have certainly taken place, but, as yet, no statement has been made by these authorities as to what their attitude will be. On the face of it, the possibility of a prohibition of wireless on cars seems impossible. It is at present not illegal to carry and use wireless on a car, and the only action that the police might take would be on the grounds that, because the driver's attention was distracted by wireless, the car was being driven negligently or dangerously. We hope that if the Home Office and the Ministry of Transport have any recommendations to put forward, or if they contemplate regulations affecting the use of wireless on cars, they will lose no time in making these known. It would be unfortunate if car radio were developed on lines which subsequently had to be revised because of new regulations.

Regulations, if any, should be with the object of ensuring simple control of the set so as to cause the least possible distraction from the attention of the driver. For this reason it seems particularly desirable that tuning should be by touch rather than visual in order to avoid any necessity for the driver to take his eye off the road in order to adjust the set.

End of Summer Time

Prepare for Winter Reception

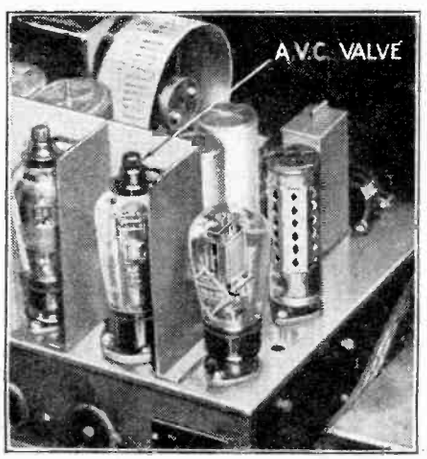
SUMMER TIME ends in the first week of October and the change will revive intense interest in foreign station reception. Let us make the most of our opportunity now during fine weather to overhaul aerials and earths and put up the best outside aerial which space will permit. With automatic volume control there are now dozens of foreign stations which can be received as well and consistently as many locals. A good aerial will make the average set a super set from the point of view of distant reception.

Delayed Amplified A.V.C.

Designing the System—Some Practical Considerations

By W. T. COCKING

A SIMPLE method of selecting the correct delay voltage for a delayed diode automatic volume control circuit was recently described[1] and it is intended in the present article to extend the treatment to cover the case of delayed amplified A.V.C., for this is a system which better fits the average receiver in which a moderate degree of H.F. amplification and a fairly large amount of L.F. amplification are employed. With amplified A.V.C., the bias voltages developed by the detector are amplified before being applied to the H.F. valves, and this results in the detector being operated at a smaller input than in the simpler case.



A duo-diode-triode provides amplified A.V.C. in the R.G.D. Superheterodyne.

The first step in design is to calculate the delay voltage required, and as before, we shall assume that two H.F. stages with Mullard V.P.4 variable-mu H.F. pentodes are used, and that for a signal input varying in the ratio of 5,000-1 the L.F. output must not change by more than 2-1, or 6 DB. The input ratio is equivalent to a change of 74 DB, so that the amplification of the H.F. stages must change by 74 – 6 = 68 DB between a weak and a strong signal. The bias voltage change on the H.F. valves for this can be read off from the curve B of Fig. 2, which is repeated from the previous article. Curve A of this figure shows the variation of amplification, with bias voltage for a single H.F. stage, and curve B for two such stages.

The Action of the Circuit

We see immediately that if the initial bias of 1·5 volts remains constant we require 16 volts A.V.C. bias for a strong signal, but that if the initial bias drops with increasing A.V.C. bias, as with cathode type biasing, we require nearly 17·5 volts. In the previous article we assumed that the initial bias was maintained, as when it is derived from a potentiometer across the H.T. supply; this time let us assume that cathode biasing is used, and we shall then need 17.5 volts A.V.C. bias for a strong signal.

Fig. 1 shows the fundamental circuit of the amplified A.V.C. system using transformer coupling to the succeeding valve.

[1] *The Wireless World*, Sept. 8th, 1933.

A duo-diode-triode type valve is used to provide signal rectification, delayed amplified A.V.C., and the first stage of L.F. amplification. Signal rectification occurs in the diode circuit A1, and the D.C. potential consequent upon rectification is developed across the load resistance R1; the L.F. voltages also appear across this resistance, and these are applied to the grid of the triode portion of the valve through the condenser C1, the resistance R1 acting as a manual volume control. The full D.C. potential across R1, however, is applied to the grid through the resistance R2.

In the absence of a signal, the grid of the triode assumes a potential which is about 0·7 volt negative with respect to the cathode in the case of the MHD4 valve, owing to the triode grid current flow, and the steady anode current of the triode is then determined by the value of the resistances R3 and R4 and by the H.T. voltage applied. Normally the circuit values are selected so that with no signal the cathode is positive with respect to the earth line by the amount of the delay voltage required. The grids of the controlled valves are returned to earth through the filter resistance R6 and the delay-diode load resistance R5, which normally has a value of some 0.5 meg. Since the cathode is positive with respect to the earth line, and the diode anode A2 is returned to the earth line through R5, the anode A2 is negative with respect to the cathode, and there is no current flow. The bias on the H.F. valves is then only that provided by their own individual biasing resistances.

AMPLIFIED A.V.C. has the advantage over simpler forms in that it operates with a modest detector input and so throws less strain on the H.F. amplifier. In this article, the design of amplified A.V.C. circuits is considered in a practical manner.

The Delay Operation

When a signal is applied to the diode A1, rectification occurs, and the diode anode, and consequently the triode grid both assume a potential negative with respect to the cathode, and of a value which is dependent upon the signal strength. As a result, the anode current of the triode falls, and the voltage drop across R4 is reduced. The cathode, therefore, becomes less positive with respect to the earth line. In the diode A2 circuit nothing happens until the cathode becomes negative with respect to the earth line; when the signal is strong enough for this to occur the anode A2 becomes positive with respect to the cathode, and this diode becomes conductive. Since the internal resistance of the diode is low compared with R5, the internal voltage drop can be ignored, and the diode anode assumes practically the same D.C. potential as the cathode. As the cathode moves increasingly negative with respect to the earth line with increasing signal strength, therefore, so the potential of the diode anode A2 and the A.V.C. line follow it.

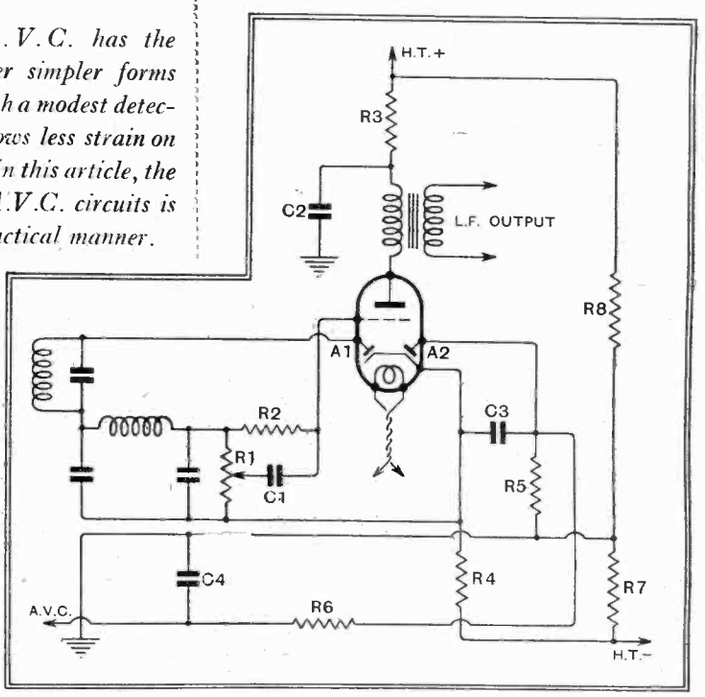


Fig. 1.—The duo-diode-triode can be connected to give delayed amplified A.V.C. The anode A2 is negatively biased in the absence of a signal and is non-conductive. With a strong signal the anode-cathode path becomes conductive and the anode assumes practically the same potential as the cathode.

To return to the design problem, it will

Delayed Amplified A.V.C.—be seen that our first problem is to assign circuit values such that with no applied signal the cathode potential is positive with respect to the earth line by the delay voltage required, in this case 17.5 volts. Let us assume that we have a total H.T. supply of 270 volts, and that we need a total of 200 volts for the H.F. stages. The drop across R8 will be 200 volts (in practice this resistance may be replaced by the other valves in the set) and that across R7 will be 70 volts. The cathodes of the

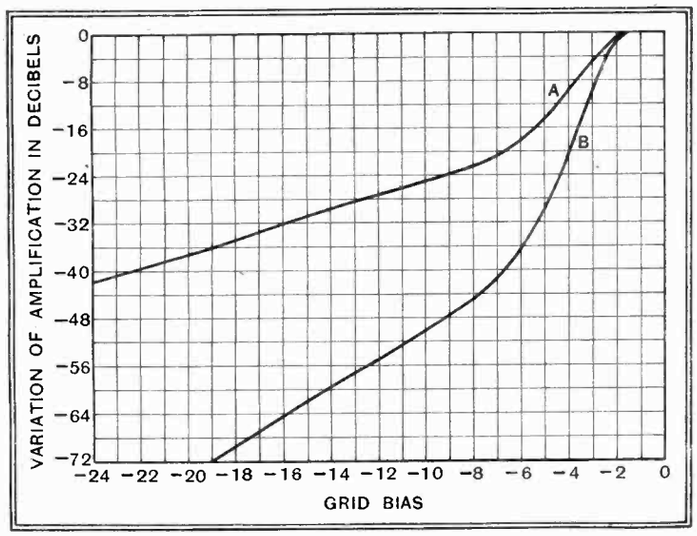


Fig. 2.—The variation of amplification with bias for one (A) and two (B) H.F. stages is shown here.

controlled valves are returned to the earth line, so that the initial cathode potential of the duo-diode-triode must be 70 + 17.5 = 87.5 volts positive with respect to negative H.T. The drop across R4, therefore, must be 87.5 volts.

Calculating Circuit Constants

The problem of selecting the value of R4 is complicated by the presence of the decoupling resistance R3, but as this will usually be necessary we cannot afford to neglect it. Let us assume that we shall lose 50 volts across R3 with no signal. The voltage available across the valve and the cathode resistance R4 will then be the total H.T. voltage less the drop in R3 or 270 − 50 = 220 volts. Fig. 3 shows the anode volts-anode current curves for the triode portion of the MHD4, and from this we can immediately derive the values of R4 and R3. We have a total of 220 volts across the valve and R4, and we know that the drop across R4 must be 87.5 volts, so that the difference, or 132.5 volts, must be the actual anode voltage of the valve. With no-signal, the triode grid potential will be about −0.7 volt, so that we can immediately read off the no-signal anode current of the valve, and this is equal to 4.8 mA.

We have, therefore, to drop 87.5 volts at 4.8 mA. in R4, which must thus have a value of 18,250 ohms, and 50 volts at the same current in R3, which must be 10,400 ohms. It should be noted that we have assumed that the L.F. transformer primary has zero D.C. resistance, which is untrue. The actual value used for R3, therefore, should be the calculated figure less the resistance of the transformer primary. One well-known transformer has a primary resistance of 2,400 ohms, and in this case the actual value of R3 would become 8,000 ohms.

The next step is to draw a load line on the valve curves with a slope corresponding to the total anode and cathode resistance, and from the full H.T. point of 270 volts. The total resistance is 28,650 ohms, and is represented by the line AB of Fig. 3. This permits the anode current of the valve for any grid potential to be read off, and by multiplying the current by the cathode resistance R4 we can obtain the voltage drop across this for any grid potential. This is shown by the curve of Fig. 4, and represents the cathode potential with respect to negative H.T. We are interested, however, in the cathode potential only during that time when it is negative with respect to the earth line, for this represents the A.V.C. bias. The figures in question can be obtained from Fig. 4 by deducting the potentials less than 70 volts (the difference between the earth and negative H.T. lines) from 70 and ignoring the potentials greater than 70, for the diode A2 is then non-conductive. We thus obtain the curve of Fig. 5.

Now for the strongest signal we need a bias of 17.5 volts, and Fig. 5 shows the grid potential necessary to give this bias, and it will be seen to be 2.95 volts, or, say, 3 volts. With this bias there will be no grid current flow in the triode, so the diode A1 must provide 3 volts bias as a consequence of rectification. Curves for the rectification efficiency of a diode show that this D.C. potential is developed when the H.F. input is about 3 volts R.M.S., or 4.2 volts peak.

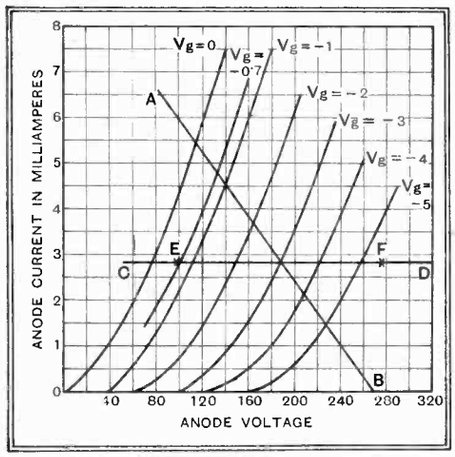


Fig. 3.—Anode-volts—anode-current curves of the MHD4 duo-diode-triode used in determining the operating conditions.

It is immediately obvious that no type of variable-mu valve at any high bias would give distortion on such a small output, even when the peak value is 7.56 volts as with deep modulation. Even with a band-pass coupling preceding the detector, the output of the last H.F. or I.F. valve will only be about 15-16 volts peak, and this should raise little difficulty. The stage immediately preceding the detector can thus be fully controlled.

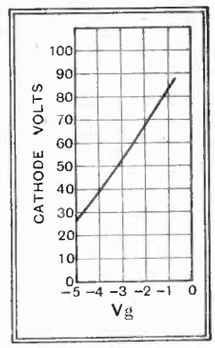


Fig. 4.—The variation in cathode potential for various grid bias voltages is shown here.

The L.F. voltage developed across the diode load R1 for 80 per cent. modulation will be 3 × 0.8 = 2.4 volts peak, so that at maximum input the L.F. grid voltage of the triode will swing between −0.6 volt and −5.4 volts if the manual volume control be set at maximum. The load impedance to L.F. currents is not the D.C. resistance of the circuit, but the transformer primary impedance, and on the curves of Fig. 3 this can be represented by a horizontal straight line drawn through the intersection of the −3 volts curve with the D.C. load line. This is shown by the line CD, the points E and F representing the limits of the L.F. grid swing. These points are nearly equidistant from the −3 volts line, so that amplification will be practically distortionless.

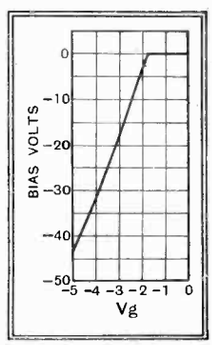


Fig. 5.—This curve shows the A.V.C. bias voltage available for various grid voltages on the MHD4.

The L.F. amplification obtained will be equal to the valve amplification factor, and at the working point this is about 34. The L.F. output on the transformer primary for maximum signal, therefore, will be 34 × 2.4 = 81.6 volts peak with 80 per cent. modulation. With minimum signal, of course, at which A.V.C. just commences to operate, the output will be one-half, or 40.8 volts. With a transformer having a ratio of 3.5-1, therefore, an output stage capable of handling an input of 142.5 volts can be fully loaded.

In the majority of cases, of course, the output stage requires a much smaller input, so that the manual volume control would normally be turned down to give a smaller proportion of the available L.F. potential on the triode grid. This means, of course, that the L.F. amplification is

Delayed Amplified A.V.C.—

really excessive, but it can be turned to good account when it is desired to receive really weak signals which do not provide sufficient output at the normal setting of the control.

Now, in the previous article describing delayed diode A.V.C., it was assumed that the maximum input to the first H.F. valve would be 5 volts R.M.S. and the minimum 1 millivolt, and it was shown that the stage gain required from each H.F. valve to fulfil the conditions led to a figure difficult to attain in practice owing to instability troubles. Let us, therefore, calculate the gain required in this case for the same input figures. The detector input for A.V.C. threshold is 1.5 volts R.M.S., and the first H.F. valve input 1 millivolt, so that the amplification must be 1,500 times, or 38.7 times per stage. This is a very reasonable figure, and quite in accordance with modern practice for two H.F. stages.

It will thus be seen that amplified A.V.C. offers considerable advantages over the simpler diode circuit, for the D.C. amplification of the bias potentials which is obtained reduces the amount of H.F. amplification necessary for good automatic volume control. Its sole disadvantages are the greater circuit complication and the need for providing a steady potential which is negative with respect to the earth line.

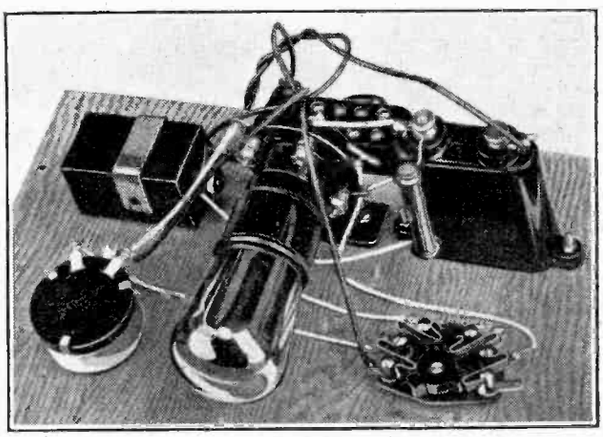


Fig. 6.—*The Wireless World* A.V.C. Unit is an example of one form of amplified automatic volume control.

The Choice of Circuit

Although it has been shown that amplified A.V.C. is superior to diode A.V.C. for the particular case which we have considered, it must not be thought that it is always so. The type of receiver taken as an example is a common one, and, therefore, it is true to say that amplified A.V.C. is usually better than the simpler diode controls. Much depends on the total predetector amplification, however, and in the case of a superheterodyne, where three stages can often be controlled, amplified A.V.C. may indeed prove disadvantageous and the difficulties of the delayed diode control are reduced. Moreover, in these two articles neither delayed diode A.V.C. with L.F. control nor delayed square law A.V.C. has been considered. The whole question as to the choice of an A.V.C. circuit may be summed up by saying that no one method is generally the best, and the best system for any particular receiver will depend upon the design of that set.

DISTANT RECEPTION NOTES

More Power Increases on the Continent

PLANS for increasing the power of the Paris PTT station from 7 kilowatts to 120 have recently been approved. The new transmitter is to be situated at Villejuste, twelve miles outside the city, though the studios will remain in Paris itself. Under the Lucerne Plan the wavelength of the station will be 431.7 metres, and it will have Belgrade on one side and Stockholm on the other as next door neighbours.

Extensive alterations will be required at the Muhlacker station of Stuttgart to increase the output power to 100 kilowatts and the wavelength to 522.6 metres. For this reason the station is now silent until 4 p.m., and it will be closed down entirely from the middle of October until the beginning of December, the old 1.5 kilowatt transmitter taking on the service.

A correspondent writes to ask why I so frequently mention Katowice as a good station since in his area " it has not been worth two minutes' attention since the winter before last." Curiously enough he lives not more than thirty miles from me, and I find Katowice one of the strongest and most reliable of Continental stations from about 8 p.m. onwards. His trouble, I think, is that lack of selectivity prevents him from separating Katowice from Athlone and Söttens.

American Stations

In a recent note I suggested that we ought soon to be hearing more of American stations with wavelengths above 300 metres. Up to the end of last month very few transatlantic stations with wavelengths higher than this were at all well heard, though several of them could be received rather feebly. I can now report excellent reception of WGY on 379.5 metres and WJZ on 394.5 metres.

A correspondent tells me that he received an American station recently at very great strength on 348.6 metres. This is WABC, the 50-kilowatt station of the Columbia broadcasting chain situated in New York City.

Is Berlin Witzleben's new transmitter now in use from about 10.30 p.m. onwards? I find the station quite weak, if indeed it is audible at all, during the early part of the evening; but later on it comes in with fine strength. Any reader who has not recently received Witzleben should certainly try for it now.

Recommended Transmissions

There is intermittent interference still with Huizen from a Russian station, though I have not often found it troublesome of late.

The long-wave stations are all in good form. Oslo in particular is showing remarkable strength.

The stations at the top of the medium waveband have now definitely returned to good strength, good reception being obtainable from Budapest, Munich and Vienna. On one recent evening, however, Vienna had a strong background which appeared to come from Riga. If so, the Latvian station must be working rather below its normal wavelength. Florence is still heterodyned on many evenings, and Turin suffers badly in the same way.

Beromünster, Prague, Rome, Toulouse, Strasbourg, Breslau, Hilversum, Heilsberg, and Trieste are outstanding medium-wave stations, though there are many others from which first-rate reception is regularly obtainable.

D. EXER.

FOREIGN BROADCAST GUIDE

BUCHAREST

(Roumania).

Geographical position: 44° 25′ N.; 26° 2′ E.

Approximate air line from London: 1,300 miles.

Wavelength: 394.2 m. Frequency: 761 kc/s. Power*: 12 kW.

Standard time: Eastern European (G.M.T. *plus* 2 hours) (Roumania adopts Summer Time.)

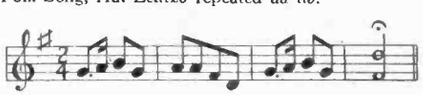
Standard Daily Transmissions.

10.00 B.S.T., Sacred service (Sun.); 13.00, gramophone records, news; 17.00, concert, news, weather; 20.00, main evening entertainment; 22.15, dance music, news, weather.

Announcer: Woman.

Call: (Phon.) *Attent-see-oon-aye ah-eetch-ee rah-dee-owe Book-oo-recht-ee.* Announcements are all made in the Roumanian language, but occasionally also in French, German and Italian.

Interval signal: The following bars of a Roumanian Folk Song, *Hai Lelitzo* repeated *ad lib.*



Closes down with good-night greetings (in Roumanian), *Buna seara luluror*, repeated in different languages and followed by *Traiasca Regele* (National Anthem) played on a gramophone record.

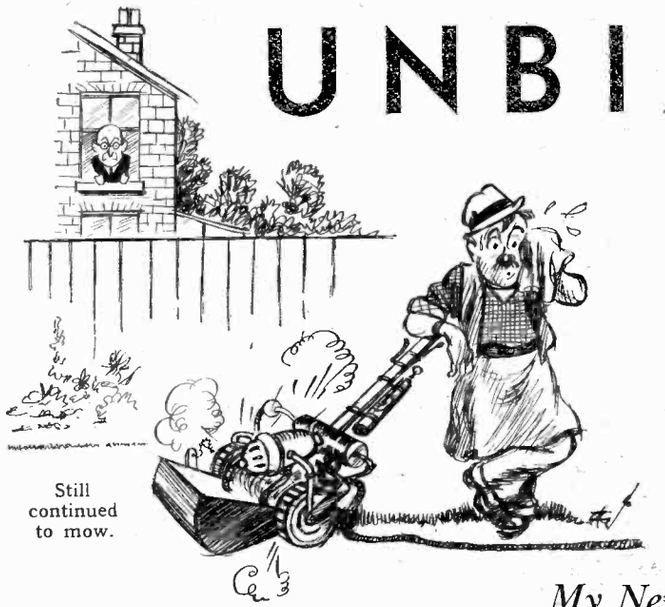
* *A high-power transmitter is under construction.*

HINTS AND TIPS BOOKLET

With the issue of October 6th, a special supplement will be included in the form of a 32-page Booklet of practical *Hints and Tips*, specially compiled by the staff of THE WIRELESS WORLD.

UNBIASED

By FREE GRID



Still continued to mow.

A Snake in the Grass

RECENTLY, when I happened to be staying at the home of a rather unpleasant sister-in-law, I was rudely awakened one afternoon, while taking a siesta in the garden, by a demand to "come and see what's wrong with the wireless." With many muttered imprecations I bestirred myself and went into the house, where I found that electrical interference of a particularly objectionable type was drowning everything.

All my efforts to stop the trouble failed, and after spending many days experimenting with various forms of interference suppressors and a goodly portion of my sister-in-law's money in purchasing the necessary gear, I dropped everything and took to detective work. After a fruitless search of the neighbourhood I had almost given the job up as hopeless when I observed that the trouble seemed to coincide with the mechanical rattle of a mowing machine a few gardens away. Naturally I immediately suspected radiation from the ignition system of a motor mower, and I hastily went upstairs to make closer observation from a bedroom window.

To my surprise nothing was in view save a perspiring little man pushing a heavy-looking mower of a more or less conventional type under the direction of an imperious-looking female of amazonian proportions. I was about to turn away when the servile little serf took advantage of a momentary disappearance of his chain-gang overseer to stop and mop his brow. To my utter amazement the mower, though standing still, continued to mow. Hastily calling for a telescope I took a further observation, and noticed a snake in the grass in the form of a cable running from the machine to the house.

I immediately consulted a large firm of mowing machine makers on the 'phone concerning this strange phenomenon, and was told that this was a new type of machine which was rapidly becoming universal; only the knives were driven by the electric motor. The older type, in which the whole machine was electrically driven, had been superseded, because members of the so-called fair sex had been in the habit of forgetting to switch off when stopping to chat with a neighbour over the fence, with the result that the machine had run amok, lopping off flowers, bushes, babies, dogs, and other impedimenta in its mad career.

My New Down Lead

IN spite of all the progress that has been made in radio, we are still faced with the incongruous sight of a set housed in a beautiful piece of cabinet work connected up to the aerial by a straggling wire which meanders through the house till it finally connects with the down lead. The reason for this state of affairs is that the average urban and suburban house has its garden, and, therefore, its aerial, at the back, whereas the listeners themselves, with that peculiar cussedness which endears them so much to the hearts of the B.B.C. programme staff, insist on sticking their receivers in a room in the front of the house.

It is true that there are plenty of patented indoor aerials on the market, but no matter how sensitive the set is, a lofty outdoor aerial is always to be preferred on account of the improved signal-strength-to-noise ratio which it gives. The same argument holds good against a set which employs a frame aerial or a "mains" aerial.

I flatter myself that I have solved the problem in a manner which greatly redounds to my credit. The arrangement I have fixed up is really very simple. All that I have done is to fix a length of screened aerial down lead under the floorboards so that one end terminates at a

A straggling wire.

wall plug, the other end, of course, carrying on outside the house until it gives place to the ordinary down lead.

I find that the losses due to this arrangement are extraordinarily small, and, of course, the lead coming from the wall plug to the set is no more conspicuous than the mains lead running from the neighbouring wall plug. As for my earth lead, this is plaited in with the mains flex, and, since I naturally use a three-point plug and socket, all difficulties of connection are completely overcome.

I find that there are very little losses even if I plait the aerial lead with the others; and so I am now waiting for an enterprising manufacturer to produce a four-point plug and socket for use in order to make the job a really neat one. Judging from my knowledge of manufacturers, however, I fear that I shall have to wait for a confoundedly long time.

Can One Steal Electrons?

I NOTICE that quite a large number of people have been prosecuted lately for stealing electrical energy from the wires of radio relay companies. In my

Carefully put back by her.

opinion none of the defendants are deserving of any sympathy save one good lady who, according to a newspaper report, has parted with the sum of £1 for "fraudulently extracting a quantity of electricity."

If the good dame will take a spot of advice from me she will appeal and, if need be, carry the case right up to the House of Lords. It may certainly have been wrong to tap the wires of the relay company and steal entertainment therefrom, but that was not the subject of the charge. I entirely fail to see how anybody can "extract" a quantity of electricity from the relay company's wires, and she could, I think, successfully plead that the electrons which she took out were carefully put back by her, as they merely flowed out of one wire, trotted round her loud-speaker windings, and then went back to the company by the other wire. If the lady cares to take action she is assured of my full moral support.

The Electrostatic Loud Speaker

II. Matching Loud Speaker and Output Valve

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

THE electrostatic loud speaker is unique in presenting a capacitative load to the output valve, and the conditions necessary to prevent distortion and overloading are essentially different from those of moving-iron or moving-coil types.

WE have seen the fundamental difference between the electrostatic loud speaker and all other types. Before it can be effectively used it is necessary to consider it as a load in a valve circuit.

A moving-iron speaker can be considered approximately as an inductance. A moving-coil speaker is conveniently (but not very accurately) assumed to be a resistance. An electrostatic speaker may be represented as a capacity, perhaps not quite so pure (i.e., free from resistance) as the very best condensers, but one does not go far wrong in neglecting the impurity.

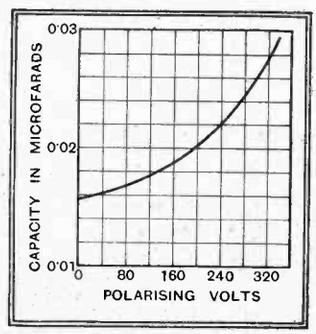


Fig. 1.—Variation of capacity with polarising voltage in the "Primustatic" 18in. × 20in. loud speaker.

It has already been explained that the effect of a voltage between the two plates is to draw them closer together. Therefore, one would expect the capacity to be increased thereby, and this is exactly what happens. Fig. 1 shows the measured capacity of a "Primustatic" loud speaker with an 18in. by 20in. diaphragm. The capacity averages about 0.008 mfd. per square foot, or a reactance of about 20 megohms divided by the frequency in cycles per second.

The Load Diagram

In drawing load curves on a valve diagram the loud speaker is usually represented by a straight line, which means a resistance, constant at all frequencies. No loud speaker ever does act just like that, but a moving-coil type is near enough to it over the middle range of frequencies for one to get at least a hazy idea of how to match it to the valve. Our condenser speaker has this advantage at least, that it is very closely a capacity load, but, unfortunately, it is therefore not a straight line at all, but an ellipse, and one of a different size at every frequency. So it is rather an exasperating business trying to fit it comfortably into the valve diagram. To start with, it would be worse than manufacturing a "Mickey Mouse" film to draw a diagram for *every* frequency, so let us select three only—80, 800, and 8,000. The respective reactances of a $2\frac{1}{2}$ square foot speaker are 100,000, 10,000, and 1,000 ohms,

There are two ways in which these figures can be altered to suit the valve: first, by selecting a diaphragm of different area, and, secondly, by using a step-up or step-down transformer, which has the effect, looked at from the *primary* side, of multiplying the reactance by the square of the transformer ratio. A step-up is equivalent to an *increase* in capacity. But it is inevitable that with any one arrangement the reactance must vary over the same range as the frequency.

The result of this characteristic is that the behaviour is strikingly different according to whether a triode or a pentode is used. Fig. 2 shows a diagram for a triode with an internal resistance (impedance) of about 2,500 ohms, and the three reactance eclipses have been drawn in to show what happens at the lowest, middle, and highest frequencies. The ellipses in each case are the largest that can go in without running into grid current on the left, or bottom-bend rectification at the foot.

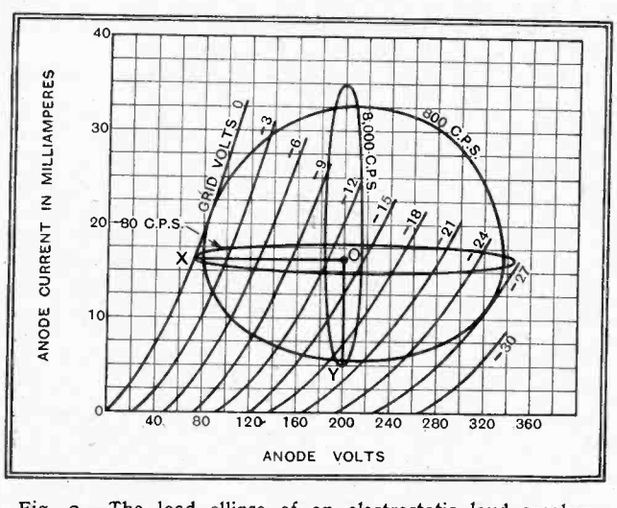


Fig. 2.—The load ellipse of an electrostatic loud speaker varies in shape and inclination as the frequency changes.

At 80 cycles the full grid excitation is possible; that is to say, the grid voltage can be swung right from zero on one side to double the bias voltage on the other, without any possible risk of overloading due to rectification. The voltage developed across the loud speaker is the maximum possible.

Permissible Grid Volts

At 800 cycles it is just possible to give it the full grid, but the ellipse has opened out so much that it is approaching the danger zone along the foot. Still, it is working quite happily and developing practically the full voltage. At any higher frequency, however, the lower half would be flattened out, unless the whole ellipse were reduced in size by reducing the grid input. This is well shown at the upper extreme of 8,000 cycles, where the grid excitation must be reduced to less than a half in order to avoid rectification distortion, and the anode voltage developed across the loud speaker dwindles to about a tenth.

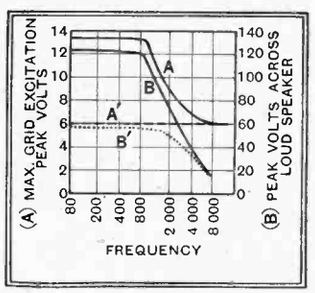


Fig. 3.—Curves showing maximum permissible grid volts with capacity load.

These features are illustrated rather more concisely in Fig. 3. Curve A shows the maximum peak volts that can be applied to the grid without overloading, and curve B shows the voltage developed across the loud speaker with maximum grid volts as given. In each case the voltage is level up to a certain critical frequency, in this case 800 cycles, after which it rapidly falls. It must not be hastily concluded that the response suddenly falls off above 800 cycles, for it must be emphasised that curve B is strictly dependent on A, and shows the maximum output short of overloading the valve.

P. P. Eckersley has shown experimentally that in normal broadcasting the amplitudes to be expected at the upper frequencies are considerably lower, and would come well below curve A. In addition, by-pass condensers, H.F. tuning characteristics, and other factors are almost certain to prevent the grid voltage from breaking the allotted bounds. So if the grid excitation is kept at a level six volts throughout, as it can be without fear of overloading (curve A′), the output is as shown by B′.

Another point is that it is the falling part of curve B′, rather than the level part, that is correct. The amplitude of diaphragm required to give a constant

The Electrostatic Loud Speaker—

output of sound gets steadily less as the frequency rises. It is not possible to state exactly what is the ideal characteristic without knowing exactly how the particular type of diaphragm behaves at various frequencies; but a listening test with a constant-amplitude pure tone shows a satisfactory response down to about 800 cycles, and a falling response below that.

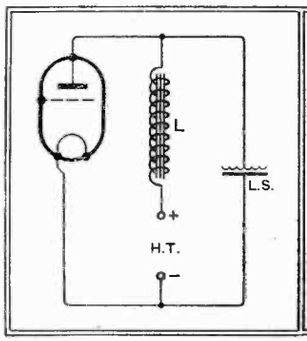


Fig 4.—Choke coupling provides the simplest connection between valve and loud speaker.

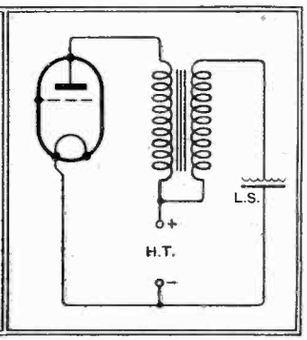


Fig. 5.—Connections for applying polarising voltage with transformer coupling.

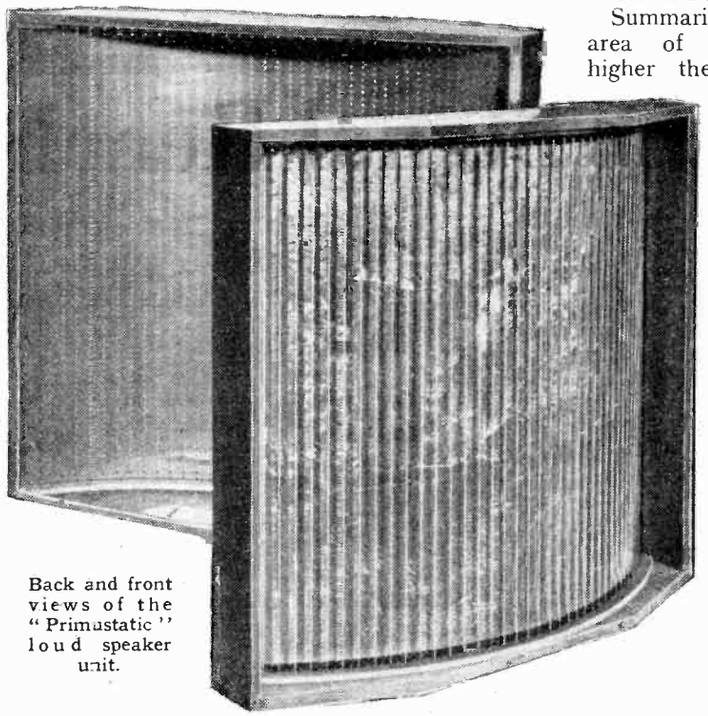
The Critical Frequency

We can calculate this critical frequency by measuring the distance in anode volts horizontally from the initial working point O on the valve diagram to the zero grid voltage point X, and dividing this by the vertical distance, in anode milliamps, from O to Y, the minimum current consistent with avoiding severe curvature. This gives the reactance in thousands of ohms, which is also equal to $\frac{1,000}{2\pi fC}$, where f is the frequency and C is the capacity in microfarads; so it is easy, knowing C, to calculate f. By altering C in either of the two ways already described it is possible to shift the critical frequency f, thus extending either the level or the falling part of the curve.

As it has just been stated that it is the falling part that is correct, it would seem that the sensible thing to do would be to make the critical frequency as low as possible. That means making either the actual capacity or the step-up ratio as large as possible. An additional allurement is that an increase in capacity means an increase in sound-radiating surface, and an increase in step-up means an increase in signal voltage, and in either case it looks as if the volume would be increased without any greater expenditure of power. But, while it is true that there is improved *uniformity* of response, the improved *efficiency* fails to materialise; for curve A is shifted to the left too, and necessitates severely cutting down the input. And, as the lower tones are less audible than the upper, there is an apparent falling-off in volume, and in endeavouring to restore it by the volume control the only result is rattling and distortion. If, on the other hand, the capacity is too small, the volume again drops, and what output there is consists almost entirely of extreme top.

Hence a compromise is necessary, giving a reasonable efficiency at the upper frequencies, the lower being augmented, if necessary, by a bass moving coil unit.

To descend for a moment from these theoretical reasonings to consider how the connection is made in practice, the simplest circuit is that of Fig. 4, where L is a choke of high inductance capable of carrying the valve anode current. In this way the loud speaker receives both the output voltage from the valve and the steady polarising voltage from the H.T. source. The choke behaves as a 1 : 1 transformer, and if its inductance is sufficiently high it by-passes a negligible proportion of the "signal," and so the whole arrangement conforms very closely to the preceding theory. It may be of interest to realise that at one particular frequency the impedance of the anode load is almost infinite, due to the resonance of choke and loud speaker, and is also a pure resistance, and hence a nearly horizontal straight line instead of an ellipse. With normal components this frequency is about two or three hundred cycles, but the phenomenon does not appreciably modify the performance as already described. The whole action is very beautifully confirmed by cathode ray oscillograph tests, using a variable-frequency oscillator. Beginning at the lowest frequencies, we see the "lengthwise" ellipse become a straight line, and then open out into an "upright" ellipse, which, unless the input is reduced, causes terrible overloading, the anode current rising much above normal.



Back and front views of the "Primastatic" loud speaker unit.

If a transformer is used to alter the ratio it is essential to allow for the polarising voltage (Fig. 5), and if it is a step-up ratio it may be desirable to add some auxiliary voltage, but only if the H.T. voltage itself is rather low. An old dry battery can be used, as no current is drawn. If the secondary is linked to the anode end of the primary the sum or difference of the voltages across both windings is obtained, giving a choice of three ratios altogether.

Push-pull Connections

A push-pull stage is much to be recommended, and Fig. 6 shows one method of connection. If there is no secondary winding, or if it is being used for another loud speaker, the connection of Fig. 7 is another of the many schemes. Although this looks a one-sided arrangement, it actually loads the whole transformer, which acts as a 2 : 1 step-down.

Summarising: the larger the area of diaphragm, or the higher the step-up, the lower is the frequency below which response falls off. But the lower also is the efficiency and the greater the tendency to rattle. So only when there is plenty of power available in the last stage is it possible to arrange these matters so as to go low down the scale. The smaller the number of milliwatts available the higher must be the critical frequency. A dual speaker combination is in any case the best for effective reproduction over the whole audible scale. Methods of obtaining this, together with tone control, and the conditions for pentode operation, will next be considered.

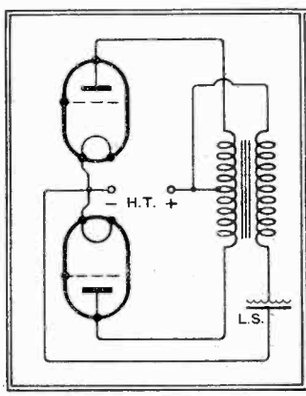


Fig. 6.—Push-pull output using transformer secondary winding to energise the loud speaker.

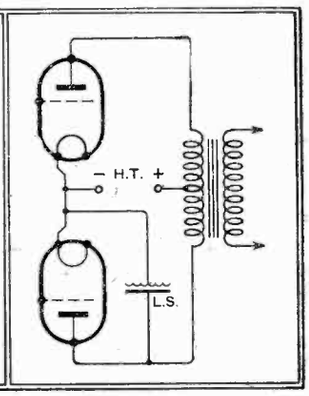
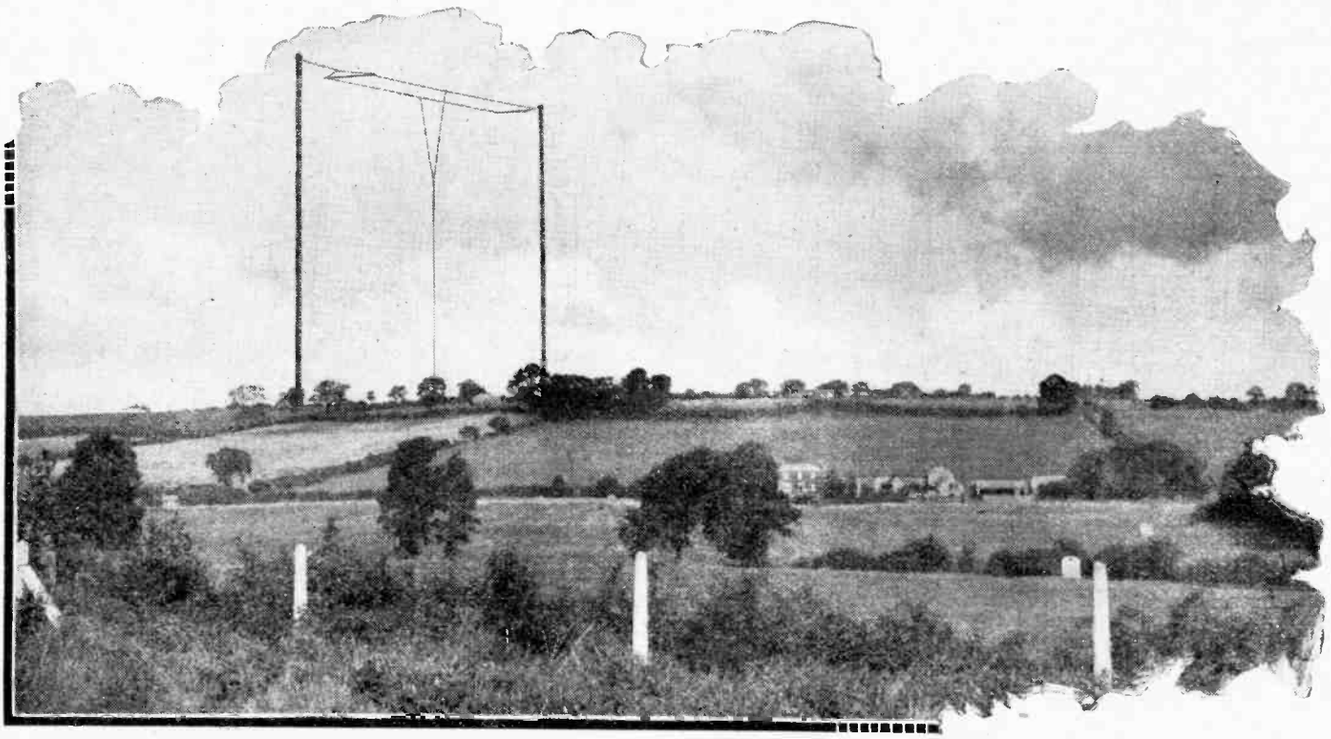


Fig. 7.—This circuit gives a 2 : 1 step-down and leaves secondary free for an additional loud speaker.



How the Signal Reaches Your Set

Modulation and the Purpose of the Carrier Wave Explained

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

THE most vital principle of wireless communication is that of modulation of the carrier wave. The purpose of the carrier wave is often not properly understood, yet no real conception of what happens in a receiver can be gained without a grasp of this fundamental principle.

AS one listens to an item in a broadcast programme one can readily appreciate that the sound waves emanating from the diaphragm of the loud speaker must bear a very close resemblance in form to those actuating the microphone at the broadcasting station. If this were not so the sounds received would be unpleasantly distorted, if not unintelligible, for the smaller the degree of wave-shape distortion in the sending and receiving systems the more realistic and true to life is the reproduction.

The air vibrations, or waves of rarefaction and compression representing sound, extend over a considerable range of frequencies. The upper and lower limits of this range, however, are not very sharply defined, depending to a very large extent on the intensity of the sound and to some extent on the individual listener. In general, audible frequencies may be considered to extend from about 16 cycles per second at the lower end of the scale to perhaps 10,000 cycles per second or more for the highest notes. In the case of orchestral music practically the whole of this range of frequencies is involved, the highest frequencies representing the overtones of violins, etc. Ordinary speech involves a frequency range from about 100 cycles per second to 5,000 cycles per second or so. Intelligible speech can be transmitted on a much narrower band of frequencies, but when this is done the speaker loses the essential characteristics of his voice, which convey to some extent an impression of his personality. So to obtain realistic reproduction at the receiver all frequencies must be delivered by the loud speaker in their correct relative amplitudes.

Need for the Carrier Wave.

At the transmitting station the microphone converts the sound waves impinging on its diaphragm into electrical variations of the same wave form, and consequently these electrical variations are represented by frequencies which all lie within the audible range. These frequencies are usually referred to as "low frequencies" or "audio-frequencies," to distinguish them from the very much higher frequency of the oscillations in the aerial system. The necessity for high-frequency oscillations will now be briefly explained.

A little thought will make it quite clear that the audible frequencies cannot be directly transmitted through the ether because, for one reason, every station would have to operate over the same range of frequencies and selection would be impossible; the transmitting station must send out from its aerial system a train of ether waves of *fixed* frequency in order that distant receivers may be accurately tuned to it. And, further, the frequency must have a very high value compared with the frequencies within the audible range, the main reason for this being that the efficiency of an aerial as a radiator of energy falls off very rapidly as the frequency is lowered. The efficiency of radiation is proportional to the square of the frequency. The lowest frequency used for ordinary broadcasting purposes is about 155,000 cycles per second, corresponding to 1,935 metres wavelength; and the shortest wavelength stations operate with a frequency in the neighbourhood of twenty million cycles per second!

The constant-frequency waves emanating from the transmitting aerial are made to serve as the means of conveying the low-frequency or speech-frequency variations, representing the matter to be broadcast, from the transmitting station to the various receiving aerials. For this reason the train of high-frequency waves, upon which the low-frequency variations are to be superimposed, is known as the "carrier wave," and we are mainly concerned here with the manner in which the audio-frequencies are combined with the carrier frequency and separated out again in the circuits of the receiving set.

Now in the first place it must be remembered that the carrier frequency is far above the highest audible frequency, and could not possibly produce any sound on its own account. During an interval between two items in a programme silence

How the Signal Reaches Your Set—

reigns (or should), although the carrier wave is being received at full strength the whole of the time. In order to convey an audible note from transmitting aerial to receiving aerial the intensity or amplitude of the carrier wave must be made to vary at the audible frequency in accordance with the wave-shape representing the note in question, and this process is referred to as "amplitude modulation." The amplitude of an oscillation is the maximum or peak value reached in each direction, and the low-frequency variation of the amplitude of the high-frequency carrier wave enables the audible note to be carried across.

A numerical example will be helpful in explaining the principle of amplitude modulation and in giving a sense of proportion as regards relative values. Suppose, for instance, that the frequency of the oscillations in a transmitting aerial is 1,000,000 cycles (1,000 kilocycles) per second, being the frequency of a station working on 300 metres. Currents of the same frequency are set up in the tuned circuits of a distant receiver, but when these currents have constant amplitude no sound would be given out by the loud speaker, a million cycles per second being far outside the audible range of frequencies.

Now suppose that the 1,000 kilocycle carrier wave is to convey between the transmitting station and the receiving aerial a single pure note of 500 cycles per second, being represented by a sine wave of this frequency. Then, by some suitable means, the high-frequency oscillations in the transmitting aerial are made to vary in amplitude, about the mean value, at a frequency of 500 cycles per second. Since the carrier frequency is one million cycles per second, it follows that for each cycle of the low-frequency variation (called the modulation frequency) there will be 2,000 high-frequency oscillations.

The constant-amplitude sine wave of Fig. 1 (*a*) represents the unmodulated

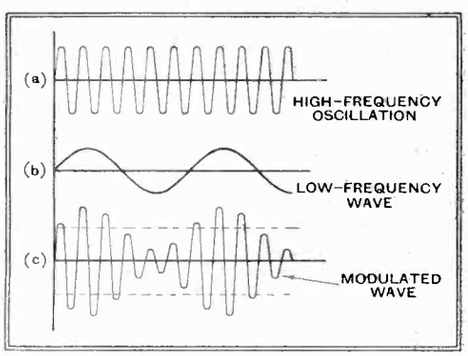


Fig. 1.—Diagram showing how the amplitude of a high-frequency oscillation is varied at an audible frequency.

high-frequency oscillations or carrier wave referred to, the frequency being 1,000 kilocycles per second. The sine wave at (*b*) represents the low-frequency variation corresponding to the pure tone of 500 cycles per second. By the action of the modulating system in the transmitting circuits these two waves are combined in such a way as to give the modulated wave of Fig. 1 (*c*). The lines passing through the positive and negative peak values respectively of the resultant high-frequency wave have exactly the same shape and frequency of variation as the low-frequency curve shown at (*b*). Of course, during each low-frequency cycle there will be 2,000 high-frequency oscillations, but for convenience in drawing only a few H.F. oscillations per low-frequency cycle are shown.

It will be observed that the number of complete reversals per second is the same for the modulated wave (*c*) as for the unmodulated wave (*a*), and so it is usual to state that the modulated wave is one of constant frequency but varying amplitude. This statement is, however, not strictly correct, because the term "frequency," as ordinarily defined, only applies to a wave which repeats itself exactly cycle by cycle, and similarly as regards the term "amplitude." So it must be understood that the frequency of a modulated wave means the number of complete or double reversals per second.

Percentage Modulation

When the amplitude of a high-frequency oscillation is varying periodically above and below the mean or normal value, the degree of modulation, or depth of modulation, is expressed as a percentage of the normal amplitude of the unmodulated wave. For instance, when the modulation is 20 per cent. the amplitude of the high-frequency oscillation varies between limits 20 per cent. above and 20 per cent. below the mean value. It is possible to modulate to a depth of 100 per cent., that is to say, to vary the amplitude of the high-frequency oscillations between zero and twice the normal value, but for practical reasons connected with the quality of reproduction at the receiver it is not usual to modulate to a greater depth than about 50 per cent.

It has been assumed that the unmodulated carrier wave represented by the curve of Fig. 1 (*a*) is a pure sine wave, and, this being the case, the modulated wave of Fig. 1 (*c*) is very frequently referred to as a high-frequency *sine wave* whose amplitude is varying periodically at the low, or modulation, frequency. This description, however, as already pointed out, is not strictly correct, for it is quite evident that the change in peak value, cycle by cycle, is brought about by changing the *shape* of each H.F. wave, the number of reversals per second being unaltered. But in the case under consideration there are 2,000 high-frequency oscillations to a low-frequency cycle, and so the difference in the amplitudes of two successive H.F. oscillations is very small indeed, their ratio being practically unity. Consequently, the extent to which the high-frequency oscillations depart from the true sine shape is extremely small, and the statement referred to above as being inaccurate may be employed in a descriptive sense. The idea of a sine wave gradually varying in amplitude is easy to understand; but such a statement would not be—indeed it could not be—tolerated by a mathematician working out the detailed theory of modulation.

Conditions at the Receiving End

The modulated ether waves reaching a receiving aerial set up in the latter high-frequency electromotive forces which vary in exactly the same way as the currents in the transmitting aerial. So when the H.F. oscillations in the sending system are modulated in any particular way, the resulting high-frequency electromotive forces in the receiving aerial are similarly

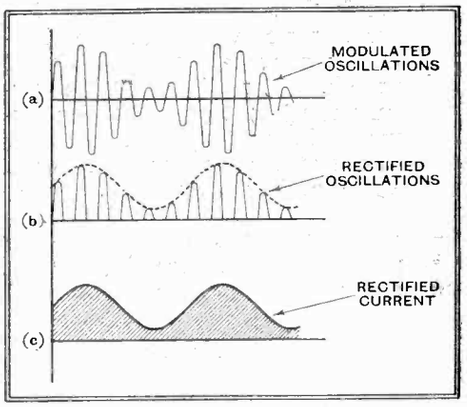


Fig. 2.—The curves show the process of separating out the low-frequency component from a modulated wave by means of a rectifier or detector.

modulated. Now if the receiving aerial circuit behaved like a simple resistance the currents set up in it would be at all times proportional to the voltage, and the resulting H.F. currents would be an exact replica of the currents in the transmitting aerial.

This would be a most desirable state of affairs, because the object is to obtain in the loud speaker an audio-frequency current which is as nearly as possible a true copy of that in the microphone circuit at the transmitting station. But it is a well-known fact that a sharply tuned receiving circuit has a modifying effect on a modulated high-frequency oscillation, the effect being to lessen or attenuate the degree of modulation.

The reason for this demodulating effect is that a certain amount of energy is stored in the tuned circuit when oscillations are present; this stored energy oscillates between the magnetic field of the coil and the electrostatic field of the condenser. The result is that any change in the amplitude of the high-frequency oscillation involves a change in stored energy, which is proportional to the square of the amplitude. Now it is a fundamental law of physics that energy cannot be accumulated or expended instantaneously, the result being that the high-frequency oscillations tend to resist any change in their amplitude, in the same way that a moving body, which possesses inertia, resists any change in its motion.

How the Signal Reaches Your Set—

The weakening effect is greatest at the highest modulation frequencies, so that the high notes tend to be reduced in greater proportion than the low ones. However, when the tuning is not too sharp, or when special filter circuits are employed, the quality of reproduction is not seriously affected on this score.

Function of the Detector

The modulated H.F. potential difference set up across the last of the tuned circuits in a receiver cannot be made to operate a loud speaker directly because, referring to curve (*a*) of Fig. 2, it will be seen that the curve is symmetrically placed about the zero line. Consequently, although the H.F. oscillations are modulated at low frequency, there would be no low-frequency current set up in the loud speaker coil. For this reason the low-frequency component or modulation frequency must be separated from the carrier wave again at the receiver, and this is the function of the detector stage.

The detector almost invariably takes the form of a rectifier, that is, a device which completely or partially cuts off all the negative half waves of the modulated oscillation by the property of possessing one-way or unilateral conductivity, in the manner shown by curve (*b*) of Fig. 2. A perfect rectifier could be defined as one which offers a constant resistance to current flowing in one direction, irrespective of the value of the current, but which allows no current whatever to flow in the opposite direction when the applied voltage is reversed. The static characteristic curve of a perfect rectifier is shown in Fig. 3 (*a*); the current is proportional to positive values of applied voltage and zero for negative values.

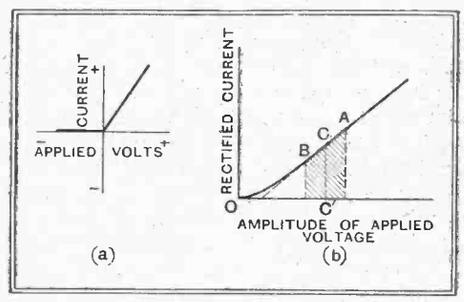
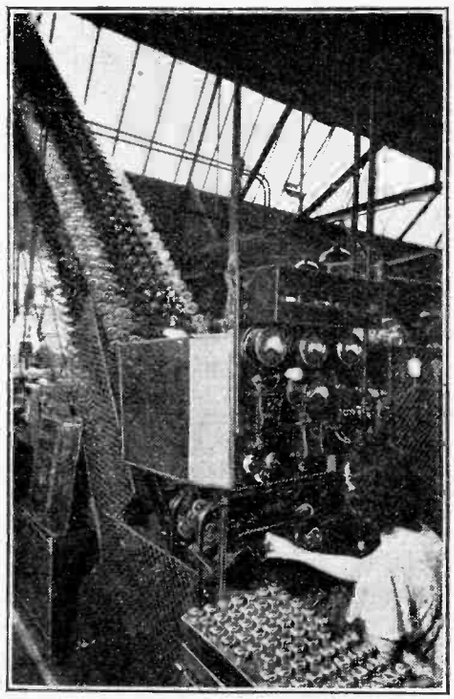


Fig. 3.—(a) The voltage/current or static characteristic curve of an imaginary perfect rectifier. (b) Representative rectification characteristic curve of a valve detector, such, for instance, as a diode.

With such an arrangement the resulting unidirectional current produced when an alternating voltage is applied will have a *mean value* proportional to the amplitude of the applied voltage. If the applied voltage has constant amplitude the successive current pulsations will all be equal, but when a modulated high-frequency voltage is applied to a perfect rectifier the unidirectional current pulsations will vary in amplitude in accordance with the audio-frequency variations as shown at (*b*) in Fig. 2. By smoothing out the radio-frequency variations with the aid of a suitable condenser filter the resulting rectified current fluctuates at the low frequency, being at all times proportional to the *amplitude* of the high-frequency oscillation as indicated by the dotted-line curve. Consequently, with a perfect rectifier, proportionality is fully maintained and no distortion of the audio-frequency wave-shape is introduced.



On this equipment at the Cossor valve works valves are carried on a continuously moving band. After first being gettered, the valves are run under operating conditions to stabilise their characteristics before testing.

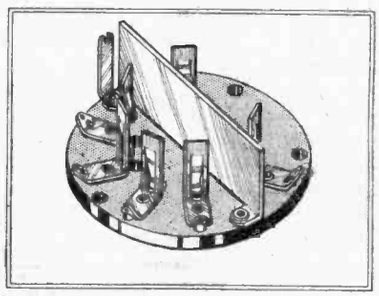
In practice it is usual to employ a thermionic valve of some kind as "detector," but, although there are several possible systems, there is not one which gives theoretically perfect rectification, because the relationship between the amplitude or R.M.S. value of the applied high-frequency voltage and the resulting rectified current is never represented by a straight line; they are not truly proportional to each other. This, of course, means that the effective resistance of the rectifier depends to some extent on the value of the applied voltage oscillation. Fig. 3 (*b*) gives a dynamic characteristic curve of a typical valve detector; although the curve is practically straight over a considerable portion of its length it is more or less curved at the lower end, and if the straight part is produced back it does not pass through the origin O.

Now if a high-frequency voltage, modulated to a depth of 100 per cent., were applied to a rectifier with such a characteristic, the rectified current would obviously not conform strictly to the variations in amplitude of the applied voltage, and distortion would result. But, as stated previously, in practice 100 per cent. modulation is rarely ever encountered and with a lower percentage modulation, distortionless rectification can be attained even though the rectification characteristic is curved at the bottom. This will be the case if the modulation is sufficiently shallow to ensure that the oscillation voltage amplitude fluctuates between upper and lower limits represented by two points such as A and B on the straight part of the curve, the wave, when unmodulated, having an amplitude OC′ represented by C midway between A and B. In these circumstances the change of rectified current is proportional to the change of applied voltage, being the necessary condition for distortionless rectification.

It should be realised that this condition can only be realised if the mean amplitude OC′ of the applied high-frequency voltage is sufficiently large to ensure that the upper and lower limits A and B, with the maximum degree of modulation, fall on the straight part of the curve. If the signal voltage were too low rectification would take place round the bend of the curve, with accompanying distortion. Consequently, for the reception of all but the strongest local transmissions it is essential to employ one or more stages of high-quency amplification before the detector.

HIGH-VOLTAGE VALVES

SEVERAL interesting developments have taken place in the design of Ostar-Ganz high-voltage valves, which, as most of our readers are aware, have heating elements designed for direct connection to either D.C. or A.C. mains of standard voltages without the intermediary of resistances or transformers.



Under-side of the new Ostar-Ganz valve-holder, showing screening plate.

Hitherto it has been impossible to obtain really high anode voltages from the indirectly heated rectifiers of the series; this difficulty is now overcome by the introduction of a voltage-doubling rectifier, which costs 22s. 9d. With a 220-volt supply a rectified output of about 440 volts is obtainable at 40 milliamps. Another new rectifier provides full-wave rectification.

The K.3560 three-electrode output valve is another interesting innovation; it has an A.C. resistance of only 500 ohms and a mutual conductance of 6 mA/V. The maximum D.C. anode dissipation is 15 watts, and the valve is specially designed to give a large output with normal supply voltages.

It has previously been necessary to employ double smoothing chokes in circuits employing Ostar-Ganz valves. The need for this special smoothing system has now been avoided by alterations in the arrangement of the pins and by the introduction of a special valve holder, in which the heater connections are effectively screened.

The agent for Ostar-Ganz valves in Great Britain is Mr. Eugen Forbat, of 28-29, Southampton St., Strand, London, W.C.2.

News of the Week

Current Events in Brief Review

The Passing of a Giant

WE understand that one result arising out of the Lucerne Conference is that the famous Eiffel Tower Broadcasting Station will cease its transmission on January 1st, 1935.

Marking Foreign Valves

THE Board of Trade's Standing Council recommends that certain imported wireless and rectifying valves should be plainly marked with the country of origin. The valves specified are thermionic valves having an anode dissipation that does not exceed 50 watts, and rectifying valves not exceeding a capacity of 60 volt-amperes or passing a current of more than one ampere. Such valves to carry a durable mark in a contrasting colour on the bulb or cap and a corresponding indication to be printed or stamped on the carton or container in which they are exposed for sale.

Guided by Music

AEROPLANE pilots in America find the broadcast programmes a pleasant means of whiling away the monotony of long flights, tuning back and forth from the special wavelengths carrying weather reports, direction signals, and landing instructions to their favourite broadcasting station along the route. The use of the direction-finding aerial makes it possible for a pilot while listening to a programme from WOR, for example, to know that he is heading in the right direction for the Newark airport.

The Obsolescent Crystal Set

IT is stated that one of the advantages to be gained by the new P.T.T. high-power station is that owners of crystal sets in Paris and its suburbs will be able to receive the programmes throughout the day, but the result of the return of the sets made in accordance with the new licence regulations would show that the declaration of crystal sets is negligible, those possessing these relics of the past are no longer using them. Strictly speaking, they are bound to declare them, but it is unlikely that the administration will go to the trouble of prosecuting them for their neglect.

Dr. Giesecke Returns Home

AMONG the various broadcasting chiefs who were recently compulsorily retired and sent to the internment camp at Oranienburg was the former Vice-President of the Broadcasting Union and Director of the Reichs-Rundfunk-Gesellschaft. We are glad to learn from our foreign correspondent that he, Dr. Giesecke, has been liberated, and that he returned home on August 23rd, though we understand that no mention of this fact appeared in the German Press.

Ultra Shorts at Sing Sing

SING SING is seeking permission to use ultra short waves to guard its prisoners. According to a Washington correspondent, the idea is that the warders would carry light-weight transmitters and receivers strapped on their backs, enabling them to converse across the prison grounds while on their beats.

Unlucky Tunis

TUNISIAN listeners want to hear French, and are loudly lamentating that they are doomed to absorb German, Italian, and other foreign comedies and lectures. Apparently the only French stations that are audible, viz., Radio Paris, Poste Parisien, Toulouse, and Algiers, are so "pursued by parasites" that five to ten minutes of listening is the utmost that can be borne.

Feeling the Economic Strain

THE Belgian Government has just decided to reduce the grant for 1933 to the National Broadcasting Institute from over 22 million francs to about 17 million. In consequence of this the I.N.R. (as it is generally known) has felt compelled to reduce both the talks and musical programmes. The broadcasting hours have been shortened to 12 noon to 2.0 p.m. and 5.0 to 10.0 p.m. on week-days. The Sunday transmission will start two hours earlier than this, but will otherwise be the same. It is hoped that when times improve the old hours may be restored or even extended.

Another Arctic Station

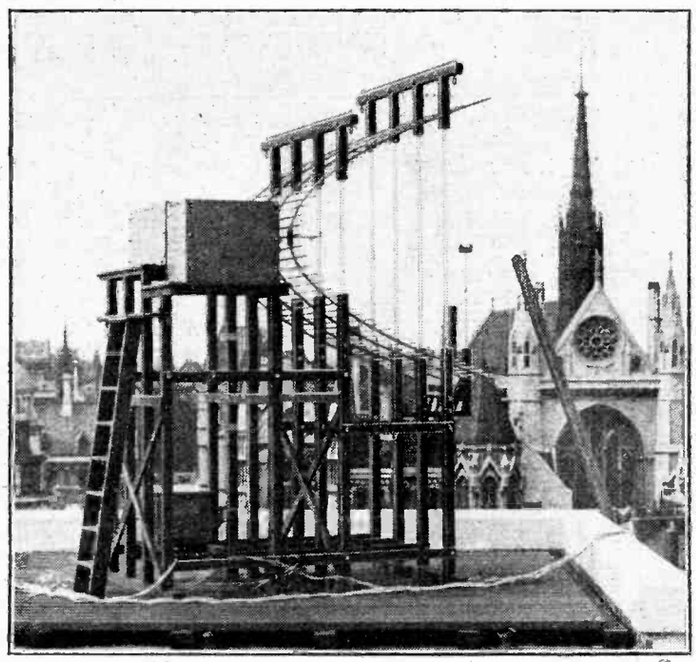
THE 10 kW. Norwegian station now being erected at Vadsö in Finnmark claims to be the most northerly station in the world, latitude 70° 4′ N. When completed it will relay the programme from Oslo.

Storms in Hungary

LOCAL thunderstorms frequently interrupt broadcast transmission in Hungary and the relay stations often have to shut down for "storm pauses." From Budapest now comes the assurance that listeners will be warned, at such times, which stations are affected and which are still continuing their transmissions, in order that they may tune in to the active station and continue to follow the programme.

Belgian Political Talks

IN view of the correspondence which has recently appeared in the English papers between three distinguished statesmen and the B.B.C. concerning the selection of speakers for the forthcoming political addresses, it is interesting to hear from our correspondent that the Belgian Government has issued a decree according to which "every one of its members has the right to use the broadcasting station for speeches up to a maximum of ten hours per month." If this is the case, Belgium stands in danger of being inundated with political addresses, and the prospect of an ardent politician insisting on his right to take the whole of his allotted time in "one fell swoop" must be rather disconcerting to listeners.



MICRO-WAVES AT ELECTRA HOUSE. The Research Department of Marconi's Wireless Telegraph Co., Ltd., has now settled down in its new quarters facing the Embankment, and one sign of the move is the erection of the parabolic aerial for the ultra-short wave beam on the roof of Electra House.

German Anti-Static Campaign

IN view of the forthcoming anti-interference law, the National Socialist Funkkammer has decided to clear the town of Baden-Baden of all man-made statics. Work has already begun under the direction of a Post Office engineer and the second burgomaster of the town, and it is hoped that by the middle of October all such interference will have ceased. The authorities have inferred that the law against man-made interference will be based on the technical requirements of the Volksempfänger (the new People's Receiver), so that every owner of this set will have clear reception without the necessity of providing shielded aerial down-leads.

Forthcoming Lectures

A NEW session of the British Radio Institution opens today (September 22nd), when a lecture will be given by Dr. L. E. C. Hughes on "The Reproduction of Sound via Radio." The meeting is to be held at 7.30 p.m. at King's College, Strand, W.C.2, and the chair will be taken by Prof. C. L. Fortescue. The Hon. General Secretary asks us to state that any of our readers who wish to attend what promises to be an interesting lecture will be welcomed. Invitation cards are available, but are not necessary for admission. The headquarters of the B.R.I. are at 36, Gordon Square, W.C.1.

R.S.G.B. Meetings

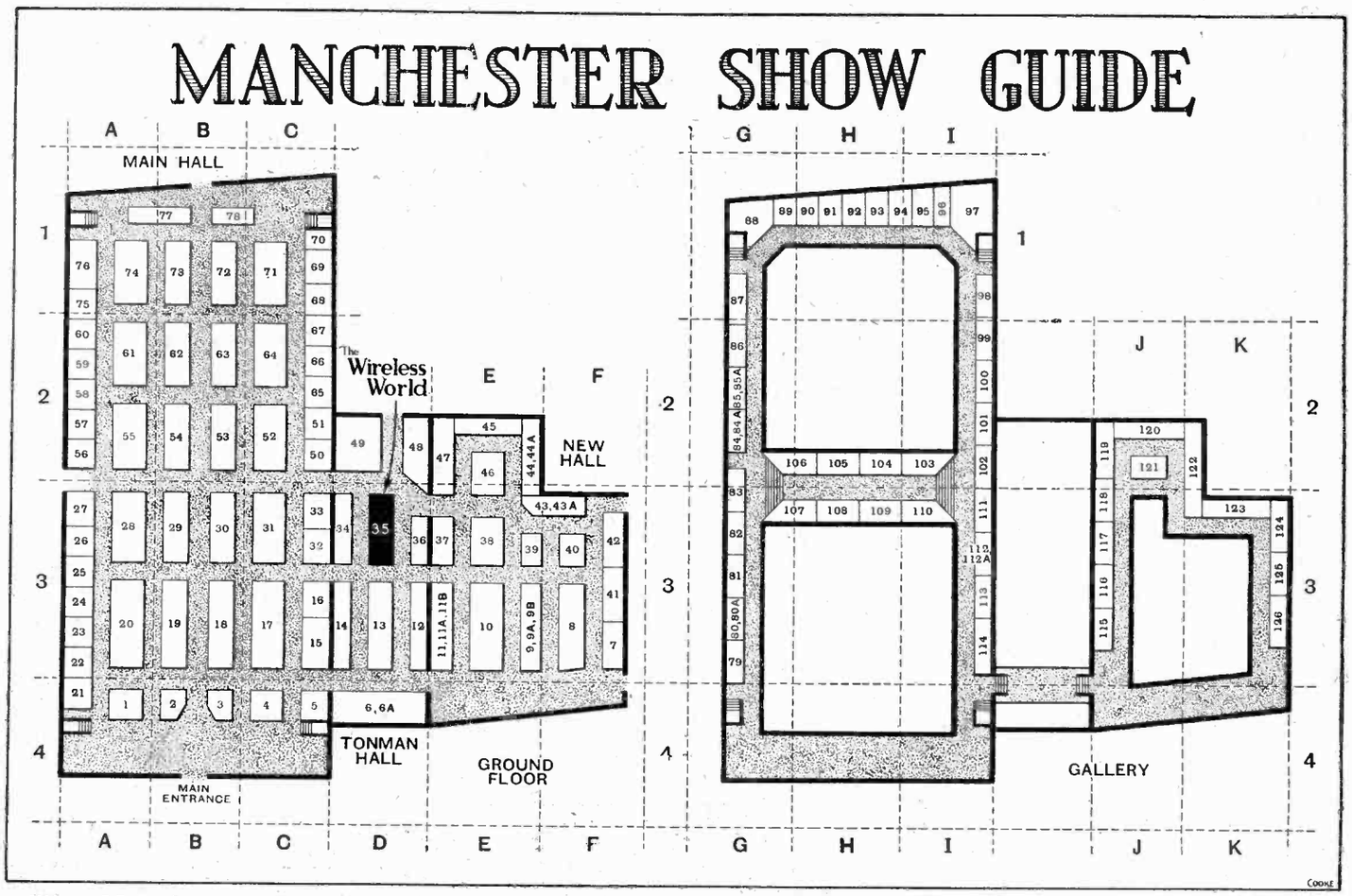
THE secretary of the Incorporated Radio Society of Great Britain has kindly sent us a preliminary list of the series of lectures which will be given on Friday evenings at 6.15 p.m. at the Institute of Electrical Engineers. The dates and subjects are:—

- September 29th. — "Experiments with Portable 56 mc. Apparatus," by R. H. Hammans, G2IG.
- October 20th.—"Technique in Valve Manufacture," by Stephen de Laszlo, B.A. (Director, High Vacuum Valve Co., Ltd.).
- November 24th.—"The Magnatron Oscillator for very High Frequencies," by Eric Megaw, B.Sc. (Research Laboratories, General Electric Co.).
- December 20th.—Annual General Meeting followed by a lecture, "Transmitting Valves for Amateur Needs," by L. Grinstead (Transmitting Division, Mullard Wireless Service Co.).

New German Relay Station

A NEW relay station from Coblenz will shortly be erected and further stations are projected for Würzburg, in Bavaria, and somewhere not yet settled in Pomerania.

MANCHESTER SHOW GUIDE



The Manchester Radio Show will be held in the City Hall, Deansgate, from Wednesday, September 27th to Saturday, October 7th, 1933

In the following list we give the names and addresses of exhibitors, with Stand numbers, and a reference (in heavier type) to be used in conjunction with the above plan for locating individual stands

FULL LIST OF EXHIBITORS

Exhibitor.	Stand.	Ref. Sqs.
AERIALITE, Ltd. ... ... Aerialite House, Amber St., Manchester.	85	G 2
Allied Newspapers, Ltd. ... 21–2 Withy Grove, Manchester.		A 4, A 3
Amplion (1932), Ltd. ... ... 82–84, Rosoman St., London, E.C.1.	34	D 3
Automatic Coil Winder & Elec. Equipment Co., Ltd. ... ... Winder House, Douglas St., London, S.W.1.	118	E 3
BALCOMBE, Ltd., A. J. ... ... 52–58, Tabernacle St., London, E.C.2.	73	B 1
Belling & Lee, Ltd. ... ... Cambridge Arterial Rd., Enfield, Mddx.	27	A 3
Bernard Jones Publications, Ltd. ... 58, Fetter Lane, London, E.C.4.	76	A 1
Berry & Wilson, Ltd. ... ... Mansion Wks., Gt. Horton, Bradford.	79	G 3
Block Batteries, Ltd. ... ... Abbey Rd., Barking, Essex.	54	B 2
Britannia Batteries, Ltd. ... ... 233, Shaftesbury Ave., London, W.C.2.	2	B 4
British Blue Spot Co., Ltd. ... ... 94–96, Rosoman St., London, E.C.1.	50	C 2
British Broadcasting Corporation. ... Portland Place, London, W.1.	94–7	I 1
British Pix Co., Ltd. ... ... 118, Southwark St., London, S.E.1.	86	G 2
British Radiophone, Ltd. ... ... Aldwych House, Aldwych, London, W.C.2.	14	D 3
British Rola Co., Ltd. ... ... Minerva Rd., Park Royal, London, N.W.10.	75	A 1
Brown Bros., Ltd. ... ... Gt. Eastern St., London, E.C.2.	48	D 2
Bulgin & Co., Ltd., A.F. ... ... Abbey Rd., Barking, Essex.	69	C 1
CARRINGTON Mfg. Co., Ltd. ... ... Camco Wks., Sanderstead Rd., S. Croydon.	44	E 2
Celestion, Ltd. ... ... London Rd., Kingston-on-Thames.	1	A 4
Cifel Products, Ltd. ... ... 134, Pentonville Rd., London, N.1.	114	I 3
City Accumulator Co., Ltd. ... ... 18–20, Norman's Bldgs., Central St., London, E.C.1.	79	G 3
Clarke & Co. (M/c), Ltd., H. ... ... Atlas Wks., Patricroft, Nr. Manchester.	29	B 3
Climax Radio Electric, Ltd. ... ... Haverstock Wks., 59, Parkhill Rd. Hampstead, N.W.3.	16	C 3
Cole, Ltd., E. K. ... ... Ekco Wks., Southend-on-Sea.	18	B 3
Colvern, Ltd. ... ... Mawneys Rd., Romford, Essex.	32	C 3
Cosmocord, Ltd. ... ... Cambridge Arterial Rd., Enfield, Mddx.	104	H 2
Cossor, Ltd., A. C. ... ... Cossor House, Highbury Grove, London, N.5.	61	A 2
Cromwell (Southampton), Ltd. ... ... 32, Brinton's Terr., Southampton.	30	B 3
DAWES, F. ... ... London Rd., Manchester.	107	G 3
Dent, R. H. ... ... 309, Oxford St., London, W.1.	9A	E 3
Diggle & Co., A. ... ... Jane St., Rochdale, Lancs.	84A	G 2
Dyson & Co., Ltd., J. ... ... Godwin St., Bradford.	36	D 3
ECONASIGN Co., Ltd. ... ... 92, Victoria St., London, S.W.1.	81	G 3
Edge Radio, Ltd. ... ... Bolton, Lancs.	12	D 3
Edison Swan Electric Co., Ltd. ... ... 155, Charing Cross Rd., London, W.C.2.	28	A 3
Electro-Dynamic Construction Co., Ltd. Devonshire Grove, London, S.E.15.	109	H 3
Epoch Radio Mfg. Co., Ltd. ... ... Exmouth House, Exmouth St., London, E.C.1.	83	G 3
Ever Ready Co. (Gt. Britain), Ltd. ... Hercules Place, Holloway, London, N.7.	53	B 2
Express Radio Factors, Ltd. ... ... 25, Gt. Eastern St., London, E.C.2.	6	D 4
FERRANTI, Ltd. ... ... Hollinwood, Lancs.	20	A 3
GENERAL ELECTRIC Co., Ltd. ... Magnet House, Victoria Bridge, Manchester.	19	B 3
Goodmans, Ltd. ... ... 69, St. John St., Clerkenwell, London, E.C.1.	103	I 2
Graham Farish, Ltd. ... ... 153, Masons Hill, Bromley, Kent.	23–6	A 3
Gramophone Co., Ltd. ... ... 98–108, Clerkenwell Rd., London, E.C.1.	52	C 2
Grampian Reproducers, Ltd. ... ... Station Ave., Kew Gdns., Surrey.	33	C 3
Gresley Radio, Ltd. ... ... Ordsall Lane, Salford Lancs.	106	G 2
HACKER & Sons, H. ... ... Ray Lea Rd., Maidenhead, Berks.	92–3	H 1
Heayberd & Co., F. C. ... ... 10, Finsbury St., London, E.C.2.	39	E 3
Hellesens, Ltd. ... ... Hellesen Wks., Morden Rd., South Wimbledon, London, S.W.19	6A	D 4
High Vacuum Valve Co., Ltd. ... ... 113–117, Farringdon Rd., London, E.C.1.	80	G 3
Hobday Bros., Ltd. ... ... 11–20, Turner St., Manchester.	56–9	A 2
Hollingdrake & Sons, Ltd., H. ... ... Princess St., Stockport.	91	H 1
Hustler, Simpson & Webb, Ltd. ... ... Aerodyne Wks., Hoe St., Walthamstow, London, E.17.	10	E 3
IGRANIC Electric Co., Ltd. ... ... 147, Queen Victoria St., London, E.C.4.	72	B 1
Iliffe & Sons Ltd. ... ... Dorset House, Stamford St., London, S.E.1.	35	D 3
LISSEN, Ltd. ... ... Lissenium Wks., Worple Rd., Isleworth, Middx.	64	C 2
McMICHAEL Radio, Ltd. ... ... Slough, Bucks.	71	C 1
Marlborough Radio Co., Ltd. ... ... Primrose Bank, Ashton Rd., Oldham.	43A	F 3

Manchester Show Guide—

Exhibitor.	Stand.	Ref. Sqs.
Milnes Radio Co. ... ... Bingley, Yorks.	108	H 3
Mullard Wireless Service Co., Ltd. ... Mullard House, Charing Cross Rd., London, W.C.2.	17	C 3
NEW London Electron Works, Ltd. ... East Ham, London, E.6.	3	B 4
Newnes Ltd., G. ... ... 8–11, Southampton St., Strand, London, W.C.2.	11	E 3
ODHAMS Press, Ltd. ... ... 68, Long Acre, London, W.C.2.	82	G 3
Ormond Engineering Co., Ltd. ... Ormond House, Rosebery Ave., London, E.C.1.	67–8	C 2, C 1
Orr Radio, Ltd. ... ... 63, Lincoln's Inn Fields, London, W.C.2.	46	E 2
Osborn, C. A. ... ... Regent Wks., Arlington St., London, N.1.	78	B 1
Osdur Manufacturing Co. ... ... 26, Adam St., London, W.1.	11A	E 3
PARTRIDGE, Wilson & Co. ... ... Davenset Wks., Evington Valley Rd., Leicester.	4	C 4
Portadyne Radio, Ltd. ... ... Gorst Rd., North Acton, London, N.W.10.	66	C 2
Practical Radio, Ltd. ... ... Stal House, Judd St., London, W.C.1.	9	E 3
Pressland Sales, Ltd. ... ... 84, Eden St., Kingston-on-Thames.	9B	E 3
Priestley & Ford. ... ... 3–11, Carrs Lane, Birmingham.	98	I 1
Provincial Incandescent Fittings Co., Ltd. High St., Manchester.	45	E 2
Pye Radio, Ltd. ... ... Africa House, Kingsway, London, W.C.2.	55	A 2
QUICKSIGN, Ltd. ... ... 106, Queen Victoria St., London, E.C.4.	112	I 3
RADIALADDIN, Ltd. ... ... 46, Brewer St., London, W.1.	47	E 2
Radio Instruments, Ltd. ... ... Purley Way, Croydon, Surrey.	65	C 2
Radiomes, Ltd. ... ... 129–131, Bridge St., Warrington.	113	I 3
Rawlplug Co., Ltd. ... ... Rawlplug House, Cromwell Rd., London, S.W.7.	44A	E 2
Reproducers & Amplifiers, Ltd. ... ... Frederick St., Wolverhampton.	5	C 4
Richardsons (R.M.L.), Ltd. ... ... 24, St. John St., Manchester.	49	D 2
Ridings Reliance, Ltd. ... ... 334, Stockport Rd., Manchester.	13	D 3
Roberts, J. ... ... Bridgewater Viaduct, Knott Mill, Manchester.	112A	I 3
SIEMENS Electric Lamps & Supplies, Ltd. ... ... 38, Upper Thames St., London, E.C.4.	15	C 3
Small Power Dynamo & Motor Co., Ltd. Old Lane, Hr. Openshaw, Manchester.	99	I 2
Sovereign Products, Ltd. ... ... 52–4, Rosebery Ave., Clerkenwell, London, E.C.1.	100	I 2
Standard Telephones & Cables, Ltd. ... 364, Gray's Inn Rd., London, W.C.2.	38	E 3
Star Radio Products, Ltd. ... ... 11, Sugar Lane, Manchester.	102	I 2
TANNOY Products, Ltd. ... ... Dalton St., West Norwood, London, S.E.27.	87	G 1
The 362 Radio Valve Co. Ltd. ... ... Stoneham Wks., Stoneham Rd., London, E.5.	111	I 3
Thomas & Bishop, Ltd. ... ... 37, Tabernacle St., London, E.C.2.	90	H 1
Trade Chronicles, Ltd. ... ... 6, Carmelite St., London, E.C.4.	85A	G 2
ULTRA Electric, Ltd. ... ... Erskine Road, Chalk Farm, London, N.W.3.	31	C 3
Universal Electric Supply Co., Ltd. ... 4, Brown St., Manchester.	110	I 3
VARLEY (Oliver Pell Control, Ltd.) ... 103, Kingsway, London, W.C.2.	77	B 1
Vince's Dry Batteries, Ltd. ... ... Garford Wks., Garford St., London, E.14.	74	A 1
WELLWORTH Wireless Co. ... ... 8, Withy Grove, Manchester.	84	G 2
Westinghouse Brake & Saxby Signal Co., Ltd. ... ... 82, York Rd., King's Cross, London, N.1.	63	B 2
Wharfedale Wireless Works, Ltd. ... 62, Leeds Rd., Bradford.	101	I 2
Whiteley Electrical Radio Co., Ltd. ... Victoria St., Mansfield.	62	B 2
Wingrove & Rogers, Ltd. ... ... Polar Wks., Old Swan, Liverpool.	51	C 2
Wireless & Gramophone Trader ... ... Dorset House, Stamford St., London, S.E.1.	60	A 2
Wireless Retailers' Assoc. of Gt. Britain and N. Ireland. ... ... 1, Mitre Court, Fleet St., London, E.C.4.	89	G 1
Wireless World. ... ... Dorset House, Stamford St., London, S.E.1.	35	D 3
Wright & Weaire, Ltd. ... ... 710, High Rd., London, N.17.	80A	G 3

In Next Week's Issue:—

"The Wireless World"

D.C. Superhet

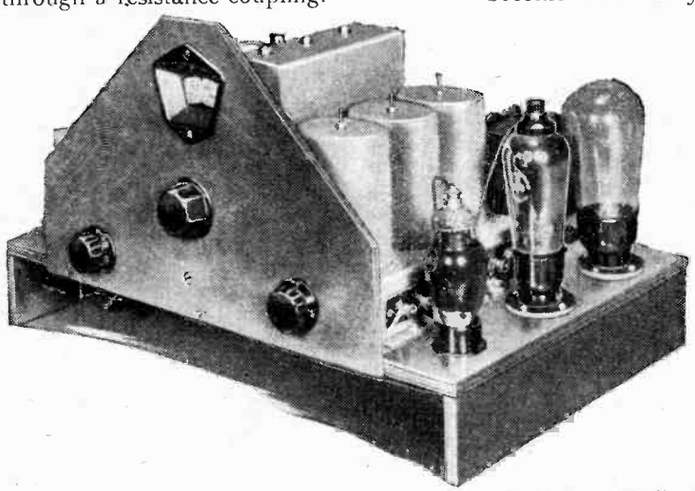
Incorporating A.V.C., Westectors and Pentagrid Frequency Changer

THE new receiver has only four valves, but is capable of a performance equal to, if not surpassing, that of a five- or six-valve set of only a few months ago. The reduction in the number of valves has been made possible by recent valve development and by the introduction of metal rectifiers for signal rectification.

A signal frequency H.F. stage with two tuned preselector circuits for second channel rejection precedes the Pentagrid frequency changer, and the single I.F. stage is coupled by means of iron-core type I.F. transformers. This stage feeds two Westectors, giving signal rectification and delayed A.V.C. on the H.F. frequency changer and I.F. variable-mu valves, and feeds the output pentode through a resistance coupling.

Due largely to this important feature, the A.V.C. system functions unusually well and maintains constant apparent loud speaker volume for large variations in signal input. In addition, the low value of L.F. amplification employed has far-reaching effects on the question of hum. A minimum of smoothing is needed, and yet the hum level is exceptionally low, even with a positive earth, while electrostatic hum pick-up is negligible.

The quality of the reproduction reaches a high level, while the selectivity and sensitivity are adequate for most purposes. The tuning dial is wavelength calibrated, and owing to the use of a special barretter for regulating the heater current of the valves, alterations to the set for different mains voltages between 200 and 250 volts become unnecessary.



New Superheterodyne Circuit Employing Four Valves Only.

Full size blue prints of the wiring connections will be available.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

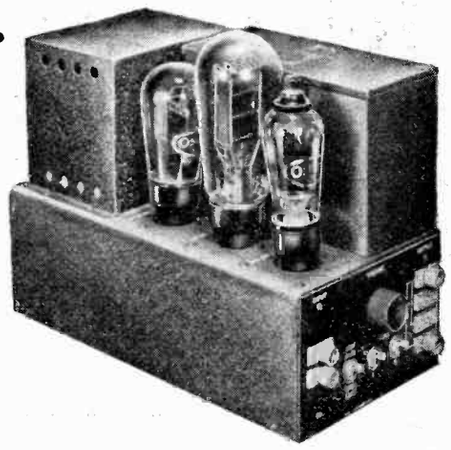
1 Super R.F. Radiopak, without volume control — **British Radiophone**
2 Ferrocart Colverdynes, 110 kc/s — **Colvern**
1 Tapered volume control, 0.25 megohm, and knob — **Claude Lyons Type 250 M-T** (Magnum, Rothermel, Varley.)
1 Potentiometer, 5,000 ohms — **Claude Lyons Type P.58** (Haynes Radio, Rothermel, Watmel.)
1 Screened H.F. choke — **Goltone Type SHF** (Kinva, Varley, Wearite.)
2 Mains H.F. chokes — **Goltone Type PHF**
1 L.F. choke — **Heayberd No. 752** (Davenset, Ferranti, Parmeko, R.I., Sound Sales, Varley, Vortexion.)
5 5-pin valve holders — **Clix Chassis Mounting Type** (Preh.)
1 7-pin valve holder — **Philco 27/6005**
1 Grid clip, for 6A7 valve — **Philco 4897** (Claude Lyons.)
1 Fixed condenser, 4 mfds. 250 v. D.C. working — **T.C.C. Type 65**
2 Fixed condensers, 2 mfds. 200v. D.C. working — **T.C.C. Type 50**
3 Fixed condensers, tubular, 0.1 mfd. 350v. D.C. working — **T.C.C. Type 250**
1 Fixed condenser, 0.01 mfd. — **Igranic Type FF.12**
1 Fixed condenser, 0.001 mfd. — **Igranic Type FF.12**
1 Fixed condenser, 0.002 mfd. — **Igranic Type FF.12**
4 Fixed condensers, 0.0001 mfd. — **Igranic Type FF.12**
2 Fixed condensers, 0.0002 mfd. — **Igranic Type FF.12** (Dubilier, Peak, Telsen.)
1 Dry electrolytic condenser, 50 mfds. — **T.C.C. Type 521** (Dubilier, Telsen.)
1 Make-and-break switch — **Claude Lyons B.A.T.728**
1 Double-pole single-throw switch — **Claude Lyons B.A.T.2728** (British Radiophone, Bulgin.)
2 Ebonite shrouded terminals, A.E. — **Belling-Lee Type "B"** (Igranic.)
2 Westectors — **Westinghouse W.6**
1 Resistor, 25 ohms — **Claude Lyons Type FW.25**
1 Resistance, 100 ohms 1½ watts ... **Seradex Type M.150**
1 Resistance, 250 ohms 1½ watts — **Seradex Type M.150**
1 Resistance, 20,000 ohms 1½ watts — **Seradex Type M.150**
1 Resistance, 0.1 megohm 1½ watts — **Seradex Type M.150**
2 Resistances, 0.25 megohms 1½ watts — **Seradex Type M.150**
1 Resistance, 0.5 megohm 1½ watts — **Seradex Type M.150**
1 Resistance, 1 megohm 1½ watts — **Seradex Type M.150**
1 Resistance, 2 megohms 1½ watts — **Seradex Type M.150**
2 Resistances, 10,000 ohms 2½ watts — **Seradex Type G.250** (Dubilier, Erie, Claude Lyons, Varley, Watmel.)
1 5-pin plug — **British Radio Gramophone Co.** (Bulgin.)
1 Bulb, 6 volts 0.15 amp. — **Bulgin Type "OB"**
1 Twin safety fuse holder, with 1 amp. fuses — **Belling-Lee Type 1033** (Bulgin.)
1 Length Screened Sleeving — **Harbros**
Plymax baseboard, 10in. × 16in. × ⅝in. — **Peto-Scott** (Overall dimensions of assembled chassis, 16in. length × 10in. width × 9½in. height.)
1 Voltage regulator — **Osram Barretter No. 251**
4 oz. No. 20 tinned copper wire, 10 lengths Systoflex, wire, wood, etc.

Screws:—
25 ¼in. No. 4 R/hd.
4 ½in. No. 4 R/hd.
7 ⅝in. No. 4 C/sk.
10 ⅝in. No. 4 R/hd.
10 ⅜in. No. 4 R/hd.
4 6BA, with nuts and washers.

Valves:—2 Marconi or Osram VDS. 1 Marconi or Osram DPT. 1 Philco or Claude Lyons 6A7.

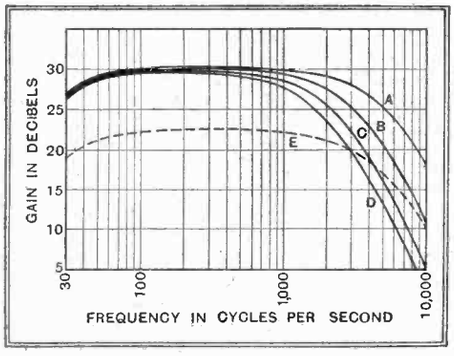
G.E.C. Six-watt Power Amplifier

Two-stage A.C.-operated Power Unit in Compact Form



Model B.C.S.1562

THE B.C.S.1562 power amplifier made by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, is an A.C.-operated two-stage unit giving a maximum undistorted power output of six watts. An output of this order is sufficient to fill a small- or medium-sized hall, and with suitable disposition of loud speakers will answer for many purposes out of doors, such as at sports meetings, garden fêtes, and the like. Yet on first acquaintance few would include it in the category of public address equipment in view of its exceptionally small size, for the overall dimensions are but 13in. × 6¼in. × 10¼in. high. Despite its compactness, there is no undue crowding of the components, nor has the safety factor in a single instance been pared down to the border line to achieve this end; indeed, the components are very generously rated.



Overall response curves of G.E.C. six-watt amplifier taken across the 15-ohm tapping of output transformer. A, normal characteristic, B, C and D with three degrees of tone control, and E, low grain characteristic.

The circuit employed is quite straightforward, and consists of an Osram MS4B S.G. valve resistance-capacity coupled to a PX25 power valve. The A.C. output from this is fed through a choke-capacity filter to an output transformer having tappings on its secondary winding to give correct matching for loud speakers of 2.5, 5, 7.5, and 15 ohms impedance. Alternatively, if two or more loud speakers are employed the wide choice of output ratios renders it comparatively easy to arrange their connections so that the total impedance of the line amounts to one of these four values. The provision for low impedance transmission lines is a wise one, for with the loud speakers located at a distance little or no loss occurs of the higher frequencies due to capacity effects.

Alternative Input

Control of volume is effected by a 500,000-ohm potentiometer in the grid circuit of the first valve, but, in addition, provision is made to reduce the input to about one-half should the need arise. A switch, marked "High Gain" and "Low Gain," is fitted, and in the former position an input of about 0.22 volt suffices to fully load the amplifier, while 0.56 volt approximately is required under low-gain conditions. A volume control of one-half megohm may seem unduly high, but it allows the amplifier to be employed following the detector valve in a wireless unit, and, furthermore, enables separate volume controls, or fading devices, to be used where two gramophone turntables or a combination of these and a microphone unit are connected to the amplifier.

Three degrees of tone control are available, but not for compensation of the amplifier's characteristic, which is entirely satisfactory without this artificial aid. They are included in order to meet any particular contingency that may arise in connection with the acoustic properties of the hall or the loud speakers. The high-tension supply is derived from a full-wave rectifying valve (Osram U.14), the output being smoothed by a single choke and the customary array of condensers.

Anode and grid decoupling is applied where necessary, with the result that entire freedom from interstage coupling is achieved, and the amplifier is perfectly stable under all conditions of working.

The only precautions we found necessary, and this applies also to all high gain amplifiers, was to shield the gramophone pick-up leads and earth the outer covering as well as the metal parts of the tone arm.

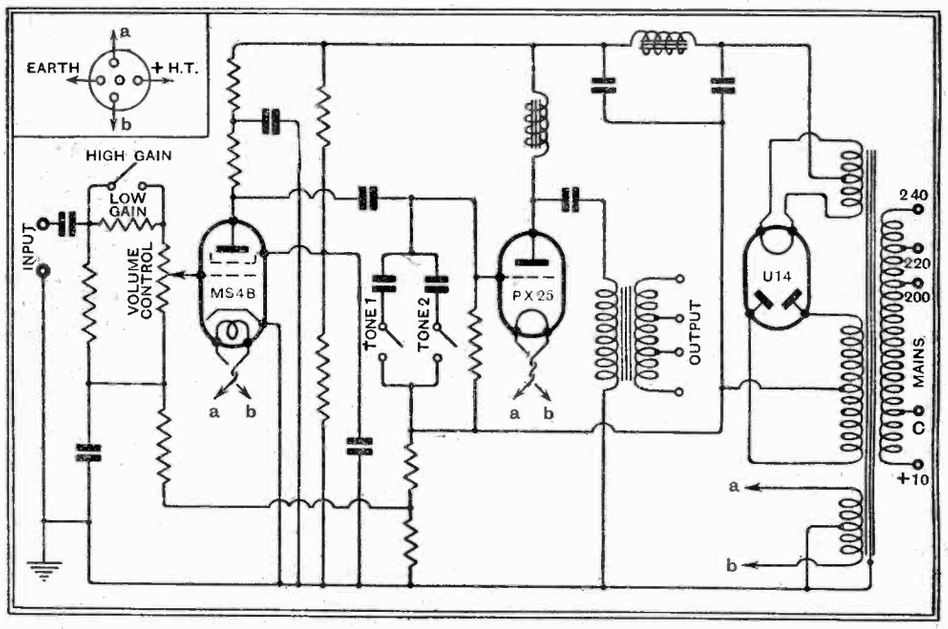
Good Characteristic

The performance of the amplifier gives no grounds for adverse criticism; gramophone recordings are reproduced faithfully, all of which is in keeping with expectations, having regard to the very satisfactory response curve. A brief explanation of this is necessary, for it may be thought at first that it represents the total gain of the unit. In order to ascertain the overall response, including the output transformer, our measurements were made by joining a 15-ohm non-inductive resistance across the 15-ohm impedance tapping. The decibel scale should be used for relative computaton of the output only at different frequencies with and without tone compensation. It also shows the relative level with the switch in the low gain position.

Curve A is the normal characteristic of the amplifier. For curve B tone control switch No. 1 was depressed; curve C shows the characteristic of the amplifier with the next degree of tone control, while with the full measure available curve D resulted. With the input switch set to "Low Gain" and without tone compensation we obtained the broken line curve, marked E on the graph.

Provision is made to take the necessary operating voltages for a microphone unit from the amplifier. At the back of the chassis is a sunk five-pin valve holder at the filament sockets of which is available a four-volt A.C. supply, while the anode and grid sockets give access to the smoothed D.C. line.

To sum up, the G.E.C. model B.C.S.1562 amplifier satisfactorily fulfils the various functions for which it is intended. It is of sound electrical design without frills or unnecessary complications likely to introduce annoying troubles, and, finally, the workmanship and finish are quite above criticism. Its compactness makes it readily portable and easily stowed away when not in use, and at the attractive price of £18 15s., complete with valves, represents very good value for money.



Theoretical circuit of G.E.C. B.C.S.1562 six-watt power amplifier.

BROADCAST BREVITIES

By Our Special Correspondent

Time Signals

THE B.B.C. has long been anxious to arrange a fixed schedule for the hours at which the Greenwich time signals are transmitted to avoid the annoyance caused when the "six pips" are superimposed on an interesting programme or when the expected signal is postponed. They hope now to arrange that the time signals in future will always be heard at fixed times, and that they will not interfere with musical or other programmes.

North Regional Dramatic Producer

THE organisation of the staff for the North Regional area proceeds apace. I understand that Mr. Robin Whitworth has been appointed the dramatic producer, working under Mr. E. F. R. Harding, the recently appointed director of programmes.

The Children's Hour

I UNDERSTAND that no decision has yet been made to omit the customary birthday greetings from the Children's Hour, but that the matter is receiving serious consideration. The B.B.C. recognises that the omission may cause acute disappointment to many children, but with the development of the Children's Hour from the informal entertainment of a gathering of "Uncles and Aunts" to its present more serious forty-five minutes, the birthday lists have grown to such a length that it is felt that they now occupy too much of the time and may have to be reluctantly abandoned.

Empire Broadcasting

THE change in the announcements of the different programmes transmitted on the Daventry short-wave sets is merely one of nomenclature. After October 8th the various Empire programmes will be known as No. 1, No. 2, and so on. Thus instead of announcing a programme for "The Canadian Zone," it will in future be known as "Programme No. 5." It has been found that there was so much overlapping of the formal zones that, in practice, the attempt to allot a certain programme to any certain zone was impossible.

Mr. Roger Eckersley's New Title

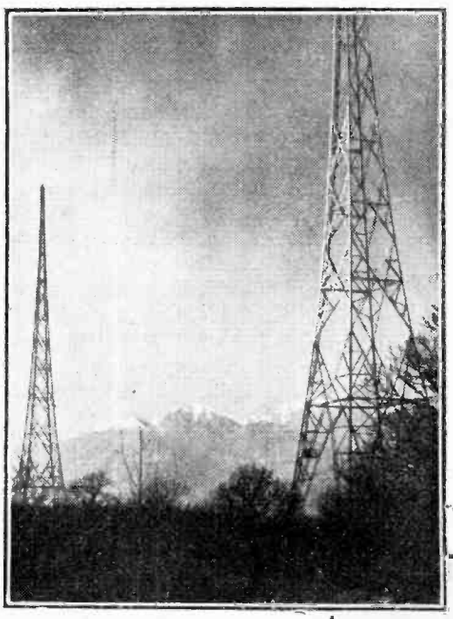
THE announcement that Mr. Roger Eckersley is now the "Director of Entertainments" only indicates a change in the name of his official post. It was found that some confusion arose occasionally between the respective posts of "Director of Programmes" and "Director of Talks," it was therefore decided to make it clear that the Director of Entertainments and the Director of Talks are two separate and hard-worked individuals, who together are responsible for the entertainment and instructional sides of the programmes.

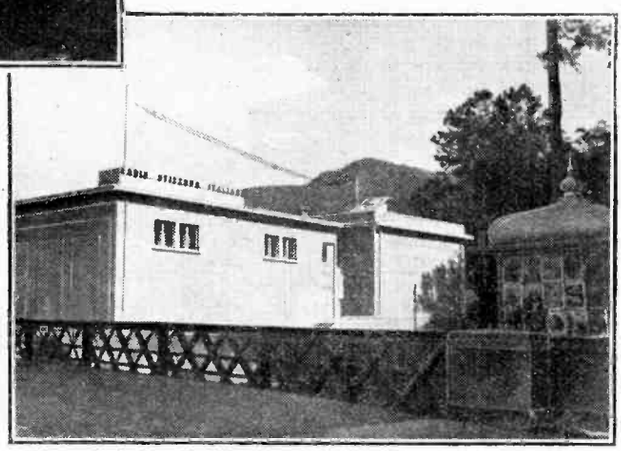
Transatlantic Relays

THE interchange of programmes between Europe and America appears likely to receive a fresh impetus from the formation of an International Committee to organise the broadcasting of talks, debates and discussions by prominent speakers in Europe, Asia and America. Dr. Nicholas Butler, president of Columbia University, is chairman, and the committee includes distinguished representatives from England, and practically all European countries, together with China and Japan. The scheme is under the auspices of the Columbia Broadcasting System, and may be regarded as their answer to the National Broadcasting Company of America, whose interchange of programmes, following the visit of Mr. F. Bate to this country, first brought to public notice the possibilities of transoceanic broadcasting.

Prospective "General Post"

ON the completion of the new National station at Droitwich it is possible that the existing medium wave National transmitters at Brookmans Park, Moorside Edge and Watchet may become redundant, but in that case it is probable that two of the transmitters will be transferred to the projected North-East of England and North of Scotland Regional stations, while the third may be re-erected at Droitwich as the new Midland Regional transmitter.





SILENT FOR A TIME. The splendidly situated masts of the Italian-speaking station at Monte Ceneri and the studio in Lugano. This station is at present closed down while the transmitters are adjusted to the new wavelength.

The Disgruntled Statesmen

THE recent correspondence between three eminent statesmen and the chairman of the B.B.C. with regard to their non-inclusion in the list of speakers to broadcast forthcoming political addresses has aroused considerable interest. Many listeners, myself included, would welcome the opportunity of hearing addresses by Sir Austen Chamberlain, Mr. Lloyd George and Mr. Winston Churchill, also by Mr. Maxton and many other prominent politicians, but those in authority at the B.B.C. wisely set a limit to the time allotted to political speeches, fearing that a plethora of such addresses would only weary listeners and thereby defeat their own object. They therefore decided, for the coming season at all events, to limit the speakers to those chosen by the leaders of the three main parliamentary parties. In the good old days when "every little boy or gal . . . was either a little Liberal or else a little Conservative," the task of selection would have been simplified, but now that there are so many shades of political thought it becomes complicated and necessarily leads to some dissatisfaction.

The New Aberdeen Studios

IT is right that Aberdeen, the home-town of Scotland's New Regional Director, Mr. Dinwiddie, should be equipped with the most up-to-date studios, but I must confess to surprise when I dropped in at the newly designed studios in Belmont Street last week.

Broadcasting House in Miniature

There will be a Press view soon, and meantime those in authority have decreed that no detailed account must appear, so I am debarred from describing the new talks studio, rigged up with the now familiar "traffic signal" system of lights for communicating between the control engineer and the speaker, of the twin gramophone turntables and the modernistic fittings and furniture, the whole giving the appearance of having been lifted lock, stock, and barrel from Broadcasting House, London, while the concert studio will certainly be Scotland's finest.

Mr. Dinwiddie's Slogan

I can, however, say this: Mr. Dinwiddie is already on the warpath with the slogan, "A fair chance for every town in Scotland," and the probability is that broadcasting studios will be erected in other Scottish centres, and a start can be expected in the region of Inverness.

"The White Château" Again

LISTENERS will welcome the opportunity of again hearing that popular broadcast play, "The White Château," which will be revived on October 9th and 10th with incidental music specially composed by Norman O'Neill.

Practical HINTS and TIPS

AIDS TO BETTER RECEPTION

SO far as the "one H.F." receiver is concerned, it is generally best to carry out the operation of adjusting the trimming condensers while the reaction control is advanced towards its limit. Although the best form of reaction control does not introduce much change in tuning, there is always the possibility of some slight disturbance being introduced, and so it is desirable that the circuits should be in most accurate alignment when the set is in the most sensitive condition—that is, with reaction fully advanced.

Reaction and Ganging.

IN the "Hints and Tips" section of *The Wireless World* of September 1st a note was published on the advantages of inserting an anti-interference filter in the mains supply leads at the point where they enter the building. The purpose of such a filter is, of course, to dispose of interference of a high-frequency nature, which may have been superimposed on the mains current by electrical machinery, etc., connected to the same mains supply system, but perhaps at a considerable distance.

Filtering and Electrical Supply.

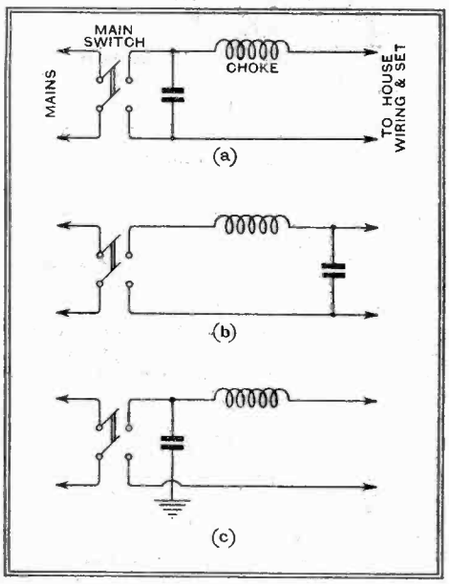


Fig. 1.—Simplified mains filters with a single choke.

As a footnote to what has already been said on the subject, it should perhaps be pointed out that in some cases the filter may be simplified and cheapened by using a single choke instead of a pair of chokes. It is therefore suggested that one or other of the arrangements shown in Fig. 1 should be tried, if only for the reason that the use of a single choke introduces less loss of voltage; looked on in another way, it becomes less important to use a choke of extremely low D.C. resistance.

Referring to the diagram, it will be seen that the various arrangements suggested differ only with regard to the position of the by-pass condenser. In circuits (*a*) and (*b*) this condenser is respectively connected on the "input" and "output" sides of the filter, while in diagram (*c*) one side of it is connected directly to earth. It can only be determined by trial which arrangement will give best results, and, above all, it must be remembered that it will depend on circumstances in which mains lead the choke should be inserted.

THE practice of fitting some form of tone control whereby heterodyne interference may be minimised by reducing the high-note response of the receiver is now fairly common. Unfortunately, most of the methods adopted are somewhat crude and extremely drastic in their action. True, many of them are effective enough in suppressing certain forms of interference from stations working in adjacent channels, but music is quite lifeless, and speech has lost much of its intelligibility.

The Best Whistle Suppressor.

This is mainly due to the fact that the filters fitted have a "tailing characteristic"; they begin to attenuate at frequencies of the order of 2,000 cycles per second to an appreciable extent. The heterodyne whistle between adjacent stations, if it is worth while trying to remove it, is of considerably higher frequency than this, and it is not hard to see that the ideal arrangement should only come into operation at a suitably chosen point in the spectrum (actually about 3,500 kc/s), leaving the upper middle register at full strength.

In the New Monodial receiver a scientifically designed low-pass filter of this nature is fitted and is so arranged that it may be thrown into circuit when heterodyne interference is present. At other times full advantage is taken of the wide frequency response of the receiver.

To hear a filter of this type in operation is a revelation of what can be done. With the receiver tuned to a station suffering from interference, and while the filter is out of operation, one hears a distressing background of whistle, mixed with sideband "splash," which may be so bad that the transmission has no entertainment value. Then, at a turn of the switch, the interference disappears as if the unwanted station had suddenly shut down.

The purpose of this note is to point out that the same type of low-pass filter is also applicable to other receivers, more especially to those which have an intermediate L.F. stage. The main requirements are that the filter should work with input and output impedances of roughly 10,000 ohms; this means that the preceding valve and the succeeding coupling device should have roughly that impedance value. If transformer coupling be employed, it will be necessary to reduce impedance artificially by shunting the primary with a 10,000-ohm resistance.

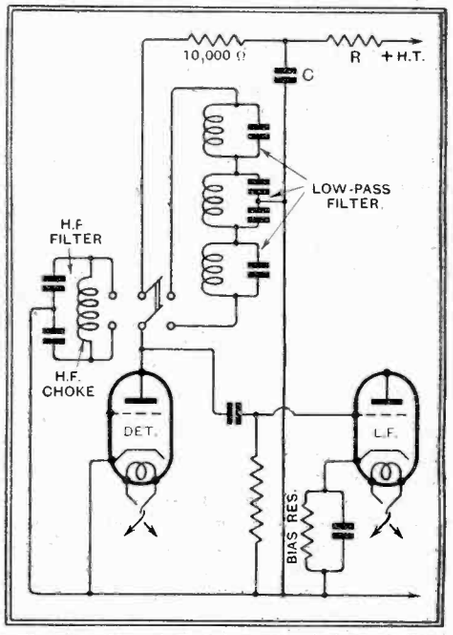


Fig. 2.—An advanced type of heterodyne whistle filter which may be thrown into circuit at will. The ordinary decoupling components are marked R. and C.

The connections of the low-pass filter unit are shown in Fig. 2 With the switch in the right-hand position the filter is in circuit, while in the other position the ordinary H.F. stopping devices become operative.

LOW-FREQUENCY transformer ratio is often a matter of considerable importance, especially in view of the fact that, in most modern sets, the detector is arranged to feed directly into the output valve without an intermediate L.F. stage.

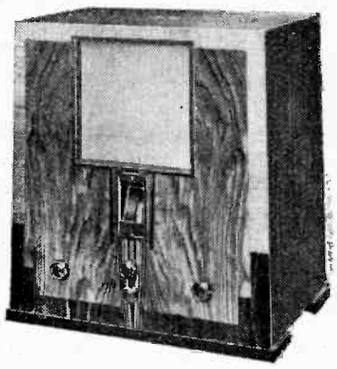
An Important Link.

It is seldom that the typical grid detector provides a large surplus of undistorted output, and so the result of using an insufficiently high step-up ratio is likely to be serious.

It should be remembered that the detector output required for loading the output stage is directly proportional to the voltage step-up provided by the transformer. If, for example, a ratio of 1 : 2.5 were employed in a set where 1 : 5 was specified, twice the detector output would be needed for correct operation.

H.M.V. "Superhet Concert Seven"

MODEL 467



FEATURES. ***Type.*** *— Seven-stage table-model superheterodyne receiver with automatic volume control. Moving-coil loud speaker and provision for pick-up and external loud speaker.* ***Circuit.*** *— Signal frequency H.F. — oscillator — first detector—I.F. amplifier—metal oxide second detector—first L.F. with tone control—triode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Main tuning with optically magnified illuminated scale. (2) Volume control and "Static Suppressor." (3) Duplex tone control. (5) Waverange, gramo. and on-off switch.* ***Price.***—*22 gns.* ***Makers.***—*The Gramophone Co., Ltd., 98-108, Clerkenwell Road, London, E.C.1.*

A Receiver of High Performance on All Points

THE specification of this table-model receiver, having regard to its compact design, is remarkably full, and the numerous detail refinements in the circuits and controls indicate that no pains have been spared to secure the highest possible performance under modern receiving conditions. The cabinet is very similar in size and general design to that of the Model 438 reviewed in our issue of June 16th, 1933, but instead of dual vertical tuning scales there is a single illuminated drum dial which is viewed through a magnifying glass prism.

There are seven valves and seven stages in the circuit, excluding the power rectifier, the reason being that a metal oxide rectifier is used in the second detector stage. Selectivity at signal frequency is provided by the first stage, which is preceded by a band-pass tuner. Separated valves are employed for the oscillator and first detector, and two band-pass filters tuned to 117 kc/s are associated with the single I.F. stage. The metal oxide second detector is tapped across a portion of the secondary of the output I.F. transformer, while a second metal oxide rectifier for automatic volume control derives its input from the primary winding. Both the first H.F. valve and the first detector are controlled, and a delay voltage is supplied by a potential divider resistance across the H.T. supply.

In addition to the A.V.C. bias on the first valve there is a variable cathode bias resistor which is fitted at the back of the chassis, and may be pre-set to give a volume level suited to local conditions of background noise. The full magnification of the set is obtained at any time by pushing inwards the main volume control spindle. This actuates a shorting switch connected across the "Static Suppressor" control resistance.

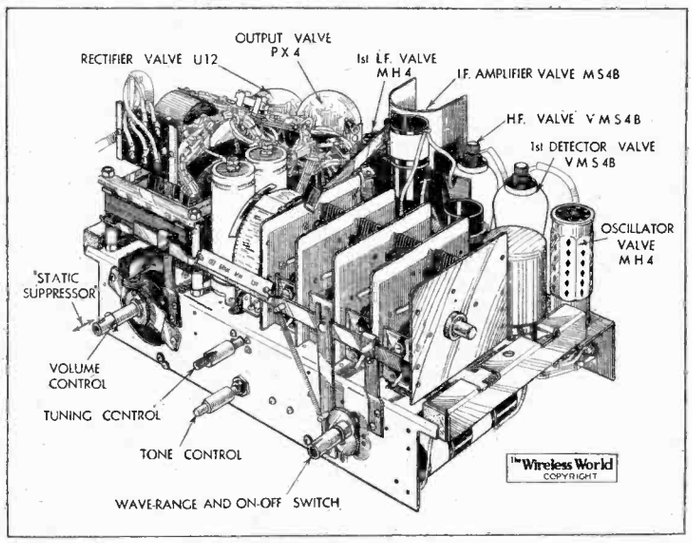
The manual volume control follows the second detector and functions both on radio and gramophone. There are two L.F. stages—both triodes—the output valve giving 2½ watts undistorted. The coupling between these stages is of the parallel-fed transformer type, and incorporates a tone control circuit which is worthy of the name. It controls both high- and low-note response, and is operated by two variable resistances coupled together, There is a mid-position which can be felt by a notch in the control, and movement to the left increases the low and to the right the high notes.

The power transformer is of unusually generous proportions, and is protected by a fuse in the centre connection to the H.T. winding and a "heat coil" in series with the primary winding. The latter is a special type of thermally delayed fuse which breaks down for steady currents in excess of 0.6 amp., but stands up to brief surges which may occur while the set is warming up.

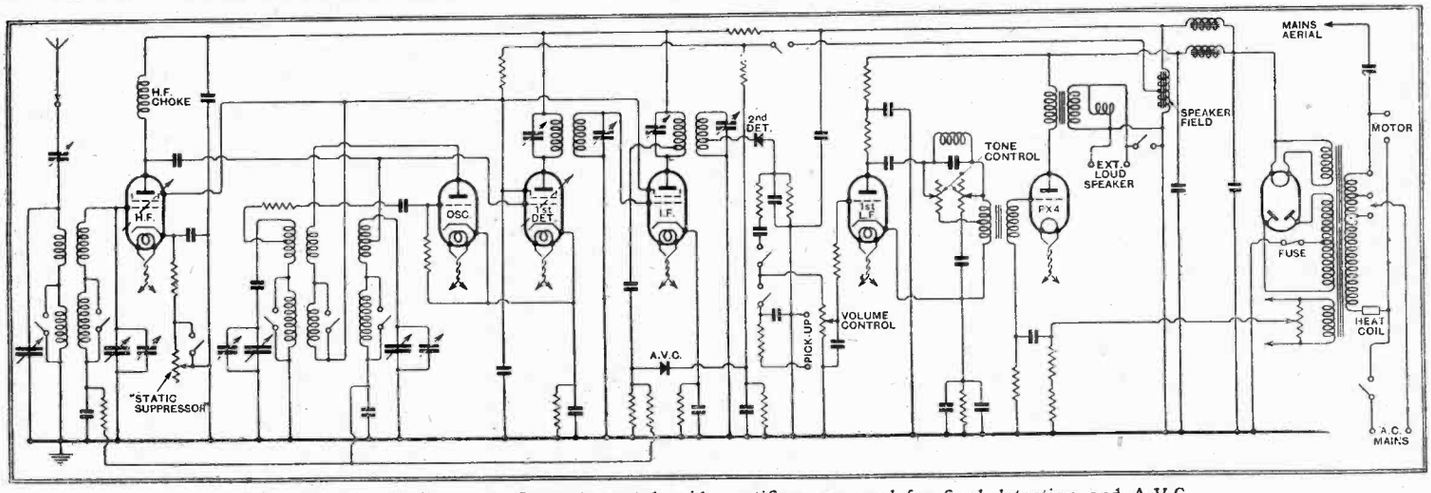
The range is all that might be expected from seven stages, and there is an ample reserve of magnification for use when conditions permit. There is not the least doubt that this set will receive any station above the prevailing noise level, and will do so, moreover, without calling for special skill on the part of the operator. At no time during the course of our tests did we find it necessary to make anything like full use of the overall amplification of which the set is capable.

The makers claim adjacent channel selectivity, and in Central London on a 50ft. outdoor aerial the set could be tuned to Mühlacker without any trace of modulation interference from London Regional. Few receivers we have tested have equalled this performance in the matter of selectivity. On long waves the range and selectivity are equally good.

The high selectivity has not been gained at the expense of quality, however, and the tonal balance with the set properly tuned and the tone control in the mid-position is, in our opinion, just right when listening to the B.B.C. stations. The move-



For a seven-stage circuit the chassis is remarkably compact.



Schematic circuit diagram. Separate metal oxide rectifiers are used for final detection and A.V.C.

H.M.V. "Superhet Concert Seven"—ment of the silk covering the loud speaker fret affords proof of the amplitudes which are developed in the bass, but the set is free from the slight over-emphasis of low tones which we have noticed in some earlier H.M.V. sets. One's personal predilections in the matter of quality are easily satisfied by the tone control, which is one of the most satisfactory we have so far handled.

A careful search of the medium waveband failed to reveal any whistles due to second channel interference, and as no special circuits have been included to suppress these the success achieved must be attributed to the high selectivity at signal frequency.

It is indicative of the satisfactory working of the A.V.C. that with the manual volume control once set for the local station no further adjustment is required when turning to the principal European stations.

Next Week's Set Review:

PHILIPS 634A SUPERINDUCTANCE RECEIVER

LABORATORY TESTS

A Review of Manufacturers' New Products

PENTAGRID VALVES

A NUMBER of American Pentagrid valves, intended for use as combined oscillator and first detector valves for superheterodyne frequency changing purposes, has been submitted for test. The valves are listed as the 6A7 type, and have a heater rated to consume 0.3 ampere at 6.3 volts; they are designed expressly for use in car radio sets where the 6-volts accumulator may rise to a considerably higher voltage when on charge, hence the peculiar voltage rating. It is stated by the makers that considerable latitude in the heater potential is permissible.

The valve is of the indirectly heated type, and contains five grids and an anode. The two inner grids form the control grid and anode of the oscillator, while the next is a screen grid arranged to screen the oscillator electrodes from the others. The remaining electrodes form the control grid, screen grid, and anode of a variable-mu tetrode which is used as the first detector. No external mixing circuit is required, and the oscillator coupling is obtained internally through electronic action.

On test, the valve gave an entirely satisfactory performance, and proved superior from every point of view to the conventional two-valve frequency changer. Although the valve is primarily intended for battery operation in a car set, it can also be used in a D.C. mains set, and tests indicated that it would give a satisfactory performance when used in this manner. It may also be operated from A.C.

6A7 Pentagrid with a heater rated at 6.3 volts 0.3 ampere.

Another Pentagrid with similar characteristics, the 2A7, but with a heater rated to consume 0.8 ampere at 2.5 volts is available, and this is suitable for use in the New Monodial Super. The makers are the Philco Radio and Television Corp. of Great Britain, Ltd., Aintree Road, Perivale, and the price is 16s.

W.B. TYPE PM4A SPEAKER

AS in most of the W.B. range of loud speaker units this year, the model tested was fitted with the "Microlode" output transformer and switching device. There are two switch arms controlling tappings on both primary and secondary of the transformer, and a choice of seventeen ratios is available for single output valves and four ratios for push-pull stages requiring a centre tap. The change, both in volume and quality, on varying the step-down ratio is most marked, and the load can be rapidly adjusted to give the best results.

W.B. type PM4A permanent magnet loud speaker incorporating the "Microlode" matching device.

Tested with the load adjusted to the calculated value, the efficiency was found to be exceptionally good for a permanent-magnet unit. Above 100 cycles it was equal to that of our standard 10in. energised unit.

The PM4A is also remarkable for the excellent response at the extreme top. Between 7,000 and 9,000 cycles it has a better output than any small commercial unit so far tested. There is a small resonance at 4,500 cycles, a more pronounced one at 2,500 cycles, and the bass resonance occurs at 130 cycles, below which the output falls steadily to a cut off at about 75 cycles.

The price of the new PM4A, which is made by Whiteley Electrical Radio Co., Ltd., Victoria Street, Mansfield, Notts, is 42s.

GOLTONE H.F. CHOKES

THE type P.H.F. heavy-duty H.F. choke has been designed especially for use in circuits passing currents of a greater magnitude than can be dealt with safely by the normal H.F. choke. It is particularly suitable for including in the heater supply circuits of a D.C. mains receiver and for certain types of interference suppressor devices where the current flowing does not exceed 0.35 amp.

Measured at a frequency of 1,000 c/s its inductance was 10,000 microhenrys approximately, yet its D.C. resistance is only 17.6 ohms. The choke is wound on a 10-section former and measures 4½in. high, the base being 2½in. × 1¾in. overall, and the price is 7s. 6d.

The standard model for use in H.T. smoothing circuits is made in two styles: the type S.H.F. and the type S.S.H.F.

Goltone heavy-duty and screened-type H.F. chokes.

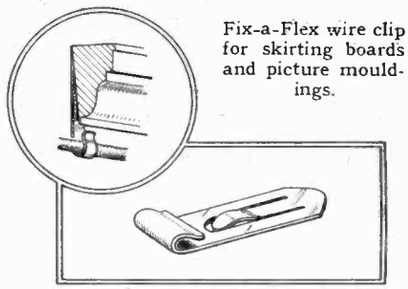
Both models are screened, the principal difference being that the type S.S.H.F. is provided with a screened lead for joining to the anode terminal of S.G. valves. The specimen tested showed an inductance of approximately 200,000 microhenrys at a frequency of 1,000 c/s, its D.C. resistance being 490 ohms. This choke will carry up to 50 mA. with safety, and the price is 4s. 6d.

The makers are Ward and Goldstone, Ltd., Frederick Road (Pendleton), Salford 6, Lancs.

FIX-A-FLEX WIRE CLIP

AN ingenious clip for fixing flexible wires such as loud speaker extensions, earth lead, etc., to skirting boards, picture mouldings and other woodwork in the room, has been introduced by N. Johnson, Fix-a-Flex Works, 35a, South Park Road, Wimbledon, London, S.W.19.

It consists of a stout brass strip, bent at one end into a loop for the wire, the other being slightly pointed and having a tongue-piece stamped out. It is fixed in position by inserting the pointed end between the woodwork and the wall; if the gap between these is too wide to afford a secure grip the tongue-piece can be opened out until a secure fixing is obtained.



Fix-a-Flex wire clip for skirting boards and picture mouldings.

They are distributed through Houghton (Ensign, Ltd.), High Holborn, London, W.C.1, and cost 1s. 6d. a box containing one dozen.

WHARFEDALE LOUD SPEAKERS

IN connection with our review of these units on page 220 of our September 8th issue, we are asked by the makers to state that the price of the "Golden" model has now been reduced from 63s. to 55s.

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CONTENTS

EDITORIAL COMMENT

Station Identification

Why Not Call Signs?

A CORRESPONDENT, whose letter appears elsewhere in this issue, raises once more the question of station identification and suggests that, when the new wavelength changes come into operation in January of next year, an excellent opportunity presents itself to remedy the present inadequate methods of announcing the identity of stations. Our correspondent recommends the system of individual station calls, as adopted by the leading networks in America.

It has always been a matter of disappointment to us that our own stations, as well as those on the Continent, do not give satisfactory indications of their identity during transmissions. It is all very well to suggest, as has so often been done, that the wavelength of the transmissions should be a sufficient guide, but it is by no means easy to identify all the stations of Europe, and when the general reshuffle of wavelengths takes place under the recommendations of the Lucerne Plan, it will be some time before listeners are able to regain confidence in the exact identity of many of the transmitters. If this change of wavelengths were made the occasion for adopting call-signs to be given out at frequent intervals during the transmissions, identification troubles would be overcome. Individual countries could be allotted call-signs commencing with a particular letter to designate the country of origin as is done when general wireless communication call signs are allotted.

There are only two complications which we foresee might arise in connection with a call-sign for the purposes of identification; the first is that in many instances in Europe a number of stations broadcast the same programme and are controlled from a common microphone, and secondly, pronunciation of letter call-signs in different countries might be difficult to interpret. The difficulty in the case of relaying the same programme might be overcome by announcing the call-signs of all the various stations taking a common programme, and in the matter of pronunciation of call letters it would probably take very little time to recognise the differences.

If a system of call-signs of this nature is to be adopted, it should be considered without delay, in order that the system could be introduced throughout Europe at the time the reshuffle of wavelengths takes place.

Double-channel Transmission

Opportunity for an Experiment

THE suggestion has been put forward through our correspondence columns recently that the B.B.C. might consider the possibility of conducting double-channel transmissions from two separate broadcasting stations at times when these stations are both taking the same programme. This would necessitate, of course, a duplication of microphones in the studio and of the amplifiers and connecting links to the transmitting stations, and at the receiving end listeners would have to employ two independent receiving sets and loud speakers.

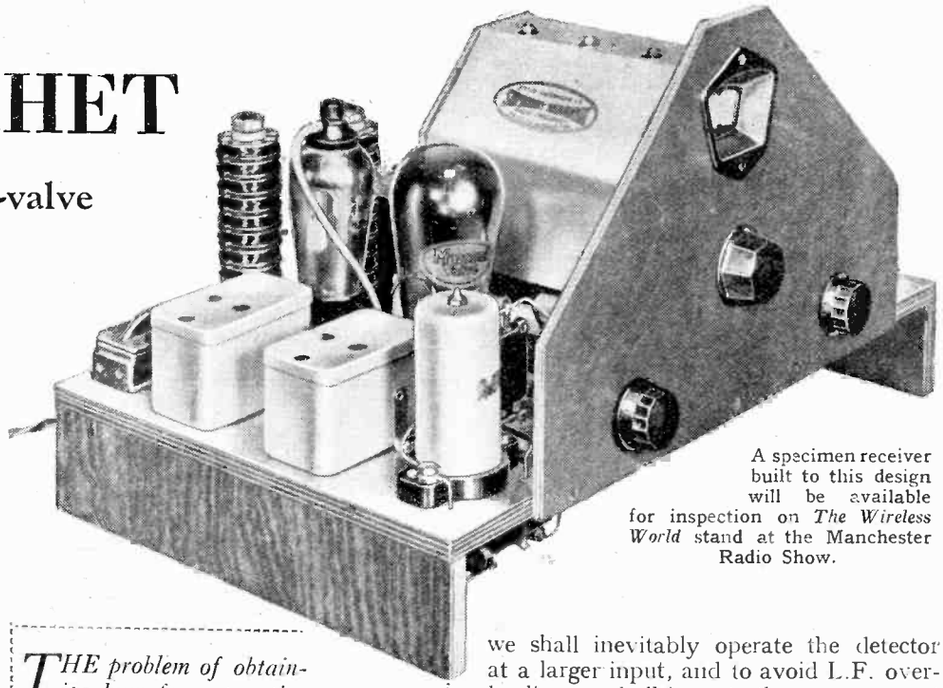
Reception under present conditions is, of course, only "one-eared," and it is not possible to obtain a stereophonic effect without a duplication of equipment. We believe that an enormous number of listeners would be prepared to set up two receivers for the purpose of testing out this experiment if the B.B.C. were prepared to do their part.

The Wireless World

D.C. SUPERHET

A Highly Selective Four-valve Receiver with A.V.C.

By W. T. COCKING



A specimen receiver built to this design will be available for inspection on *The Wireless World* stand at the Manchester Radio Show.

THE problem of obtaining hum-free operation and good automatic volume control is considerably greater in a receiver operated from D.C. mains than in one designed for working from an A.C. supply. These difficulties have been completely overcome in "The Wireless World" D.C. Superhet, and the receiver gives exceptionally good quality of reproduction with an entire absence of hum, while the A.V.C. system employed holds all stations at approximately constant volume and largely counteracts fading.

THE difficulties attendant upon the design of a D.C. mains receiver are considerably greater than those attached to the production of a set for alternating current supplies for two reasons: first, the voltage available is limited to that of the mains, and, secondly, complete isolation of the receiver circuits from the mains is not possible. The first of these is reflected in the choice of the output equipment and the A.V.C. system, while the second necessitates greater care in mechanical construction.

Practically speaking, we are limited to pentode type output valves with D.C. working, for the high bias voltage usually prohibits the use of triodes. Of the satisfactory automatic volume control systems we must usually choose the delayed diode type, for practically all others require a source of voltage additional to the H.T. supply. It was shown in a recent article[1] that the delayed diode A.V.C. circuit can only give satisfactory results if the delay voltage is large and the detector is operated at a correspondingly large signal input. At first sight there appears to be no alternative to using a duo-diode-triode type of second detector to give signal rectification, delayed A.V.C., and first-stage L.F. amplification. Even if the triode be resistance coupled to the output pentode, however, its amplification will not normally be less than about twenty times, and as a pentode only requires an input of the order of 10 volts, the triode input could not be greater than 0.5 volt if overloading were to be avoided. A delay of only 0.5 volt on the A.V.C. system, however, would not permit good control to be obtained, for the bias on the early stages has to be at least 10 volts on a strong signal. If we use a larger delay voltage, we shall inevitably operate the detector at a larger input, and to avoid L.F. overloading we shall have to throw away most of the amplification provided by the L.F. stage.

This is obviously uneconomical, and to avoid these difficulties in the present receiver no L.F. amplification is used between the detector and the output valve. The output pentode is operated with a grid bias of about 9 volts, and so requires a signal input of this value for maximum output. A duo-diode type of delayed A.V.C. system is used, the delay voltage being 9 volts, and being actually derived from the output valve bias. A.V.C., therefore, does not act until the detector input exceeds 9 volts, with which an L.F. output of very nearly 9 volts is obtained on deep modulation. With such a large detector input, rectification is truly linear and distortionless, and the A.V.C. action is extremely good.

The disadvantages of operating with such a large detector input are two: the pre-detector amplification must be unusually high for a given overall sensi-

[1] *The Wireless World*, September 8th, 1933.

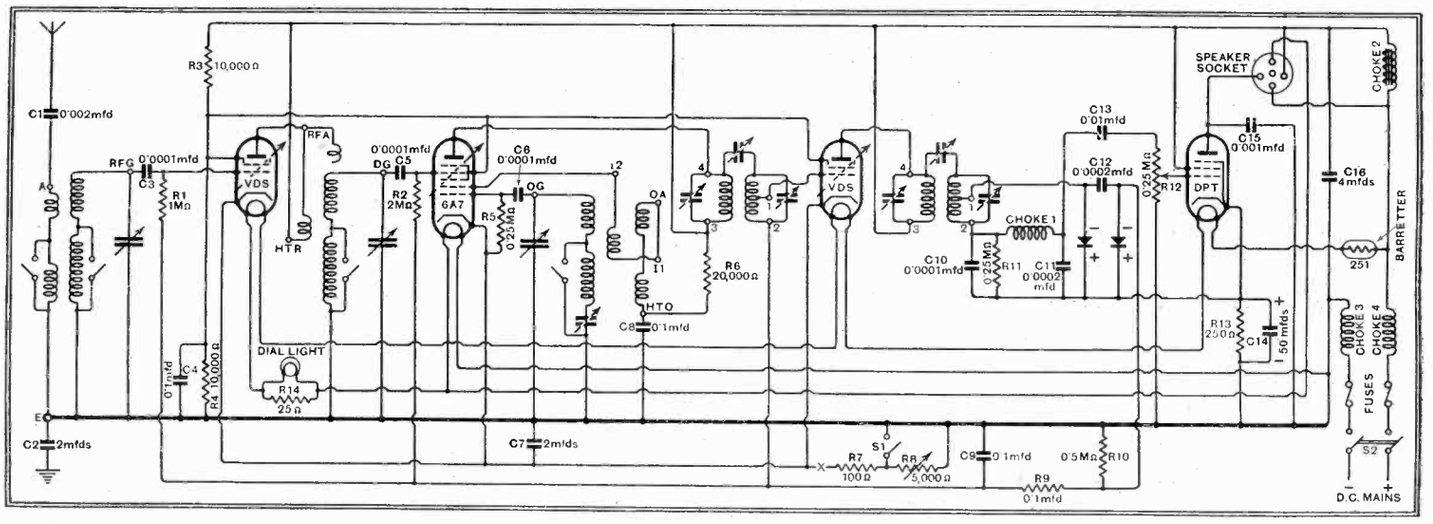


Fig. 1.—The complete circuit diagram of the new superheterodyne. The field winding of the speaker is connected across the "grid" and "plate" pins of the speaker socket and so provides additional heater current for the 6A7 valve.

"The Wireless World" D.C. Superhet—

tivity, and it is not possible to use the receiver with a gramophone pick-up, since the L.F. amplification is insufficient for adequate volume even with a sensitive pick-up. These points, however, are far outweighed by the advantages, for apart from the unusual freedom from detector distortion and the good A.V.C. system, there is a complete absence of hum under normal conditions owing to the small amount of L.F. amplification incorporated. To anyone with experience of the difficulties often encountered in the elimination of hum in a D.C. mains receiver, this alone would offer sufficient justification for the arrangement employed.

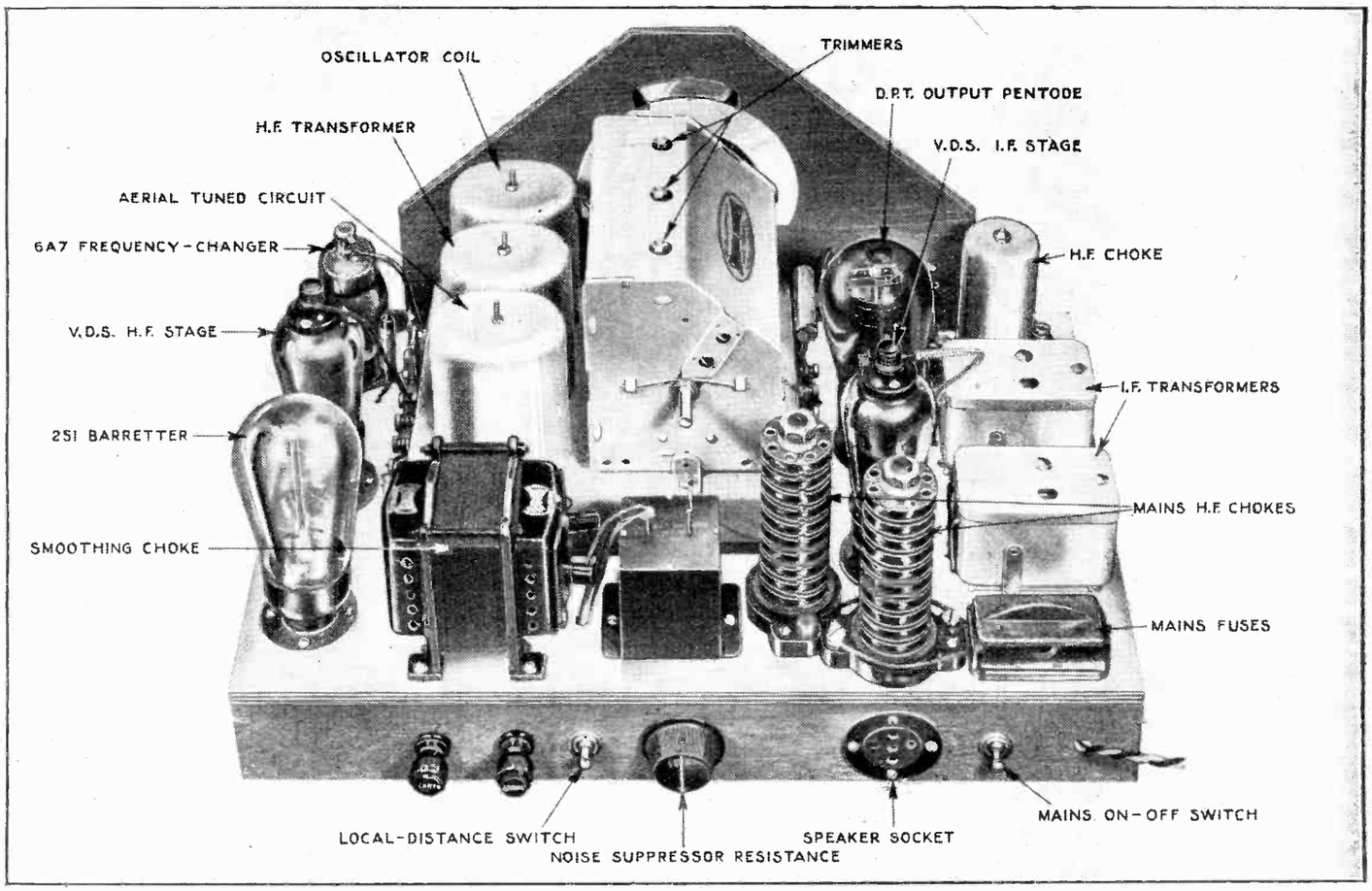
the tests, even with positive earthed mains.

After smoothing, the total H.T. supply is about 180 volts with 220 volts mains, and the full voltage is applied to the anode and screen of the output pentode, which is self-biased by the drop in the 250 ohms resistance R13, which is shunted by the 50 mfd. electrolytic condenser C14, the positive terminal of which is connected to the valve cathode.

The Use of Westectors

The duo-diode second detector actually consists of two Westectors. They are both fed from a tapping point on the secondary of the second I.F. transformer, one with respect to the earth line. The Westector anode, therefore, is biased 9 volts negatively, and rectification does not occur until the signal input exceeds 9 volts. The potential set up across R10 as the result of rectification is applied to the grids of the controlled valves through the filter R9 of 100,000 ohms and C9 of 0.1 mfd.

The I.F. stage employs a variable-mu valve coupled to the second detector through an iron-core type transformer, thus giving high selectivity and amplification. The component is of the band-pass type, permitting the retention of high audible frequencies, and the adjustment of the circuit coupling is carried out by a



A general view of the D.C. Superhet showing the chief components. The local-distance and mains switches are fitted at the rear as they require only occasional operation.

The circuit diagram of the complete receiver is shown in Fig. 1; a double-pole mains switch S2 is fitted to permit complete isolation of the chassis from the mains when the set is switched off. A fuse in each mains lead offers protection against short-circuits, and 10,000 mH. chokes Ch3 and Ch4 tend to isolate the receiver circuits from the mains so far as H.F. currents are concerned, and also tend to reduce L.F. interference from the supply. The current for the series-connected heaters is then tapped off, and that for the H.T. line passes through a single smoothing choke Ch2, which is followed by a 4 mfd. condenser C16. Tests showed that this modest equipment was sufficient to reduce hum to inaudibility during all

directly and the other through the 0.0002 mfd. condenser C12. The first provides signal rectification, and its circuit is completed through the load resistance R11 shunted by the 0.0001 mfd. condenser C10. The L.F. potentials developed across this load are applied through the filter circuit Ch1 and C11 of 0.0002 mfd. to the output valve, the grid condenser of which is given a value of 0.01 mfd. The 250,000 ohms tapered potentiometer R12 acts as the pentode grid leak and the manual volume control.

The 500,000 ohms load resistance R10 of the second rectifier is returned to the earth line, whereas the Westector itself is returned to the pentode cathode, which is 9 volts positive

small variable condenser. As the detector input impedance is fairly low, the secondary is tapped to give a step-down ratio, thus reducing detector damping.

The input to the I.F. stage is taken from the frequency changer through another identical transformer, also used with a tapped secondary, this time, however, to maintain stability. It is the usual practice to tap the primary of a transformer in cases where the coil efficiency is so high that stability cannot be maintained with the full winding in circuit. In the case of a transformer following a frequency changer, however, this practice is inadvisable, for the efficiency will suffer unless a low impedance load be placed on the frequency changer at the signal and

"The Wireless World" D.C. Superhet—

oscillator frequencies, and H.F. instability may occur if this load be inductive. A tapped primary leads to a fairly high load impedance at high frequencies, and gives an inductive load; it is, therefore, to be avoided. With modern high-resistance screen-grid valves the amplification obtainable is the same whether the tapping point be in the primary or secondary, and in this receiver, therefore, a tapped secondary has been adopted.

For the frequency changer the Pentagrid type valve has been chosen on account of its marked superiority over the conventional two-valve arrangement. The oscillator grid is self-biased by the grid current flow along the 250,000 ohms grid leak R5, the tuned circuit being fed through the 0.0001 mfd. condenser C6. The tuning condenser, which is of the shaped plate type, and coils employed in this set are obtained as a complete unit, which was designed originally for a two-valve frequency changer with cathode injection. A coupling coil is provided, therefore, in the oscillator section which is not required with the Pentagrid valve, since coupling then takes place by electronic action. The normal reaction turns, however, are insufficient to maintain reliable oscillation with the Pentagrid, since the unit is designed for an oscillator valve of higher mutual conductance. The spare coupling coil, therefore, is used in series with the reaction coil proper to give increased feed-back, and experiment shows it to be entirely satisfactory in this respect. The oscillator anode circuit is fed through the 20,000 ohms resistance R6 with a 0.1 mfd. condenser C8 as a by-pass to earth.

The H.F. Transformer

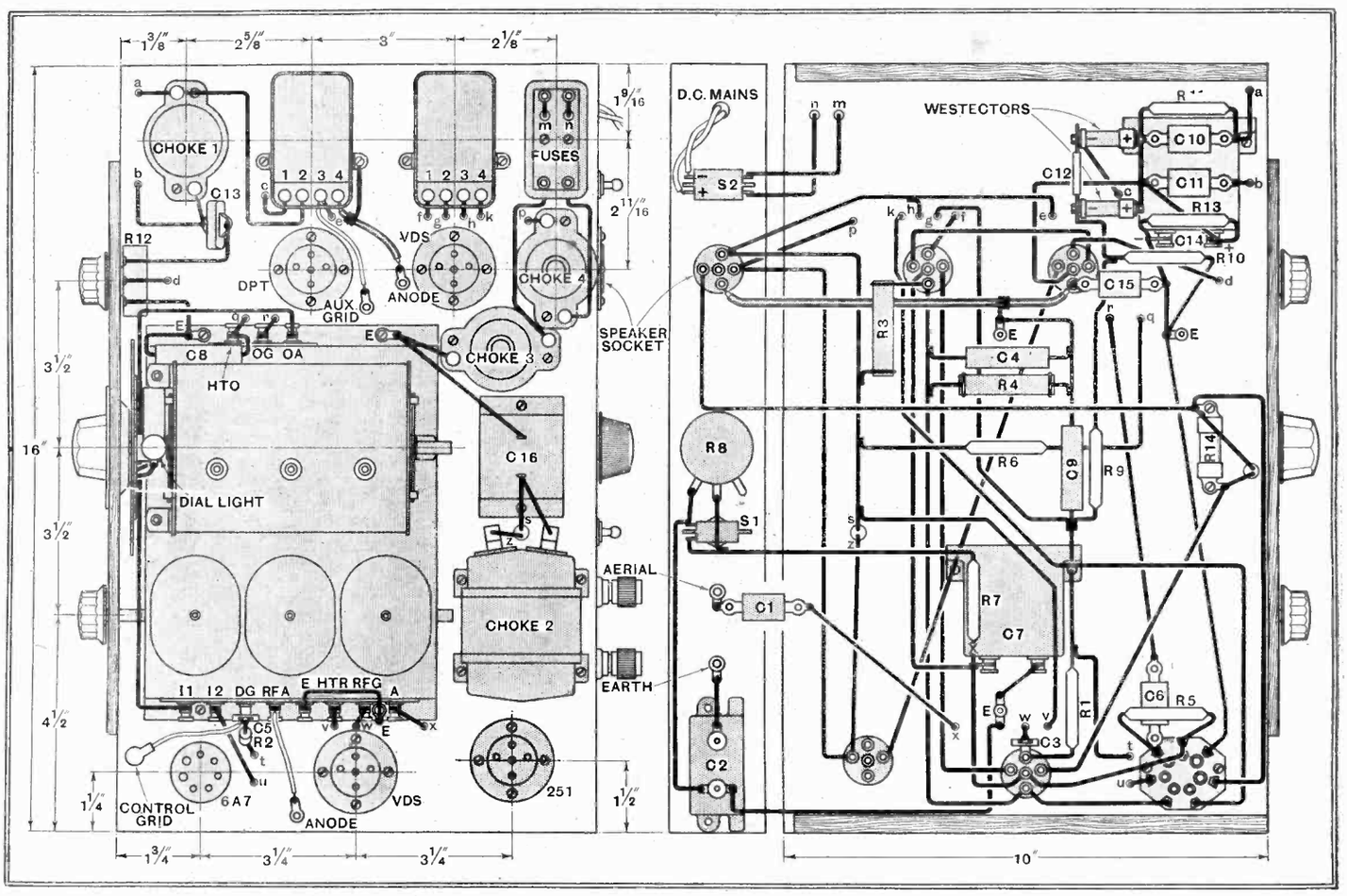
The variable-mu H.F. valve is coupled to the variable-mu tetrode section of the Pentagrid through an H.F. transformer of a type specially designed to maintain high efficiency at the low-frequency end of the medium waveband. The H.F. stage is preceded by a further tuned circuit, thus giving two signal frequency circuits to guard against second channel interference. A 0.002 mfd. condenser C1 and a 2-mfd. condenser C2 in the aerial and earth leads respectively are used as a protection against short-circuits.

The screen grids of the H.F., frequency changer, and I.F. stages are all fed from a common line derived from the junction of two 10,000 ohms resistances R3 and R4 across the H.T. supply; a by-pass condenser C4 of 0.1 mfd. maintains the screens effectively at earth potential to H.F. currents. The cathodes of these stages are also commoned, and, with the switch S1 closed, are taken to earth through the 100 ohms resistance R7, shunted by the 2-mfd. condenser C7, which provides the minimum bias. With the switch open, a variable resistance R8 of 5,000 ohms is connected in circuit for two purposes—to act as a noise suppressor and to assist the A.V.C. system in dealing with a very strong local station.

For use as a noise suppressor, the switch is opened, and with the set tuned to no signal the resistance is adjusted until the background of atmospherics and local interference is not excessive. Nothing louder than this pre-determined level will then be heard, and the process of tuning will be quiet. When a station has been tuned in the switch can be closed and the maximum sensitivity of the set is then available to counteract fading. For local reception it may be found that with the switch closed there is a certain amount of distortion, for the I.F. valve may be unable to provide the detector with sufficient input to give the requisite bias without being overloaded. The switch is opened for local reception, therefore, and the resistance adjusted nearly to the point at which a perceptible change in volume can be heard.

The H.F., I.F., and output valves are all of the type requiring 16 volts at 0.25 ampere for their heaters. No British D.C. mains type Pentagrid is yet available, however, and here an American valve, the 6A7, has been used. This is rated for 6.3

PRACTICAL WIRING DIAGRAM.



The clean layout and simplicity of the wiring are readily seen from these drawings.

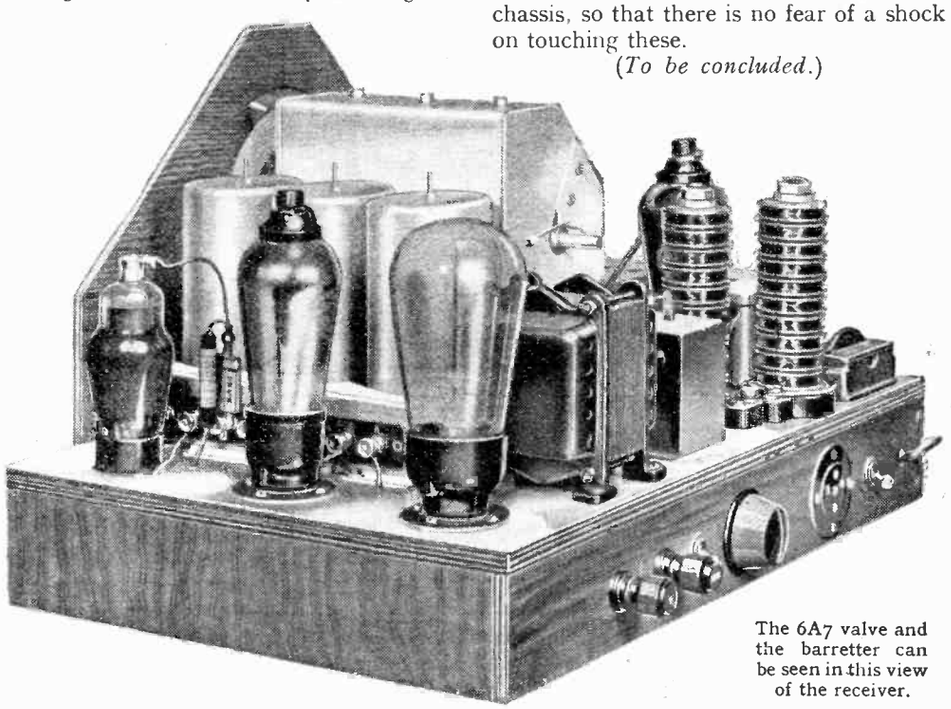
"The Wireless World" D.C. Superhet—

volts at 0.3 ampere, so that the heater connections are slightly more complicated than usual. The heaters of all valves and the 25 ohms resistance R14 shunting the dial light are all wired in series, with the 6A7 valve at the negative end of the chain. The positive end is then connected to the supply through the Osram 251 barretter, which maintains a constant current of 0.25 ampere through the whole circuit, irrespective of mains voltage variations between the usual limits of 200-250 volts. The British valves then all have their correct current, but the 6A7 current is low by 50 mA. This additional current, therefore, is passed through its heater by means of a 5,000 ohms resistance connected between the positive line and the positive side of the 6A7 heater. The Pentagrid thus receives its correct current of 0.3 ampere on 250 volts supplies, and about 0.29 ampere on 200 volts; since the lower current is sufficient to maintain an entirely satisfactory performance, the arrangement is simple and satisfactory.

The 5,000 ohms resistance used for this purpose will not be found as such on the circuit diagram, for the field of a moving-coil speaker is there shown as serving this purpose. In cases where a 5,000 ohms speaker field is not available, an alternative arrangement must be used, and the connections then required will be given in next week's issue.

The receiver is exceptionally easy to build, and no difficulty should be experienced, since the chassis is obtainable with the large holes ready drilled. When connecting up, care should be taken to preserve the correct polarity of the electrolytic condenser and of the Westectors. When using the set it must be remembered that the chassis of the set and all metal parts are in direct connection with the supply mains; if the positive of the mains be earthed, therefore, there is a risk of a shock on touching any metal part. It is advised, therefore, that the receiver be always operated in a cabinet, and that the grub screws in the control knobs be well countersunk. The switches mounted on the rear of the set are not connected to the chassis, so that there is no fear of a shock on touching these.

(To be concluded.)



The 6A7 valve and the barretter can be seen in this view of the receiver.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

1 Super H.F. Radiopak, without volume control — **British Radiophone**

2 Ferrocart Colverdynes, 110 kc/s — **Colvern**

1 Tapered volume control, 0.25 megohm, and knob **R12** — **Claude Lyons Type 250 M-T**
(Magnum, Rothermel, Varley.)

1 Potentiometer, 5,000 ohms **R8** — **Claude Lyons Type P.58**
(Haynes Radio, Rothermel, Watmel.)

1 Screened H.F. choke, Ch1 — **Goltone Type SHF**
(Kinva, Varley, Wearite.)

2 Mains H.F. chokes, Ch3, Ch4 — **Goltone Type PHF**

1 L.F. choke, Ch2 — **Heayberd No. 752**
(Davenset, Ferranti, Parmeko, R.I., Sound Sales, Varley, Vortexion.)

5 5-pin valve holders — **Clix Chassis Mounting Type**

1 7-pin valve holder — **Philco 27/6005**

1 Grid clip, for 6A7 valve — **Philco 4897**
(Claude Lyons.)

1 Fixed condenser, 4 mfds. 250v. D.C. working, **C16** — **T.C.C. Type 65**

2 Fixed condensers, 2 mfds. 200v. D.C. working, **C2, C7** — **T.C.C. Type 50**

3 Fixed condensers, tubular, 0.1 mfd. 350v. D.C. working, **C4, C8, C9** — **T.C.C. Type 250**

1 Fixed condenser, 0.01 mfd., **C13** — **T.C.C. Type M**

1 Fixed condenser, 0.001 mfd., **C15** — **Igranic Type FF.12**

1 Fixed condenser, 0.002 mfd., **C1** — **Igranic Type FF.12**

4 Fixed condensers, 0.0001 mfd., **C3, C5, C6, C10** — **Igranic Type FF.12**

2 Fixed condensers, 0.0002 mfd., **C11, C12** — **Igranic Type FF.12**
(Dubilier, Peak, T.C.C., Telsen.)

1 Dry electrolytic condenser, 50 mfds., **C14** — **T.C.C. Type 521**
(Dubilier, Telsen.)

1 Make-and-break switch, S1 — **Claude Lyons B.A.T.728**

1 Double-pole single-throw switch, S2 — **Claude Lyons B.A.T.2728**
(British Radiophone, Bulgin.)

2 Ebonite shrouded terminals, A.E. — **Belling-Lee Type "B"**
(Igranic.)

2 Westectors — **Westinghouse W.6**

1 Resistor, 25 ohms, **R14** — **Claude Lyons Type FW.25**

1 Resistance, 100 ohms 1½ watts, **R7** — **Seradex Type M.150**

1 Resistance, 250 ohms 1½ watts, **R13** — **Seradex Type M.150**

1 Resistance, 20,000 ohms 1½ watts, **R6** — **Seradex Type M.150**

1 Resistance, 0.1 megohm 1½ watts, **R9** — **Seradex Type M.150**

2 Resistances, 0.25 megohms 1½ watts, **R5, R11** — **Seradex Type M.150**

1 Resistance, 0.5 megohm 1½ watts, **R10** — **Seradex Type M.150**

1 Resistance, 1 megohm 1½ watts, **R1** — **Seradex Type M.150**

1 Resistance, 2 megohms 1½ watts, **R2** — **Seradex Type M.150**

2 Resistances, 10,000 ohms 2½ watts, **R3, R4** — **Seradex Type G.250**
(Dubilier, Erie, Claude Lyons, Varley, Watmel.)

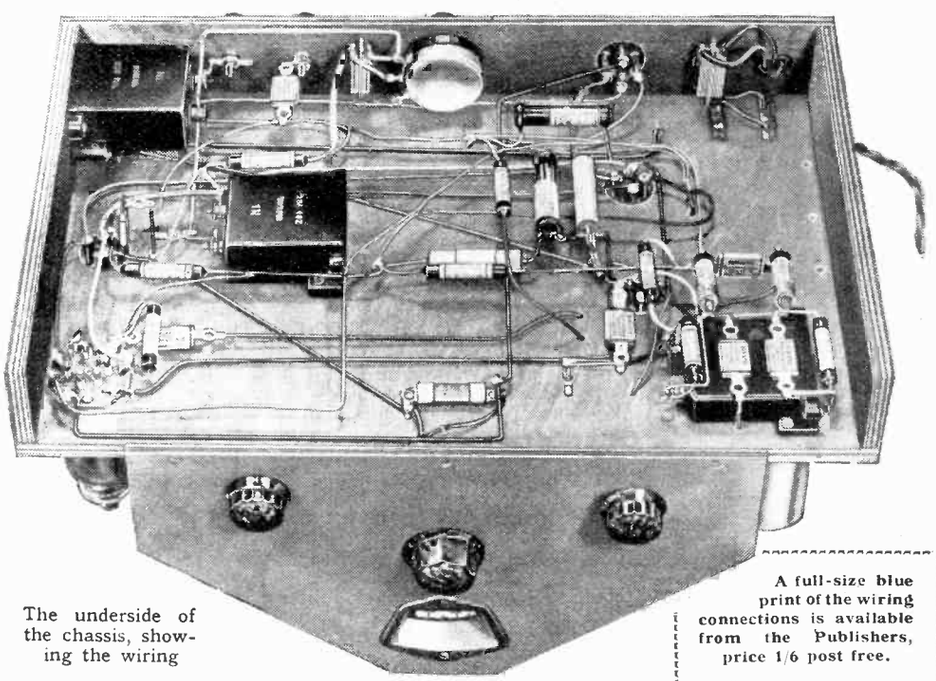
1 5-pin plug — **British Radio Gramophone Co.**
(Bulgin.)

1 Bulb, 6 volts 0.15 amp. — **Bulgin Type "OB"**

1 Twin safety fuse holder, with 1-amp. fuses — **Belling-Lee Type 1033**
(Bulgin.)

1 Length Screened Sleeving — **Harbros**

Plymax baseboard, 10in. × 16in. × ⅜in. — **Peto-Scott**
(Overall dimensions of assembled chassis, 16in. length × 10in. width × 9½in. height.)



The underside of the chassis, showing the wiring

A full-size blue print of the wiring connections is available from the Publishers, price 1/6 post free.

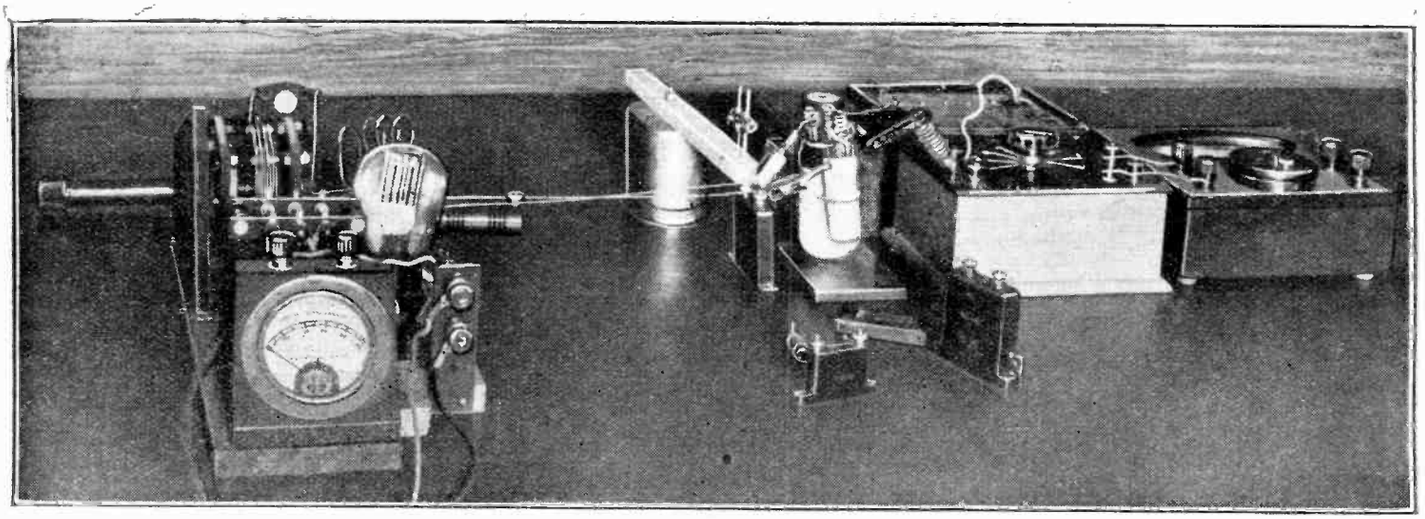
1 Voltage regulator — **Osram Barretter No. 251**

4 oz. No. 20 tinned copper wire, 10 lengths Systoflex, wire, wood, etc.

Screws:—

25 ½in. No. 4 R/hd.
4 ¾in. No. 4 R/hd.
7 ⅝in. No. 4 C/sk.
10 ⅜in. No. 4 R/hd.
10 ⅝in. No. 4 R/hd.
4 6BA, with nuts and washers.

Valves:—2 Marconi or Osram VDS. 1 Marconi or Osram DPT. 1 Philco or Claude Lyons 6A7.



By-pass Condensers for 5-metre Work

Experimental Equipment Required for Comparative Measurements

THE performance of H.F. by-pass condensers on the ultra-short wavelengths has not hitherto received much attention, but as these very high frequencies are now coming more to the fore the results of some actual measurements made with several different sizes and types of condenser should prove of more than usual interest.

"WHEN is a condenser not a condenser?" The answer, "On 5 metres!" is more likely than not to be true. In fact, most things are quite different from what they are supposed to be at these short wavelengths. Which is the secret of their fascination, no doubt. It is splendid to be able to signal 200 miles on wavelengths that can't possibly travel more than about fifty.

But that is not our subject at this moment. Some time ago[1] Mr. Sowerby wrote an article showing how the inductance of a fixed condenser is important. The object of a fixed condenser—in the larger sizes, at any rate—is to provide a path of as low impedance as possible, in cases where an actual short-circuit is not permissible because of D.C. voltages. The greater the capacity of the condenser, the lower the impedance. But one cannot go on improving things by using larger and larger condensers, because beyond a certain point the inductance of the condenser, small though it is, sets a limit. The shorter the wavelength, the more serious is this restriction. Mr. Sowerby showed how the older type of 1 mfd. condenser reaches its minimum impedance at about 850 metres; below that it increases again. The "non-inductive" type, with a residual inductance of only about 0.02 microhenry, is better; its minimum is at about 270 metres, and it is still quite low at 100 metres, which was the lowest wavelength shown.

If even a "non-inductive" condenser is inductive below 270 metres, what about 5 metres! The condenser makers having done their best in reducing inductance to a minimum, we cannot turn to them for further help. With a view to providing some definite guidance on selection of condensers for 5-metre work, the following results are put forward. This particular wavelength has been singled out for attention because a good deal of interest has been devoted to it by amateurs. The figures to be given may, however, provide food for thought on ultra-short waves generally.

The title illustration shows the apparatus used for measuring impedance of condensers at 5 metres. The oscillator on the left is coupled through a one-turn coil, tuning condenser and fuse lamp to the "goal-post" inductance and condenser under test, the voltages across which are measured by the skeleton valve voltmeter on the right.

Before getting to the actual results, the method of obtaining them may be of some interest, as the problems met in devising it illustrate some of the delightful difficulties of 5-metre work.

If the same current is passed through two components, one known and the other unknown, the voltage across each is proportional to their impedances, so this provides a method for comparing them. The 5-metre current is easily obtained from an oscillator. The known impedance and the voltmeter are not quite so easy. As even an inch of wire has a large inductive impedance at this wavelength, there is not much hope of getting a standard resistance. And a condenser—well, that is our "unknown." So the only possible standard is an inductance. Fortunately, one

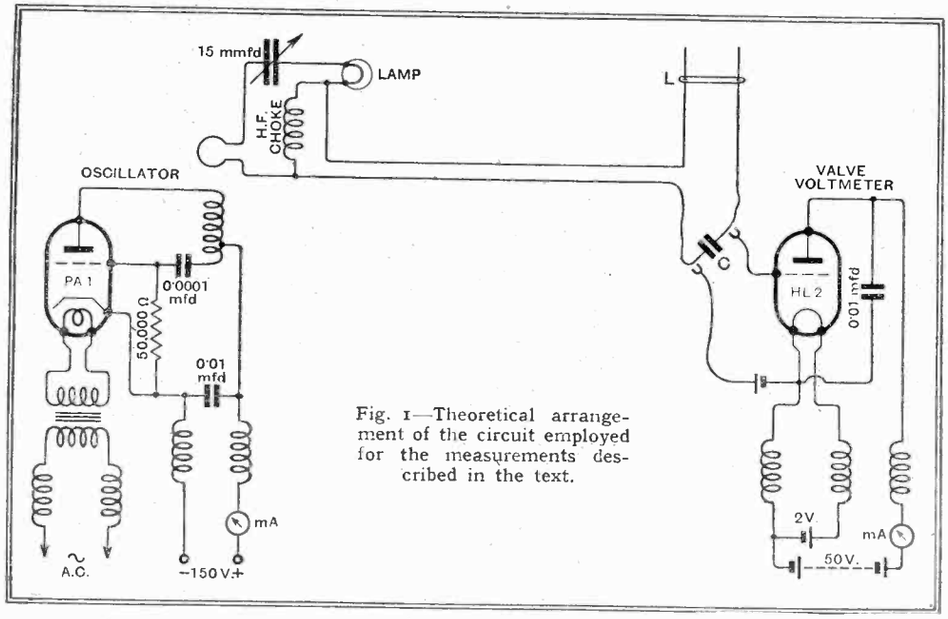


Fig. 1—Theoretical arrangement of the circuit employed for the measurements described in the text.

[1] *The Wireless World*, July 15th, 1932.

By-pass Condensers for 5-metre Work—

can calculate the inductance of regular geometrical circuits quite easily. The type found most convenient is like a miniature Rugby goal—two uprights and a cross-bar. The inductance is varied by moving the cross-bar up or down.

The voltmeter—obviously a valve voltmeter is the only hope—gave more trouble. However short the leads were made to it, some H.F. current *would* stray along them and produce almost as large a deflection with the grid-filament input short-circuited as when applied across an impedance in the intended circuit! Ultimately, sensible results were obtained with a specially rigged voltmeter as illustrated. The valve itself, a Mazda HL2, was suspended in mid-air, with no holder, and input clip leads cut down to about two inches, including a small grid cell picked for low resistance and wrenched out of its battery. The anode path was completed as shortly as possible by a 0.01 mfd. condenser.

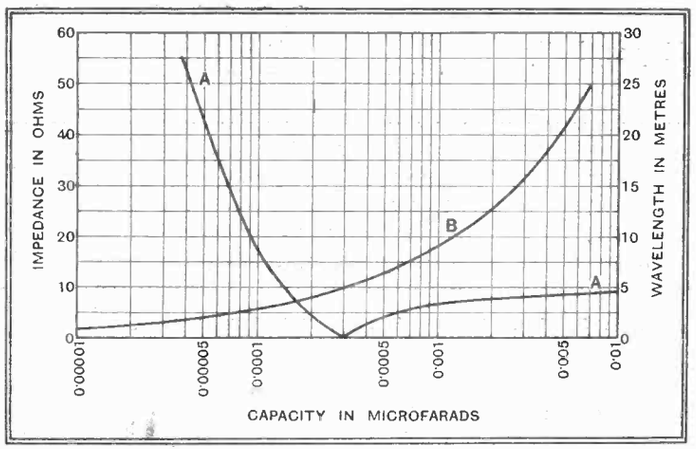


Fig. 2.—Curves showing how impedance of condensers varies with capacity and frequency. The optimum value for 5 metres can be obtained from curve A.

Circuit Described

This little assembly was isolated, so far as H.F. was concerned, by chokes in all the battery and meter leads—40 turns on a ½-inch former gives 7.5 microhenrys, which, assuming a self-capacity of 1 mmfd., forms a circuit roughly tuned to 5 metres, and therefore a very effective rejector. The grid-filament path was investigated and found to introduce negligible shunt loss on the components, viz., the goal-post inductance L, and the unknown condenser C (Fig. 1). Actually, L was about 1½in. high by ½in. apart, 18 S.W.G. wire. The rest of the circuit was separated about a foot by close parallel wires, to avoid direct pick-up from the oscillator. The H.F. choke was to provide a conducting path for the voltmeter when measuring C, and the tuning condenser to adjust the current, which is maintained constant by getting the little fuse lamp *just* visibly glowing. This is quite a sound and sensitive method when all others fail.

There is nothing very special about the oscillator. A high-slope PA1 valve was used because of its easy oscillation. Less than one turn was required for grid coupling.

The goal-posts were calculated to give an inductance of 0.034 microhenry—not very much, but 13 ohms at this wavelength!

The various types of condensers tested gave impedances as shown in the table.

The condenser consists of a capacity in series with a small unavoidable inductance, and what is measured is the resultant of both. The two work in opposite directions, and, as the capacity effect can be calculated, it is easy to arrive at the inductive contribution, which is shown in the last column.

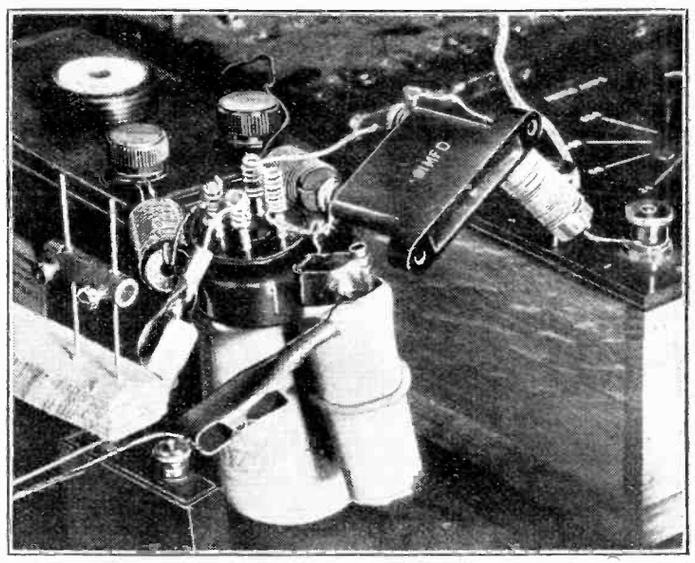
It will be noticed that there is a fairly considerable uniformity about these last figures. The two old inductive types are higher, but not enormously so. The others average about 9 ohms. Now 9 ohms is the inductive reactance of a piece of wire a little over an inch long. This is equal to the minimum distance from one terminal to the other, and therefore confirms the measurements. Incidentally, the inductance is 0.024 microhenry, which agrees very well with the figure given for "non-inductive" condensers.

But, you may say, surely the 1 mfd. condenser, with scores of turns of foil, should have a very much larger inductance? Well, it would have if the current took the trouble to go along all its tortuous convolutions. But it is much too rapidly oscillating for that, and finds the capacity of the first fold quite a good enough path, and the rest is just ignored. So the route taken, as the measurements show, is only about double the minimum distance between the terminals.

Thus a large condenser is in no case very bad. But, seeing that the inductive reactance cannot possibly be got lower than about 9 ohms, the only chance of improving matters is to choose such a capacity as just wipes it out—in other words, to employ a tuned acceptor circuit. The required capacity is 0.0003 mfd., and that this works out in practice is shown by the nearest example measured—the 0.00027 mfd., with only 1½ ohms.

Fig. 2 (curve A) shows how the impedance of condensers depends on the capacity, assuming 0.024 microhenry inductance in each case. The conclusion, then, is that the best value to choose for by-pass condensers in 5-metre circuits is 0.0003 mfd., assuming normal construction, which gives the inductance stated. Of course, the best value for other wavelengths is different; Fig. 2 (curve B) shows this.

It is not quite so important to get such a low-impedance path as would be necessary for a by-pass in sensitive medium or long-wave receivers, with amplification running into thousands, because such amplification is not attempted by direct means using ultra-short waves (and no wonder!). Nevertheless, it is useful to know definitely the best value instead of blindly thinking of a number; and so to reduce the many uncertainties of this work.



Specially rigged valve voltmeter for condenser measurements at 5 metres. The goalpost inductance is seen on the left.

IMPEDANCES OF VARIOUS TYPES OF CONDENSERS TESTED.

Condenser.	Actual capacity	A. Measured impedance; ohms.	B. Calculated capacitive reactance; ohms.	Inductive reactance derived from (A) and (B).
1 mfd. Paper; old type ..	1.0 mfd.	18	Negligible	18
1 mfd. Paper; non-inductive	1.1	7.7	„	7.7
0.1 mfd. Paper; old type ..	0.10	13.8	„	13.8
0.1 mfd. Paper; non-inductive	0.095	7.3	„	7.3
0.01 mfd. Mica	0.010	9.1	„	9.1
0.01 mfd. Paper; tubular, 1in. long	0.010	7.1	„	7.1
0.0005 Mica	0.00053	4.1	5	9.1
0.00025 Mica	0.00027	1.5	10	8.5
0.00025 Mica	0.00020	4.2	13	8.8
0.0001 Mica	0.000090	18	30	12

MANCHESTER RADIO SHOW

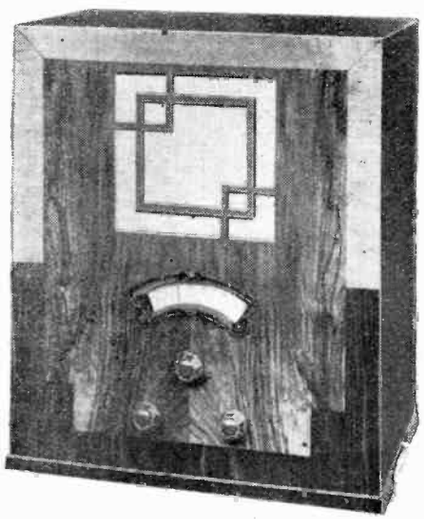
Sept. 27th to Oct. 7th.

11 a.m. to 10 p.m. Daily

THE tenth northern national Radio Show opened at the City Hall, Deansgate, Manchester, on September 27th, and promises to create records both in size and in public attendance. Manchester has been a radio centre since the very earliest days of broadcasting, and even before that was the home of an enthusiastic body of amateurs who played a considerable part in hastening the development of broadcasting in the early days.

Importance of the Northern Exhibition

THE Manchester Exhibition was in former years really a local show mainly supported by Northern manufacturers, but with the growth of broadcasting the position has changed somewhat, and to-day it is really in the



B.W. Distavox receiver (Berry and Wilson).

nature of a duplicate of the Olympia Show held in London in August.

On this account our three special numbers dealing with the exhibits at Olympia, and dated August 11th, 18th and 25th, can really be taken as a guide to Manchester, since the majority of the stands are exhibiting the same sets and components. In fact, our Olympia Show numbers comprise a review not of any particular exhibition but of the new season's products in general.

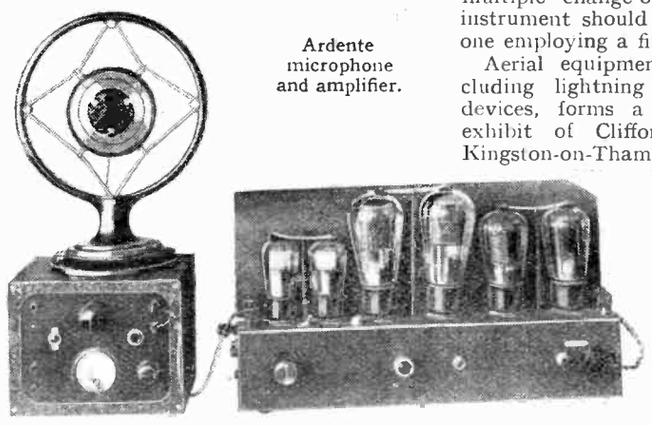
In the present article we propose, therefore, to confine our attention principally to the exhibits of those firms at Manchester which were not showing at Olympia, and to new products of other firms which have made their appearance since.

Visitors to Manchester will notice two outstanding features of this year's sets. First, sensitivity and selectivity have been greatly increased and the superheterodyne type of receiver is more in evidence than ever before. Interest in foreign-station reception must be taken to be the cause of this change. Secondly, the price of sets has reached a very low figure indeed, and yet without any apparent sacrifice in efficiency and quality. Undoubtedly sets and components of this season are an investment, for with the sets selectivity has been attained of an order which precludes the possibility of their becoming obsolete on this score. The number of foreign stations and their power already have reached a point when the problem of selectivity cannot become greater, so that as this season's sets are adequate in selectivity for present-day requirements they should remain equally serviceable in the future. Prices, we believe, could not be further reduced without a compromise with quality of reproduction, and since it would be suicidal for the manufacturers to cheapen sets at the expense of quality, no further reduction can be anticipated, but rather may we expect an increase in price in the future.

What the North is Doing

The local firm of Garnetts (Gresley) Radio did not exhibit at Olympia, and are now showing a series of sets manufactured in Salford. It will probably be agreed that their most interesting production is a five-valve (plus rectifier) mains-operated superheterodyne which embodies delayed amplified A.V.C. and has a total of seven tuned circuits. The chassis may be mounted either in a console or in a radio-gramophone cabinet. Other models include a Class "B" receiver and a similar radio-gramophone.

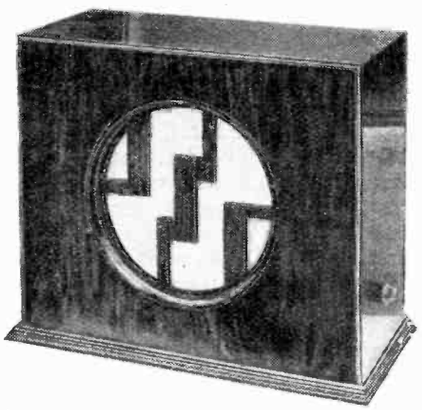
Berry & Wilson, another Northern firm, are showing a complete range of sets, both for battery and mains operation. Their "Distavox" model is a seven-stage set with two screened-grid H.F. pentodes and a



Ardente microphone and amplifier.

double-diode-triode giving delayed A.V.C. Iron-cored tuning coils are employed in this receiver.

The firm of R. H. Dent, showing at Manchester, did not exhibit at Olympia. Amplifiers for cinema, church and public-address purposes are produced in addition to the well-known deaf-aid devices. It is



Wharfedale extension loud speaker with independent volume control.

interesting to note that an exceptionally compact deaf-aid amplifier which, complete with battery, microphone and earphone, weighs under 4 lb. is one of the latest models to be produced.

Measuring instruments shown by Pifco have many points of novelty; probably the most attractive of the new products is the "Rotameter" Universal Meter, which covers eight separate ranges. The appropriate scale for each range is brought into position automatically by operation of the multiple change-over switch, and so the instrument should be simpler to read than one employing a fixed scale.

Aerial equipment of various kinds, including lightning arrestors and earthing devices, forms a prominent part of the exhibit of Clifford Pressland, Ltd., of Kingston-on-Thames, who is also showing an extremely low-priced dual-range screened tuning coil.

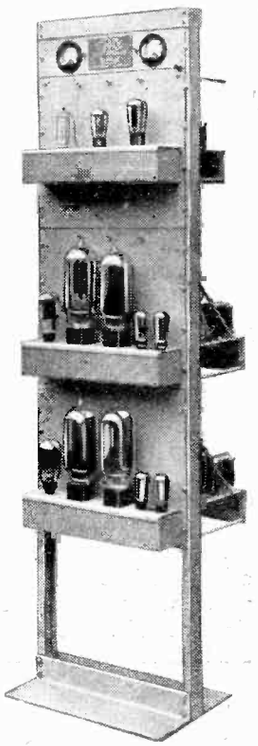
The series of permanent magnet moving-coil loud speakers made by Wharfedale Wireless Works, Bradford, has recently been supplemented by an extension model intended for adding to an existing receiver. This instrument is, of course, mounted in a cabinet and has the valuable feature of an independent volume control and on-off switch.

Manchester Radio Show—

The Star H.F.-Det. L.F. set employs pentode valves in all stages, and is offered at an extremely moderate price. The makers are also showing valves, batteries, and other components and accessories.

Although high-tension batteries form the principal "Universal" exhibit, several components, including dual-range coils and fixed condensers, are shown.

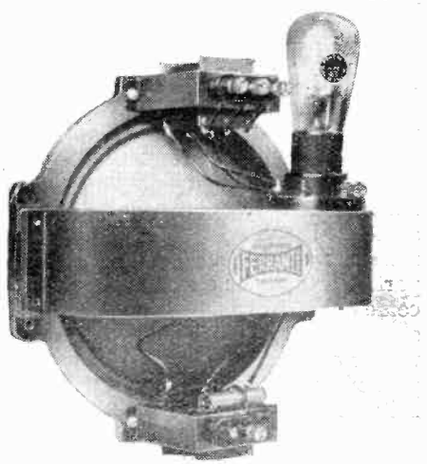
Battery charging equipment, which is mainly of interest to dealers and garages, is manufactured by Diggle, John Roberts, and the Small Power Dynamo Co.



Rack-built receiver-amplifier by Tannoy.

Although their programmes for the present season were described at length in our Olympia Show numbers, it is opportune to remind readers of the activities of several well-known local firms which are also exhibiting at Manchester. Of course, L.F. transformers of all conceivable types, including the latest designs for battery-economy circuits, figure prominently on the Ferranti stand. The new range of superheterodyne receivers makes a spectacular exhibit; space does not permit of a full description of these sets, but, as they include all the latest and most desirable features, such as automatic volume control, visual tuning, etc., the visitor should not miss an opportunity of examining them.

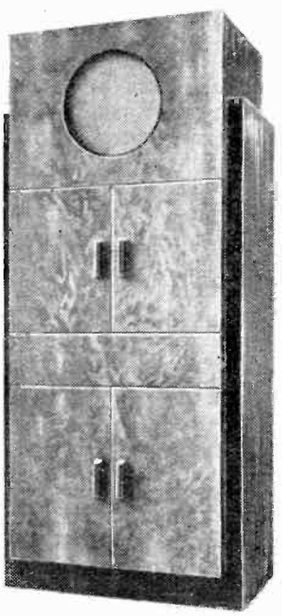
Clarke's Atlas have a very up-to-date range of sets for the present season, including an A.C. three-valve model with pentodes in all positions. Class "B" battery sets are also made, and the series of Atlas eliminators has now been supplemented by a new model intended for sets having Class "B" or similar output stages; the regulation of voltage output has been made specially constant for this purpose. Northern listeners now have an opportunity of examining the extremely attractive range of "Drummer" receivers made by the new firm of Edge Radio, Ltd., of Bolton. All types are represented, but as an example we may take the five-valve superheterodyne chassis, which is available in various forms of cabinet work, including a radio-gramophone with such refinements as automatic record changing and dual loud speakers. Adequate selectivity is assured by the provision of a total of seven tuned circuits, and delayed A.V.C. is included. An interesting new tendency brought about by the introduction of efficient battery economy circuits is illustrated by the production of an extremely ambitious battery-operated radio-gramophone with Class "B" amplification.



Ferranti Class "B" loud speaker unit.

As already stated, there have been few changes or additions in the programmes of the principal firms which exhibited at Olympia, but a few alterations are announced; for instance, the Ekco Model 74 superheterodyne chassis has been made available in a console model since the opening of the London Show. This chassis is well worth examining, as it includes many interesting circuit details, and is extremely well made in spite of its low price. It will be interesting to see how the North reacts to the modernistic black bakelite case, relieved with chromium insets, in which one of the models is housed.

The Dynatron "Ether Lord" radio-gramophone is now shown as a battery-fed set with Q.P.P. amplification. Here we have another illustration of the tendency to provide those who are forced to use batteries with the most ambitious and refined types of receiver. Improved "battery economy" circuits are, of course, responsible for this.



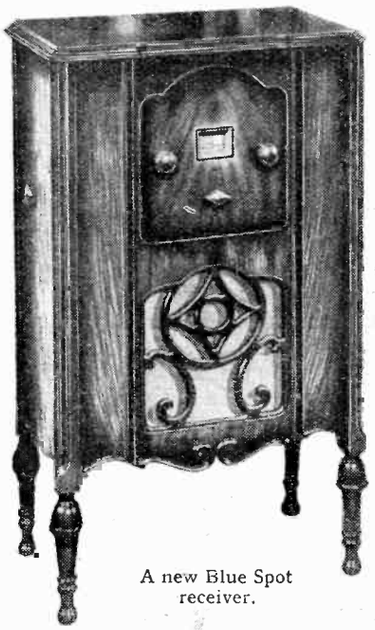
An example of modern cabinet work; the Dynatron receiver.

With regard to components, there have been few changes, but the firm of Graham Farish are now manufacturing a ganged version of the Zelos variable condenser, and a complete range of non-inductive fixed condensers as well.

Belling & Lee are making a feature of their Mains Disturbance Suppressor, which is designed in accordance with Post Office recommendations.

A few reminders as to other exhibits that should not be missed will not be out of place, in spite of the fact that they were described in our Olympia Show numbers. The larger G.E.C. superheterodyne merits attention, if only for the reason that it is one of the few to include a fully automatic system of "quiet" A.V.C.

Each one of the many H.M.V. sets have points of interest, but attention will probably be focused on the "de luxe" model—the Superhet 10 Autoradiogram. McMichael are concentrating on "straight"

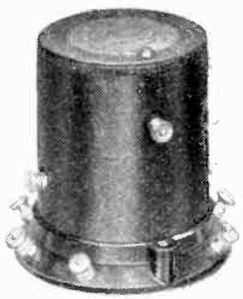


A new Blue Spot receiver.

sets as opposed to superheterodynes, and have several very interesting models, including one with built-in dual speakers.

Unconventional cabinet work and radically new ideas in the housing of receivers are much in evidence this season. For example, the Climax "Casket" in which the loud speaker aperture is cut through the base, gives no visible indication that an up-to-date superheterodyne is mounted in the cabinet. A still more novel style of mounting is adopted by Ferranti for one of the superheterodyne sets, which is mounted in a low "bookcase" type of cabinet, with the controls most conveniently arranged so that the user can operate them while reclining in an arm-chair. Just the thing for the "tired business man" of whom we hear so much, and, seriously, an excellent idea.

The City Accumulator Company are also showing some highly original cabinet work, and, incidentally, are specialising in kits of parts for *Wireless World* receivers, in addition to sets of their own design. While on the subject of kits, it should be pointed out that the Cossor Melody Maker, on view in its latest form, is an extremely workmanlike job, and is available in several forms for both battery and mains operation. Lissen is also specialising in kits; one of the most interesting productions is an "all-wave" model (12-2,000 metres).



R.I. "Micrion" iron-cored tuning coil.

Among the new components, iron-cored coils as shown by Colvern, R.I., Varley, and Igranic will be examined with special interest, as will the new "plateless" Block batteries and the extraordinarily comprehensive range produced by Bulgin. In addition to the well-known Avometer multi-range measuring instrument, there is now a smaller model, with plug-and-socket change-over, known as the Avominor, which is sold at an extremely attractive price.

UNBIASED
BY FREE GRID

At the Bar

KING SOLOMON is reported to have said once in a burst of confidence that there were two things in life that got him down, and while I do not presume to attain to his eminence, either in the matter of wisdom or women, I must confess that to me one of the greatest mysteries of life is the manner in which the great superstition persists that Christmas and no other season is the proper time to buy a new wireless set. I mention this here since, in spite of my recent remarks upon the matter, this fact was forcibly brought home once more by an incident which—emulating the example set by Sir John Reith—I intend to inflict upon you whether you like it or not.

A friend of mine who is well known at the bar—not the alcoholic variety—recently approached me with the statement that as a result of a recent action in the high court concerning a wireless set, during which he had an opportunity of hearing it demonstrated, he had been so delighted with the musical reproduction that he had definitely decided to join the ever-growing ranks of the radiophiles. He wanted to know if, in my opinion, it was the most suitable instrument for him, and, if not, what did I advise? I told him that while the instrument was undoubtedly good, I thought he ought to hear one or two others before finally making up his mind, and volunteered to accompany him there and then to the showroom of a dealer who, I knew, always carried a varied stock, and who, moreover, possessed premises wherein customers could make their choice in real comfort.

Borrowing his own weapon of cross-examination.

To my amazement he demurred, saying that this was no time to buy a set, and he intended to wait until Christmas, which he alleged was the proper time to do it. Borrowing his own weapon of cross-examination, I soon elicited the fact that his opinion was solely based on hearsay from people as ill-informed in the matter as he himself proved to be. As a lawyer he should, of course, have known that what the soldier said is not evidence; but, seriously speaking, it occurred to me that if a man in his position, with a mind trained to form a sane and level-headed opinion upon almost anything under the sun, can fall into such an error, how much more so is the man in the street likely to go wrong. By dint of threats and cajolings I eventually got him along to the dealer's, and with my assistance he eventually chose a particular set which I'll warrant is not likely to be surpassed in performance for a long time to come.

Dropping a Brick

IT has caused me much pain and sorrow to read an ebullition from the pen of a well-known star who always twinkles brightly in the firmament of an old-established wireless company.

The cause of my distress and bewilderment is a statement to the effect that in one of their sets this old and honourable firm use a valve, to wit, a second detector, in which there are "three anode-to-cathode electron streams." Now it is not the number of the electron streams in this valve about which I am quibbling, but their nature.

Being born at the very peak of Victorian respectability, I was always very strictly brought up in the belief that no self-respecting valve ever allowed any electrons to chase each other along from the plate to the grid. It is painfully obvious to me, however, that I must be a back number from the point of view of valve technique, for I feel sure that the alternative theory, namely, that the writer in question has made an error, or to quote the language of the vulgar—dropped a brick—is quite untenable.

The Radio Roundabout

ONE feels almost dizzy at times at the number of revolutionary improvements that nowadays follow so hard on each other's heels in radio matters. "Revolutionary" is, I think, certainly the correct word to use with regard to some of them. I have in mind one in particular which a certain newspaper has just announced with great gusto. The "revolutionary" invention is a set which is operated by remote control. It struck me as somewhat strange, since a local firm put one on the market some years ago; what is stranger still, however, is that the firm which has just "invented" the set is the *same* one which marketed it several years ago. This "revolutionary" business is certainly designed to make your head whirl.

Caveat Emptor

ALTHOUGH I have been threatened with dire penalties, including that of being put on the spot, I intend here and now to draw attention to what I consider is a very great scandal, and that is the reprehensible practice of the B.B.C. giving free advertisements in the Press to all the butchers and bakers and candlestick makers whom they patronise; this is apt to be extremely misleading to the general public, who are accustomed to look up to the B.B.C. as the fountain of all knowledge.

Some years ago the B.B.C. adopted a certain make of gramophone pick-up which was peculiarly suited to their particular needs. Half-hearted attempts were made to conceal its identity, with the result

Half-hearted attempt to conceal its identity.

that the public's curiosity was piqued and eventually the secret was discovered. The upshot of the matter was that Mr. Everyman bought it, and found to his dismay that the volume obtained was far less on his set than that given him by the pick-up which he had discarded. The result was that the manufacturers of the device were unjustly blamed by the general public for selling them something which was not equal in every respect to that supplied to the B.B.C.

The above is, perhaps, an extreme case which I have deliberately chosen to illustrate what evils can result from the half-hearted concealment adopted by the B.B.C. All trouble could have been averted if they had taken thorough measures to conceal the identity of this particular component or, better still, have come out into the open and issued a frank statement explaining just why this particular pick-up, although suitable for their particular needs, was not necessarily suitable for attachment to the *average* set.

Since that date we have been regaled with the names of gramophone motors, pianos, furniture, and all manner of things chosen by the B.B.C. which very unfairly leads people to think that those of any other make are not worth considering.

News of the Week

Current Events in Brief Review

Meeting of the U.I.R.

THE Union Internationale de Radiodiffusion will hold its next meeting from October 4th to October 13th in Amsterdam. A certain amount of importance will be attributed to this meeting as, no doubt, attempts will be made in Amsterdam to obtain the adhesion to the Lucerne Plan of the eight non-signatory countries. On the other hand it must be stressed that the U.I.R. is only an expert body and its decisions are by no means binding. But it may be easier to discuss matters in a semi-official manner than directly between postal administrations.

Bari Links Up With Rome

THE big telephone cable connecting Naples to Bari in the south of Italy has been completed, and as a result Bari has been connected with the South Italian group of stations since September 18th, receiving most of its programmes from Rome. The completion of this cable has been eagerly awaited by Italian broadcasters as, owing to the lack of suitable lines, most of the day's programme has hitherto to be provided in Bari itself, and this has proved very expensive.

Evening Lectures at the Borough Polytechnic

A SPECIAL course of twelve lectures and demonstrations on Loud Speakers and Acoustic Problems will be given by Dr. N. W. McLachlan, who is well known both as an authority on this subject and as a frequent contributor to our pages. The lectures, which range from loud speaker mechanism to transients and the general acoustic problems associated with speakers, are to be given on Mondays, at 6 p.m., at the Borough Polytechnic, Borough Road, S.E.1, beginning on October 2nd. The fee for the whole course is only 10s., and applications for particulars should be made to the Principal.

High Power Station in France

IN addition to the new P.T.T. station now in course of erection at Villebon-sur-Yvette, about 18 miles from Paris, work has begun on the 120 kW station at Thourie, 37 miles distant from Nantes, and it is expected that this station also will be transmitting in 1934.

Police Sets at Brighton

THE issue to the Brighton Police of pocket receivers with a calling device, such as were described in our issue for September 9th, 1932, has been the subject of a number of paragraphs in the provincial Press, and several writers to the lay papers appear to regard it as the precursor of two-way communication which, as we stated last week, is proposed for the warders at Sing Sing. It is doubtful, however, if such two-way working would be of much practical use. The system being tried at Brighton seems mainly applicable to urban areas where, presumably, any police officer receiving a call from headquarters can readily get on the telephone.

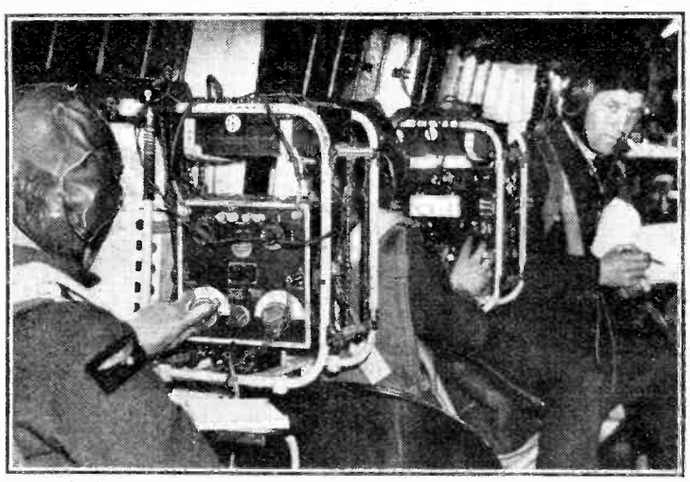
American Amateurs

ULTRA-SHORT wave working has taken a great hold on American amateurs, as is shown by the rapid increase in the number of amateur transmitting stations. In 1931 licensed amateur stations in the United States totalled 22,000. The figure now is 40,000, and, despite the depression, the Federal Radio Commission is receiving new applications for amateur stations at the rate of about 200 a week.

Japan Goes Ahead

ACCORDING to Tokio reports, Japan has made astounding radio progress in the last eighteen months. The total number of listeners now exceeds a million and a half, the Tokio region alone supplying more than 636,000. No fewer than nineteen broadcasting stations are in service, including the famous Joak, Tokio, and other high-power stations at Osaka, Nagoya, Hiroshima, Kumamoto, Sendai and Sapporo, each of which is well up to Western standards in technical design and studio construction.

In the meantime, the amateur transmitters are gaining strength and the Ministry of Communications has had to formulate new regulations to cope with them.



"HIGH-CLASS" RECEPTION. An aircraft cabin fitted as a classroom for the wireless instruction of R.A.F. pupils at the Electrical and Wireless School at Cranwell.

American Amateurs Again to the Rescue

DURING the violent hurricane which raged along the Atlantic Coastline of the United States at the end of August, amateur transmitters had a busy time re-establishing communication links with stricken areas in Maryland, Delaware, Virginia, Florida and Texas. In the neighbourhood of Salisbury, Maryland, power lines, telegraph and telephone lines were down, no trains or buses were running, and motor traffic was impossible.

A group of amateurs held a hurried conference and decided to move the station of Mr. E. L. Thompson (W3CQS) to the small section of the city where power was available. The erection of a new aerial in a fifty-mile gale was no easy matter, but eventually the little band of enthusiasts, standing ankle deep in water, managed to get into contact with W9CVW, Mr. J. Haggan, at Louisville, Kentucky. Emergency pleas for relief, Press messages, personal and official traffic flowed from the transmitter from the small hours of one morning till 5 p.m. on the following day, when normal telegraphic communication was resumed.

New Station for Poland

THE Polish authorities are contemplating the erection of a relatively high power station in the port of Gdynia. Our Berlin correspondent states that one object is to counteract, in the "Polish Corridor," the influence of the propaganda transmitted from the neighbouring station at Königsberg in Eastern Prussia.

Future Prospects in Ulster

THE Vice-Chairman of the Radio Manufacturers' Association, Mr. S. W. Cole, anticipates a very considerable expansion of the wireless industry in Northern Ireland when the new station for Belfast has been opened. At present it is estimated that only ten per cent. of the homes in the six counties possess a wireless set, but he envisages a time in the near future when there will be a radio in every other house and wireless manufacturers establishing works and helping to absorb local labour.

Swiss Broadcasting House

THE French-speaking cantons of Switzerland are to be provided with a new "radio house," the existing studios at Lausanne being inadequate for their present needs. A site has been purchased at La Salla, a suburb of Lausanne, where work on the building will soon start, and when opened, as is anticipated, in July, 1934, it will contain one large and two smaller studios with two rooms for talks.

New York Radio Exhibition

THE Wireless Exhibition which, until last year had been held annually since 1923 in Madison Square Garden, New York, has been revived this year, and forms a part of the National Electrical Exposition now being held in New York under the auspices of the National Electrical Manufacturers' Association.

Powerful South American Station

A NEW 37.5 kW. broadcasting station is projected for Buenos Aires, and the transmitter is now being constructed by the Telefunken Company. When complete this station will be the most powerful in South America.

Licence Expectations in France

IN a recent speech the French P.M.G., M. Laurent-Eynac, after outlining the progress of the new broadcasting service according to the "Ferrié plan" mentioned that, contrary to the expectations of sceptics, 1,400,000 declarations of sets had already been received, and it was hoped that the 1½ million mark would be passed before the end of the year. A minimum of 60 million francs would be brought in by the new taxes this year and the Government counted on 100 million next year.

Next Week's Special Number

HINTS AND TIPS BOOKLET

With next week's issue dated October 6th a special Supplement will be included in the form of a 32-page Booklet of practical HINTS AND TIPS specially compiled by the staff of *The Wireless World*. The full week's Foreign Programme Supplement will appear in a new form. A new Three-valve A.C. receiver with automatic volume control will also be announced in this issue.

The Electrostatic Loud Speaker

III.—Circuits for Operation with a Moving-coil Unit

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

IN this article the author concludes his review of the electrostatic loud speaker with an analysis of the operating conditions when using pentode output valves and gives practical hints on the best method of combining electrostatic and moving-coil units.

IT has been shown that when an electrostatic loud speaker is connected to a triode output valve there is a certain critical frequency below which the response falls off. The critical frequency is that which makes the reactance of the loud speaker (which being in effect a condenser is dependent on frequency) equal to OX (volts) divided by OY (amps) (Fig. 1) where Y is the lowest permissible anode current without serious bottom-bend rectification.

It is convenient to remember that this reactance is roughly equal to the optimum load for the valve. The critical frequency can be pushed lower to widen the effective response, but only at the expense of efficiency. So unless a very large output is available and used rather wastefully, it is better to obtain the bass response by means of a moving-coil loud speaker and to make the critical frequency quite high, say about 1,000 cycles per second. The table below may be useful.

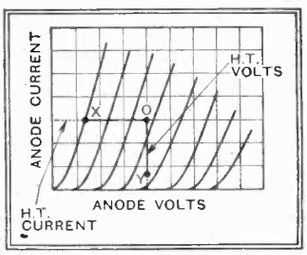


Fig. 1.—Critical reactance is given by OX in volts divided by OY in amps.

The capacity of the loud speaker is the actual capacity multiplied by the square of the output transformer ratio; a step-up giving a larger capacity and vice versa.

Fig. 2 shows a method of adding an electrostatic speaker to an existing triode and moving-coil (or inductor) speaker. The latter is likely to have a resonance somewhere about 2,000 or 3,000 cycles; and as this comes within the province of the electrostatic it is desirable to cut it out by inserting a choke L1, with an inductance of about one henry, preferably variable to allow of adjustment to suit the working conditions. If L1 is used, it is important to avoid any capacity across the transformer, or even excessive self-capacity, or there will be a series resonance and a worse state of affairs than ever. Another improvement is a variable resistance R of about 10,000 ohms, which can be used to prevent the high-note overloading described last week. A further refinement, with the object of preventing large low-frequency voltages reaching the electrostatic speaker and causing it to rattle, is the choke L2, also tapped, with values up to 2 or 3 henrys.

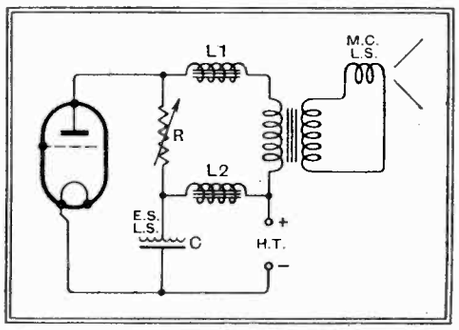


Fig. 2.—Practical circuit for combining the electrostatic with a moving-coil loud speaker following a triode output valve.

The Pentode Valve

If R is in, the parallel resonance due to C and L2 may undesirably emphasise one frequency; if it is out, there may be both high- and low-note overloading. But as L2 is of value mainly in high-power stages, the overloading point is not likely to be reached; and, in any case, the danger of overloading can be minimised by stepping down, as shown in Fig. 3. Remember that stepping down tends to reduce the electrostatic low-note response, and vice versa, while excessively wrong ratio causes loss of volume too.

The case of the pentode is considerably different from that of the triode, and the situation is best explained while looking again at a valve load diagram (Fig. 4). Again we take the extreme and middle frequencies of 80, 800, and 8,000, giving with a loud speaker capacity of 0.02 mfd. reactances of 100,000, 10,000, and 1,000 ohms. Neglecting for the moment any complications due to the necessary coupling arrangement, these three conditions are again represented by the three ellipses. Here the lowest frequency ellipse develops across itself the maximum possible anode voltage, but unlike the triode it does so with a very small grid swing. Any larger grid swing would result in excessive voltages being developed, besides severe distortion.

The medium-frequency condition is similar to that of the triode in so far as the full grid swing results in full output voltage with just tolerable distortion. The load ellipse only just succeeds in fitting in. The highest frequency condition is also similar in that the anode voltage developed is very low, but full grid swing is possible at all the upper frequencies. Transferring these results to Fig. 5, it is seen that curve B, which shows the maximum voltage that can be developed across the speaker without overloading the valve, is practically the same as that for a triode. But the actual state of affairs is very different, for the output shown is on the assumption of maximum allowable grid swing, which as indicated by curve A is just the opposite to that of the triode. Moreover as in average broadcasting the actual distribution of grid swing over the frequency scale is very different from curve A, being greatest at low frequencies, curve B must be interpreted accordingly. If the grid swing were distributed according to the intensity given at the various frequencies during normal broadcasting,

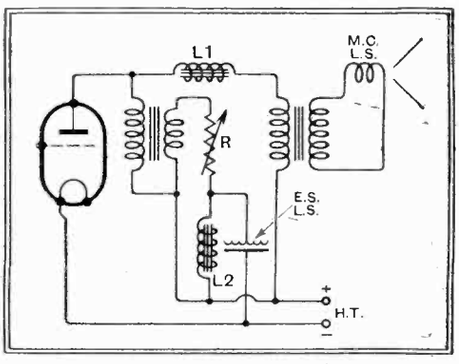


Fig. 3.—Modified arrangement of Fig. 2, with step-down transformer to minimise overloading.

Critical frequency.	Critical reactance of loud speaker in ohms.					
	0.064 8	0.040 5	0.024 3	0.016 2	0.008 1	0.004 cap. mfd. 0.5 sq. ft. approx.
250	10,000	16,000	26,500	40,000		
400	6,200	10,000	16,500	25,000		
600	4,100	6,600	11,000	16,500	33,000	
1,000	2,500	4,000	6,600	10,000	20,000	40,000
1,500	1,650	2,600	4,400	6,600	13,000	26,000
2,000	1,250	2,000	3,300	5,000	10,000	20,000
3,000	830	1,300	2,200	3,300	6,600	13,000

The Electrostatic Loud Speaker—

the resulting curve B would slope off at the high frequency end very steeply indeed. A listening test confirms this by giving the rather surprising result that this type of loud speaker, noted for high-note response, is deficient in the same when run from a pentode.

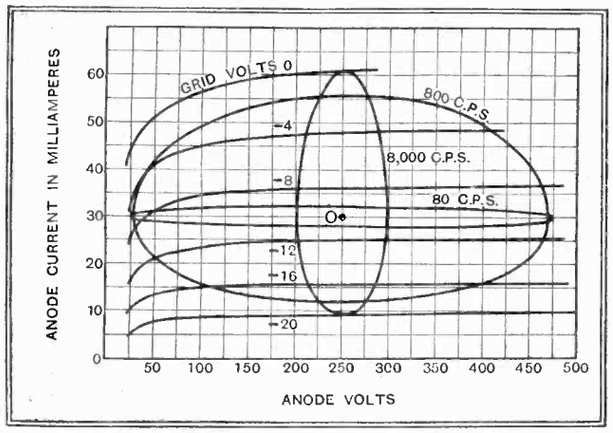


Fig. 4.—Load diagram for the electrostatic loud speaker in conjunction with a pentode output valve.

At the lowest frequencies, however, there is a considerable divergence between theory and practice. It was explained in connection with the triode that some sort of coupling device is essential, and if this takes the form of a choke or a transformer, the loud speaker resonates with the inductance at some moderately low frequency. That causes little concern in the triode, for as long as the impedance in the anode circuit is *greater* than several times the valve impedance it makes little difference, and it is a *series* resonance, which causes the load impedance to become very small, which is to be guarded against. But in the pentode the output voltage increases almost without limit as the load impedance is raised, and the effect of a parallel resonance is to cause excessive emphasis of the resonant frequency, accompanied by severe overloading unless the volume is reduced so that all other frequencies are very feebly reproduced.

Practical Schemes

This serious objection can be counteracted by connecting a resistance in parallel with choke and loud speaker. If, for example, the resistance is 20,000 ohms, it is obvious that the load can never *exceed* this figure, and so a limit is set to the voltage that can be developed, and a much more uniform response obtained, but somewhat at the expense of efficiency.

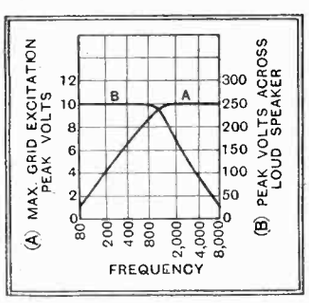
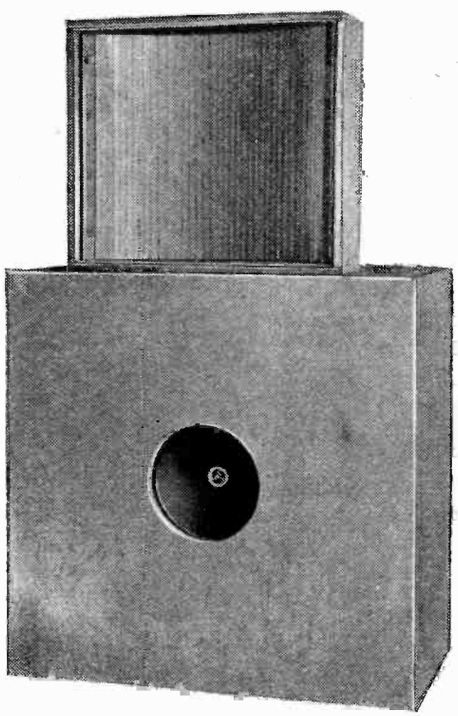


Fig. 5.—Operating conditions for a pentode derived from the curves of Fig. 4.

Fortunately, the efficiency of the pentode drive starts off at a considerably higher maximum than that of the triode.

But the desirability of a dual loud speaker system is even more marked with the pentode, and so is the desirability of preventing the low-frequency voltages from being set up across the electrostatic loud speaker. This object can be achieved by shunting it with a relatively low inductance and also a resistance to prevent a sharp resonance. A fairly large condenser shunt across the moving-coil loud speaker completes the division of labour, and a resistance is necessary here also. All this sounds very complicated, but Fig. 6 shows how a single variable resistance can be made to serve not only as both shunting resistances but also as an effective tone control.

The ordinary transformer is used for the moving-coil loud speaker, and the upper frequencies are by-passed by the 0.1 mfd. condenser. The electrostatic loud speaker coupling choke may be 1 or 1.5 henrys on the primary side, and a secondary inductance to suit the size of loud speaker. The Varley 3H choke provides a variety of taps for obtaining the best balance. A 1:1 ratio is about right for a 0.01 mfd. speaker.



The combination of moving-coil and electrostatic units gives full bass response with unusually good reproduction of high frequencies and transients.

The tone-control potentiometer gives every tone from extreme low to extreme high preponderance.

Although any standard moving-coil loud speaker can be successfully used in a circuit of this type, it is, of course, preferable to use one specially intended for low-note reproduction. If there is no necessity to look after the high volts, it is possible to do better justice to the bass by selection of suitable cone material and dimensions, and in other ways.

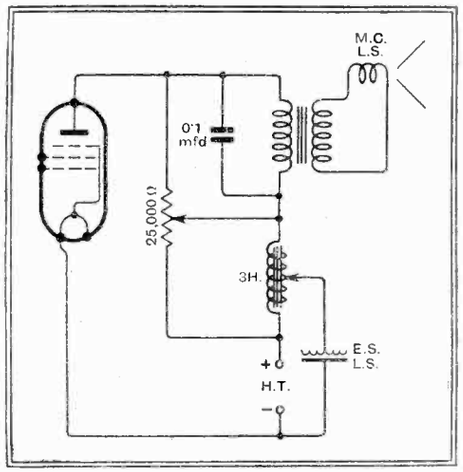


Fig. 6.—Dual loud speaker connections for a pentode output valve. The variable resistance provides tone control.

A simpler and less satisfactory circuit, but one which is more convenient to add to an existing receiver, and also gives some degree of tone control, is given in Fig. 7. It will be seen that in this the electrostatic loud speaker takes the place of the usual tone-compensating condenser, but, of course, it is essential that the H.T. voltage should come across it.

When applying to existing sets, it is important to see that any tone-compensating system that may be left in circuit is not preventing the electrostatic loud speaker from pulling its weight. In fact, the whole receiver, whether with triode or pentode output, must obviously be capable of passthe higher audible frequencies to the loud speaker if it is to reproduce them. This point needs to be stressed, because it is customary to cut high frequencies down fairly drastically in the interests of selectivity and freedom from mush, scratch, and hiss. The best plan is to restrict such limitation to one particular part of the circuit, where it can be controlled.

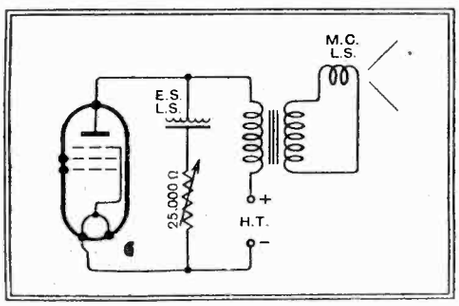


Fig. 7.—Simplified circuit for adding the electrostatic loud speaker to existing receivers. The loud speaker takes the place of the tone-correction condenser.

Where conditions permit—as when a station is being received at short range in relation to its power—the "top cut" can be removed and the advantages of the elec-

The Electrostatic Loud Speaker—

trostatic principle realised to the full. Attention should therefore be paid to by-pass condenser, anode filter chokes, grid "stopper" resistors, and other devices which tend to side-track the high tones.

It is a disputed point whether *phase* distortion is an important imperfection in reproduced sound. It is generally agreed that the ear is not sensitive to displacement of phase, such as occurs whenever a transformer coupling is used, in the case of sustained sounds like those of the flute or organ. This matter, being so extremely difficult to handle either theoretically or experimentally, seldom goes beyond vague references to "attack," yet it is undoubtedly of importance.

There seems little doubt that the electrostatic type of loud speaker is superior to any other in the reproduction of transients, but it hardly has a chance if there is considerable phase distortion in the preceding stages. The substitution of well-designed resistance coupling for transformers helps, but even if transformers are eliminated from the receiver there are likely to be several in circuit before ever the wave strikes the receiving aerial. Careful test has established, however, that the removal of even one transformer of several can be detected by a sensitive ear. So the point is one worth considering, and the electrostatic loud speaker is the most useful with which to consider it.

Distant Reception Notes

DETAILS of France's revised Ferrié Plan announced by M. Eynac in his speech at the Paris Wireless Exhibition are interesting, for they show that the Government has no intention of taking over any of the large privately owned stations which are already in existence. These stations will have apparently to come down to a maximum power output of 5 kilowatts and to work on common-wave channels. It seems rather a curious business, for some Government high-powered stations are being built quite close to the private ones.

One correspondent enquires why there is now nothing to be heard on the short waves before the time when reasonable men go to bed. I am afraid that I cannot say why *he* hears nothing, for there is certainly a great deal going on on most evenings. Zeesen, for instance, has five different transmissions, DJA, DJB, DJC, DJD, DJE, three of which are generally well received before midnight. DJC is a small hours station on 49.83 metres, but DJA on 31.38 metres starts operations at 11 p.m. DJD on 25.51 metres transmits from 4 p.m. until midnight, and DJB on 19.73 metres from 2 to 10.30 p.m. DJE on 16.89 metres has no regular times at present.

Other European short-wave transmissions worth attention are Rome, 2RO, on 25.4 metres, usually to be heard at good strength at any time during the evening. Radio Nations, Switzerland, HBP, on 38.47 metres, to be heard on Saturdays after 11 p.m., Madrid, EAQ, on 30 metres at work from 11 p.m., and Skamlebaek, Denmark, OXP, on 49.4 metres from 7 p.m.

Of American short-wave stations, W2XAD of Schenectady, works on 19.6 metres on Mondays, Wednesdays and Fridays from 9 to 10 p.m., W8XK, of Pittsburgh, transmits on 25.27 metres from 10.30 p.m. onwards, and W3XAL, of Boundbrook, is to be heard on 49.18 metres on Saturdays after 9.30 p.m. W2XAF, of Schenectady, on 31.48 metres does not come into operation until 1 a.m.

There is still occasional interference with Huizen (Hilversum programmes) from a Russian transmitter. Radio-Paris, Luxembourg, Kalundborg and Oslo are excellent on the long waves, and Motala is showing considerable improvement. Zeesen has been particularly good lately.

Lyons Doua has returned to splendid strength on the medium waveband, and Beromünster is coming in so well that it is frequently receivable in daylight. First-rate reception has also been obtained during the past week from Budapest, Munich, Vienna, the two Brussels stations, Prague, Langenberg, Rome, Katowice, Leipzig, Toulouse, Hamburg, Strasbourg, Milan, the Poste Parisien, Breslau, Bordeaux, Hilversum, Bratislava, Heilsburg, Turin, Hörby, Trieste and Nürnberg.

D. EXER.

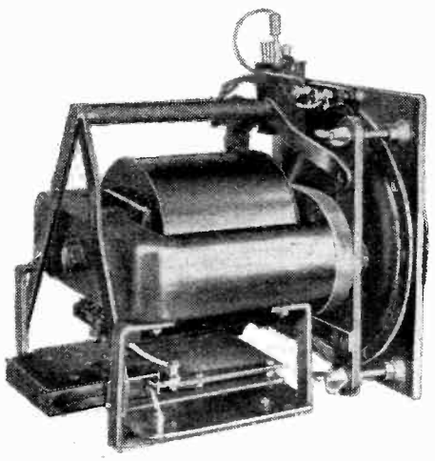
VOIGT LOUD SPEAKERS

Moving-coil Units of High Electro-Acoustic Efficiency

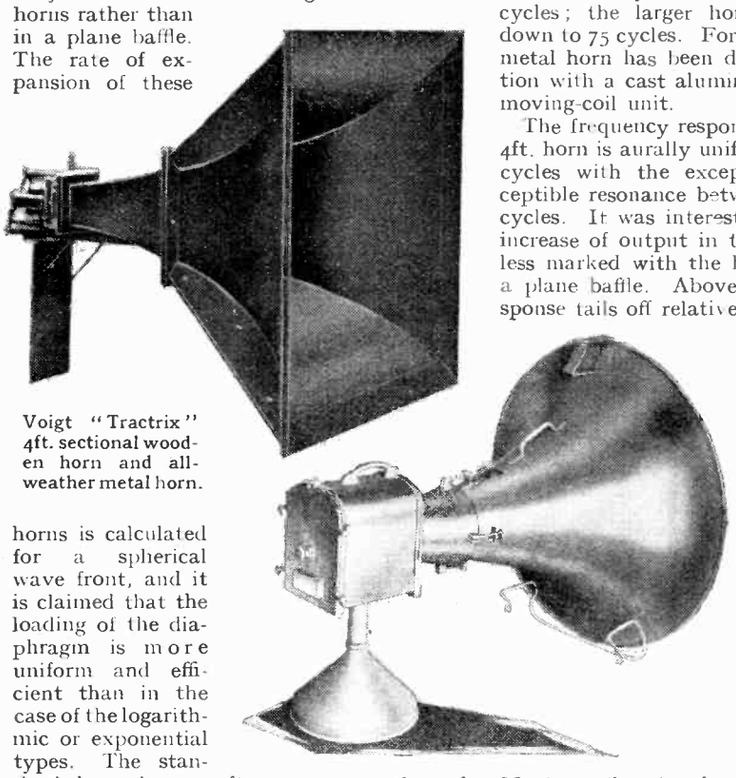
THE driving unit is of the moving-coil type with a 6in. cone diaphragm, and is remarkable for its exceptionally high efficiency. To obtain some estimate of the relative efficiency, the unit was first tested on a plane baffle, and it was found that for a given input the sound output was fully 5 db. above that of any unit we have so far tested. With the 4ft. horn a further increase of 3 db. was obtained.

The efficiency is largely attributable to the high flux density—according to N.P.L. tests, about 17,000 lines under working conditions. This has important consequences in other directions, for not only is the diaphragm damping increased, with consequent improvement in transient response and freedom to overloading due to excessive diaphragm displacement, but the usual rise in the impedance of the coil at high frequencies is prevented. Actually, the average impedance is between 30 and 35 ohms, and the impedance at 8,000 cycles is of the order of 50 ohms. Much better matching with the power valve is thus obtained over the frequency range.

The unit has been designed to work in conjunction with the Voigt "Tractrix" horns rather than in a plane baffle. The rate of expansion of these horns is calculated for a spherical wave front, and it is claimed that the loading of the diaphragm is more uniform and efficient than in the case of the logarithmic or exponential types. The standard horn has a 4ft. square mouth and is built up of wood sections which are readily dismantled for transport. It is intended for indoor use, and a smaller horn of the same type with a 2ft. mouth is available for use where space is limited. Naturally, the bass cut-off in the latter is higher, and was estimated aurally to be in the region of 110 cycles; the larger horn goes comfortably down to 75 cycles. For outdoor work a spun metal horn has been developed in conjunction with a cast aluminium housing for the moving-coil unit.



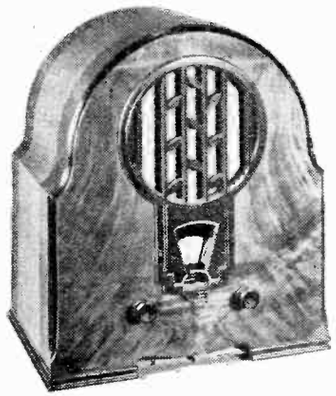
The Voigt moving-coil unit is provided with a field magnet giving 17,000 lines per sq. cm.



Voigt "Tractrix" 4ft. sectional wooden horn and all-weather metal horn.

The frequency response with the standard 4ft. horn is aurally uniform from 75 to 6,000 cycles with the exception of a just perceptible resonance between 3,500 and 4,000 cycles. It was interesting to note that the increase of output in this region was much less marked with the horn loading than on a plane baffle. Above 6,000 cycles the response tails off relative to the general level, but the response at 8,000 cycles is nevertheless higher than that of the majority of high-grade moving-coil loud speakers. The performance in general sets a very high standard of quality, both as regards balance and the reproduction of transients.

The makers are Voigt Patents, Ltd., The Courts, Silverdale, London, S.E.26, and the prices are as follow: Moving-coil unit, £14 10s.; 4ft. horn, £8; 2ft. horn, £4; all-metal horn and unit housing, £12 (provisional).



Philips "Superinductance" Receiver

MODEL 634A

FEATURES. ***Type.—****Five-stage "straight" set with two tuned H.F. stages: designed for external aerial. Automatic volume control. Permanent magnet moving-coil loud speaker.* ***Circuit.—****Two tuned variable-mu H.F. stages preceded by band-pass filter—single diode tetrode detector-amplifier—pentode output valve. Full-wave valve rectifier.* ***Controls.—****(1) Combined tuning and waverange. (2) Combined volume control and sensitivity selector and mains switch.* ***Price.—****16 guineas.* ***Makers.—****Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2.*

A "Straight" Set of High Selectivity and Long Range

THOSE responsible for the design of Philips receivers have always been consistent supporters of the "straight" set in which the amplification prior to detection is carried out at the frequency of the incoming signal. To meet modern requirements as regards range and selectivity in a receiver of this type calls for considerable knowledge in design and skill in construction, and the makers are to be congratulated on having solved the problem in a manner which has won unstinted praise from the adherents of rival systems of reception.

The success of the design is largely attributable to the efficiency of the tuning coils, which are Litz-wound on glass formers, and to the accuracy of alignment of the tuning condensers. There are four tuned circuits—two in the band-pass input circuit and one in each of the coupling transformers associated with the high-frequency amplifying valves. Detection is carried out by a single-diode S.G. valve which supplies the bias for automatic fading compensation to the first H.F. valve, and amplifies the L.F. component of the output before passing it through resistance coupling to the power valve.

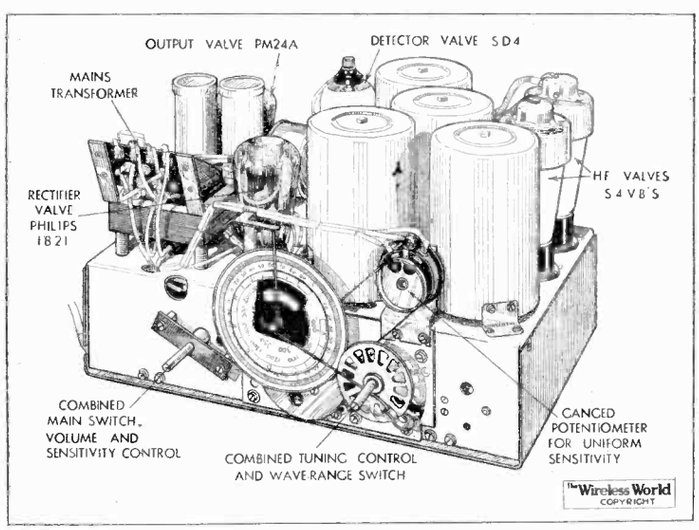
To compensate for the variation in sensitivity between the top and bottom of the wavelength scale, the bias of both H.F. stages is varied by a wire-wound potentiometer ganged to the main tuning control. A further step in the sensitivity of the set as a whole is introduced by switching in or out a section of the bias resistance network. The manual volume control is situated between the diode and amplifier sections of the detector valve, and operates both on radio and gramophone reproduction.

It is interesting to observe that the smoothing of the H.T. supply is accomplished by resistance-capacity circuits, without the aid of iron-cored chokes or even of a loud speaker field winding. The method is successful, as the mains hum is inaudible under normal working conditions.

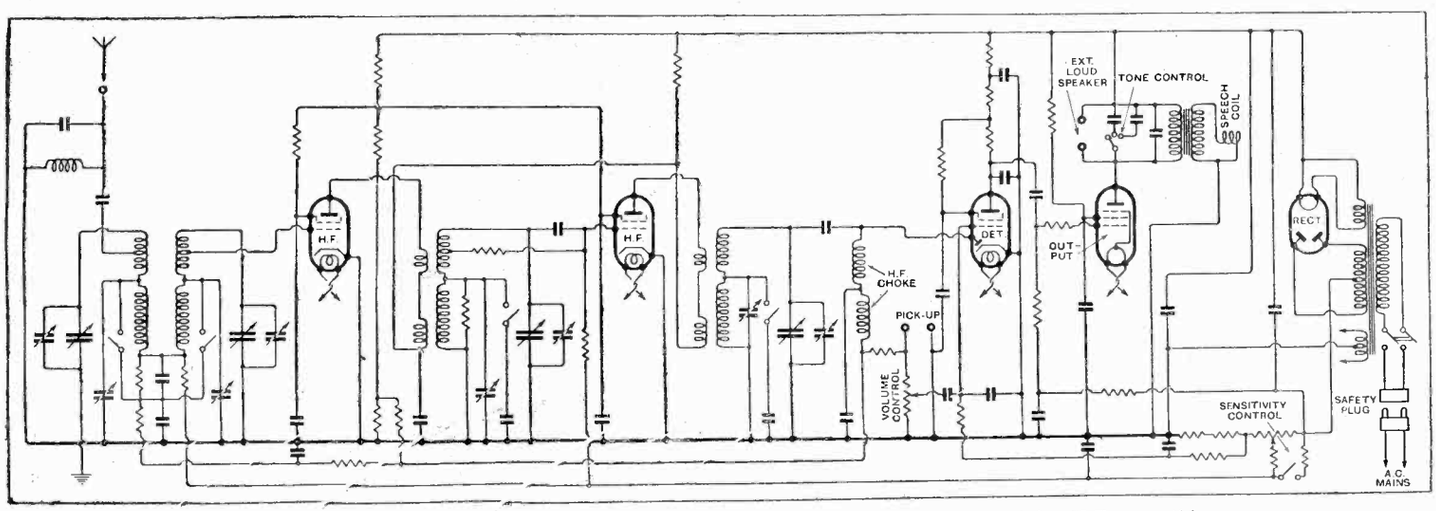
It might be thought that in a highly developed set of this type the handling of the controls would call for a corresponding degree of skill. This is far from being the case, as the geared micrometer dial with its open scale, and the accurate station calibration chart provided, offset any difficulties that might otherwise arise from the high selectivity of the H.F. circuits. There are only two knobs on the front of the cabinet, and both are arranged to combine a push-pull switching action with the usual rotary motion. Thus the right-hand knob takes care of waverange switching as well as tuning, and the left-hand control combines volume control with a sensitivity or "local-distance" switch and the main on-off switch. At the back of the set there is a three-position tone control for use when background noise is troublesome.

The set is a very pleasant one to handle and the automatic fading compensation reduces background noise to a negligible level on all worth-while stations. The range is at least as good as that of the average superheterodyne with an equal number of stages. The long-wave performance is particularly good and the selectivity on this range has not been bettered by any set so far tested. On medium waves, adjacent channel separation was possible on all stations other than those lying immediately on either side of the local stations. Under identical conditions, more channels are lost with many superheterodynes.

The permanent magnet moving-coil loud speaker is free from objectionable bass resonance, and the general character of the response is crisp and bright. This is probably due to accentuation of the upper middle register, as the high-frequency response above 3,500 to 4,000 cycles has been cut to reduce background hiss. Output is sufficient, but not exceptional.



General view of chassis showing micrometer dial gearing.



Complete circuit diagram, showing bias resistance network. No chokes are included for H.T. smoothing.

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, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

Station Announcements

JANUARY, 1934, when the wavelength changes come into operation, presents the B.B.C. with an unique opportunity to remedy the confusing methods now employed in connection with "Station" call sign announcements. Let the B.B.C. scrap the grossly misleading "National" and "Regional" announcements in favour of the highly organised system of individual station "call signs" as adopted by the leading "networks" in America.

Wallasey. L. DAVIES.

Double Channel Transmission

MAY I endorse the suggestions made by Mr. Moor concerning double channel transmissions, in your issue of September 8th?

I suggest that the reason why electrically reproduced music sounds unnatural is that each instrument is fixed only by a system of "mono-focal" co-ordinates.

The use of a single channel for it with one or more microphones enables the mind to fix the position of the performers in one way only, namely, the distance from the microphone.

Now, if double-channel transmission were used, feeding into loud speakers placed at the same distance apart as the microphones, we have a system of bi-focal co-ordinates; each instrument is now definitely fixed by its distance from the two microphones *separately*.

The two receivers necessary could be built into the same cabinet with a loud speaker on each side, the two receivers having a common power unit.

I believe that by this means a high standard of reproduction could be attained, even with the receivers available commercially to-day. R. B. RANSOME.

Ipswich.

Wireless Set and Electricity Charges

YOUR reproduction of the notice issued by the Electricity Department of the Mexborough U.D.C. restricting the use of radio receivers to lighting circuits must have been read with very mixed feelings by those of your readers who, like myself, are, or have been, connected with the supply of electricity.

Until my resignation in 1933 I was for over eight years managing director of an electricity supply company, whilst I have owned radio receivers ever since 1921, so perhaps I am not unqualified to see both sides of the picture.

Let me say at the outset that I regard such a restriction as most short-sighted and extremely detrimental to the interests of the electricity department concerned. My personal experience is that the advent of the H.T. eliminator and then of the all-mains set led to the ousting of gas, at least for lighting purposes, in thousands of houses, and made a definite contribution towards making up the losses which the introduction of "Summer Time" inflicted on the supply industry. Furthermore, the relatively late hour to which broadcasting continues has undoubtedly led to a greater consumption of current in houses where there is a receiver. I have always done my best to foster the use of radio sets from the mains because I am convinced that radio is one of the quickest ways of getting electricity into a house and ensuring its developed use when there, but I frankly feel that the righteousness of your indignation led you to adopt a singularly unfortunate line of attack.

Nowhere in any of the Electricity Acts will you find any support whatsoever for your statement that the lighting rate can only be exacted where electricity is used for purposes of illumination.

There is, in law, no obligation whatsoever on a supply authority to sell its current at a rate below the maximum rate laid down in its Statutory Order, which in the case of the Mexborough Order is 8d. per unit, whereas the rate charged in that area for heating is 1d. per unit.

If, for the purpose of increasing its sales of current and levelling up its load, an undertaking concedes special rates for specific purposes, it is at liberty to lay down certain conditions, and consequently may dictate the type of apparatus which may be connected to circuits metered at these special rates.

Finally, I would point out that the prohibition contained in Section 27 of the Electric Lighting (Clauses) Act, 1899, of any control or interference by the supply authority with the consumers' manner of using electricity supplied to him has been held to apply only to cases where the maximum rate, permitted under the Order, is being paid by the consumer. D. N. W.

London, W.1.

Valves or Stages ?

THE letter of Mr. J. Baggs, of Messrs. Ferranti, Ltd., in *The Wireless World* of September 1st calls for a reply in support of the new description applied to multiple-valve receivers. Your leader of August 4th stated that a well-known firm of manufacturers, Messrs. E. K. Cole, Ltd., had adopted the principle of designating their receivers according to the number of stages—a stage being an anode-to-cathode electron stream. I agree with Mr. Baggs that to describe a receiver which incorporates even one multiple-purpose valve by the number of its valves would be misleading and unfair to the manufacturer of such a set, as it would be understating its capabilities. Clearly, then, some other description is necessary, and the new system appears to be the only sensible alternative, which after a short time has elapsed for its general adoption, cannot possibly lead to confusion.

In support of his criticism, Mr. Baggs states that in *The Wireless World* review of the Ferranti "Gloria" Consolette, in the issue of August 4th, it was wrongly described as a six-stage receiver. I agree with him that it has seven stages. Possibly *The Wireless World* omitted to take into account the A.V.C. diode, which does, of course, fulfil the condition of an anode-to-cathode electron stream. However, the system is quite new, and one cannot condemn it and strangle it at its birth.

The public must know what it is buying, and here again I must differ from Mr. Baggs. My experience is that the man in the street *does* know what he wants, and has, up to now, been guided in his choice very considerably by taking into account the number of valves employed in a receiver. When his neighbour becomes the plutocratic possessor of a four-valve set, against his three-valve, pride will not be satisfied until he himself purchases a five-valve. This is good for trade, Mr. Baggs, of the sales department, and you at least will be the last person to deny that the public should not be deprived of some reliable measure to guide its purchases. I contend that the "stage" description meets the case admirably.

Finally, I cannot congratulate Mr. Baggs on his solution of the problem. He states that his firm have "gone still farther than any of the foregoing proposals," by the simple process of not mentioning the number of valves or the number of stages at all! This, surely, is an Irishman's advance. It certainly does not help one iota.

Sheffield. G. A. TAYLOR.

IN your issue of September 1st we notice a letter criticising our new policy of describing sets by stages instead of valves. This suggestion is that a better method would be to make no mention either of stages *or* valves other than to list the valves in the specification.

The problem of how best to give a description of the capabilities of a receiver is admittedly difficult, but we do frankly believe that a "stage" is the best descriptive unit available at the present time.

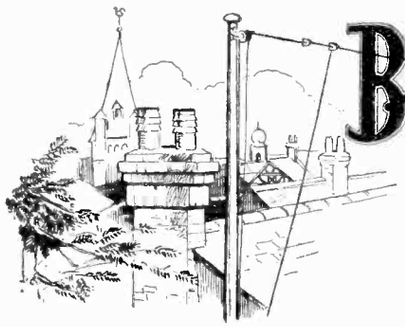
The alternative suggested by your correspondent to our view will not only maintain the use of "valves" but will also introduce once again our old friend the rectifier. The average member of the public has been brought up on "three-valve sets" and "six-valve sets," and similar terms. When he buys a new set he naturally wants to know something about it, and if it is not described as having "so many valves" he will count them either in the set or in their printed description. In both cases the rectifying valve is there to mislead him or to involve him in a lengthy argument.

The ideal method of description, no doubt, would be a term metaphorically equivalent to the use of "horse-power" in rating cars. Whether "stages" provides this equivalent or whether it has yet to be found must remain in question until future inventions and developments decide.

In conclusion, we regret that your correspondent should suggest that our new description will "open up the paths for misrepresentation." It was solely with the object of lessening this risk that we adopted it. Support for the method has been unanimous from Press, trade and public, the only note of dissension being from your correspondent. BARRY KAY,

Sales Promotion Manager, E. K. Cole, Ltd.

Southend-on-Sea.



Broadcast Brevities

By Our Special Correspondent

Provincial Progress

THE alterations in the studios and offices of the Midland Regional station are practically completed, and within a short time the staff will enter into full possession of the new and up-to-date studios, offices, and technical apparatus, all of which, following the experience gained at Broadcasting House and elsewhere, are devised to facilitate the task of programme production.

Personnel of the Midland Regional Station

The Station Director at Birmingham is Mr. Percy Edgar, well known to all Midland listeners as he has been in charge of the station for eleven years. With him will be Mr. H. G. Dunkerly as Programme Director, Mr. Victor Hely-Hutchinson as Musical Director, and Mr. Mostyn Webster as Director of Productions. Mr. Dunkerly has had a wide experience at the Liverpool and Manchester stations of the B.B.C., and has for the last month or so been in sole charge of the North Regional, while Mr. Mostyn Webster has for some time been engaged in the production of some of the revues and lighter programmes at Broadcasting House. Mr. Hely-Hutchinson is too well known to all listeners to need any introduction.

Midland Regional for the Midlands

When writing last week about the Aberdeen studio I gave Mr. Dinwiddie's slogan as "A fair chance for every town in Scotland," and Mr. Edgar holds strong views that the Midland Regional programmes should be, as far as possible, contributed by Midland artistes. At present those of local origin constitute only 40 per cent. of the whole.

Cardiff Studios

THE large single-deck studio at Cardiff has been reconstructed to make it double-height. The architect, Mr. Edward Maufe, who decorated the religious studio at Broadcasting House, has been responsible for the decorations as well as for those of a smaller studio.

New Premises at Bristol

At Bristol, new premises have been taken over by the B.B.C., and the Corporation has carried out certain alterations, while Mr. J. C. Proctor, the architect who decorated the studio in Leeds, is preparing designs for the decoration of a studio in Bristol which will be used for dramatic performances and talks. Mr. Proctor will also carry out the decoration of a new large studio to be constructed in the garden at the back of these premises.

Belfast Station

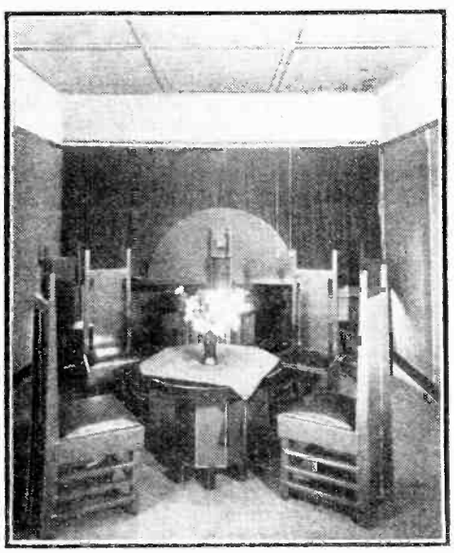
I UNDERSTAND that the question of the mineral rights of the site chosen for the new High-power Station for Northern Ireland is still unsettled, but the legal advisers of the B.B.C. are hopeful of a speedy solution of the difficulty. It is not intended that this station shall have twin transmitters as at Brookmans Park, but a single transmitter as at the projected Midland Regional station.

A Fair Warning

LISTENERS in Newcastle, Sunderland, Gateshead, South Shields, and the surrounding areas should make a note that the G.P.O. is arranging a "comb-out" of that district next month in order to trace unlicensed receiving apparatus. The investigation will probably start on October 2nd, so any listener whose conscience convicts him of working a wireless receiver without a licence and reads this note will have a day or two in which to repair this unfortunate omission.

The Wanderer's Return

TURNING to lighter and more pleasant subjects, I hear that when Mr. Henry Hall stepped off the "Berengaria" at Southampton last week he looked the picture of health and evidently was suffering no ill-effects from the overwhelming welcome he had received in America. He came back with considerably more luggage than he took out, and this increase included the scores of some of the American music which he intends to introduce to our notice.



NOT THE "SALLE À MANGER." An emergency studio at the Huizen transmitting station for use in case of a breakdown in the normal lines connecting to the main studios.

No Time Wasted

In the short space of a fortnight Mr. Hall met practically everybody of note in his particular sphere on the other side of the Atlantic, including Vincent Lopez, Wayne King, Emil Coleman, Johnny Morris, and Ben Bernie, who, I understand, delight all the "radio fans" of the United States. Their music, as interpreted by them, will be introduced to British listeners by Henry Hall during the winter months, so jazz enthusiasts may expect many a treat.

Talks on Sport

THE Talks Department of the B.B.C. has been busily engaged on the lighter side of its work, and is arranging an attractive series of sports talks by record-holders and other leading lights. In addition to Mr. H. W. Austin's discourse on Lawn Tennis to-morrow, Mr. W. C. Lyle on "Sport in other Countries" on October 7th, Mr. C. Buchan on "Association Football" on October 21st, and General Critchey on "Greyhound Racing" on October 25th, we are promised a talk by Larry Gains, the British Empire Boxing Champion, and by Colonel Peel on "Tunny Fishing," while, in all probability, listeners will also have an opportunity of hearing Sir Malcolm Campbell on "Motor Racing," Mr. and Mrs. Mollison on "Long Distance Flying," Stan. Woods on "Motor Cycle Records," Miss M. Foster on "Rifle Shooting at Bisley," and the veteran, Mr. J. H. Taylor, will give us an account of fifty years' experience in Golf.

The West Regional Director of Programmes

THE appointment of Mr. J. T. S. Sutthery as director of programmes for the West Regional station has, as usual, aroused some protest from Wales on account of his not being Welsh. The objectors do not seem to realise that the West Regional station serves the enthusiastic listeners in Devon, Somerset, Cornwall, Gloucestershire and Hereford, and should not, therefore, be considered as belonging exclusively to the Principality. I understand, also, that Mr. Sutthery spent a considerable part of his boyhood at Llandaff, so that he is not altogether a stranger to Wales.

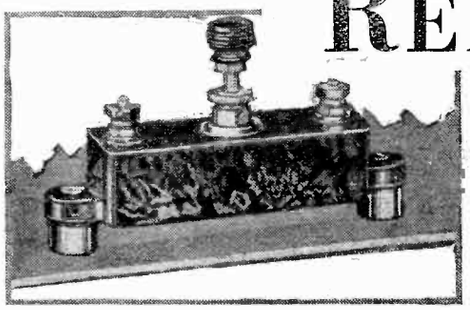
Anti-Interference Campaign

THE special committee of the I.E.E., formed at the instigation of *The Wireless World*, which is considering the best means of overcoming "man-made static," will get into its stride at the general meeting summoned for October 5th. Meantime its members are busy collecting more evidence for discussion in detail, and it is expected that the committee will have a busy time during the winter months.

Possible Legislation

The possibility of introducing some form of legislation under the Wireless Telegraphy Act will probably have to be considered. Even though experience shows that in a great number of cases it is not difficult to persuade parties responsible for various forms of interference to adopt ameliorative measures without having to resort to compulsion, yet legislation would remove the risk of unfairness. All manufacturers should be on the same basis, and imported apparatus, too, must be controlled. In the meantime the B.B.C. and the Post Office are handling an average of 150 complaints about interference each week.

READERS' PROBLEMS



Reducing stray capacity by mounting a compression type of condenser above a metal base.

Alternative Components

PROVIDED that a certain amount of discrimination be exercised, it is not essential that all the components used in building the New Monodial should be of the same makes as those employed in the original model; in many instances substitutions may be made without impairing performance.

But, with regard to the 0.002-mfd. compression condenser in the oscillator circuit, it should be pointed out that the particular make of component specified has a low residual capacity to earth when mounted in the normal manner on a metal baseplate. The substitution of other makes of condenser will in some cases add an excessive amount of stray capacity across the oscillator circuit, unless the precaution be taken of mounting the condenser some ¼in. above the metal base, as shown in the above illustration.

In order that the full range of capacity variation may be available, it will sometimes be necessary to place a rigid backing-plate of insulating material under the condenser.

Peaked Tuning

THE observant visitor to the recent Olympia exhibition may have noticed that a new expression has crept into the language of radio. This is "peaked tuning," which is now sometimes applied to circuit arrangements which differ in no obvious way from the band-pass filter with which we are all familiar.

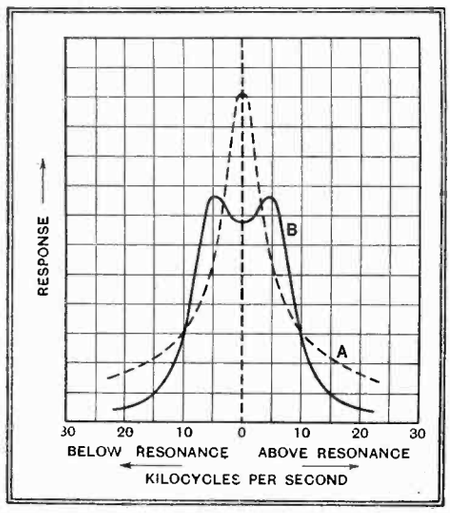


Fig. 1.—The double-humped resonance curve is that of a band-pass filter: the other is that of a similar pair of circuits, but coupled more loosely to give "peaked tuning."

A reader's request for information on this point may be satisfied by saying that peaked tuning differs from band-pass tuning only in that the coupling between the component circuits is made just close enough to give maximum transference of energy, but no "double hump." This is illustrated diagrammatically in Fig. 1.

This method of adjusting a two-circuit tuner is sometimes referred to as "peaked band-pass," which seems to be a contradiction of terms, as no attempt is made to pass on a definite band of frequencies at full strength. Of course, peaked tuning confers no immunity from sideband cutting, and so, when it is employed, suitable compensation must be made in the L.F. circuits by providing tone correction.

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 brief particulars, with the fee charged, are to be found at the foot of this page.

H.F. on Short Waves

SEVERAL readers seem to be uncertain as to the benefits likely to result from adding an aperiodic H.F. stage to their short-wave converters.

It should be made clear that no appreciable amount of true H.F. amplification is to be expected from such a stage, but, paradoxical as it may seem, the addition is one that can be thoroughly recommended. In the first place, radiation from the aerial and consequent interference with other listeners will be minimised, and also the interposition of the H.F. valve between the aerial and the tuned circuit will remove the damping effect of the former and make operation very much easier and more certain. In particular, the reaction adjustment will work more consistently, and "dead spots" should be absent.

Is the A.V.C. Working?

IT is far from easy to form a definite opinion as to whether an automatic volume control system is working properly. From its very nature, A.V.C. should function unobtrusively by maintaining volume at the required level irrespective of fluctuations in the strength of incoming signals.

Unless it is possible to make comparative tests during periods of fading against a receiver which is not fitted with A.V.C., it is almost impossible to check the functioning of the control system without the use of a milliammeter. This instrument should be connected in series with the anode circuit of one or of all the controlled valves, and a strong transmission should then be tuned in. If everything is working well, a considerable increase in anode current should take place as a result of touching the high potential end of one of the tuned circuits of the receiver. This will show that sensitivity is being automatically increased to make good the loss of volume which would otherwise arise through artificial detuning of one of the circuits. A still more convincing test may be made after darkness has set in by tuning in a short-wave station known to be subject to fading; violent fluctuations of controlled anode current will probably take place every half-minute or so.

The Low-pass Filter

THERE is no reason why the low-pass filter included in the New Monodial superheterodyne should not be adapted to almost any type of receiver, arrangements being made to place it in circuit when heterodyne interference is present. But it should be pointed out to a correspondent who raises this query that a filter of this kind is of little benefit in eliminating whistles due to second-channel and similar forms of interference.

Taken Too Literally

CERTAIN expressions used in the radio art are admittedly rather confusing to the newcomer, who is particularly likely to be misled by the terms "earth" and "earthy." One of our newer readers has been misled by the expression "earthed end of the tuning coil," as used by a more knowledgeable friend, and, by taking him literally at his word, has imposed an accidental short-circuit across his H.T. battery.

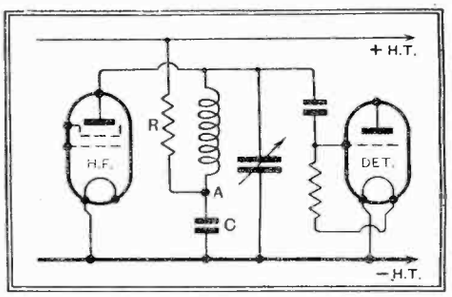


Fig. 2.—Although point A may be positive with respect to earth by the full voltage of the H.T. battery, it is "earthy" so far as H.F. voltages are concerned.

It must not be assumed that the earthed or low-potential end of a circuit is always joined directly to the earth line, or chassis, of a receiver. The expression as generally used relates to the part of the circuit or component which is at low-potential with regard to signal-frequency voltages, whether H.F. or L.F. For instance, in Fig. 2, point A would be spoken of as the earthed end of the tuned anode coupling coil, although, so far as D.C. is concerned, it may be at a potential of a couple of hundred volts above earth. But there should be no appreciable signal-frequency difference of potential between point A and earth, as it is "tied down" by the combined action of the decoupling resistance R and the by-pass condenser C.

The Wireless World INFORMATION BUREAU

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.

Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, 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.