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EDITORIAL COMMENT

Post Office Tentacles

Danger of Monopoly Abuse

THE success which has of late years attended most of the undertakings of our vast organisation ruled over by H.M. Postmaster-General has had the effect of making the Post Office commercially minded to an extraordinary degree. The Post Office trading profits break fresh records every year and these achievements call forth unstinted admiration on all sides.

So long as the Post Office confines its activities to the development of those sections of its services in which it has an exclusive field, it is unlikely that its successes will be hailed with anything but satisfaction.

Recently, however, there has been so much evidence of Post Office threats to interfere with, if not actually to curtail, legitimate and beneficial activities of other bodies, that it seems time to ask whether the Post Office monopoly is not in danger of being abused by those of its officials who seem to think that there need be no limit to the encircling tendencies of the Post Office tentacles.

Radio Industry Threatened

Readers will remember that we have had occasion to express our concern over the attitude adopted by the Post Office towards relay services as a means of distributing broadcast programmes, and we have pointed out that if, as the evidence seems to show, the Post Office intends to develop the relay services on a huge scale so as to cover the whole country, these efforts can hardly fail to cripple, if not completely paralyse, an industry which over years of often very difficult periods has been built up on the assumption that broadcast reception would continue to be carried out by means of wireless receivers. The threat to the wireless receiver applies equally to the television receiver, the Post Office visualising the distribution of television by means of wire throughout the country.

Greed for Channels

The latest cause for anxiety in regard to Post Office ambition centres around the allocation of short waves for communication purposes. There have been, we understand, conferences between the Post Office, the B.B.C., the Services, the Air Ministry, and other users of the ether to prepare for the international deliberations at the Cairo Telecommunications Conference. We understand that a common policy between these parties has by no means been reached and that the stumbling block to agreement is that the Post Office appears to the other parties to be unreasonable in its demands for channels for its own services. The Post Office requires these channels for commercial exploitation, and although, like the other users, they can be regarded as supplying public services, there is the peculiar distinction that the Post Office alone derives revenue directly therefrom.

This brings us face to face with the fact that the Postmaster-General, under the terms of the Wireless Telegraphy Act, is the licensing authority for wireless stations in this country, so that, unless the Post Office policy is conducted with an impartiality almost too much to expect of human nature, it may be extremely difficult to ensure that the Post Office acts fairly as a licensing authority, avoids any risk of abuse of its monopoly, and yet carries on its highly commercial attitude towards the various trading undertakings for which it is responsible.

Navigation by Wireless

A SIMPLE explanation of the methods employed by navigators in determining a vessel's position with the help of bearings, taken by a direction finder.

AMONG the many important applications of radio in the maritime world, that of the direction finder as an aid to navigation is possibly the most useful of all. The marine radio direction finder is to-day almost as consistently employed for navigation—at any rate, when making the land—as is the compass, chronometer and sextant; and when bad weather and visibility conditions exist and most other aids to navigation fail, it becomes an almost indispensable part of the vessel's equipment. In this way it is instrumental in saving time and money, and so contributes to the economical working of a ship.

Some idea of the importance now attached to direction finding may be gathered from the fact that the International Convention for the Safety of Life at Sea has made it compulsory for all passenger ships of over 5,000 gross tons to be equipped with a direction finder, while, so far as the British Mercantile Marine is concerned, a very large number of vessels below that tonnage are voluntarily so equipped. At the end of 1935 well over 5,000 merchant vessels had direction-finding equipment installed.

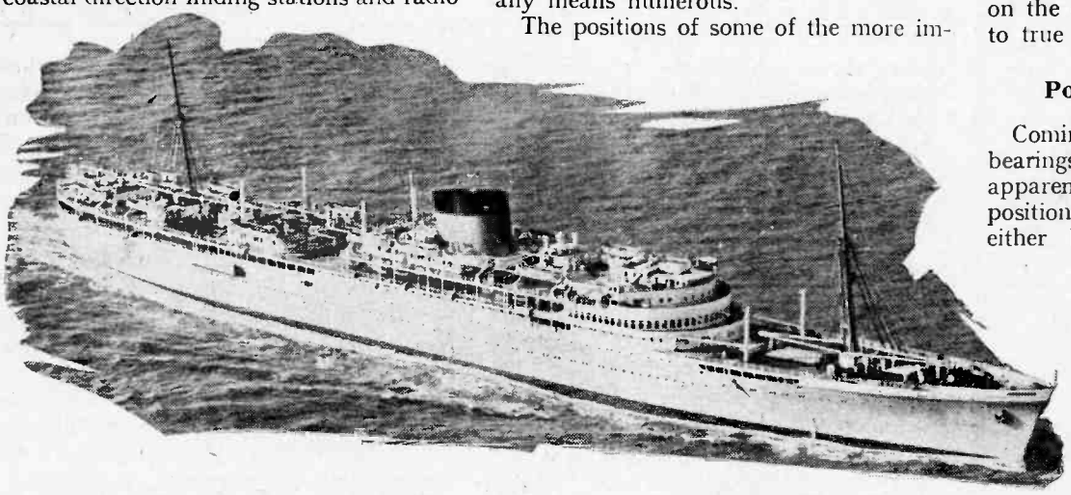
It is not the purpose of this article to discuss the technicalities of direction-finding equipment or to deal with the various systems employed, but it may be of interest to consider some of the shore facilities provided for navigation by radio and to see how the bearings are actually taken and employed in navigating a ship.

Most maritime countries have established round their coasts a system of coastal direction-finding stations and radio beacon stations for the express purpose of assisting in the navigation of vessels in the vicinity. The function of a coastal direction-finding station is to take bearings of a vessel upon request and to communicate them to the ship, and it will be apparent that the station can be made use of by any vessel equipped with radio, whether she has a direction finder or not. These stations, which usually work on 375 kc/s (800 m.), exist sometimes singly, as on an open coast, and sometimes in groups, as at the approaches of a harbour or congested waterway, in which case one of the stations only has transmitting equipment and acts as the control station, receiving by land wire the bearings of the ship from all the stations in its group, and communicating them to the ship. This permits of the ship having its bearings taken by two or three DF stations simultaneously, and, having received these "cross bearings," its position can at once be ascertained from them with reasonable accuracy. Radio beacons are transmitters—generally located at lighthouses and on other important landmarks—which, at given intervals, automatically transmit signals especially suitable for DF work. These usually consist of a repetition of the call letters of the station followed by a long dash, and the stations work on the band 290-320 kc/s (1,034-938 m.). The ordinary beacon stations can only be of use to vessels equipped with a direction finder, which can, in addition, make use for the same purpose of any wireless station which happens to be transmitting and whose position is accurately known.

How DF Bearings are Applied

There exist, also, special types of radio beacons whose utility depends upon the directional type of transmission which they employ, but they are not, as yet, by any means numerous.

The positions of some of the more important coastal direction-finding and radio beacon stations established round the coasts of the British Isles are indicated in the accompanying map (Fig. 1).



The comprehensive wireless installation of the modern liner is put to considerable use as an aid to the navigation. Our photograph shows one of the latest Union Castle motor vessels.

In most modern direction-finders the bearing of a distant station is taken by rotating the loop aerial of the system until the signal strength falls to a minimum value. When this condition occurs, the plane of the loop is exactly at right angles to the direction of the station, and this direction is indicated on a 0°/360° scale, which forms part of the instrument. At a shore DF station or in a ship fitted with a gyro compass this can now be read off as a true bearing, i.e., 0° corresponds to true North, 90° to East, 180° to South, and 270° to West. On most ships, however, this is not possible, as the bearing is only indicated relative to the ship's head, and will be a true bearing only if the ship happens to be steering true North. Thus, 0° corresponds to right ahead, 90° to the starboard beam, 180° to right astern, and 270° to the port beam. To convert a bearing, read off from the dial into a true bearing, it is necessary to add to it the true course of the ship at the time the bearing was taken. At the same instant that the bearing is taken, the bridge officer notes the compass course of the ship, and, by applying the compass errors for deviation and variation (occasioned respectively by the metal structure of the ship and by the fact that the compass needle points towards the magnetic and not the true North), converts it into the true course. By adding this to the radio bearing, a true bearing is obtained, suitable for plotting on the chart as a bearing with reference to true North.

Position by Cross Bearings

Coming now to the utilisation of radio bearings in navigating the ship, it will be apparent that a vessel desiring to fix her position by radio cross-bearing may do so either by obtaining bearings simultaneously from two or more coastal DF stations, or by herself taking more or less simultaneous bearings on two or more radio beacons or ordinary wireless stations, or by a combination of these two methods.

Having obtained the true bearings, and provided the stations are not more than about 60 miles distant, it is a simple matter to obtain the ship's position on the chart. The navigator merely draws lines on the chart from the appropriate stations, running in the direction indicated, and the point at which they intersect is the ship's posi-

tion, as at A, Fig. 1. When, with more than two bearings, the lines do not pass exactly through one point, and a small triangle is formed, as at B, Fig. 1, the ship's position is generally assumed to be the approximate centre of the triangle.

at the ship, the ship will, in this particular instance, be placed farther to the South-east on the chart than she actually is. It is, therefore, necessary to convert the great circle radio bearing into a Rhumb Line bearing, or straight line on the chart. This is done by applying a correction known as the Conversion Angle. The latitude and

found with reasonable accuracy by elementary navigational methods. Bearings are taken at intervals and the position obtained by allowing for the ship's run in the interval, as illustrated in Fig. 2. Suppose X to be a radio beacon as shown on the chart, and AX to be the first line of bearing. All that is now known is that the

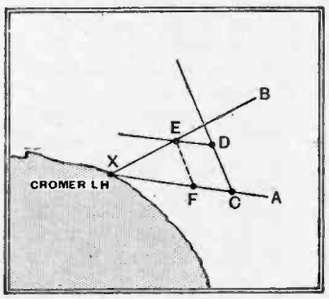


Fig. 2.—Determination of position by bearings taken from a single beacon station.

Fig. 1.—Illustrating the operation of laying off, on a chart, wireless bearings taken in various circumstances.

It should be remembered, however, that charts used for navigation are usually on Mercator's projection, in which the meridians and parallels are all straight lines, and the earth's surface is represented as being flat. The track of a radio wave, however, is a great circle following the curvature of the earth, and great circles are not straight lines on a Mercator chart. In other words, it is not correct to lay off a radio bearing as a straight line on a Mercator chart, and it should really appear as a curved line. However, for distances below about 60 miles, where radio bearings are likely to be mostly used, it is so nearly a straight line that it can be taken as such and the bearings laid off directly on the chart. For long-distance bearings the ship's position arrived at in this manner would not be correct, as is indicated at C, Fig. 1. From this it will be seen that if the bearings are laid off from the two stations as straight lines in the direction from which they appear to bear

longitude of both ship and station are roughly estimated, the middle latitude and the difference between the longitudes found, and the correction calculated from $-\text{Conversion Angle} = \frac{1}{2} \sin \text{mid. lat.} \times \text{diff. long.}$, or more readily found from tables. Some idea of the reason for the above procedure will no doubt be apparent when it is remembered that, on a Mercator chart, owing to the earth's shape, the nearer the poles and the farther apart in an east-west direction that two points are, the greater will be the curvature of the Great Circle joining them.

Plotting Corrected Bearings

Having applied the Conversion Angle, then, the bearings may be plotted as straight lines on the chart, and the ship's position fixed from them.

When only one suitable station exists on which to take a bearing, as sometimes happens, the ship's position may still be

vessel's position is somewhere on this line. Simultaneously with taking this bearing, the ship's log and course are noted, and, after allowing her to run a reasonable distance, another bearing is taken, giving the position line BX, the ship's position now being somewhere on this line. To fix the exact position take any point C on line AX and draw a line in the direction of the ship's course, measuring off along it a distance corresponding to that run by the ship in the interval between the bearings, as shown by the log, thus arriving at D. From D draw a line parallel to AX to cut BX at E. This is the ship's position. By drawing EF parallel to CD we have the actual track of the ship in the interval, F being the position when the first bearing was taken, because EF is equal to CD, i.e., the course and distance run in the interval.

By using positions obtained by one or other of these methods it is possible to run a vessel for hundreds of miles along an in-

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tricate coast without sighting any of the usual aids to navigation. For instance, it is a common experience among navigators during the winter months to enter the English Channel from the westward and run as far as Dungeness before any land is seen, the vessel being navigated practically entirely by radio bearings.

And lastly must be mentioned the assistance provided by radio to rescue vessels and salvage tugs in the location of distressed or disabled ships at sea. In this case the procedure is for the disabled vessel to send her call letters at frequent intervals, and for the searching vessels to steer direct along the line of bearing thus obtained by their own direction finders. By this means time spent in searching is considerably lessened, and help often brought within reach of a vessel and crew to whom delay would be fatal.

Radio - Nations

BROADCASTING IN THE CAUSE OF PEACE

THE League of Nations station at Prangins has been used by the League for broadcasting purposes since September, 1932. Until the opening of the Palais des Nations and the League Assembly Hall in September, 1937, a small provisional studio in an annexe to the old Secretariat building was employed. Engineers are still busy completing the technical equipment of the seven radio commentators' boxes in the Assembly Hall which, it is hoped, will be ready for the next Assembly. Meanwhile, broadcasts take place from a small studio on the ground floor.

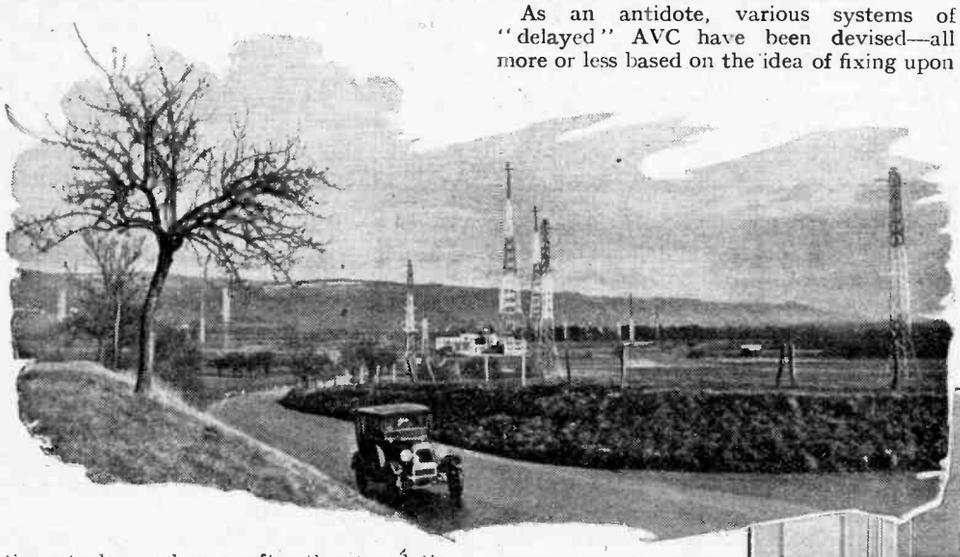
The schedule of the English broadcasts, which consist entirely of bulletins giving the latest official details of proceedings and take place on short waves only, is as follows:—

Fridays: 7-7.15 GMT on HBO (26.31 metres) for South Africa, England and Scandinavia.

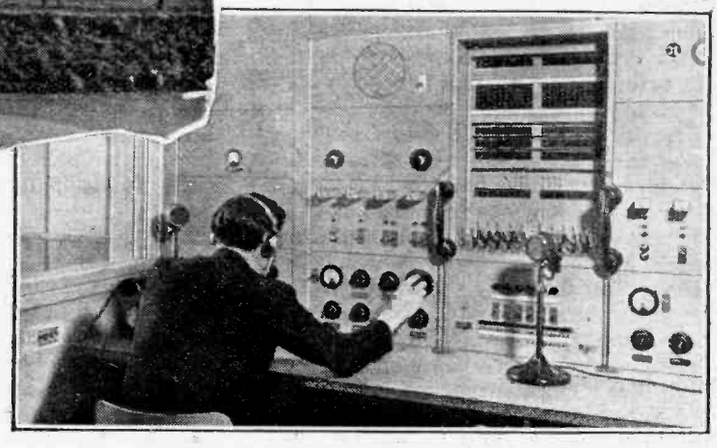
Saturdays: 12.30-12.45 a.m. on HBL (31.27 metres) for North America.

The League's new studio, which will continue to be used even after the completion of the reporters' cabins, is situated next to the League "crisis" communications centre. In times of crisis the League takes over direct control of the wireless station which ordinarily is operated by the Radio-Suisse company. A number of international landlines terminate in the small control-room which forms an ante-chamber to the studio, while disc-recording apparatus is provided in an adjoining room.

A committee of experts will meet before July next to advise on a possible extension of League activities towards the use of broadcasting in the cause of peace. This committee will be called by the International Committee on Intellectual Co-operation and will make suggestions for the supply of material by the League to national broadcasting organisations.



ALL-EMBRACING VIEW of Radio-Nations showing, in the rear, the two tall masts which support the aerial for the medium-wave telegraph transmitter. The short-wave beam aerials are slung between the short masts. On the right is shown the control panel.



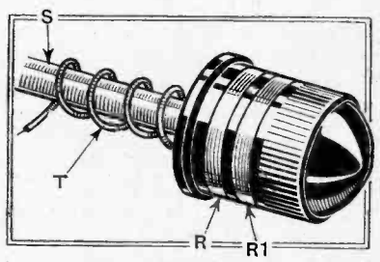
"Muting" by Hand

ALTHOUGH AVC is now the accepted remedy for fading, one must admit that it tends to create some new problems in place of the one it solves. Amongst other things, for instance, it makes for "noisy" tuning, when changing-over from one programme to another. This disagreeable symptom is due to the abnormal sensitivity of the valves at inter-station settings, when there is nothing but static and the "mush" of distant carrier-waves within reach.

As an antidote, various systems of "delayed" AVC have been devised—all more or less based on the idea of fixing upon a datum line which serves to divide those stations that are worth listening to from those that aren't. When a programme comes in above the "threshold" level of strength, the receiver functions in the ordinary way. But for all signals below par, one of the amplifying valves remains biased below the cut-off point, and the set is automatically "muted." In practice the effect is like switch-tuning in the sense that all the "worthwhile" stations can be picked up one after the other, in regular sequence, against a perfectly quiet background.

But there are simpler ways of securing much the same result. In one known arrangement the control knob is deliberately pressed inwards, when changing-over to another programme, until the tuning indicator comes into line with the new station-marking on the dial. The pushing-in of the knob applies a paralysing bias to one of the valves, and so shuts out all reception, including "noise," until the pressure is released.

The accompanying drawing shows an even simpler method (Patent No. 472722) of "muting" by hand. Two metal rings R, R1 are let into the surface of the tuning-control knob, a short distance from its knurled end. One ring is connected to the metal shaft S, which is earthed through the chassis, while the other is connected to a helical spring or pigtail T which, in turn, is connected to the anode, say of a detector diode.



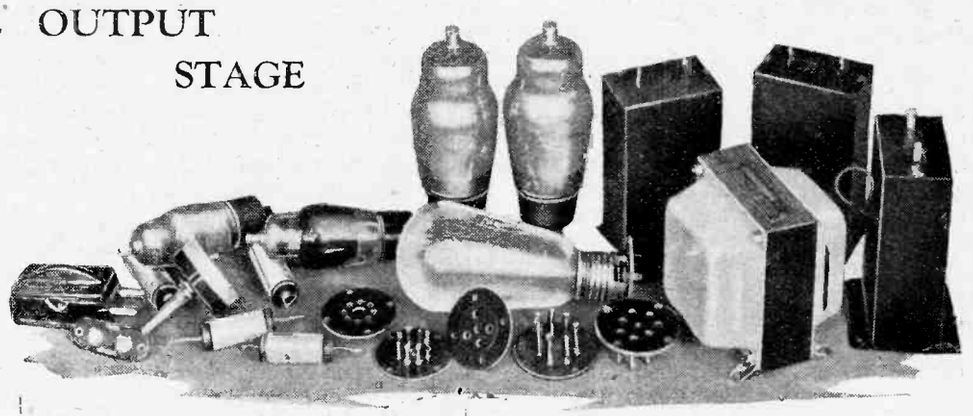
For normal tuning the knob is held by its knurled end, while to mute the receiver it is gripped in such a way that the metal rings R, R1 are short-circuited by the user's fingers.

The operator can now mute the set, as and when he desires, simply by allowing his finger to bridge the gap between the two rings R, R1. This, of course, earths the anode and so "paralyses" both the detector and the loud speaker. The resistance of the circuit bridged is such that the current passing through the operator's finger cannot exceed one-tenth of a milliamp., so that there is no risk of receiving any perceptible shock.

How a Receiver is Designed.—IV.

DC Quality Amplifier

PUSH-PULL TETRODE OUTPUT STAGE



FOLLOWING the simple receiver which has been described in the earlier parts of this series of articles, the design of a high-quality amplifier for operation from DC mains is now begun. The output stage, which is of the push-pull type, is here discussed and later articles will deal with the design of the early stages.

IN previous articles in this series the design of a simple AC/DC receiver was discussed in some considerable detail, but, naturally, every point could not be touched upon.

Where the highest possible quality of reproduction is required there are many factors which must be taken into consideration but which can be ignored when such a high standard is not considered necessary. It should not be thought that this lower standard of reproduction is in any way bad, for it is actually very good, and inferior only to the best which it is possible to achieve. All the points which crop up when an endeavour is made to reduce all forms of distortion to a minimum are probably best appreciated by designing an amplifier of this type. Experience shows that for the best reproduction a frequency response flat within ±1 db. from 30 cycles per second to 10,000 cycles per second is necessary, together with an output of the order of 4 to 6 watts. This is for domestic purposes, and a greater output is naturally needed for public address equipment, but we need not consider this at present.

The input required for maximum output need not be less than 1 or 2 volts if the amplifier is to follow the diode detector of a receiver, and this is actually a suitable value also for gramophone purposes when a piezo-electric pick-up is used. For the average pick-up, however, rather greater gain is advisable so that the full output can be secured with an input of about 0.5 volt. For use with a microphone still more gain is necessary, and the full output should be obtainable for an input of certainly not more than 0.05 volt. A microphone input, however, is required comparatively rarely, and it would, consequently, seem best to design the amplifier for an input of 0.5 volt and to use a pre-amplifier should it be necessary at any time to employ a microphone.

Triodes in the Output Stage

In addition to these details, the effective output resistance of the amplifier should not be more than a few thousand ohms if resonances in the loud speaker are to be properly damped. An amplifier having such characteristics and designed for operation from AC mains supply was described some years ago in *The Wireless World* under the title of the "Push-Pull Quality Amplifier." Its design was dealt with in considerable detail, and it is sufficient to say here that it includes two push-pull triodes in the output stage fed from a push-pull triode penultimate stage with resistance coupling, this being preceded by a single phase-splitting valve. The performance of this amplifier, in spite of the time which has elapsed since its design, still leaves nothing to be desired, but hitherto no amplifier with a similar performance has been described for DC mains operation. The design of such an amplifier is actually a very much more difficult problem, and it will consequently be more instructive to deal with such an amplifier than with an AC one, and the completed design will be filling a long-felt want among those, and they are many, who still have DC mains.

The great difficulty with a DC mains supply lies in the output stage, for a comparatively low voltage is available. Most supplies have a voltage lying between 200 and 250, and the majority of supplies are probably nearer 225 volts, so that we should take this mean figure for design purposes.

The first step in design is to choose the output valves, and here the only thing to do is to consider the various valves which are suitable as regards their heater requirements for DC operation, and a glance through *The Wireless World* Valve Data Supplement shows that there is actually only one triode type designed for DC supplies. This is the Mazda PP 3521, which is rated for a maximum output of 5.6 watts with an anode voltage of 200. This is for a pair of the valves in push-pull with a total quiescent anode current of 140 mA. At first sight this appears ideal, because the triodes have inherently a low output resistance. A little thought, however, will show that under normal conditions this output cannot actually be secured because with a supply of 225 volts we cannot obtain 200 volts on the anodes of the valves. To obtain this output with 200 volts for the anodes, 25 volts grid bias is needed, which brings the total required up to 225 volts. In addition, the output transformer primary will have a resistance for each half of the winding of about 100 ohms, and it will usually be necessary to use a 50-ohm anti-parasitic resistance in the anode lead of each valve. With a current of 70 mA. per valve this gives a voltage drop of 10.5 volts, bringing the total up to 235.5 volts.

Tetrode Output Valves

Some smoothing will be needed as well and the choke will hardly have a lower resistance than 100 ohms, and, allowing for the currents taken by earlier stages, the voltage drop across it is not likely to be less than 15 volts; and this brings the mains voltage required up to some 250 volts. It is, therefore, just possible to operate the valves under the conditions quoted with 250 volts mains, but not with mains of lower voltage.

With a 225-volt supply the anode voltage actually works out at about 175 volts only and the output of a pair in push-pull is then about 3 watts only.

It is clear, therefore, that the use of triodes is ruled out and we shall consequently have to turn to pentodes or tetrodes. These score not only on account of their higher efficiency but, especially in a DC set, because they require a much lower value of grid bias, and a higher anode voltage is consequently possible. More choice is possible in the case of pentodes than with triodes, but in general tetrodes are preferable, since they have somewhat straighter

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characteristics and are less inclined to introduce harmonics of high order which cause serious audible distortion, although they may actually represent a very small percentage of the fundamental.

On looking through the valve lists one type which appears especially suitable is the Marconi and Osram KT 31 tetrode. This valve has a heater taking 0.3 amp. at 26 volts and is rated for 200 volts anode and 180 volts screen potentials, with a grid bias of −4.4 volts. The anode current is 40 mA. and the screen current 10.6 mA. A single valve requires a load resistance of 5,500 ohms and gives an output of 2.5 watts for 7.5 per cent. distortion. By the application of negative feed-back, however, the output resistance can be reduced from some 20,000 ohms to 1,000 ohms only and at the same time the distortion reduced to only two per cent. This is satisfactory, except that the output is less than we require. By using two valves under the same conditions in push-pull we should obtain just double the output, or possibly slightly more, since the push-pull condition balances out even harmonics.

Class AB Operation

The maker's rating for these valves in push-pull, however, is quite different. The same anode and screen voltages are applied, but the no-signal grid bias is increased to −5.9 volts and the total anode current is then only 45 mA. for the two valves. With a signal, the bias and anode current increase and at full output the total current is 57 mA., the output being 6 watts for 3 per cent. distortion. By applying negative feed back the distortion can be reduced to 2 per cent. and the apparent output resistance becomes only 4,000 ohms.

Now this operating condition is known as Class AB, whereas that with two valves biased to the same degree as for a single output valve is known as Class A. The Class AB condition is characterised by an appreciable rise in anode current with signal and is similar in its essentials to the scheme widely used in battery sets and known as quiescent push-pull. Here the valves are biased nearly to anode current cut-off, but in the true Class AB condition, which is now widely used in mains sets, the bias is not made nearly as great as this and the anode current fluctuations are correspondingly smaller.

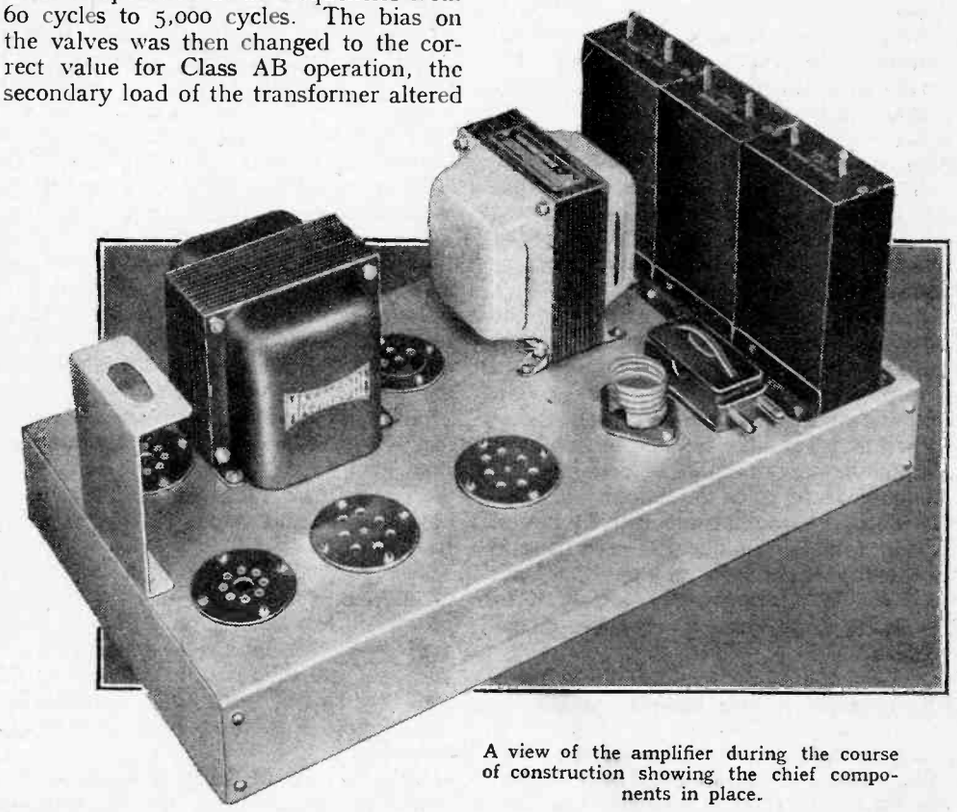
At first sight the Class AB condition seems better than the Class A, for it gives 6 watts output as compared with 5 watts. The fluctuating anode current is no great disadvantage in a DC mains set because it is easy to keep the total resistance of the HT supply circuit low, as only a single smoothing choke need be included. On the other hand, a much better design of output transformer is necessary, and there is a much greater chance of the performance being upset by variations in the characteristics of the valves. Most push-pull calculations, as opposed to measurements, presuppose the use of two identical valves. In practice, of course, this is never found, and the result with an arrangement which depends for the avoidance of distortion largely upon the use of matched valves is not likely to be as good as one which, while possibly giving less output in the ideal condition, is by no means critical as regards matching.

In the true Class AB condition, as opposed to quiescent push-pull, normal variations in valves do not have a big effect upon the performance, but they undoubtedly have a greater effect than in the case of the pure Class A system. The question of the output transformer is more serious. When both valves are operative the whole time, as in Class A, it is only necessary for the transformer to have the correct ratio, an adequate primary inductance for the maintenance of the load on the valves at low frequencies, and a low leakage inductance between primary and secondary to maintain the high-frequency response. With Class AB it is also necessary for there to be low leakage between the two halves of the primary.

As a matter of interest, the writer set up two KT 31 valves in push-pull and, with an especially good quality output transformer of normal design, a measured output of 5 watts was secured with Class A operation at all frequencies from 60 cycles to 5,000 cycles. The bias on the valves was then changed to the correct value for Class AB operation, the secondary load of the transformer altered to give the correct new primary load, and the output again measured. At 400 cycles it had increased to 6 watts, the correct figure, but at 60 cycles and at 5,000 cycles only about 2 to 3 watts output could be secured. Examination of the wave form with the cathode-ray oscillograph showed that at the full output, undistorted across the secondary load, the wave form of the voltage appearing between each valve anode and earth showed very serious distortion. This is, of course, to be expected with Class AB, and it is balanced out, as far as the secondary is concerned, by the push-pull connection of valves, the actual balancing taking place in the output transformer.

Over the middle range of frequencies from about 200 to 2,000 c/s the reactance of the leakage inductance is low, and the coupling between the two half-primaries is thus sufficient to enable the proper balancing action to be secured. The full output is consequently obtained with very little distortion. At high frequencies, however, the leakage reactance prevents the proper balance from being secured, so that, although the actual output of the valves may be no more distorted than at lower frequencies, the distortion is not balanced out. At low frequencies the action is rather different and the increase in distortion is almost certainly due to the primary reactance becoming comparable with the load impedance and so reducing the effective load on the valves.

These difficulties can be got over by a different design of output transformer. It is necessary to use a primary in which the two half-primaries are sectionalised and interleaved with each other as well as with the secondary. This naturally makes the output transformer more expensive and it is consequently pertinent to enquire whether it is worth while to use such a transformer when the output obtainable by doing so is only 6 watts as compared with 5 watts for the Class A condition. If the output were, say, 10 watts with Class AB instead of 5 watts with Class A, then there is no doubt that



A view of the amplifier during the course of construction showing the chief components in place.

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this condition would be worth while, and it would be also if it were necessary to economise in anode current consumption, as in the case of an AC/DC set where a rectifier has to be provided and there is usually a severe limitation on the permissible current.

In the writer's view there is in this particular case no justification for the use of Class AB operation, for an output of 5 watts is adequate for all normal domestic purposes. Although the anode current of the two valves will reach 80 mA., there is no objection to this in a DC mains set, for an increase in current consumption does not involve one in any increase in initial cost, and the increase in running costs is quite negligible.

We will, therefore, decide to operate in Class A, and the circuit of the output stage alone, neglecting feed-back for the moment, becomes that of Fig. 1.

Voltage and Current Requirements

From the valve-maker's figures we find that the grid bias must be −4.4 volts, so that the cathodes of the valves must be 4.4 volts positive with respect to negative HT; consequently, the screen voltage must be 184.4 volts positive with respect to this point, to give 180 volts between screen and cathode. In the case of the anodes we have to allow, also, for the drop in the DC resistance of the output transformer primary and for the drop in the anti-parasitic resistances R. A suitable value for these resistances is 50 ohms and the resistance for each half-primary of a good output transformer is likely to be 100 ohms. The anode current of each valve is 40 mA.; the total resistance in the anode circuit of each valve is 150 ohms, so that the voltage drop is 6 volts. The potential of the HT supply relative to negative HT must, therefore, be 210.4 volts. It can be seen that it will not be difficult to obtain this with 225 volts mains, since it will allow for a drop of some 15 volts in the smoothing equipment. Of course, those who are unfortunate enough to have only 200 volts mains cannot operate the valves at the full voltage and will consequently obtain a lower output.

The total anode current of the two valves is 80 mA., and the total screen current 21.2 mA., so that the total cathode current is 101.2 mA. To produce a 4.4 volts bias, therefore, the bias resistance R1 must have a value of 43.4 ohms, and the power dissipated in it is 0.456 watt, so that a resistance of 0.5 watt rating is just adequate.

This value of resistance is non-standard, but it can be obtained by using two resistances in parallel, 50 ohms and 350 ohms, both of which are standard values. The actual value of these two in parallel is 43.75 ohms, which is quite near enough.

The stage requires a load impedance of 11,000 ohms, and if we adopt the most common speech coil resistance of 15 ohms, the output transformer ratio comes out at 27.21. The primary reactance at the lowest frequency required should ideally be twice the load impedance as a minimum. This would mean a reactance of 22,000 ohms at 30 cycles. This, however, would mean a primary inductance of no less than 116 henrys, which is impracticably high if a good high-frequency response is to be secured at a reasonable cost. It is, in fact, necessary to compromise, and experience shows that it is satisfactory to make the primary reactance equal to the load impedance at about 50 cycles. This gives a primary inductance of 35 henrys only, which is much more reasonable. Actually, the inductance depends upon the voltage at which it is measured and increases with an increase of voltage. An inductance of some 25 H at 3.5 volts is a suitable figure for this case, and it will rise to five times this figure or more if measured at a voltage corresponding to that obtained on full output.

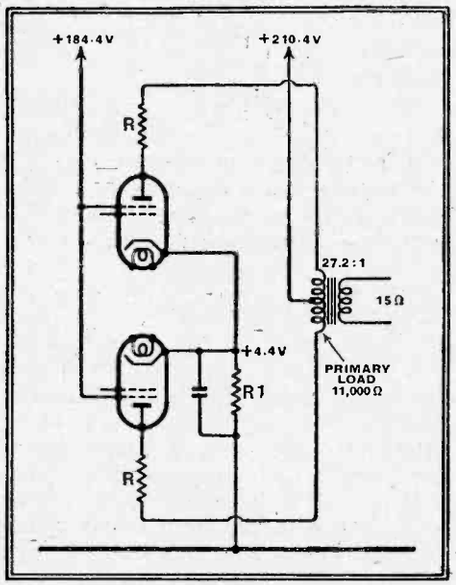


Fig. 1.—The basic circuit diagram of a push-pull output stage using tetrode valves is shown here.

(To be continued.)

On the Short Waves

PERHAPS in my last notes I wrote too soon when it was stated that short-wave conditions were not really bad; all that was wrong was that, owing to a low degree of sunspot activity, the optimum night frequencies were inconveniently low.

On the day on which my last notes appeared, Greenwich reported the appearance of a very large group of sunspots, only five similar groups having been noted since accurate records were kept. Conditions, particularly on the North American route, have been very poor indeed, although on Sunday, January 23rd, quite good 28 Mc/s signals from the U.S.A. were received until well after sunset. In response to enquirers, may I say that for reception on 10 metres and below I am using a new AC/DC British Midwest. This receiver is in all respects similar to the familiar AC model, but has not yet been generally released.

At Epsom the sound transmissions from Alexandra Palace completely closes the "Magic Eye" on this new receiver, even when a normal broadcast aerial is used.

To return to conditions. It is, of course, very difficult to say why very large sunspots seem to have such a disastrous effect on short-wave communication, especially between England, Canada and the U.S.A., when a few small spots seem to have just the opposite effect during most of the time they are visible.

Whatever may be the precise agent causing these fade-outs there seems little doubt, in view of the concentration of the effect at the poles, that charged particles ejected by the sun are to blame.

Nevertheless, a study of previous 27-day cycles shows that from now onwards we may expect conditions to improve. In spite of the brilliant red Aurora during the evening of January 25th last, good 'phone signals were intercepted from several U.S. amateurs in the 14 Mc/s band at 9.30 p.m., but after about 15 minutes they faded out, and northern Gs and GMs took their place. For an hour or so at least conditions remained remarkably good for the "locals" and, in particular, GM2UU was an outstanding 'phone signal.

One understands that all short-wave circuits were affected except that from Capetown, even the South American route being "out" for an hour or two before midnight.

One distressing feature of the past few weeks has been a very noticeable increase in the activities of the stations which cause such serious interference with the Italian and other foreign-language transmissions from Moscow and Madrid.

The transmitters affected are RW96 on 6.054 Mc/s, RAL on 9.565 or 9.590 Mc/s, and RKI on 15.08 Mc/s. In addition, the interference also affects Madrid, EDZ on 9.48 Mc/s and EAQ on 9.83 Mc/s.

Unfortunately, owing to the very broad nature of the carrier plus modulation of the jamming station, other transmitters besides the Soviet and Spanish ones suffer interference, which is often quite severe on GSA, and is at times noticeable on the Arabic broadcasts on GSC.

Two or three transmitters appear to be responsible, and they are multiple tone-modulated. It is a great pity it exists, for such interference will undoubtedly bring disastrous results to the already overcrowded broadcasting bands.

A feature of the period under consideration has been the afternoon performance of W2XE on 21.52 Mc/s. This transmitter alone of all the North American stations has succeeded in putting in consistent programme value signals into this country, with the exception of about two afternoons when conditions were exceptionally bad. The changing conditions gave rise to the following paragraph from a correspondent: "In radio, conditions change so rapidly and uncertainly that I find myself bewildered with even my own facts."

The Editor has passed me a very interesting letter from "G6DH," in which this well-known amateur draws attention to the long-period fade-outs on January 16th and 17th (mentioned earlier in these notes) on North American signals. Transmissions from other directions, he says, were hardly affected, but on both days the fade-outs were preceded by "hissing" of considerable intensity and duration on frequencies above 20 Mc/s.

ETHACOMBER.

Batteries v

By "CATHODE RAY"

"LOOK how much more a battery set costs to run!"

"*But the set itself is cheaper——*"

"It ought to be, for the rotten results it gives!"

"*——and so are the valves.*"

"But they are much more easily burnt out."

"*And how your mains set hums!*"

"And how yours squawks when the HT is running low!"

"*By the way, what did you mean—'rotten results'? A good battery set is better to listen to than any reasonably priced mains set; not so much crackle.*"

"I suppose you enjoy staggering home with recharged accumulators and new HT's at frequent intervals, or hearing their dying gurgles just as the Royal Command performance is due to start!"

"*I take care that nothing of the kind happens, but all you can do won't stop a breakdown at the power station. And do you remember when your smoothing condenser broke down and you had a bill for a new transformer and rectifier?*"

AND so the argument goes on. There are some cases for which a definite answer can be given. Where there are no mains, a battery set is better than a mains set. Any objections?

Where there are no batteries . . . "Oh, but there *is* no such place!" says Mr. Exide. Very well, then, so be it.

Where *both* are available the question cannot be settled outright. I suppose that in the vast majority of places where there are mains a mains-driven receiver is preferred. But as the Correspondence column has recently shown, it is possible for batteries to be used by choice. Each case must be considered on its merits. Some of the points in favour of or against each side have been suggested in the dispute we have just overheard. They, and some others, are set forth more dispassionately on these pages. In making a decision, the right weight must be assigned to each of these items before striking a balance.

Each Kind of Supply Has Its Advantages

On a Basis of Cost

Looking down a list of about 600 receivers now on the market, arranged in order of price, I see that the cheapest 2-waveband battery sets, inclusive of batteries, are just below £6, whether they are portable or table models. For "all-wave" models about £1 more is asked. Make the pounds guineas, and you have the prices of the corresponding AC models. It is rather surprising that there is so little difference at the cheap end of the list, because the transformer, rectifier, and smoothing components are a large proportion of the whole, and might be expected to have a corresponding influence on the cost. Also it is the cheaper battery sets that are made in large enough quantities for economical manufacture. There is such a small market for elaborate battery sets that they sometimes actually cost more than mains-driven models of similar performance.

That is so far as manufactured sets are concerned. Home construction is rather different, and although I have no comparative cost figures, I would say that the advantage is more definitely on the side of batteries.

It is even more difficult to present a general comparison of running costs. The one thing that *is* quite clear is that batteries are more expensive. Whether the difference is very enormous or only just enormous depends on circumstances. The cost of a Board of Trade Unit supplied by HT dry batteries is between £2 and £3. The same amount through the mains is seldom more than sixpence, and may be a halfpenny. The cost of LT current, if obtained from an accumulator charged by the dealer at standard rates, is about 6s. per unit, exclusive of depreciation, which is apt to be rather rapid. But as a mains valve takes about twenty times as much LT as a battery valve, it may actually cost more to heat if electricity is paid for at the lighting rate. At ¾d. per unit it costs about one-fifth as much.

Not all of the power taken from the mains is effective for HT. Usually one-to-two-thirds is wasted in rectifier, loud speaker field coil, etc. Even so, battery HT may cost nearly 1,000 times as much per unit in an extreme case. So, of course, much more care is taken in battery sets to reduce the HT consumption to a minimum, and up to a point it may be possible to do this without affecting the results. For example, a QPP system avoids much waste of current during programme intervals and quiet periods.

Consider three typical cases: (1) High quality reproduction (in *The Wireless World* sense) at something like the original sound intensity. To get this, one is bound to use lots and lots of HT (QPP and Class B outputs can be very good, but even so are just a *shade* less good than the very best). Dry battery supply is practically prohibitive.

(2) Average commercial loud speaker results. A five-shilling 120-volt battery every two months costs £1 10s. per annum. LT in the same period is likely to be a 6d. charge three times a month. Total for both, £2 8s. (I am not allowing for those who listen 24 hours per day, nor for those who only use the set to hear the King at Christmas.) Mains sets of equal HT stinginess are not made even in the cheapest classes, and they are generally used for longer hours, so the comparison is not strict; but assuming 40 watts consumption and 20 hours per week, the cost is 2s. 6d. per annum at ¾d. a unit, or 10s. at 3d. a unit.

(3) A small receiver for phones only. The HT consumption is so trifling, and a mains unit to provide this power so inefficient, that mains drive loses all its attractions, including even that of cheapness. Above all, it is difficult to avoid hum in the phones, and for long-distance reception of amateurs, for example, the quiet background with battery drive would be worth even some extra cost.

Those who put hum down as a very bad mark against mains for ordinary broadcast reception no doubt have some particularly unfortunate experience in mind. There is no reason why, with sufficient care, hum should be audible more than a yard or so from the loud speaker in even the quietest room. The fact remains that many sets as sold (and not always at the lowest prices) do hum perceptibly, and some people don't like it.

Inconstant Battery Voltage

The deterioration in results that one has to suffer from a receiver if a reasonable HT battery life is to be obtained is a serious objection, in my opinion. And so is the bother of seeing to recharging and renewing. Although I am a technical bloke I am as lazy as the next man, and hate to have to think about batteries. If the HT is run down to half its full voltage (and some people are meaner even than this) the output is down to about a quarter of its original quite scanty enough milliwattage. Of course, some mains voltages fluctuate rather wildly, but real

IN FAVOUR OF BATTERIES.

First cost usually rather less.

No hum.

No mains-borne interference by direct connection.

Simpler receiver.

Less heat, so less risk of tuning drift and component breakdown, and less ventilation needed.

Less electrical stress and no expensive power-pack breakdowns.

No uncontrollable breakdown due to supply failure.

No external connection necessary: may be portable.

No waiting for valve to heat up.

Cheaper valves.

Mains

trouble of this sort is quite exceptional. A change of 10 per cent. is considered to be "wild"; not 50 per cent., or even 30!

I confess that waiting for the valves to come to life is my chief objection to mains drive. One particular make is, or was, especially irritating. If there is anything really important in the news it comes in the first paragraph, which can easily be lost while the valves are heating. And with a battery set one can find

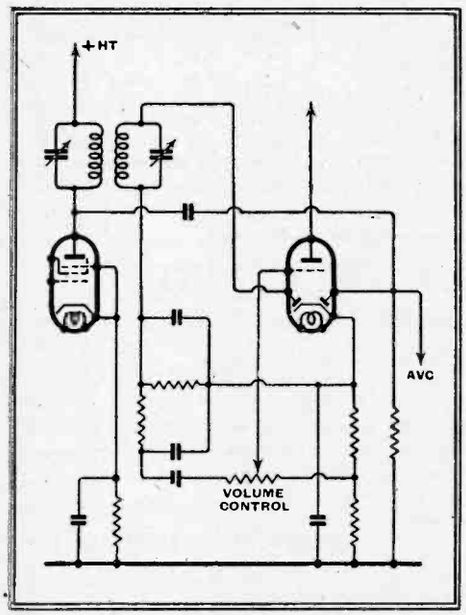


Fig. 1—This kind of thing cannot be done with battery valves.

out at once what is on, and whether the wanted programme is ready to start. But if the set has been out of use for a long time it is the other way about, only more so; it is a case of waiting until new batteries can be bought.

To refer to the more technical points, the separate heater of the mains valve allows greater scope in circuit design. Look at Fig. 1, for example, which shows a bit of a typical superhet circuit. The bias resistors between cathode and earth line of the second valve provide three different bias voltages for the various electrodes of that valve, while the bias voltage of the other valve (and valves not shown) can be arranged quite independently. This is so much of a convenience that a few indirectly heated battery valves have been brought out for no other reason.

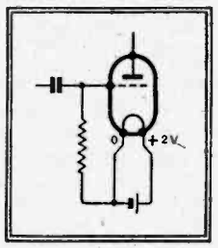


Fig. 2 — Explaining another weakness of battery valves.

Then the cathode of a battery valve, being the same thing as its heater—the filament—has at least two volts difference between different parts of it. In Fig. 2, where a valve is shown with no grid bias battery, the grid is unbiased with regard to one end of the filament, but biased 2 volts negative with regard to the other. In the same way, if negative bias is provided, it is greater towards one part of the filament than to another; and as the bias is varied from the "bottom bend" different parts of the filament come into action at different bias voltages.

There are other little complications that would take some time to explain fully.

On the other side, the relative absence of heat from a battery valve is a distinct technical advantage, especially for short-wave reception, in which a large rise in temperature is liable to make the tuning drift right away from the station. It is perhaps a small point, but every little helps in such a poor case as batteries have to show for general use. One concludes that it is difficult to justify them except for such special things as portables, some short-wave sets and headphone receivers.

IN FAVOUR OF MAINS.

Running cost far less.
In consequence more power can be afforded.
So there is less risk of distortion due to overloading.
Less variation of performance due to supply variations.
No deterioration of power when out of use.
Power supply has not to be carried about.
Less attention needed.
Momentary short-circuits less disastrous, especially to valves.
Greater variety of valve types available.
Unipotential cathode has certain technical advantages.
So has separate heater.
Fewer valves for a given performance.
Valves more robust.
No hand winding of gramophone motor.

FLYING THROUGH FOG

A Radio "Robot"

IF two frame-aerials are mounted at a fixed angle to each other on a rotatable shaft, each will receive equal signals from a distant transmitter, provided the latter is situated along the line bisecting the common angle. If, however, the signal comes from any other direction, one of the aerials will pick up more energy than the other. The stronger signal-voltage can then be used to rotate the aerial shaft, through a relay mechanism, until the frames automatically set themselves again into the "balanced" position, with the transmitter midway between them.

The arrangement, in fact, acts as an automatic "seeker" which can be used, among other things, to control the flight of a pilot-less aeroplane from a distance. As the wireless control beacon comes into operation, the frame aerials on the aeroplane automatically set themselves into line with it, and by their movement alter the steering controls so that the aeroplane follows suit.

The same principle is used in a recent American scheme for guiding a pilot through fog to the nearest airport, and for helping him to land safely even when the visibility is practically nil.

The pilot first transmits a series of morse "dashes" from the air. These are received by two, or preferably three, "seeker" aerials, which are arranged at different points about the aerodrome, and at once "set" themselves into line with the invisible craft. Thereafter they automatically "follow" it throughout its flight. Each seeker is electrically connected to a central station on the aerodrome, where the angle through which it rotates is "repeated" by a corresponding pointer. The latter—two or three in number—are co-ordinated over a map where they register the path of flight of the machine from moment to moment.

Simultaneously, the airport "call" is sent out from the aerodrome to the pilot, and two beacon transmitters which mark out the proper course by overlapping beams are also brought into operation and directed towards the plane. As soon as he identifies the call signal the pilot fits a "chart" of that particular aerodrome into a panel on his dashboard, and presently sees a spot of light move over its surface. The spot represents his own position in the air, and he thereafter steers so as to keep it clear of the hangars or other buildings which are marked on the chart. In this way, he is able to avoid obstacles that are completely masked from direct observation.

How Position is Shown

The moving spot indicator is controlled by the overlapping beams transmitted from the aerodrome. These carry separate tone frequencies, and the degree of modulation, as between one tone and the other, is automatically regulated by the position of the aeroplane as registered on the map at the aerodrome control station. The wireless receiver on the plane is fitted with two filter circuits which separate the two notes, and apply the corresponding rectified currents to control the movement of two slotted vanes. These move in such a way that the point of intersection of the two slots automatically "follows" the movement of the machine. In other words, the record first made at the aerodrome of his changing position in the air is "repeated" on a chart placed directly before the pilot's eyes, so that he can steer a safe course.

The British Journal Photographic Almanac, 1938.—Published by Henry Greenwood and Co., Ltd., 24, Wellington Street, London. 2s. net.

THIS well-known photographic annual appears this year in an even more comprehensive form than formerly. It contains a photogravure supplement and a number of illustrated articles of interest to the serious photographer. Other contents include technical information and reviews of photographic apparatus and accessories.

THE AURORA: Effect on SW Ship-Shore Communication

AT Burnham Radio, the station through which the short-wave ship-to-shore Portishead Radio is remotely controlled, the first indications of exceptional wireless conditions became apparent about 1750 G.M.T. on January 25th. Abnormality was first marked on the 18-metre band, which is Burnham's main long-distance communication channel until 2000 G.M.T.

A British liner approaching New York communicated with Burnham at about 1730 and commenced sending a batch of messages, but by 1800 signals from this vessel had gradually faded to inaudibility, despite the fact that reception and transmission were being carried on with directional aerial arrays.

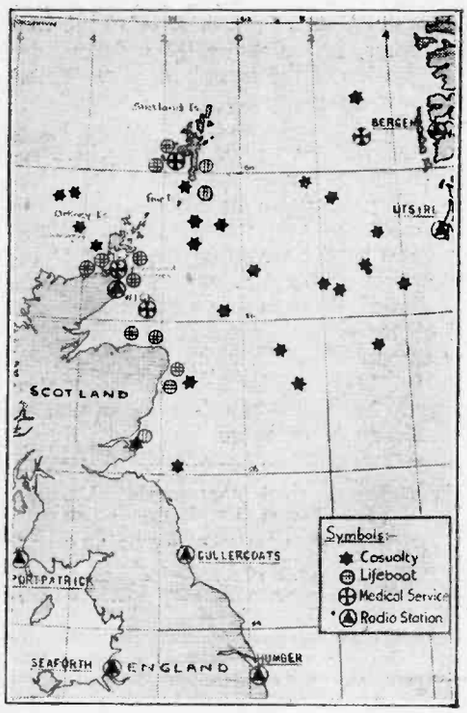
As soon as this difficulty became apparent, Amagansett Radio—Burnham's "opposite number" on the American seaboard—was called, but without success. This Long Island radio station is usually so well received that immediate contact can be relied upon, but although Burnham ran an automatic calling slip for nearly two hours, no reply was forthcoming from either the liner or the U.S.A. station. Amagansett was just audible about 1900 G.M.T., but communications from the westward on its frequency continued to be nil, except that Palo Alto (California) Radio was readable on 18 metres at maximum strength, which was unusual.

Communications on the 24-metre band were not noticeably adversely affected other than to the westward; the American coast stations were just audible. Conditions on 36 metres were variable, with intermittent periods of extreme fading and very heavy atmospherics; this state continued until about 0400 on January 26th. On the other hand, good communication was maintained on the 2,013-2,479-metre band.

The spectacle at Burnham-on-Sea was remarkable. From west to north-east the sky to a great height was a dull pink in colour gradually changing to various tints of green.

MURRAY IS STILL BUILDING

MAJOR GLADSTONE MURRAY, who left the B.B.C. in order to take up the position of General Manager of the Canadian Broadcasting Corporation, has, after a brief year, exerted that influence which did so much to build the organisation of British broadcasting. In the year the C.B.C. has increased the sustaining programmes from six to twelve hours a day, has put overseas broadcasts on a regular footing, and, as recently announced in these pages, has built two new stations. It has also permitted the building of numerous 100-watt privately owned stations. There are now fifty-four stations in the C.B.C. network, and it is proposed to start publishing a programme magazine.



SOS MESSAGES broadcast by the B.B.C. in 1937 were analysed in these pages last week, but it should be remembered that they are vastly outnumbered by calls for help from shipping. This map shows positions of casualties of various kinds helped by the G.P.O. station at Wick during fourteen consecutive days of stormy weather last winter.

NEWS OF

START POINT

Channel Islands' Plea

AS announced in *The Wireless World* in November, the proposed 100-kW B.B.C. transmitter at Start Point, South Devon, will have two masts, one being used as the aerial and the other as a reflector to reduce the strength of radiation over the sea to the south. Consequent upon this comes the plea from Guernsey, sponsored by the *Guernsey Evening Press*, asking that the reflector be not used as it would impair the already poor "Channel Islands Regional Service."

In reply, the B.B.C. stated that it felt that Start Point would give more satisfactory results than at present.

[Courtesy: Daily Telegraph

THE MEMORY of Marconi is honoured by the issue of a new Italian stamp which bears his name and portrait above the Fascist Lictor's rods and the emblem of the House of Savoy.

SUNDAY TELEVISION

B.B.C. Programme Policy Maintained

THE long anticipated addition to the present television programme hours, by the introduction of Sunday transmissions, was announced by Mr. Gerald Cock, B.B.C. Director of Television, during his talk to National listeners on Tuesday last.

Although expected to be given in the afternoons, the transmissions, which commence on April 3rd, will be from 9.5 to 10.5 p.m., the reason for this odd time being that listeners will thus be able to hear the news bulletin before switching over to television.

It is authoritatively stated that the introduction of a Sunday afternoon programme will follow as soon as possible.

The programmes will exclude all jazz and variety, but will include drama and light musical shows and all the ground already covered by television. When started, the afternoon programmes will specialise in O.B. features.

Televising the Derby

As stated in these pages last week, the B.B.C. had still to obtain permission from the Epsom Grand Stand Association, which controls the racecourse, before the much-talked-of possibility of televising the Derby could be realised.

It was officially announced last Friday by the Association that it "would not in any circumstances give permission for the televising of any races on Epsom Downs." We understand that this step was taken before any representation had been made by the B.B.C. to the Association. It is unfortunate, for we understand that excellent pictures have been received at A.P. during tests carried out near the racecourse.

DAVENTRY IN CANADA

"Clear as a Bell Chime"

FOLLOWING close on the news from a reader in California, published two weeks ago, that the B.B.C. transmissions are poorly received there, come the following refreshing extracts from Canadian letters received by the B.B.C.

A correspondent from Saskatchewan (425 miles west of Winnipeg, 125 miles north of Regina), writing on January 4th, states that the 19.6-metre transmission GSP daily gives a very good signal, averaging R8, Q5.* Very often it is received at R9 with speech as clear as a bell chime. He goes on to say that the German transmissions to N. America from DJB (19.74 metres), DJD (25.49 metres) and DJC (49.83 metres) were not heard from the first week in November until the last day in December. The Paris station TPA3 (25.23 metres) has also been out of the picture during that period, but is just coming through at R6, Q4. In fact, he says, "Your Daventry transmitters are the only ones to give a reliable day-to-day service."

From Vancouver come the congratulations of a listener who says that Daventry is heard as plainly as locals.

* Complete intelligibility.

THE WEEK

RELAYS FROM ABROAD

Some Interesting Facts

EXACTLY 291 relays were taken by the B.B.C. during 1937 from foreign countries and the Empire. An interesting analysis shows that 155 of these relays were carried out *via* special telephone circuits belonging to the British and foreign Post Office administrations. Post Office radiotelephone services were used for 102 relays.

The remaining 34 relays were picked up by Tatsfield from short-wave stations overseas. In addition, a large number of transmissions were received at Tatsfield and electrically recorded at Maida Vale for subsequent inclusion in feature and composite programmes. Care has to be taken that no indiscriminate use is made of haphazard recordings, and in every case the copyright question has to be investigated.

Some of the intended relays were failures. Of those taken over land lines, eleven were spoilt owing to distortion or interruption. Some of the European cables were 1,000 miles in length with line amplifiers, and perhaps twenty repeater stations.

As might be expected, the radio link was not quite so reliable. Completely successful relays by Post Office radio telephone services number 79; only three, however, were complete technical failures, the remaining 20 reaching the requisite technical standard for rebroadcasting, being only partially marred by surge distortion and atmospheric conditions.

Perhaps the most remarkable feature of the analysis is the success of Tatsfield reception. Of the 34 relays attempted it was necessary in only two cases to abandon the broadcast. No doubt these satisfactory results were due to "diversity" reception in which the effects of fading are greatly reduced by the simultaneous use of three receivers connected to three separate aerial systems.

RECIPROCAL PROPAGANDA

AS the result of negotiations begun by the British Ambassador, between the Argentine Propaganda Department and the B.B.C., it is understood that an agreement has been arrived at whereby the B.B.C. is to undertake publicity on behalf of the Argentine broadcasts from Buenos Aires, on 31 metres, in return for publication of the Corporation's programmes in the Argentine.

It is also likely that an interchange of special programmes between London and Buenos Aires will commence shortly.

EUROPEAN RECORDINGS EXCHANGE

ON the return from Berlin in November of Mr. Fletcher, Recorded Programmes Executive of the B.B.C., we reported the fact that both the Deutschland Rundfunk and the B.B.C. were anxious to build up record libraries designed to present a cross-section of contemporary life and that other countries were interested in the possibility of forming a European Recordings Exchange. This idea seems to have gone a stage farther towards fruition, for the Programme Committee, during the December sessions of the International Broadcasting Union, proposed the establishment of an archive of recordings of nationally and internationally historic broadcast events.

Another proposal from this committee was that on New Year's Day, 1939, a gigantic international round-the-world broadcast should be arranged.

ENGLISH BROADCASTS FROM FRANCE

RUMOURS that the French stations are to cease broadcasting in English has produced a spate of letters in the B.B.C. postbag bitterly complaining against the Corporation's alleged responsibility in the matter. Many listeners believe that the B.B.C. has made direct approaches to the French authorities urging the suspension of all sponsored programmes intended for British ears.

Actually, the B.B.C. has never come into the open on this question, but no shrewd observer can have doubts as to the attitude of Portland Place to these rival attractions abroad. What must be borne in mind, however, is that the Corporation has no authority to approach a foreign Government. This can only be done through the Foreign Office.

BROADCASTING IN INDIA

THE Controller of Broadcasting in India, Mr. L. Fielden, in a recent broadcast talk from the Bombay station, gave some reasons why short-wave transmitters, in preference to medium-wave, should be employed in India. The main reason given was that short-wave transmissions, being less affected by atmospheric disturbances, which are very marked during the summer months, would give a more satisfactory service throughout the year.

A special receiver for India has been marketed by the German Saba company. It has four wavebands, three being for the short waves, and covering 13.6 to 102 metres, and one for the medium band—200-600 metres. A feature of the receiver is that the tuning dial is calibrated with the names of the Indian and Far Eastern transmitters. This 6-valve receiver is the first to be so calibrated.

ANOTHER LUXEMBOURG?

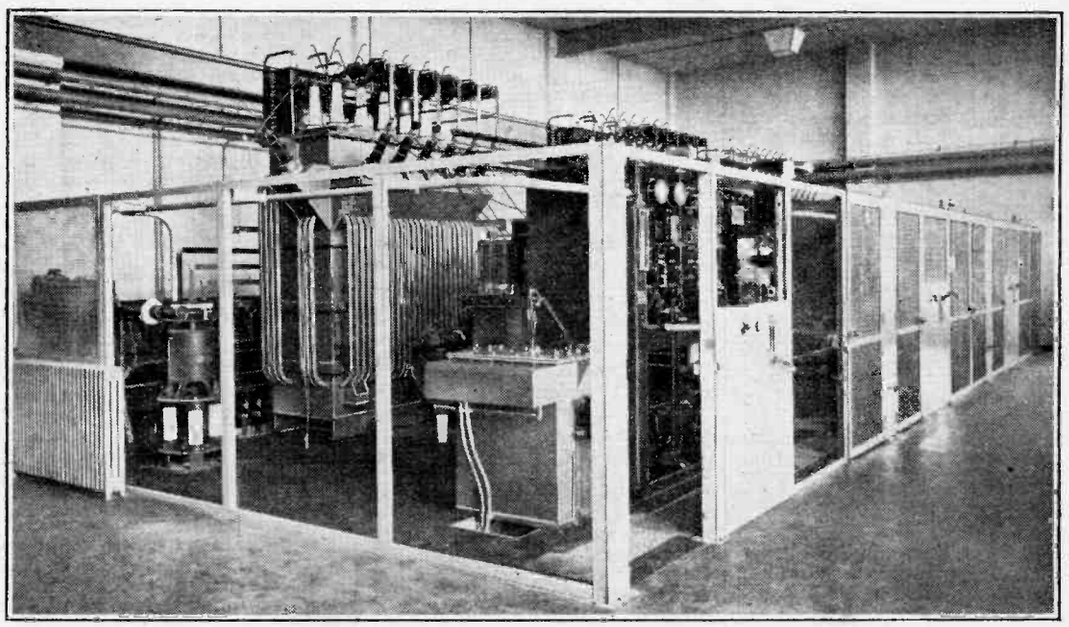
IT is reliably reported that a syndicate is contemplating the erection of a high-power station in Liechtenstein, the small state between the Austrian and Swiss frontiers. The inhabitants of this state pay a Swiss listener's licence fee, and the control of its posts and telegraphs is in the hands of Switzerland. It would, therefore, be necessary for the sponsors of this station to obtain permission from that country.

GOOD FOR EVIL

AMATEURS who find that their call signs are being used by unlicensed transmitters, usually inform the licensing authorities in the hope of bringing the offender to book. An amateur, however, in Eire, whose call was being used by a pirate, offered to pay the necessary £3 licence fee if the miscreant applied for the official permit, the reason being that the offender was putting out such good telephony that it would have been a loss to amateur radio if he stopped transmitting.

R.C.M.F.

AT the annual general meeting of the Radio Component Manufacturers' Federation, held on January 24th, Sir Percy Greenaway, Bt., was again appointed President. Vice-



THE B.B.C. EMPIRE STATION at Daventry uses British Thomson-Houston 400-kW, 12,000/22,000-volt rectifier equipments, shown here with screens partly removed. Five of these are installed, leaving space for a sixth. Normal voltage control is effected by induction regulators, but the equipment is also capable of giving grid control of voltages down to zero. The control grids are also used for high-speed arc suppression.

presidents are Col. G. D. Ozanne, Mr. A. F. Bulgin, Major L. H. Peter, Mr. E. M. Lee and Mr. F. H. McCrea. The new Chairman is Mr. A. Middleton, of Ferranti, and the Vice-Chairman Mr. Weese, of Quadrant Carbon and Metal Products. Mr. Taylor, of T.C.C., is the treasurer, and Mr. C. Gordon Bonser continues as secretary.

The council consists of the Executive Delegates from the following firms: Belling and Lee, Bulgin, Dubilier, Ferranti, Plessey, Quadrant Carbon and Metal Products, Reproducers and Amplifiers, Standard Telephones, Tannoy, T.C.C., Westinghouse and Wingrove and Rogers.

MAJOR L. H. PETER, of Westinghouse, the Chairman of the Radio Manufacturers' Association for the current year. The Rt. Hon. Lord Hirst of Witton has accepted the office of President.

FROM ALL QUARTERS

DF Memorial

THE Prime Minister of New Zealand has proposed that the Dominion Memorial to the crew of the American flying boat, *Samoan Clipper*, should take the form of a wireless beacon to direct aircraft arriving at Auckland. The entire crew of seven were killed when the *Clipper* crashed while on the last stage of its flight from Honolulu to Auckland.

Television with a Punch !

IT is reported from Germany that the power of Berlin's new television transmitter will be 20 kW, and of those on the mountain tops, Brocken and Feldberg, 50 kW each.

Radio on L.P.T.B. Coaches

A NEW fleet of twenty-four Green Line coaches which are to operate on special routes of the London Passenger Transport Board have been wired for the installation of wireless equipment. One of these coaches is already in use and three more are shortly to be equipped. If these prove satisfactory the remaining twenty will also be fitted out.

Silence is Golden

Is America waking up to the beauties of occasional silence? Says the *Radio Dial*, Cincinatti: "The other evening, while listening to the B.B.C. stations, there were twenty-two minutes of silence between Transmissions 4 and 5. Imagine the utter consternation that would run on this side over twenty minutes of dead air; but, of course, the British are right. One trouble with American broadcasting is that it goes on and on and on."

"D.G." on the High Seas

SIR JOHN REITH is enjoying a health cruise to the West Indies and is not expected back at Broadcasting House for another month. In the interval Vice-Admiral Sir Charles Carpendale is acting Director-General, probably for the last time, as his retirement takes place at the end of March next.

Television in France

TELEVISION transmissions from the Eiffel Tower take place from 4.30-6.30 p.m. on Sundays and from 4.30-5.30 p.m. on week-days. Sound is on 7.14 metres and vision on 6.52 metres.

A Lesson in Licences

THE immediate result of the 10 per cent. rise in the Austrian wireless licence fee was that some 37,000 listeners renounced the use of their sets. Debates on the advisability of raising the cost of licences in France have, in consequence, been considerably influenced.

Radio Servicing in Denmark

IN order to raise the standard of radio servicing in Denmark a new organisation, to be called Radio Teknisk Forening, has been formed in Copenhagen. A special three months' course, arranged under the auspices of the Copenhagen Institute of Technology, is obligatory to membership. This course will have to be attended annually as a refresher.

France's Radio Minister

THE Postmaster-General in the new French Popular Front Government is also the Minister of Radio, M. Fernand Gentin. He has had a brilliant career both in industry and politics and his influence on the radio organisation is likely to be a powerful one.

New Stations on Order

SWITZERLAND has now ordered its new 25-kW short-wave transmitter, which should be ready for operation at the end of the year. This station will relieve the pressure on Radio-Nations, the Swiss commercial station which is used by the League of Nations.

A 100-200 kW transmitter has been ordered by the Algerian Post Office for Mount Eucalyptus. It is to replace the present low-powered station and will radiate on 318 and 269.5 metres.

The Lorenz Company, of Germany, is building a new short-wave station for Yugoslavia on a site about 8 miles from the town of Batajnice. It will have a power of 10 kW and will be adaptable for special transmissions directional on the United States and South America.

Italy's third ultra-short-wave transmitter will shortly be erected at Milan, and will be used for experimental television transmissions.

A short-wave 50-kW transmitter is to be built in the suburbs of Vienna. It will have four beam aerials.

Singapore Dock Broadcast

THE Dutch radio-telephony service from Java to Amsterdam will be used in the B.B.C. relay of the opening of the Singapore naval base on February 14th. The actual ceremony takes place between 10.45 a.m. and 1.50 p.m. and will be relayed direct in the Empire transmissions. Home listeners will hear an electrical recording in the National programme at night.

Blind Navigation

AN adaptation of a blind landing system is to be installed on the Danish railway ferry boats operating on the Korsor and Nyborg service, the important link between the eastern and western halves of the island kingdom.

The Noise Nuisance

BY-LAWS for the prevention of unnecessary noise have been established in many places, and now people in Gravesend who work their loud speakers so as to cause annoyance to neighbours will be liable to prosecution under a by-law which has been proposed by the Town Council and now awaits approval by the Home Office.

Index and Binding Case

THE Index for Volume XLI of *The Wireless World*, July to December, 1937, is now ready, and may be obtained from the publishers, at Dorset House, Stamford Street, London, S.E.1, price 4d. post free, or with binding case 3s. 1d.

Radio Helps Lighthouse Builders

WITH special permission from the P.M.G. transmitter-receiver communication established between an amateur in the new Sorel Point lighthouse, Jersey, and another on board a tugboat, was instrumental in fixing the exact width of the beam of red light to be radiated from the lighthouse over just that sector of sea dangerous to shipping.

Mediterranean Broadcasting

EGYPT is planning the construction of a 100-kW transmitting station at Cairo. The subject will be raised at the International Telecommunications Conference.

Italy and Ethiopia

COMMENCING this month lessons in Abyssinian dialects will be broadcast by all Italian stations. The *temporary* wireless station at Addis Ababa, which is soon to be replaced by a high-powered transmitter, is to broadcast in Amharic, Galla, Arabic and Italian.

International Language

THE increasing use of Esperanto in broadcasting is shown by the fact that during January there were eighty transmissions in the international language, the majority emanating from Hilversum, Rome, Prague and Radio Paris.

Loud Speaker Demonstration

AT the meeting of the Romford section of the National Radio Engineers' Association, to be held on February 23rd, Mr. G. F. Redgrave, of Voigt Patents, will lecture on horn loaded loud speakers. All interested are invited to attend at 8.30 at "The Durham Arms," a well-known local hostelry.

Arctic Radio

WIRELESS apparatus used in the Arctic will figure amongst the exhibits shown by a mobile Russian *intellectual exhibition* which is visiting America, France and England this year.

THE WIRELESS INDUSTRY

IN view of the increasingly exacting standards of frequency stability in certain receiver circuits, it is interesting to learn that Dubilier has introduced a new range of moulded metallised fixed condensers in which capacity drift under the influence of changing temperature is extremely small, as compared with "plate" condensers. The new series, embracing Types S690W and S691W, comprise mica dielectrics with electrodes automically attached by the Dubilier metallising process.

◇ ◇ ◇ ◇

Quartz crystals for the various amateur broadcast and commercial frequency bands are described in the 5th Edition of the Quartz Crystal Company's catalogue, which also deals with components of especial interest to transmitters. Address: 63, 71, Kingston Road, New Malden, Surrey.

◇ ◇ ◇ ◇

Speeches of delegates to the Cairo Telecommunications Conference will be amplified by G.E.C. equipment.

An extremely informative booklet dealing with Centralab potentiometers, etc., particularly from the point of view of avoidable noise in receiver circuits, has just been issued by British Centralab, Ltd., Canterbury Road, High Road, Kilburn, N.W.6.

◇ ◇ ◇ ◇

A useful and instructive sectional chart showing the construction of a cathode-ray tube, as well as the method of focusing, has just been produced by Mullard Wireless Service Company, of 225, Tottenham Court Road, London, W.1. Although these charts are primarily intended for technical schools, etc., copies will be sent free to readers who apply to the company.

◇ ◇ ◇ ◇

Hounsells, Ltd., of Bridport, Dorset, manufacture a four-strand fibre line, which, on account of its weather-resisting properties should be especially suitable for use as the supporting spans of anti-interference aerials. Enquiries from manufacturers are invited.

The Diode Detector

Avoiding Distortion in the Load Circuits

Concluded from page 76 of last week's issue

By W. T. COCKING

IN the foregoing discussion it has been assumed that the circuit of the detector corresponds to that of Fig. 1 and also that the reactance of the condenser C is zero at radio-frequency and infinite at modulation frequency. For the present we shall still make this latter assumption, but shall consider the circuit of Fig. 5 which is more commonly used than that of Fig. 1. The change consists of the inclusion of C_1 and R_1 to prevent the steady rectified voltage from being applied to the AF valve.

This change, however, considerably alters the conditions and introduces the possibility of serious amplitude distortion. For a steadily maintained input C_1 and R_1 play no part and the conditions are the same as if they were absent. For changes in the amplitude of the input voltage, such as those caused by the modulation, the detector load resistance is no longer R but R and R_1 in parallel, assuming C_1 to be of large enough capacity, as will usually be the case in practice.

The operation for rapid changes in the carrier amplitude is thus no longer along the load line drawn for R in Fig. 3. This line still represents the conditions for the carrier, but not for the modulation. To see what happens at modulation frequency we must draw a new load line through the intersection of the DC load line for R with the valve curve for the particular input which we are going to use. This new load line must have a slope corresponding to R and R_1 in parallel ($=RR_1/(R+R_1)$).

Suppose, for instance, that we make $R=0.25$ MΩ, then the conditions for the carrier are given by this line in Fig. 3. If we use a carrier amplitude of 15 volts RMS ($=21.2$ v. peak) our new load line must be drawn through the point A and is the line BC for the case when $R_1=R=0.25$ MΩ. Now, if the carrier is modulated 100 per cent. it will vary between 30 volts RMS and zero and we must read off the changes in output voltage and current along the line BC. At 15 volts input the rectified current is 77μA. and at 30 volts it is 225 μA. The change in current is thus 148 μA. on the positive half-cycle of modulation. On the negative half-cycle the input is zero. A glance at the dynamic characteristic BC in Fig. 4, for the abrupt change in the curve clearly shows the point at which distortion commences. For this case it is for 9.5 volts peak input, and, as the carrier input is 21.2 volts peak, the detector is free from distortion for modulation depths up to 55 per cent., but not for deeper modulation.

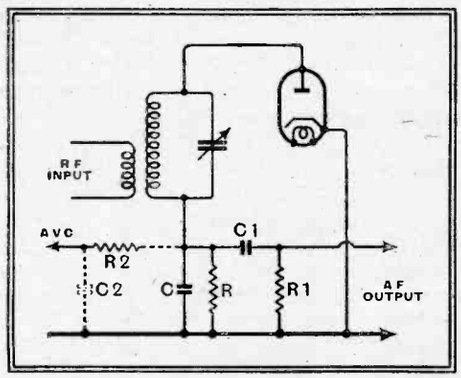
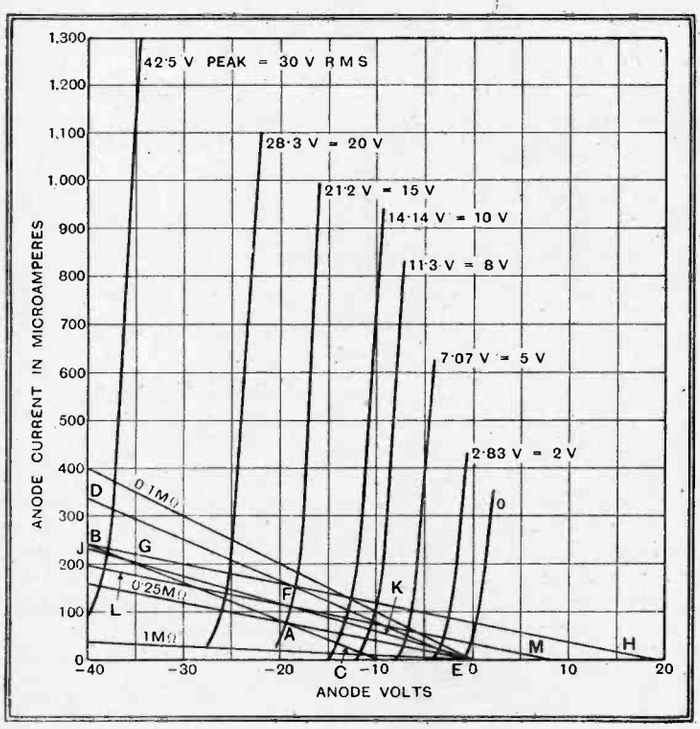


Fig. 5.—This diagram shows the conventional detector circuit. The DC load is provided by R, but the AC load by R, R1 and R2 in parallel.

THE importance of load impedance in the avoidance of distortion is dealt with in this article, and it is shown that the AC load must be kept as nearly as possible equal to the DC load. An alternative method of avoiding distortion by using a positive bias is also discussed.



The set of diode curves which appeared in last week's issue as Fig. 3 is repeated here for easy reference.

It can be shown that the maximum depth of modulation which the detector can handle without distortion is equal to the ratio of the AC to DC load circuit resistances; that is, $m=R_1R/R(R+R_1)=R_1/(R+R_1)$ for Fig. 5. This equation gives $m=0.5$, or 50 per cent. modulation for the case when $R=R_1$. Working graphically, however, we found that the detector could deal with 55 per cent. modulation. The discrepancy is interesting and the reason for it points the way towards reducing the distortion.

A High AC Load

Before dealing with this aspect of the matter, however, let us consider the above expression for modulation depth a little more deeply. It is obvious that no values of R and R_1 will enable distortion to be avoided on 100 per cent. modulation, but that the higher the value of R_1 relative to R, the deeper can be the modulation before distortion sets in. Obviously, therefore, the first step is to make R_1 as large as possible. Here we are limited by the following valve, and it is generally considered unwise to make the grid circuit resistance of the ordinary small triode or RF pentode greater than 2.0 megohms; with an output valve the resistance must be 0.25 MΩ or less.

We are thus limited to a maximum of 2.0 MΩ for R_1 in normal circumstances. We can in theory make R as small as we

curves shows that the output is zero, but that it is also zero for inputs less than about 6.5 volts RMS, for the load line intersects the current axis at this point! The application of the usual formula, which is probably not very accurate for this extreme case, for second harmonic distortion shows the harmonic to be nearly 16 per cent.

The effect is even more clearly shown by plotting the

The Diode Detector—

like, but in practice we shall not be able to maintain very good linearity for lower values than 100,000Ω with the ordinary small diode. Furthermore, the efficiency will fall off and the detector will damp the tuned circuit heavily. In general, 0.25 MΩ is taken as a suitable compromise, and with $R_1 = 2.0$ MΩ $m = 2/2.25 = 0.89 = 89$ per cent. This is fairly deep modulation and the detector is quite good.

In practice, however, matters are often much worse, for AVC is often provided by the detector and the AVC filter forms another shunt to the load circuit. This filter is shown dotted in Fig. 5, and when it is included the effective AC load is no longer R and R_1 in parallel but R, R_1 and R_2, all in parallel. Now, valve makers often place a limit to the total resistance which must be included in the grid circuit of an RF valve and the limit is 2.0 MΩ. If a resistance is common to more than one valve its value multiplied by the number of valves must not be greater than 2.0 MΩ.

Now, in Fig. 5, R and R_2 are common to all controlled valves. Suppose there are two, then the maximum value for R and R_2 together is 1.0 MΩ, and if R is 0.25 MΩ, R_2 must be 0.75 MΩ. If R_1 is 2.0 MΩ as before, the AC load is the parallel value of 0.25 MΩ, 0.75 MΩ and 2.0 MΩ; that is, 0.1715 MΩ. Consequently, $m = 0.1715/0.25 = 0.686 = 68.6$ per cent.

The Use of Positive Bias

One way out of the difficulty is to make R quite small. This has the disadvantage of making the input impedance so low that a power RF stage is necessary to drive the detector. Another way out is to insert a choke in series with R. If R and R_1 have the same value and the choke inductance and C_1 are correctly proportioned, the AC and DC impedances are the same and the circuit is distortionless. There is no correction for R_2, however, and even when R is as low as 50,000Ω the choke must have an inductance of several hundred henrys. This solution is consequently expensive and is open to the objection that the choke is liable to pick up mains hum.

There is, however, a third solution to which the way is shown by the discrepancy between the modulation depth the valve can deal with theoretically and that which it can actually handle as found graphically. The formula which we have been using is derived on the assumption that the diode anode current ceases at zero anode volts, whereas in practice it continues to flow until the anode is appreciable negative. Now, the effect of this is the same as the application of a positive bias to the anode of the theoretical diode which ceases to pass current at zero volts. Consequently, it seems reasonable to suppose that we could increase the modulation capability of the detector by applying a positive bias to its anode.

Let us turn back to Fig. 3 and see what can be done in this direction. Taking $R = R_1 = 0.25$ MΩ, the AC load is 0.125 MΩ. Now for distortionless detection with 100 per cent. modulation the AC load line must cut the curve for zero input, so we can draw the line from the point at which the zero input curve cuts the scale for zero anode current. This gives us the line DE in Fig. 3. We can now draw the DC load line (for 0.25 MΩ) through the intersection of this line with the diode curve for the particular input with which we are concerned. Suppose this is 15 v. RMS, we draw the line GH and this cuts the zero anode current ordinate at +18.75 volts. This, therefore, is the positive bias which must be applied for the avoidance of distortion for modulation depths up to 100 per cent. under the conditions quoted.

It is easy to see from Fig. 3 that if a larger input is applied the bias must be increased to avoid distortion. It is not necessary, however, to reduce the bias for smaller inputs, for the AC load line will still cross all valve curves. Several general conclusions follow from the foregoing: the bias should be determined for the maximum likely input; the bias required increases with input; the bias required increases as the ratio of the AC to DC loads falls.

When AVC is taken from the detector some care must be taken in the arrangement of the circuit to ensure correct operating conditions for the controlled valves. With the circuit of Fig. 5 and no bias there is a potential of about −0.8 volt applied to the AVC line with no signal, due to the anode current flowing through R. This increases the bias on the controlled valves and can be offset by reducing their cathode bias resistances When we apply a positive bias we must take care that it is not also applied to the AVC line. This can be done by the arrangement of Fig. 6, in which the bias is obtained from the HT supply with the aid of the resistance R3. The capacity of C_3 should be large enough to bypass this resistance R3 effectively at the lowest audio-frequency.

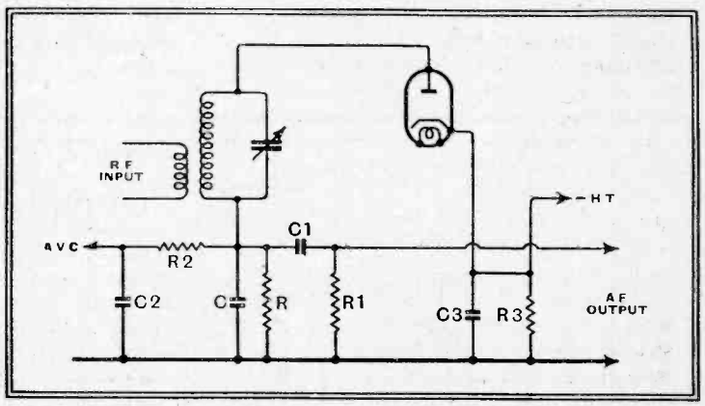


Fig. 6.—The circuit of Fig. 5 is shown here, but with a positive bias on the diode anode obtained by inserting R3 between the earth line and — HT.

The no-signal voltage across R then depends on the value of R and upon the anode current. With the values quoted above it is about +0.25 volt, and this can be offset by increasing the initial bias of the controlled valves by this amount. It is, of course, wise to design the circuit so that the no-signal voltage across R is as near zero as possible in order to reduce to a minimum the effects of variations in valves and components.

Before concluding this section it may be as well to determine the conditions existing when AVC is used, just as we did for the case of the unbiased detector. Taking the same values as before ($R = 0.25$ MΩ, $R_1 = 2.0$ MΩ, $R_2 = 0.75$MΩ) we have 0.1715 MΩ for the AC load and 0.25 MΩ for the DC load. This gives the line JK (Fig. 3) for the AC load at maximum input. If we take this maximum input as 15 volts RMS we draw the 0.25 MΩ load line LM and read off the bias required. It is +8.0 volts only, and the no-signal voltage across R is −0.25 volt.

These are very satisfactory conditions and give a detector which will supply AVC to two valves and give distortionless rectification for modulation up to 100 per cent. (of course, apart from the initial curvature of the characteristic) so long as the carrier input does not exceed 15 volts RMS.

Input Resistance

We have now to consider the input impedance of the detector. When the AC and DC loads are equal we have seen that the effective input resistance $Ri = R/2n$, and this also applies when the loads are unequal, but to the unchanging carrier only. To the rapidly changing carrier amplitude of a modulated signal the input resistance is

$$Ri = \frac{R_{AC}}{2n'} \cdot \frac{\sqrt{1 + m^2/2}}{\sqrt{\left(\frac{R_2 + R_{AC}}{R_A + R_{DC}}\right)^2 + m^2/2}}$$

As both R_{DC} and R_{AC} are usually large compared with Ra, the diode resistance, we can say with very small error that $Ri = R_{AC}/2n'$ where n' is the rectification efficiency calculated for the AC load line.

This change in effective input resistance between the modulated and unmodulated carrier conditions results in a lowering of the modulation depth of the input by an amount which depends on the impedance of the intervalve coupling. If we call the impedance at carrier frequency Z and at sideband frequencies Z′ the gain at these frequencies will be gZ and gZ' respectively where g is the mutual conductance of the valve preceding the detector. Let the tuned circuit have a dynamic resistance R_D and assume that this value holds over the range of sideband frequencies. Then

The Diode Detector—

$Z = Ri\ R_D/(Ri + R_D)$ and $Z' = R'i\ R_D/(R'i + R_D)$.

The gain at sideband frequencies relative to that at the carrier frequency is thus

$$Z'/Z = \frac{R'i\ (Ri + R_D)}{Ri\ (R'i + R_D)} = \frac{1 + R_D/Ri}{1 + R_D/R'i}$$

Take the example considered earlier of Fig. 5 with $R = 0.25$ MΩ. $R_1 = 2.0$ MΩ and $R_2 = 0.75$ MΩ, for which we found that the maximum modulation depth was 68.6 per cent. We have $R_{DC} = 0.25$ MΩ, $R_{AC} = 0.1715$ MΩ. From the curves of Fig. 3 we can calculate the efficiency and we find $n = 0.92$ and $n_1 = 0.88$, then $Ri = 0.25 \times 0.92/2 = 0.115$ MΩ and $R'i = 0.1715 \times 0.88/2 = 0.0755$ MΩ.

A reasonable value of dynamic resistance for a modern tuned circuit is 0.2 MΩ and with this $Z'/Z = \frac{1 + 0.2/0.115}{1 + 0.2/0.755} = 0.75$. This means that the modulation depth of the signal is reduced to 75 per cent. of its original value by the effect of the detector on the tuned circuit. With a 100 per cent. modulated signal, the actual modulation applied to the detector will not exceed 75 per cent. As the original modulation capability of the detector was 68.6 per cent., this means that under the particular conditions assumed it can actually deal with a carrier modulated to $68.6/0.75 = 91.5$ per cent.

The Input Tuned Circuit

This demodulating effect increases in magnitude as the dynamic resistance of the tuned circuit increases, and it also has the result of decreasing the effective efficiency of the detector circuit. In the above example the stage gain computed normally is $gZ = 2 \times 10^{-3} \times 7.3 \times 10^4 = 146$ times with a valve having a mutual conductance of 2.0 mA/v. As the detector efficiency n_1 is 0.88, one would expect the overall gain to the detector output to be 128.5 times, this figure representing the ratio of the peak AF detector output to the peak RF carrier input to the last IF valve. Actually, however, the effective gain is 75 per cent. of this figure, or 96.5 times, on account of the change in detector input resistance.

With 100 per cent. modulation, therefore, the peak AF output is less than the steady voltage across the load resistance instead of being equal to it as it is when the AC and DC loads are equal. The ratio of AC to DC outputs is given by $n'\ Z'$ and $n\ Z$ in the example quoted is $0.956 \times 0.75 = 0.717$.

To some extent it is this factor which makes it necessary in practice to adopt a larger detector input than one would expect from the usual simplified explanation of the detector's action. The instantaneous peak input with which the detector must be supplied is quite large, and for a 100 per cent. modulated carrier it is 2.828 times the RMS carrier input, in the case when the detector does not reduce the modulation depth. Actually, the reduction in modulation depth by the change in detector input impedance does not help one as regards the avoidance of overloading in an RF or IF stage when the usual RF pentode is employed, for it is brought about by a reduction in the load impedance of this valve and its input must be maintained.

Keeping to the above example, suppose we want to feed an amplifier which needs 7 volts peak input, from the data given above, the RMS carrier input must be 7.5 volts, with a 100 per cent. modulated signal, so that the IF valve must be capable of an undistorted output of 21.2 volts peak. This is not enormous, but it is not sufficient, for most people consider it desirable to be able fully to load an amplifier with about 30 per cent. modulation only. To do this the IF valve must be capable of an output of 70.5 volts peak, which is not so easy to obtain.

So far we have said nothing about the effect of the by-pass condenser C. If it is too large it shunts R_{AC} and reduces the high-frequency response, thus giving a reduction of high notes. It also lowers the AC load at high frequencies and so introduces amplitude distortion on deep modulation. This lowering of the load, however, reduces the detector input impedance and so the modulation depth at high frequencies. This in turn means a further reduction in the high-frequency response, but renders amplitude distortion less serious.

If the condenser is too small the full RF input voltage is not applied to the detector, and efficiency suffers. It does not suffer as much as one might expect, however, for the input impedance also increases and the tuned circuit is less heavily damped.

The Parallel-Connected Detector

The anode-cathode valve capacity adversely affects the performance, partly because it reduces the input voltage actually applied to the diode, and partly because it passes some current when the diode is non-conductive. For modulation frequencies it appears in shunt with C and must be included with this capacity when calculating the modulation frequency response.

There are several alternative ways of arranging the circuit of a diode detector, and the most general alternative to that of Fig. 5 is the one shown in Fig. 7. This is known as the parallel-connected circuit and has the advantage that both the tuned circuit and the valve cathode can be earthed. It is not so good as the arrangement of Fig. 5, however, for the input circuit is more heavily damped; instead of the effective input resistance approaching $R/2$ it is more nearly $R/3$. Furthermore, the full RF voltage applied to the diode appears across the output terminals together with the rectified modulation frequency output. With the series circuit of Fig. 5 the only RF voltage across the output is that developed across C and would ideally be zero; in practice, however, the RF output may be one-tenth or less of that with Fig. 7, thus rendering the problem of filtering it out much simpler of solution.

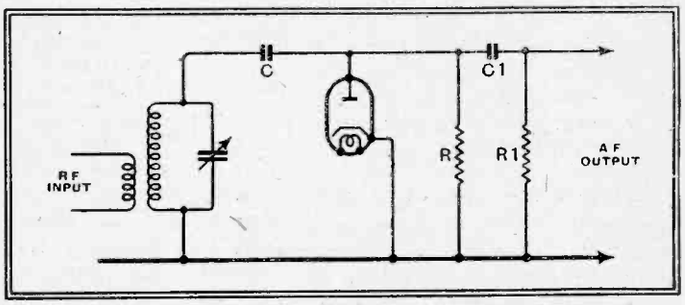


Fig. 7.—A diode circuit which is sometimes used in straight sets is shown here. It has a lower input resistance than the more usual circuit.

Television Programmes

THURSDAY, FEBRUARY 3rd.

3, "After Supper," an intimate cabaret. **3.30,** British Movietonews. **3.40,** 117th edition of Picture Page.

9, Charles Heslop in "Up the Gunners." **9.30,** Gaumont-British News. **9.40,** 118th edition of Picture Page.

FRIDAY, FEBRUARY 4th.

3, Making a News-Reel, Part I. Viewers will see a Gaumont-British News Reel filmed in Alexandra Park. **3.20,** Gaumont-British News. **3.30,** Variety, including Nelson Keys and Paddy Drew. **3.55,** Preview.

9, Making a News-Reel, Part II, O.B. from the Gaumont-British News studios at Shepherd's Bush. **9.25,** Starlight: Nelson Keys. **9.35,** Cartoon Film. **9.40,** R. H. Wilenski on the Exhibition of Seventeenth-Century Art. **9.55,** Preview.

SATURDAY, FEBRUARY 5th.

3, Nan Kenway and Douglas Young. **3.10,** Commentary on a Darts Match between *News of the World* champions and a B.B.C. team. **3.20,** British Movietonews. **3.30,** "Up the Gunners."

9, "Continental," an international entertainment. **9.15,** Gaumont-British News. **9.25,** "The Beautiful One": a play by T. B. Morris.

MONDAY, FEBRUARY 7th.

3, "The Three Bears," a short ballet with music by Eric Coates, the orchestra conducted by the composer. **3.15,** British Movietonews. **3.25,** "The Beautiful One."

9, Cabaret. **9.25,** Craftsmen at work—II: compèred by S. P. B. Mais. **9.35,** Gaumont-British News. **9.45,** Repetition of 3 p.m. programme.

TUESDAY, FEBRUARY 8th.

3, Madame Lyana Grani, Coloratura soprano. **3.10,** Gaumont-British News. **3.20,** Theatre Parade: "Thank you, Mr. Pepys," by W. P. Lipscomb.

9, Speaking Personally—X. **9.10,** A Little Show. **9.40,** British Movietonews. **9.50,** Repetition of 3 p.m. programme.

WEDNESDAY, FEBRUARY 9th.

3, The Russian Choir from Paris. **3.10,** Friends from the Zoo. **3.20,** British Movietonews. **3.30,** Park Avenue to Park Lane Cabaret from Grosvenor House. The Orchestra conducted by Sydney Lipton.

9, Repetition of 3.30 p.m. programme. **9.30,** Gaumont-British News. **9.40,** Indian Music. **9.50,** The Russian Choir from Paris.

Pilot MODEL 106

FEATURES. ***Waveranges.***—*(1) 4.5-15 metres. (2) 12-30 metres. (3) 26-70 metres. (4) 65-195 metres. (5) 190-550 metres.—(6) 750-2,200 metres.* ***Circuit.***—*Var.-mu pentode RF amplifier—pentode separate oscillator—pentagrid mixer—var. mu pentode first IF amplifier—double-diode pentode second IF. amplifier and AVC rectifier—double-diode-triode second detector and phase inversion—push-pull double triode-output valves. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Volume. (3) Treble tone control and on-off switch. (4) Bass tone control. (5) Waverange.* ***Price.***—*25 guineas.* ***Makers.***—*Pilot Radio Ltd., 87, Park Royal Road, London, N.W.10.*

JUDGED from the point of view of its specification, the Model 106 is technically the most interesting receiver in the Pilot range. There are, including the rectifier and electron tuning indicator, no fewer than ten valves, and it covers wavelengths from 4.5 to 2,200 metres with the usual small gap between the medium- and long-wave ranges to allow for the intermediate frequency. A high overall gain is ensured by the employment of an RF amplifier on all but the shortest waveband and two stages of IF amplification. The push-pull output stage employs two special double-triode output valves combining ample power output with high magnification.

The circuit diagram shows that following the pentode RF amplifier is a two-valve frequency-changer employing a pentode oscillator connected as a triode and a pentagrid mixer-amplifier valve. The first IF stage follows normal practice, and is controlled by AVC, but the second is unusual in that the two diodes are included in the same envelope with the pentode amplifier. One diode is used for AVC rectification with a suitable delay voltage, and the other is used to operate the electron tuning indicator with a delay bias in order that maximum sensitivity may be obtained on weak signals.

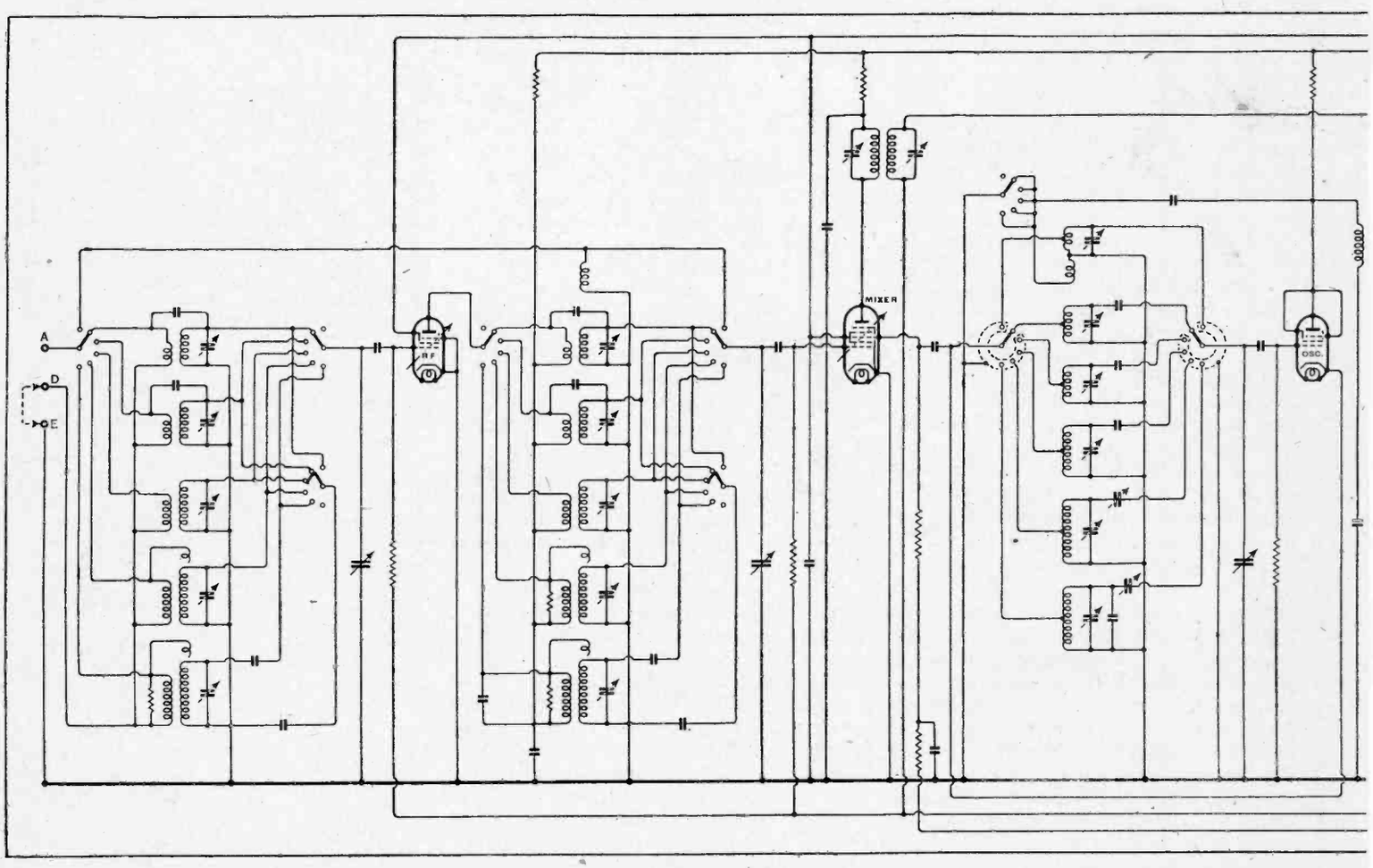
Usually the control for the tuning indicator is derived from the signal rectifier diode, but in the present receiver this arrangement is not permissible, as the cathode of the double-diode-triode second detector is "floating" in order that the triode portion may perform the function of phase inversion for the push-pull output valves.

The 6N6 valves used in the output stages are a recent development of the 6B5 valve described in our issue of July 5th, 1935. Each valve contains a pair of triodes in which the cathode of the first valve is directly connected to the grid of the second. The second valve operates under conditions in which there is a continuous flow of grid current, and the potential which is thereby established constitutes the cathode bias for the input circuit to the valve. This common coupling between the two elements also introduces reverse feed-back, which reduces the harmonic content while still retaining an overall amplification factor which is comparable with that of a pentode type of valve. A pair of valves of this type are capable of an output of 20 watts, but under the conditions of operation which have been chosen for this receiver the output is stated to be 14 watts—a formidable figure for a table model receiver.

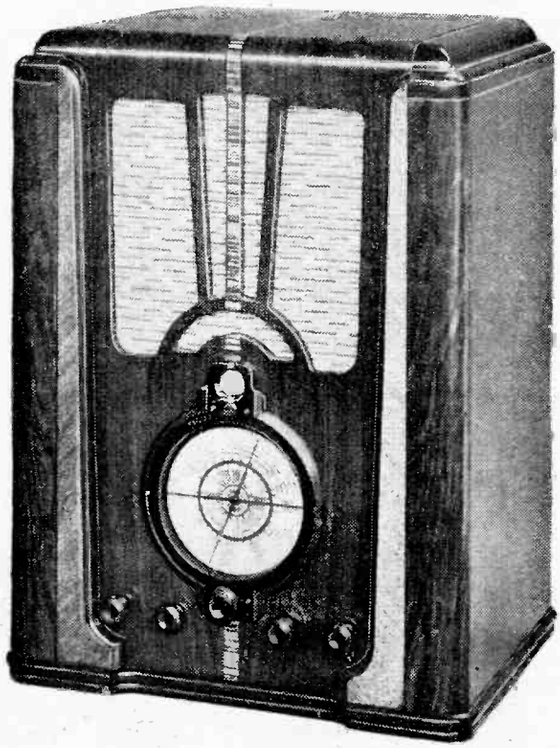
Tone compensation is divided between two controls, a variable resistance-capacity shunt across the input to the push-pull stage and a double-pole switch giving alternative values of coupling condensers to control the bass response.

In a receiver of this type, which is likely to be much used for serious short-wave listening, the provision of a telephone jack before the output stage is a thoughtful refinement. A second jack introduced before the phase-inversion valve is for the connection of a gramophone pick-up.

There are two IF stages and the second of these includes separate diode rectifiers for AVC and tuning indicator control. The valves in the output stage are of the double-triode type with direct internal connection between the cathode of the first section and the grid of the second.



MPREHENSIVE AND FICIENT SHORT-WAVE CEPTION WITH NEROUS OUTPUT



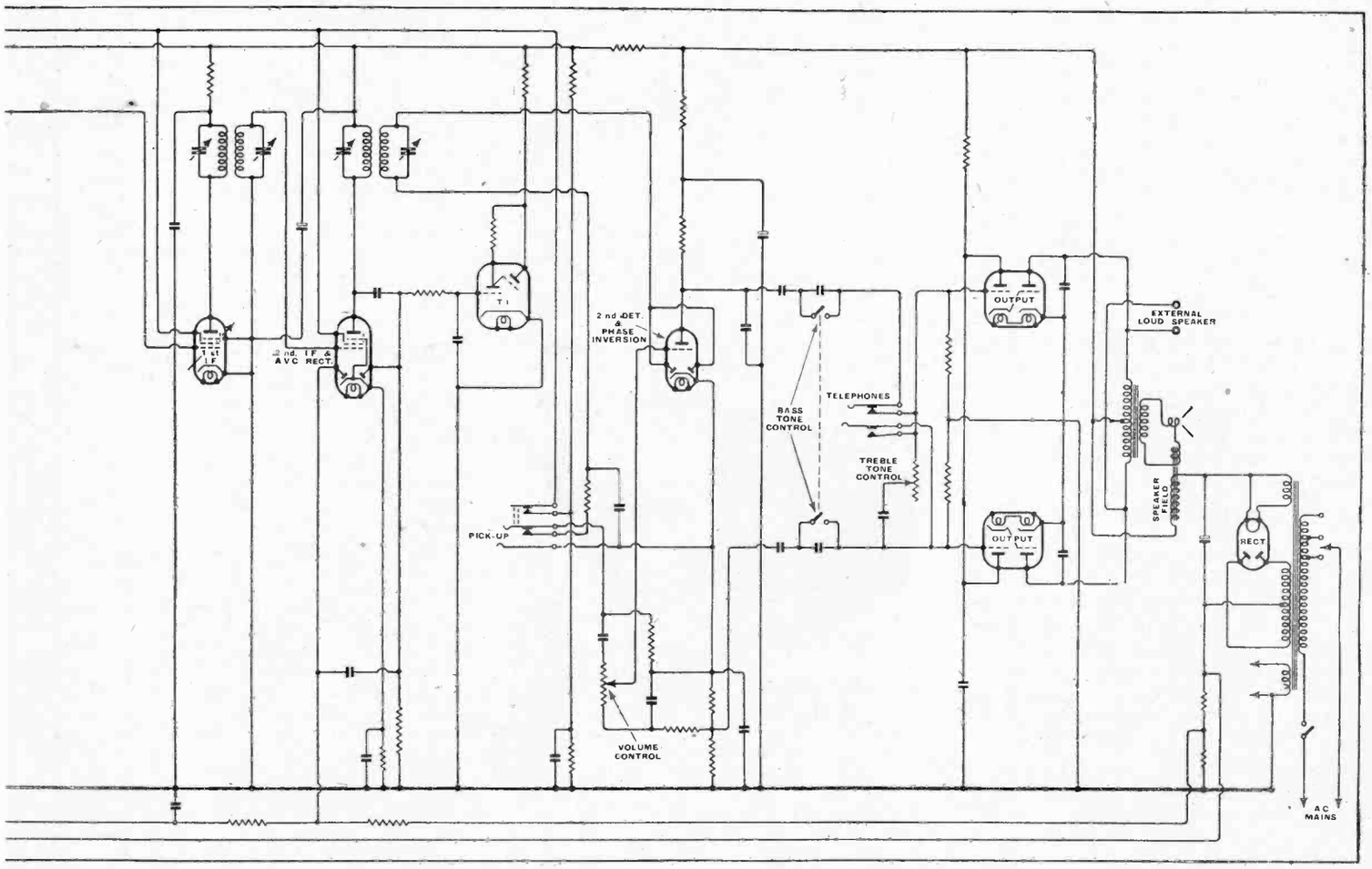
The outstanding impression left after testing this receiver is its firm and powerful handling of every type of signal. The credit for this must be shared by the high overall magnification and the astonishing acoustic output. Although the cabinet and the loud speaker appear to be built to stand up to the work, few will wish to make use of the full volume of which this set is capable. For one thing, the output is not by any means free from distortion with the volume control at maximum, but there is no audible trace when the control is turned down to a level estimated at 6-8 watts—more than enough for a small hall. A slightly higher output level is permissible if the treble tone control is reduced to suppress a tendency to harshness in the upper middle register. The bass tone control is useful on speech and occasionally for short-wave listening, but, as it cuts rather far into the middle register, the resultant reduction in sensitivity is noticeable, and, having regard to the absence of microphonic effects, the full range of bass response can be used on all wavebands.

Poor reception conditions resulting from recent sunspot activity failed to obscure the intrinsic efficiency of this receiver on short waves. On the lowest waveband the excessively strong carrier from Alexandra Palace was, of course, received at two settings in the absence of pre-selection. At least one other experimental television transmission was picked up, and above 10 metres there was no lack of material for those who enjoy the search for, and identification of, new experimental stations. It was interesting to compare the region of overlapping between the first and second waveranges with and without an RF stage, for it revealed the considerable amplification even at these high frequencies which is obtainable from a well-designed RF amplifier. It was also instructive to note how second channel repeat points were cleared up by the pre-selection associated with the additional amplification.

Good Signal-to-Noise Ratio

As is usual in Pilot receivers, the signal-to-noise ratio was exceptionally high, and when reports were coming in from all sides of the impossibility of receiving American stations, we found no difficulty in tuning in Schenectady, although admittedly it was below its usual standard from a programme point of view. AVC in this receiver is particularly good, and swallows up all but the severest types of fading on short waves. On a reasonably strong signal there is no audible change of level between an aerial a foot long and the standard 100ft. outdoor aerial.

The two remaining short-wave bands,

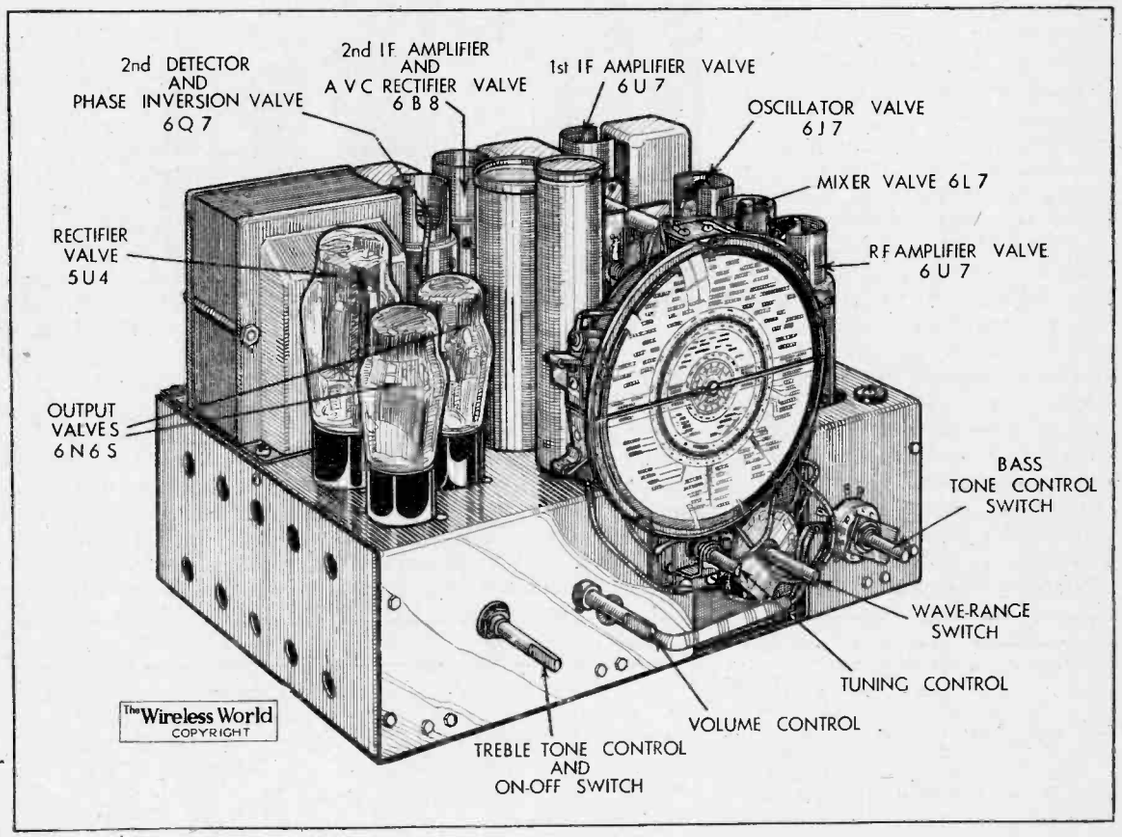


Pilot Model 106—

which carry us without a gap to the foot of the medium-wave band, provided broadcast, amateur, trawler and other interesting transmissions not available on the average all-wave receiver.

Our expectations of a sparkling performance on the medium band were not disappointed. On account of the high sensitivity and efficient AVC there is little to choose between the day and night performance on this range. The additional tuned circuits in the IF amplifier also gave a higher selectivity than we have been able to record now for some time. The spread of the London Regional transmission when using the set in Central London was, in fact, no more than 18 kc/s, i.e., only half a channel on either side of its allocated band. The amplification throughout the range is uniform, and an exceptionally good signal-to-noise ratio in the region of 500 metres was noted. The only blemish was a single self-generated whistle just above the London Regional station.

The long waves are enriched by good reception from those comparatively low-powered stations whose names are familiar to us from the lists, but which we seldom actually hear. The separation of the Deutschlandsender from its neighbours in wavelength on either side was satisfactory, but the technically unavoidable residue of side-band interference might have been reduced still further in the acoustic stage by an extension of the scope of the treble tone control.



A deep and rigid chassis results from the use of a centralised tuner unit which is situated behind the dial and carries the ganged condenser and the first three valves of the circuit.

Constructional Details

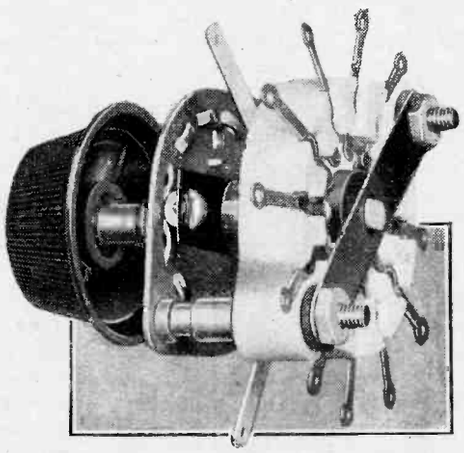
Calibrated scales for the six wavebands are cleverly worked into a circular dial 5in. in diameter. The various wavebands are selectively illuminated and the smallest diameter scales are used for the long-wave and ultra-short-wave ranges. The chassis layout is compact, and the sides are deeper than usual. The RF tuning circuits and their associated valves are concentrated in a well-screened and rigidly constructed unit, and there are three groups of rubber mountings between the gang condenser and the cabinet. The absence of microphony previously noted is attributable to this method of construction and to the fact that the vanes of the oscillator section of the gang condenser are given a wider spacing than the aerial and RF coupling sections.

The wide waverange, the excellent signal-to-noise ratio on short waves, the unusual high selectivity on medium waves and the impressive reserve of volume combine to make this receiver an outstanding example of the table model type.

WEARITE CERAMIC SWITCH

A PLATE-TYPE switch made of good quality ceramic and intended primarily for use in short and ultra-short wave receivers and apparatus has been developed by Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N.17.

There is provision on the ceramic plate for twelve fixed contacts in addition to those needed for the selector plates and it is thus possible for it to be assembled so that several separate switches are embodied in the one unit.



New Wearite ceramic switch for use in short- and ultra-short-wave apparatus.

As the selector-plate contacts are brought out on the opposite side of the ceramic wafer to that of the fixed contacts any combination involving a total of twelve fixed points can be assembled on a single plate.

Thus it can be supplied as a two-pole six-way, as a three-pole four-way, or as a four-pole three-way, to give three of the possible arrangements. In addition, short-circuiting contacts can be included if required.

Tests were made at a frequency of 20 Mc/s, i.e., 15 metres, with the new Wearite switch and another of similar pattern, but not assembled on ceramic. With two adjacent contacts on the switch connected across a tuned circuit the Wearite switch introduced a loss of 15 per cent., while the other produced a 24 per cent. reduction in efficiency.

With all fixed contacts wired together and all moving points likewise connected in both switches so that all the possible leakage paths were in parallel, the Wearite model reduced the efficiency of the circuit by 18 per cent.; the other switch reduced it, however, by 59 per cent.

It does not follow that this improvement will be achieved in full measure in a practical circuit, since losses elsewhere and over which the user has no control, such as the input impedance of valves at the very high frequencies, have to be taken into account. The test serves to show, however, that some improvement can be effected when suitable components are employed.

The new Wearite ceramic switch costs 5s. for a single unit, including the locator plate and knob. Extra wafers or switch units cost 3s. each and spindles of any length with locator plate can be supplied as required.

UNBIASED

By FREE GRID

A Point of Law

ONE of the reasons which is sometimes put forward against the reporting of crimes in the columns of our daily newspapers is that it is apt to lead unprincipled people to emulate the exploits of the criminal. Thus if, for instance, full and detailed reports are given of the trial of somebody who has tried to rob a bank, it is said that instead of acting as a warning it merely acts as an incentive to some people to have a shot at it themselves in the hope that their scheme will be more detection-proof.

I cannot say that I altogether agree with this, as reading of the trial of would-be bank robbers has never incited me to try my hand at the game, as, quite frankly, I don't think that there *is* a detection-proof method; at any rate, I have never been able to fathom one out. I must admit, however, that in certain cases there *is* a little danger in reporting crime, judging by the result of an item of news which appeared in this journal a few weeks ago to the effect that certain citizens of Hamburg had been charged with stealing energy from the local broadcasting station. It appeared that certain of them, living under the shadow of the transmitting aerial, had found out that, by rigging up a tuned circuit, it was possible to extract sufficient energy from the carrier wave to light their houses.

I should have thought no more about this had not a letter turned up recently from a reader asking me to suggest an AVC arrangement to control the voltage of his household lighting system, which fluctuated so violently both above and below normal that several lamps had actually been burnt out on more than one occasion. I replied pointing out that if he used proper fuse wire instead of hairpins he could at any rate safeguard his lamps, but even this did not satisfy him, and he wrote again. I was a little curious, as I had never heard of such violent

Reluctant to give full details.

voltage fluctuations as in his case, and bit by bit I extracted the whole story from him, although he seemed extremely reluctant to give me the full details.

It appears that on reading the Hamburg story he had sold up his home in the centre of London and moved out to Brookmans Park, taking a house which was within the proverbial stone's throw of the B.B.C. transmitting aerial. He estimates that the extra cost of his season ticket to London is more than saved on his electricity bill, which is, of course, nil. As for his moral scruples, he has none, for he assures me that he is not actually stealing anything from the B.B.C., as the Corporation have already been paid for it by the share which they take of listeners' licence money.

However, everything in the garden is not as lovely as it might be, since, as already mentioned, the voltage fluctuations are very bad indeed, especially late at night, and he is of the opinion that the B.B.C. is deliberately introducing them in order to deter him and others of like kidney from this free light business, and, as already mentioned, I have been asked to advise him as to a suitable AVC system to regulate the incoming voltage. On the face of it, a barretter seems the ideal thing, but it is far too simple a remedy for my liking, and I am busy puzzling my brain to find something better.

Snobbery Up to Date

ALTHOUGH wireless is one of the most modern branches of science, it is, paradoxically enough, full of superstitions, and always has been throughout its history. Nowadays, of course, the leading superstition is to the effect that modern sets need no aerial or, at any rate, no outdoor aerial.

Only the other day, while Mrs. Free Grid and the charlady were busily engaged in making the house thoroughly uncomfortable and miserable, the lady of the mops and pails made a truly illuminating remark on this very subject. I had, of course, gone out to escape from the clouds of dust which were being raised by these cleansing efforts, and while they were working the charlady turned to Mrs. Free Grid, after doing her best to wreck my lead-in tube with her feather duster, and remarked: "Old-fashioned gentleman, Mr. Grid, ain't he; now me and my old man 'ave got a wireless set wot don't need any of these h'aerial wires."

Now the very fact of the existence of this old superstition that aerials are superfluous is sufficient to account for quite a lot of the poor reception due to man-made static which listeners are putting up with, but there is a far greater canker in our midst which is causing listeners to avoid good outdoor aerials, a canker concerning the existence of which I had not the remotest suspicion until the other day.

The house in which Mrs. Free Grid and I are at present living—or, at any rate, existing—is situated in an exceedingly aristocratic district where everything is very *comme il faut* indeed. As a matter of fact, we only moved there a comparatively short time ago, and I have been spending a good deal of time lately erecting a very lofty and elaborate anti-static aerial, as the interference in the neighbourhood is very bad.

Social calls in the neighbourhood.

I had been struck when I first moved there by the complete absence of aerials, although I knew full well that this was not due to lack of sets, as I had seen them when returning one or two social calls in the neighbourhood which Mrs. Free Grid had insisted on our doing soon after we first moved in. I am not a very observant sort of person so far as non-wireless matters are concerned, but even I could not help noticing the frigidity, amounting almost to complete social ostracism, with which our new neighbours greeted us soon after I commenced my aerial erection.

Naturally, I took particular care to make my aerial blend with the landscape as far as possible, even going to the extent of growing ramblers along the wire, taking care, of course, that the roots were well insulated from earth. It was not until Mrs. Free Grid came rushing in one day with a command to dismantle the aerial immediately that I learned the bitter truth, namely, that in these days of snobbery the presence of an aerial is presumed to indicate that you are unable to pay for a sufficiently expensive set to work without one.

Subsequent enquiries on my part have confirmed that this information is quite correct, and it shows only too clearly the tremendous "sales resistance" which vendors of anti-static aerials are up against, or, for that matter, all of us technical people in trying to put over the idea of interference-free reception. It is a problem which only an industrial psychologist is capable of tackling.

Random Radiations

By "DIALLIST"

Imports and Exports

IN some ways the import and export figures for wireless goods for last year make good reading. They show, for instance, a balance in our favour of £450,000 in round figures, which is the best since 1933. Again, we exported £41,000 worth of batteries against negligible imports. We sold abroad radiograms to the value of £155,000 and bought only £35,000 worth from other countries. By far our best customer was South Africa, which spent with us £22,000 on receiving sets, £14,000 on valves, £16,000 on components and £50,000 on radiograms. Next comes British India, with Sweden third and the Netherlands fourth. So far so good, but there are some not very heartening items. We sold, for example, 69,000 receiving sets abroad and bought 60,000. Every imported set (even if its average value *is* under £3!) means one less British made set sold in this country. And we imported components to the tune of over three-quarters of a million pounds, though our sales were worth less than half a million. But valves make the worst showing of all. We exported a total of 1,700,000 valves and valve parts worth rather less than £4,000. We imported 2,500,000 valves and over £200,000 worth of valve parts.

Charming the Arab Ear

FROM letters which have reached me from the Near East I gather that, though the Arabs are attracted by our plain, straightforward news bulletins in the short-wave broadcasts intended specially for them, they are quite the reverse of attracted by the musical entertainment that has been provided. The Italians delight them by giving concerts of Arab music, and we shall have to take a leaf out of their book (perhaps we have begun to do so already) if we want to attract listeners to the voice of Daventry. Arab music sounds pretty queer stuff to us. Whenever I hear it I'm reminded of one of the many stories about the Shah of Persia who came to visit Queen Victoria. Amongst his adventures was a visit to the Opera. Whilst the orchestra was making the excruciating noises that are necessitated by the process of tuning-up his face was wreathed in smiles, and enthusiastic applause burst from him at frequent intervals. But once the real music started he was plunged into gloom and sat holding his fingers to his ears. Still, if our broadcastees in the Near East like their music that way, we must give it them.

Mains and Interference

NOT a few people nowadays use the power circuits instead of the lighting circuits for running their sets, and there is, I believe, nothing against this. Anyhow, I don't see why there should be any objection, for light is the last thing we want in the wireless set; any light that the valves do emit is pure waste. If you are thinking of using the power mains, it is just as well to see that they aren't unduly noisy. In many localities—perhaps in most—they are far worse in this respect than the lighting mains, for fairly obvious reasons. It may, too, be a more difficult business to obtain quiet working by means of suppressors if the power mains are used. And, after all, even a big wireless set costs so little to run nowadays that, unless lighting current is exceptionally expensive, the saving effected by using the power circuits is hardly big enough to be worth bothering about.

A Neglected Cell

IT'S rather curious that in this country little, if anything, has been done to develop wireless receivers designed to obtain their filament supply from air-cells. In the United States receivers are made specially to work from these cells, and they are widely used in places where it is difficult to get accumulators charged. There should be a fair demand for British-made sets of similar type, for there are many people to whom the recharging of filament accumulators presents considerable difficulties. And they would certainly make a strong appeal to those living in remote spots in many parts of the Empire. Air-cells have been made in this country for many years. I believe that they are to some extent used for filament heating, though their employment is probably confined to home-made sets constructed specially for the purpose or to commercial receivers which have been adapted for working from them.

How it Works

The air-cell, or air-depolariser cell, to give it its full title, is fundamentally of the ordinary Leclanché type, the electrodes being carbon and zinc and the electrolyte a solution of sal-ammoniac in water. The great difference between it and the familiar Leclanché cell is that there is no sac or porous pot surrounding the carbon; it does not, in fact, employ a chemical depolariser at all. The carbon rod, which is of large diameter, is of an extremely porous kind. Owing to its special construction moisture does not penetrate into the pores, though the gases which cause polarisation do so, mixing there with oxygen from the air. The performance of these cells is quite remarkable. One that I had under test some time ago maintained an EMF of over 1 volt under a load of 0.4 ampere for some eight months at four hours a day. At the end of that time the zinc was done for, but the

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, FEBRUARY 3rd.

Nat., 7.45, Stanelli's Bachelor Party—15. 8.30, The Way of Peace—4. 9.20, A Chopin recital by Orloff, pianoforte.

Reg., 8.30, "The Rebel Maid": light opera. 9.30, Variety from the North.

Abroad.

Milan Group, 7.30, "Siegfried"—Wagner.

Hilversum 1, 9.10, Modern Dutch Music.

FRIDAY, FEBRUARY 4th.

Nat., 7.5, Debroy Somers and his Band. 7.45, Ernest Milton in "Rope": an essay into the grotesque. 9.20, Talk on Russia.

Reg., 8.15, Ralph Reader's review. 9, Violin recital by Albert Sammons.

Abroad.

Munich, 8, Folk Songs of the Nations.

Radio Normandie, 9.30, Sound Film from the Normandie Cinema, Rouen.

SATURDAY, FEBRUARY 5th.

Nat., 8, "Palace of Varieties." 9.20, American Commentary, from New York. 10.40, "Sofa One, Sofa Two": a short story.

Reg., 6, Repetition of "Rope." 7.30, Works by John Ireland, sung by Parry Jones, with the composer at the piano. 9, "A Ballad of 1400," historical programme from Wales.

Abroad.

Cologne, 7, Variety.

Frankfurt and Stuttgart, 11, Gala operetta.

SUNDAY, FEBRUARY 6th.

Nat., 6.5, "Cyrano de Bergerac"—play. 9.5, Georgian Melodies. 10, "Up the Garden Path" II—Cheatle.

Reg., 6.5, London Palladium Orchestra. 9.5, Sunday Orchestral Concert—XVII, conducted by Julius Harrison.

Abroad.

Vienna, 7.5, Gala operetta. (Strauss and Léhar).

Strasbourg, 8, "Don Giovanni," opera by Mozart.

MONDAY, FEBRUARY 7th.

Nat., 7, Monday at Seven. 8, Cinema Talk. 9.20, "World Affairs." 9.35, B.B.C. Orchestra (F), conducted by Clarence Raybould.

Reg., 6.30, Swift Serenade. 8, West Indian Dance Band. 8.30, Side Lights on contemporary musical opinion.

Abroad.

Athlone, 7, "David Copperfield" (Dickens).

Radio Paris, 8.30, Offenbach's "Les Brigands."

TUESDAY, FEBRUARY 8th.

Nat., 8, Adaptation of the film "Top Hat." 9.20, "How I Began," by C. R. Fairey. 9.35, The Italian School—I, music by section of the Military Band with organ.

Reg., 6.40, From the London Theatre. 7.50, Russian Music, Lilias Mackinnon, pianoforte. 8.10, A Round Table discussion. 9, Variety.

Abroad.

Warsaw, 7.10, Poznan Cathedral Choir.

Eiffel Tower, Lyons, etc. 8.30 Symphony concert.

WEDNESDAY, FEBRUARY 9th.

Nat., 7.15, "Intermission," novelty numbers by the Variety Orchestra. 8, W. H. Berry as Mr. Macawber. 8.15 and 9.15, B.B.C. Symphony Concert—XII.

Reg., 7.30, "The World Goes By." 8.15, "Band Waggon." 9.30, "Mail Coach," a story of the coaching days.

Abroad.

Warsaw, 8, Chopin recital by Etkin-Moszkowska, pianoforte.

Brussels 1, 8, Homage to the memory of Ravel.

carbon electrode outlives three zincs. The air-cell cannot be used with the ordinary radio set as it stands, since rheostats are required—the cells pick up considerably when they are rested, though they settle down to a "straight line" EMF within a quarter of an hour or so of being placed under load.

Sorting Out the Short Waves

THE Telecommunications Conference at Cairo has a formidable task before it when it tackles the chaotic conditions now prevailing on the short waves. When a preliminary discussion took place at the Nice meeting of the I.B.U. it was agreed that present troubles had arisen owing to the absence of any sound international plan for allocating short-wave channels. Almost every civilised country wants to get hold of a selection of channels so as to be able to maintain its services at all hours and at all seasons. Hitherto, grabbing channels has been a favourite method of acquiring them, a method which has come more and more into vogue of late owing to the rapid increase in the number of short-wave transmissions. The Cairo Conference seems to be pretty representative, and one trusts that common sense will result in the preparation of a soundly based world plan for the short waves.

What of the Ultra-Shorts?

It seems as if something like an international plan might soon be required, too, for the ultra-short waves. The idea that transmissions on such wavelengths have ranges of the order of 50 miles or so has now been completely exploded by reception in this and in other countries of USW transmissions from almost every part of the world. Yet the United States has already allocated the whole band of frequencies between 30 and 300 megacycles (10 metres to 1 metre) to a vast number of internal services, including television. Actually, the U.S.A. distribution divides this huge band of frequencies into some 1,300 channels with an average width of a little over 200 kilocycles. A great deal of experimental work will be necessary before a world plan for the ultra-short waves can be drawn up. One hopes that it will go forward rapidly and that it may come into being before conditions become chaotic.

Homing Pigeons

ONE of the problems that besets those to whom it falls to test receivers of various makes is to get them back into the hands of the firms to whom they belong after the work has been completed. I don't mean that the actual conveyance of a set from your home to their works is difficult to accomplish; the railway companies or the carriers do that for you. The trouble is to make them stay where they belong once they have got there. Not long ago I duly returned such a set, enclosing an explanatory note within the package and writing also by post. Some forty-eight hours later came a postcard from the service department of the firm in question saying that the set was now in thorough working order and had been despatched to me by Carter Paterson. It arrived soon after the postcard, and I sent it off promptly once more, enclosing this time a note in block letters.

Odyssey of a Radio Set

The plot now began to thicken. From one department I received a bill for the set; from another a request that I should return it if I had finished with it; from a third, a plaint that as the set had been thoroughly tested and found in perfect condition my grievance was not understood. Whilst tears that were almost more than metaphorical stained the paper, I wrote to all three departments in simple words and short sentences. By return of post came apologies from each, but that morning the set itself was also delivered to me again. I am all for good, clean fun, but it seemed to me that the game had now gone on long enough. This time I enclosed a note: "If this set comes back again I'll pulverize it with a sledge-hammer." That seemed to have the desired effect, but I have a lurking fear that one of these days Mr. Carter Paterson will again deliver it at my door.

More Eyewash

TO a Canadian reader I am indebted for a further instance of the way in which some American radio manufacturers play up to the man-in-the-street's belief that the more valves a receiver has the better it must be. In the same catalogue you may find, say, a 10-valve model at 150 dollars and a 12-valve at 200 dollars. That seems quite plain sailing, doesn't it? The aforesaid man-in-the-street is in no two minds as to which is the better set. But the service man who has access to circuit diagrams has a different tale to tell. In the 10-valve set there are two triode-pentodes, each performing dual functions. The only difference between its circuit and that of the 12-valve set is that in the latter each triode-pentode is replaced by a pentode and a triode. And there you are. The buyer gets his "two more valves," the seller gets an extra 50 dollars, and everyone is happy.

DISC DICTATING MACHINE, employing lateral-cut recording on discs, in contrast to the usual vertical (hill-and-dale) cut on cylinders, has been developed by the Discavox Dictating Machine Co., of London. It records speech on both faces of a flexible gelatine disc, 7-in. diameter and 1/100-th in. thickness. Each side of the recording blank will hold 6½ minutes' continuous dictation, or about 1,000 words. Among the useful features of this machine are an asynchronous electric motor, which rotates the turntable at 33 or 78 r.p.m., production of permanent records cheaply, ease of filing, as little space required, and "spoken letters" can be made and despatched safely through the post. If desired, one Discavox can be used for both dictating and transcribing.

Letters to the Editor

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

Television

I FEEL that judgment on television and the programmes now being provided should be passed by those who, like myself, look-in regularly and not by those who go to stray demonstrations.

In my opinion the programmes, apart from an occasional lack of general appeal, have improved tremendously. An extra Treasury grant would help, of course, but it is interesting to note that some of the best items have been those which were obviously easy and inexpensive to produce, while the more ambitious productions—like "Tristan and Isolde" with double cast, miming and singing—have not proved nearly so successful. IRENE STILES.

London, S.W.18.

Northern Lights

CONDITIONS on the 7 and 14 M/c amateur bands on Tuesday, January 25th, the day before the recent remarkable display of Northern Lights, were extraordinary.

The writer came on the 7 M/c band about 09.00 G.M.T. Tuning over the band revealed the fact that something certainly was amiss. This band, usually so full of R9 signals, produced no signals with a strength greater than R6. It was as though a veil had been drawn over the band and a few of the stronger signals were just succeeding in breaking through. A test call produced no replies, but at 09.15 G6II, of Portsmouth, was contacted. He reported the writer's signals at RST559, a very poor report for that distance at that time of the day.

At 09.40 G5XW, in Croydon, was contacted. His signals were rapidly fading from R8 to R5, and he gave the writer a report of RST569.

At 10.00 a very weak, whispery CQ signal was heard at about R3. It had the characteristics of a real DX signal and we thought it was at least a W6 or 7. It proved to be PAOKP! He was called and connected and reported the writer's signals RST579! No further contacts were attempted, but a few phone stations were listened to. They were all received at greatly reduced signal strengths and were heard to be complaining of very poor conditions. They were all suffering from rapid fading.

A change to 14 M/c was made, but conditions were not much better on this band. Signals were few and erratic, being R8, at times fading right out in a few minutes.

At 11.30 ZL2AN was received at R6, the strongest ZL the writer has ever heard. OZ7K was heard at RST579 about 11.50. On contacting him he reported the writer's signals very good and commented on the extraordinary conditions. OK2MA was contacted at 14.20. He was R7, and reported the writer as R4 with peaks up to R8. He faded right out suddenly a few minutes after contacting him.

At 15.30 HSIBJ was heard working a G at RST559. This is the first time a HS station has been heard here.

A return to 7 M/c was made at 15.45 G.M.T., and G8UK, in Monkseaton, was contacted. He remarked on the peculiar conditions and said he had received reports of R4 from some of his "local" stations.

At 17.00 both 14 and 7 M/c were practically dead and listening was discontinued.

At 20.00 the Aurora was first observed. Listening on both 14 and 7 M/c was recommenced. 7 M/c was quite dead and 14 gave a few weak "whispery" signals which were unidentifiable.

The writer's station is located on the outskirts of Southend-on-Sea, Essex. The receiver used was an O-v-Pen, using a dipole aerial. The transmitter is a CO-FD-PA, an input of 25 watts, with a 132-foot end-on aerial, being used.

The Aurora was seen in the north-west sky and consisted chiefly of reddish light extending almost to the zenith. This was occasionally streaked with bright yellow and white light, and behind and between the masses of red was a flickering greenish-white glow, the whole presenting a very magnificent sight indeed. A. C. G.

Southend-on-Sea.

Morse Interference

AFTER reading letters from Mr. C. B. Fagan and Mr. E. S. Lefeaux, I feel that both correspondents would be interested to know the origin of these signals. I, too, have noted the wide band width of the transmissions in question, being spread from 500 kc/s to 700 kc/s.

After listening to the signals for about 35 minutes, all of which were coded, on the 16th inst., the station signed the call S.P.Z., which is the Ministerstwo Poczt i Telegrafow, Warsaw, Poland.

Shalford, Surrey. R. G. LANE. (2 BYA.)

Batteries v. Mains

AS the user of a battery set I was very interested in the strong claims made by Mr. E. R. J. Robbins regarding the superiority of battery sets. I am afraid, however, that the more I read his letter the more bewildered I became, as organ recordings and Class A amplification are hard to reconcile with dry batteries at all.

The last Class A set I ran from dry batteries cost me over £3 for replacements in a single year, and its output was considerably less than half a watt. That was seven years ago; and although the Milnes Unit, which followed, satisfactorily solved the problem of expense, the problem of obtaining a reasonable output under Class A conditions looks like remaining indefinitely.

Nevertheless, during these seven years I have done a fair amount of experimenting, and have reached the conclusion that the alternatives to Class A are by no means so hopeless as some technicians would have us believe.

My first acquaintance with Class B resulted in such horrible distortion of the quieter passages that I was certain I had got a defective valve; my confidence in that respect, however, received a severe shock when a second specimen proved to be even worse than its predecessor. Connecting the grids to positive low tension ultimately brought a decided improvement, and I found the quality just bearable with 4½ volts positive bias.

I could fill a book with my subsequent experiences with Class B. I am at present using a Mazda valve which requires negative bias; the driver valve resents any attempt to reduce its current, and is very critical about the ratio of the driver transformer which follows. Fortunately, I purchased one with a tapped primary. The output valve works far better with a large transformer wound specially to suit it, and the least drop in filament voltage shows up instantly.

The quality? Well, it is undoubtedly ahead of the average mains-driven table model. True, the valve's rated output is a shade under three watts, but it is a fact that the volume of sound obtainable without noticeable distortion is distinctly greater than that of the sets mentioned. Soprano voices, my chief bugbear in the past, come through loud, clear and natural, and without the slightest accompanying noises. Despite the use of two AF transformers, the transients are not too bad; and, although I have heard, with profound admiration, a friend's *Wireless World* Quality Amplifier, I can still enjoy listening to my own outfit.

The coming of negative feed-back may mean that in future battery sets will be obtained which for domestic use are beyond criticism, but with battery pentodes no cheaper than their mains brethren. I am not inclined to try further experiments meanwhile. Perhaps some fellow-reader might have something to recount in this direction. JAMES NICOL.

Kirkcaldy.

Sponsored Programmes from Abroad

EIGHTY per cent. of listeners on the South Coast use Fécamp and Luxemburg for their Sunday programme, only using B.B.C. for weather and news. (This applies right round to Bristol.) There is nothing objectionable in advertising to the man-in-the-street listener, but I know there are fanatics for B.B.C. stuff only.

If the B.B.C. had given the Sunday programmes desired, there would not have been these "outside" broadcasts. Advertising, where this is done in moderation, is not offensive. Again, one can always switch off or tune to another station. I have never heard any propaganda nor do I know of anyone who has.

Eastbourne. W. A. PELLY.

"International" Octal Base

IN view of the number of valve bases now on the British market, we should like to make clear our policy so far as Osram valves are concerned.

We shall continue to use on Osram valves of the "International" range the type of Octal base which originated in America and is now in general use throughout the world. Our object in so doing is to aim at standardisation and to make Osram valves interchangeable with other valves in the world's markets and to avoid confusion in the minds of the trade.

The main consideration in the adoption of the American-type base has been the convenience of manufacturers of receivers.

It is a generally accepted view that British receiver manufacturers must to a large extent look to the export market for expansion in their business. We have satisfied ourselves by careful investigation that receivers fitted with valves different in characteristics or bases from what the trade already know and understand are likely to meet with a poor reception in world markets. Hence our

decision to standardise a base identical with the American-type base to enable the same chassis to serve for the home and export markets, with resultant saving in cost.

On battery and 4-volt AC mains valves we shall continue to use the existing resilient pin bases. The General Electric Co., Ltd.,

G. A. MARRIOTT,
Manager, Osram Valve Dept.

Transformer v. Resistance Coupling

A LETTER in the correspondence columns of *The Wireless World* some three weeks ago caused me much interest, not to say amazement. It was from Mr. H. A. Hartley, and stated that he refuted all his former championship of the transformer method of coupling if transients were under consideration.

At one time he went so far as to administer "technical thick ears" over this subject!

I use a radio equipment consisting of the *W.W.* Monodial with variable selectivity, and a Hartley-Turner 12-watt amplifier and speaker. On a good transmission the transients come out with a vicious kick which would do credit to an Army mule.

If there were much improvement to be got from using resistance coupling on some transmissions, especially those rare ones of the late dance music from the studio, one's bricks and mortar might not like it.

Could Mr. Hartley give any indication of methods of measurement of transient response as opposed to judging by ear? I presume that photographic records of the transient on a cathode-ray tube, which should respond perfectly even to Mr. Voigt's transient, might help to settle the matter, but such equipment is rather scarce.

It is amusing to see that Mr. Hartley has shifted his base to Fort William. He can deliver bombshells from there without risk of physical assault. If he is finally forced to retire to the S.M.C. climbing hut on Ben Nevis, I wish him much enjoyment on the Tower Ridge and the Northern Gullies!

Cambridge. R. A. FELL.

Club News

Ilford and District Radio Society

Headquarters: St. Albans Church Room, Albert Road, Ilford, Essex.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Mr. C. E. Largen, 44, Trelawney Road, Barkingside, Ilford, Essex.

The Club's syllabus for the remainder of the season is as follows:—

Feb. 3rd: Lecture on "Long Distance Telephony and Co-axial Cables," by Mr. R. W. Chamney, of the G.P.O., at which the members of the Southend Radio Society will be guests.

Feb. 10th: Junk Sale.

Feb. 17th: "An Evening with the Cathode Ray Tube," by Mr. Parr, of Ediswan.

Feb. 24th: Informal.

Mar. 10th: Mr. Stott's Bulgin Gadget evening.

Mar. 17th: Lecture by Mr. H. G. Menage, of Rothermel, on "Piezo-electric Crystals."

Mar. 24th: Lecture on "Contrast Expansion," by Mr. W. G. J. Nixon, of the G.E.C.

We have received the December and January numbers of a very well-produced bulletin detailing the activities of the Society.

Southall Radio Society

Headquarters: Southall Library, Osterley Park Road, Southall.
Meetings: Tuesdays at 8.15 p.m.
Hon. Sec.: Mr. H. F. Reeve, 26, Green Drive, Southall.

At a recent lecture Mr. E. Cholot, of Lissen, demonstrated several receivers, including the new "Monarch" radiogram. At a later date Mr. S. R. Williams, of the Automatic Coil Winding Co., dealt with a number of the well-known Avo measuring instruments.

The City and Guilds College Radio Society

Headquarters: City and Guilds College, Exhibition Road, South Kensington, London, S.W.7.
Meetings: Tuesdays at 5.15 p.m.
Hon. Sec.: Mr. J. D. McNeil, City and Guilds College, Exhibition Road, South Kensington, London, S.W.7.

At the last meeting Mr. S. A. Stevens addressed the Society on the subject of "Metal Rectifiers."

Edgware Short Wave Society

Headquarters: Constitutional Club Hall, Edgware.
Meetings: Wednesdays at 8 p.m.
Hon. Sec.: Mr. G. Yale, 40, Raeburn Road, Edgware.

Meetings are in future to be held at 8 p.m. every Wednesday at the Edgware Constitutional Club Hall, which is opposite the Ritz Cinema. Mr. Thorogood has promised an electric clock to the first member who obtains a full transmitting licence.

Lincoln Short-Wave Club

Headquarters: 30, Tentercroft Street, Lincoln.
Meetings: Tuesdays at 7.30 p.m.
Hon. Sec.: Mr. C. Babbs, 203, Wragby Road, Lincoln.

The members of the above club feel that the time is now ripe for a reorganisation of the club and that steps should be taken to plan ahead a suitable syllabus of lectures and demonstrations. The secretary would be very glad to hear from the secretary of any other club who can assist him and also from firms or organisations who can supply lecturers or who can lend apparatus for lecture-demonstration purposes.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

A somewhat unusual evening was spent recently when Mr. Harris, of the Radio Development Co., talked on Short-wave Surgery. Mr. Harris brought with him a considerable amount of apparatus and demonstrated this method of "bloodless surgery" by cutting off a lump of steak by means of ultra-short waves.

There was a very large attendance at the high-fidelity demonstration given by Mr. V. Williams. The lecturer used *The Wireless World* All-Wave Super Seven and Push-Pull Quality Amplifier in conjunction with a Voigt loud speaker. Demonstrations were given both of wireless and gramophone reproduction.

The society's programme up to Easter is as follows:—

Feb. 3rd: Joint meeting with the British Sound Recording Association, to be held in Central London. The subject is a talk and demonstration on Sound Recording on Direct Play-back Blanks. Special travel facilities and location of hall will be announced later.

Feb. 8th: Mr. H. J. Walters, of Belling and Lee, will lecture on Electrical Interference Suppression as applied to Broadcast Reception.

Feb. 15th: Mr. P. K. Turner, of Hartley-Turner Radio, will demonstrate a new "B" type negative feed-back amplifier.

Feb. 22nd: A representative of Mullard Wireless Service will discuss the latest valve topics, including valve application in television receivers.

Mar. 1st: Mr. G. A. Hoskins, Vice-Chairman, will give another recorded musical programme.

Mar. 8th: To be arranged.

Mar. 15th: Demonstration and Talk by Mr. R. P. Jonas, Hon. Librarian.

Mar. 22nd: Progress in Commercial Set Design. Latest models will be shown and their performance compared. This special feature has been arranged by Mr. Marks, of C. A. Mackenzie, South Croydon.

Mar. 29th: Annual General Meeting for presentation of balance sheet and election of officers for session 1938-39. After this a selection of ten-minute talks by members will be given.

Apr. 5th: Loud Speaker Night.

The first meeting of next season will be held on October 4th.

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

SECONDARY EMISSION SURFACES

FOR devices such as the electron multiplier, in which amplification is effected by causing a primary electron to set free several secondary electrons, the production of surfaces capable of giving a large emission of secondary electrons is becoming important.

According to the invention a surface of the kind in question consists of a pure carbon layer in which metals such as magnesium, calcium, etc., have been adsorbed by a process involving the "high-frequency" heating of the metals in an atmosphere of acetylene.

N. V. Philips Gloeilampen-fabrieken. Convention date (Germany), February 10th, 1936. No. 473398.

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"QUIET" TUNING

THE set is "muted" each time it is tuned to a new station, the circuits being restored to action shortly after the tuning indicator has been brought to the new setting.

The operation is as follows:—The tuning knob (not shown) is first pressed inwards so as to close the contacts AB. This earths the grid circuit of the output valve V1. Further depression of the knob next closes the contacts B, C so as to throw a heavy negative bias on the amplifier V. This is derived from a resistance R shunted across the field-coil F of the loud speaker.

The tuning knob is now rotated to the required setting for the new station, and then released. As the contacts A, B, C separate, the blocking bias on the amplifier V leaks away through a resistance R1, and the circuits are restored to normal. A visual tuning indicator is used whilst the receiver is "muted."

E. K. Cole, Ltd. and H. Hunt. Application date, April 29th, 1936. No. 472922.

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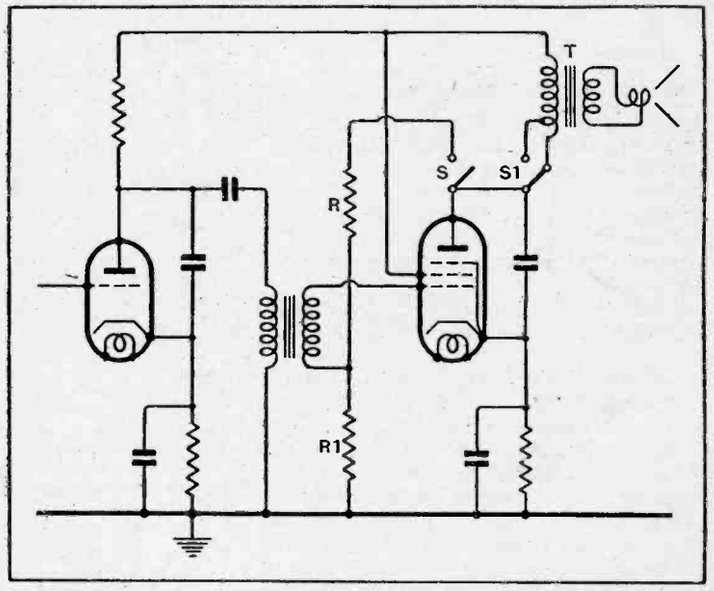
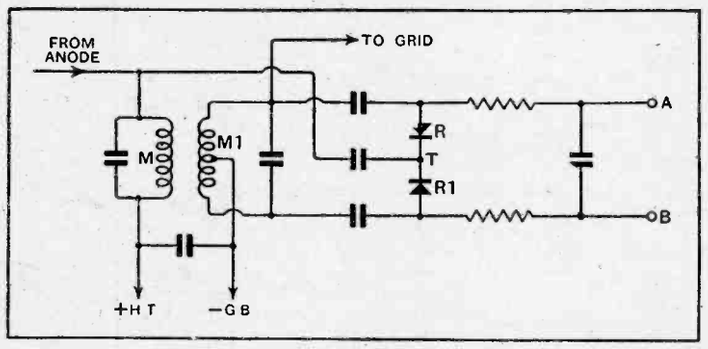
TUNING INDICATORS

A VISUAL tuning indicator is made to show a large change in brilliance for a small departure from the critical point of resonance, and at the same time to distinguish between the two directions in which mistuning can occur.

The Figure shows, for instance, a band-pass intermediate-frequency circuit in a superhet receiver. The top end of the primary winding M is connected to the anode of a preceding valve, whilst the top end of the secondary winding M1 goes to the grid of the next valve. A connection is made from M to a point T between two rectifiers R, R1 so that the primary and secondary voltages are accurately balanced across the "bridge" at the critical point of resonance.



Method of applying negative feed-back so that its use is optional.



Circuit for visual tuning indicator showing also degree and direction of mistuning.

Any movement "off resonance" will then change the phase-relations so that the resulting voltage across the terminal points A, B varies both in magnitude and direction with the degree of mistuning. The resulting voltage is applied to two glow-discharge tubes, the luminous column in one increasing in length, and that of the other decreasing, for a rotation of the tuning control in a clockwise direction. These indications will be reversed for an opposite rotation of the control.

Marconi's Wireless Telegraph Co., Ltd. (assignees of G. Guanella and M. Lattman). Convention date (Switzerland), September 23rd, 1936. No. 472520.

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VARIABLE SELECTIVITY

THE use of "reverse" or negative feed-back is now a well-known expedient for reducing the effect of loud-peaker resonances and various other forms of distortion. It has, however, the disadvantage of reducing the overall sensitivity of the set, because the reaction is in the "sense" to cut down amplification.

In the circuit shown, reverse feed-back is applied to the output valve V through resistances R, R1, which are normally left in circuit when a near-by programme is being received, in order to keep the quality as perfect as possible.

But when it is desired to receive more distant stations, the negative feed-back is cut out by opening a switch S. Simultaneously a second switch S1, ganged to the first, is moved to a tapping on the transformer T, so as to adjust the output impedance of the valve V to the new conditions.

E. K. Cole, Ltd. and G. Bradfield. Application date, May 28th, 1936. No. 472712.

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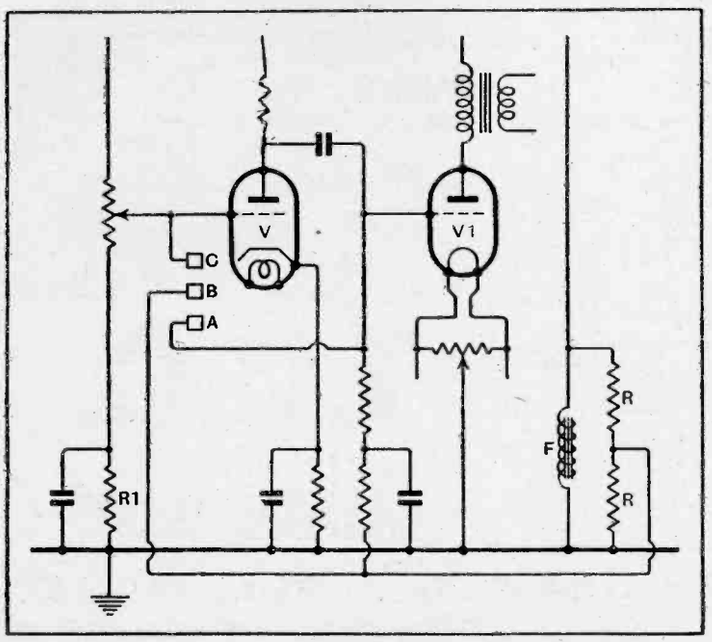
CATHODE-RAY TUBES

IT is found that the presence of certain metal vapours, particularly those of copper and nickel, adversely affect the amount of light given off by the fluorescent screen of a cathode-ray tube. When these metals are used for the electrodes of the tube, some of the vapour is invariably produced during the heat treatment in the course of manufacture.

To avoid this source of trouble the electrodes of the tube are made solely of chrome-iron or chrome-steel alloy.

N. V. Philips Gloeilampen-Fabrieken. Convention date (Germany), January 25th, 1936. No. 473173.



Muting circuit manually operated by the tuning control.

The British abstracts published here are prepared with the permission of the controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

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CONTENTS

EDITORIAL COMMENT

An Alternative Programme

Neglected Facilities

IT has always been a matter of surprise to us, when we hear so many complaints that the broadcast programmes are disappointing and that there never seems to be a programme worth listening to, that an obvious alternative available to nearly all owners of a wireless set is not more widely appreciated.

We refer, of course, to the facility for reproduction of gramophone records. Even apart from the question of whether or not the programmes of the B.B.C. are acceptable at the time when we want to listen, we must remember that unless variable selectivity is incorporated in the set all programmes passing through radio-frequency or intermediate-frequency stages must be restricted in audio-frequency range by the selectivity of circuits dictated by the requirements of present-day reception. These requirements are, of course, the result of overcrowding in the broadcast wavebands.

The best quality of reproduction of which the loud speaker is capable is never available when listening to broadcasting in these circumstances.

Record Response

The position with the reproduction of modern records is, however, quite different. The restrictions of broadcast reception do not apply in the case of the input from a pick-up entering after the detector stage. The modern record, going up to at least 8,000 cycles, is able to give, with a high-grade pick-up, quality of reproduction better than that available even from the local broadcast station.

It seems hardly understandable that so many who aim at high quality of reproduction in preference to anything else should not show more enthusiasm for the possibilities of the record now that modern recording methods have improved so much.

It is not even as if a heavy expenditure is necessary to be able to avail oneself of gramophone reproduction, because the majority of modern sets already provide pick-up terminals, and the addition of the pick-up and turntable is all that is necessary to complete the outfit. Perhaps it is because in most designs the pick-up terminals are located at the back of the set that these facilities, being out of sight, are out of mind.

Quality Opportunities

The gramophone record provides considerable scope for improving quality of reproduction, the designer of the reproducing equipment being without the handicap of the frequency band restriction on the radio-frequency side.

Quality of a very high order is obtainable from the best modern records and, coupled with this, we know that the record has been made after many rehearsals and with every precaution taken to see that the performance is as perfect as possible. In general, too, only first-class artistes are engaged for record-making, whereas the B.B.C. has often to be content with an occasional "star" but a great deal of mediocre talent.

We feel, therefore, that the gramophone side should be commended to all those who express their dissatisfaction with the B.B.C. programmes. Every owner of a wireless receiver has it in his power to appoint himself an alternative programme director, with full discretion, not only as to the choice of material, but also the time and order of presentation.

Short-Wave Fade-outs

DIFFERENT TYPES AND THEIR CAUSES

SPECTACULAR displays of the Northern Lights and the accompanying disorganisation of short-wave services has recently drawn attention to fade-outs of signals, a phenomenon distinct from the more familiar effect of periodic fading. The nature and causes of these interruptions are discussed in this article

FADING is more or less inherent in short-wave reception owing to the constantly changing character of the medium through which the waves are propagated. It is due, in its most familiar form, to phase differences in the signal voltages applied to the receiver: a number of down-coming rays arrive at different angles, the rays having traversed different transmission paths, each of which is subject to more or less rapid changes in its properties of refraction and absorption. The changes in these two quantities affect respectively the phase and amplitude of the arriving waves, and the total received voltage will thus be the sum of voltages of random phase and amplitude. The periodicity of the fading may vary from a few milliseconds to several minutes, depending on the rapidity of the changes, and thus on the degree of stability of the ionospheric part of the transmission path.

The above remarks are made not as an introduction to a discussion on fading, but because there appears to be some tendency to confuse the terms "fading" and "fade-out." The latter is, fortunately, a much more rare phenomenon than the former, and differs greatly from it in its duration time. A "fade-out" might be broadly defined as an abnormal deterioration of short-wave signal strength lasting for any time, from ten minutes to a week, the deterioration varying in intensity from a noticeable decrease from normal strength to a complete cessation of all signals in the short-wave bands.

It is now well established that these fade-outs are of two distinct kinds, both being attributable to solar phenomena, which, however, differ for the two cases. As will be seen, the two types of fade-out exhibit markedly different characteristics.

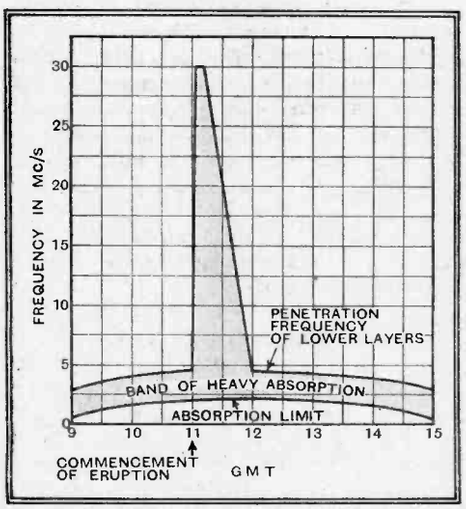
The Two Types

The first type is known as a Dellinger fade-out, in which practically all signals in the short-wave bands (frequencies above about 3 Mc/s) quite suddenly either disappear entirely, or at least become seriously weakened. The lower frequencies suffer the more severely, though at the beginning of the fade-out signals on the highest frequencies often disappear also. The fade-out is confined to transmission paths which pass through the daylight hemisphere, and it is most intense in low latitudes and near the noon longitude. The degree of its intensity is usually severe, and it may last from a few minutes to nearly an hour. The return to normality is fairly rapid, signals on the highest frequencies reappearing first and reaching their usual strength, and with lower and lower frequencies following one after another until normal conditions are restored. These occurrences are much more frequent in the years near the peak of the eleven-year sunspot cycle than in years of low solar activity.

The second type is that usually associated with a magnetic storm, and, indeed, is often loosely spoken of as being *due* to a magnetic storm. In this case the fade-out does not usually occur with the suddenness characteristic of a Dellinger fade-out, the signals sometimes taking an hour or so to disappear. The higher frequencies are most affected and long-distance communication is sometimes maintained by shifting to a lower frequency, though even here signals are usually below their normal strength. The fade-out does not favour either the daylight or darkness hemisphere, but is invariably more intense on transmission paths passing near the Poles. The degree of its intensity is not usually so severe as in the Dellinger type—at least over the whole short-wave band—but it often causes a cessation of all signals over a certain band of frequencies. Its minimum duration is usually several hours, and sometimes a week elapses before complete normality is reached, the recovery being comparatively slow. Magnetic storms and bright auroral displays often accompany the radio disturbance, and the latter occurs oftener during the period of low solar activity than at any other time.

So much for the observed radio effects. To understand the causes we must briefly consider the ionospheric conditions which determine the propagation characteristics of a transmission path.

It will be remembered that waves of the frequencies we are considering are propagated by refraction in the ionosphere, where there are several belts of ionised air, notably the E layer at a virtual height of 120 km, the F layer at a virtual height of 300 km, and the F2 layer at a virtual height of from 300 to 400 km. The F2 layer is the part of the F layer which plays an important rôle in wave propagation during daylight hours, and the virtual heights given are those for July, 1937.[1] The refraction usually takes place at the F layer during night and at the F2 layer during daylight, though in summer the E layer may, at certain times of the day, be sufficiently highly ionised to refract completely some of the waves we are considering. The ionisation of the air particles forming the layers is brought about by the action of an agent radiated by the sun, and thought to be a wave of a frequency in the ultra-violet part of the spectrum. The density of the air particles at the F layers is low, and because of this much of the ionising radiation is not absorbed, but penetrates to the E layer. Also, the recombination rate of the ions and electrons at the F layer is comparatively low, for the same reason.



Illustrating broadening of absorption band due to lower layers of the ionosphere during eruptions which occur in the gaseous envelope of the sun.

Causes of Attenuation

At the E layer the air particles are much more dense, and though the amount of ionising radiation reaching the layer is less than that at the F layers, and the ionisation level produced is thus much lower, the mean free path of the ions is small. So that when they are set in motion by a

* T. R. Gilliland, S. S. Kirby, N. Smith and S. E. Reymer, "The Ionosphere at Washington," J.I.R.E., Sept. 1937.

Short-Wave Fade-outs—

radio wave collisions readily occur, and energy is absorbed, thereby causing the layer to become the main source of attenuation of the wave. The recombination rate for the layer will also be high, again owing to the high density of the air particles.

Thus the waves are usually refracted at the F layers, but in passing through the E they suffer attenuation, the degree of refraction and the amount of attenuation both decreasing as the frequency is increased.

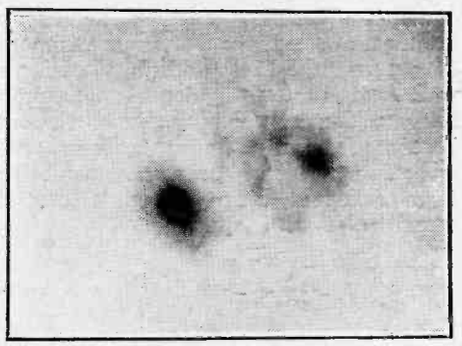
The Dellinger Fade-out

It is now fairly well established that the Dellinger fade-outs are caused by large eruptions which occur in the gaseous envelope of the sun. These eruptions in the chromosphere—as it is called—are vast upheavals which appear to be associated with the beginning of sunspots, since they usually occur near a sunspot group which is in a state of expansion. By means of spectro-helioscopic observation it is found that clouds of hydrogen and calcium vapour are thrown off when they occur, and it is by noting the exact time of the appearance of these clouds of gas that correlation with the radio fade-outs is obtained. According to a recent paper by Dr. Dellinger there were 104 fade-outs of this type during 1936, and 51 of these were correlated with a chromospheric eruption, and, as to the others, it must be remembered that, owing to atmospheric obscuration, the sun is not under observation all the time.

It is evident, then, that emission of some agent capable of affecting the ionosphere occurs when a chromospheric eruption takes place. The time taken for electro-magnetic wave radiations to travel a distance equal to that between sun and earth is just over 8 minutes, and it has been found that an eruption as observed from the earth often commences simultaneously with a Dellinger fade-out. Furthermore, it is found that a fade-out can occur irrespective of the position of the eruption on the sun's disc. These two facts indicate that from the eruption is emitted a sudden radiation which is universally diffused and travels at the speed of light; in fact, an electro-magnetic wave of ultra-violet frequency. This radiation travels outward from the sun and reaches the earth's atmosphere on its illuminated side. Owing to the rarity of air particles at the F layer it penetrates this region and reaches the E layer (and lower layers having similar characteristics to the E), where the air particles are more dense, and, moreover, are not already ionised to the same extent as at the F. Here it expends its energy in producing a sudden excessive rise in the ionisation.

In a Dellinger fade-out the observed radio effect is evidently one of attenuation and not one of inadequate refraction, because the lower frequencies are the most affected, and attenuation is a property which varies inversely with frequency. Also, as the highest frequencies are the first to become normal on the cessation of the fade-out, it is apparent that the refractive index of the F is more than adequate to ensure the return to earth of the lower frequencies. So we must assume that the sudden burst of abnormal radiation raises the ionisation of the E and lower layers to such an extent that the attenuation of the waves on passing into them is so severe that they are completely absorbed, even frequencies as high as 30 Mc/s often being so affected.

On the cessation of the eruption and the removal of the abnormal solar radiation recombination of the ions and electrons commences, and proceeds rapidly



Fade-outs of the "magnetic storm" type generally occur when groups of spots appear on the surface of the sun. Dellinger fade-outs appear to be associated with the early stages of sunspot formation.

Photograph by courtesy of the Journal of the British Astronomical Association and with the permission of the Royal Observatory, Greenwich.

because of the high gas pressure at the lower layers. As the attenuating ionisation becomes reduced lower and lower frequencies reappear and return to normal, until, usually within the hour, the effect of the eruption has passed.

It has been found on a number of occasions that, coincident with the start of a Dellinger fade-out, there is a slight abrupt decrease in the horizontal intensity of the earth's magnetic field. It is now thought that part of the earth's magnetism is caused by the movement of ions through the ionosphere, which form a huge current and so produce a magnetic field; thus an abrupt change in the ionic drift produces a corresponding disturbance in the associated field.

Magnetic Storm Effect

The magnetic storm type of fade-out is less well understood, though it is fairly certain that is again the result of a solar radiation. In this case the radio effect is not one of attenuation, but of inadequate refraction at the F layers. For it is the highest frequencies that suffer most, appearing to pass through the F layers and escape into space. The measured critical frequency of the F layers on disturbed days is found to be much reduced, and from this it would seem that some sort of de-ionisation process occurs at the layer. It is observed, also, that a magnetic storm fade-out usually occurs when there is an active sunspot group near the sun's central meridian. This points to some form of corpuscular radiation from the sunspots, because, unlike wave radiation, which reaches the earth regardless of where it originated on the sun's disc, the corpuscles must be shot off from near the sun's centre in order to reach this planet. The corpuscles also appear to possess a charge, since they produce their greatest effect near the earth's poles, and their movement in that direction produces severe disturbances in the earth's magnetic field. In fact, the magnetic effects were observed long before the radio phenomena; hence the name.

The corpuscles appear to rain upon the outer ionosphere and cause the de-ionisation process in the F layer, but the exact mechanism of the process is not yet clear. It has been suggested that bombardment of the air particles by the corpuscles causes the F layer to expand, and thus reduces the overall ionisation level. Whatever the actual process may be, it seems that the corpuscular radiation is capable of neutralising the ionisation produced by the normal ultra-violet radiation from the sun, as the ionisation definitely falls and the critical frequency becomes reduced. The effect is not sudden, the ionisation level falling fairly rapidly as the corpuscular bombardment continues. Once the ionisation level is reduced it seems that only a further subjection to the ultra-violet radiation can again raise it, and thus the effect is present in the night hemisphere as well as in the day. The recovery period is slow owing to the rarity of the air particles at the F layers.

The Northern Lights

Simultaneously with the commencement of the disturbance there occurs a large decrease in the horizontal force of the earth's magnetic field, which may be 20 times as great as that occurring at the commencement of a Dellinger fade-out. This gives rise to large earth currents, and the fluctuations of both usually continue to occcur for several days. The aurora is another manifestation of the abnormal solar radiation of this type, being of a particular brilliance during severe storms and visible in latitudes far south of the normal.

It may be of interest to record that on October 3rd, 1937, a display of Aurora Borealis was observed by the master of a vessel engaged in fishing off the Cornish coast. On October 4th it was noticed that an extremely active sunspot group, which had appeared on the sun's east limb on September 28th, was in a position approaching the central meridian, having travelled approximately along the sun's equator and increased in size during its passage. The period September 29th to October 6th was notable for a succession of short-wave fade-outs and unsettled conditions, which in the earlier cases seem to have been due to chromospheric eruptions, but in the later ones seem to have shown the characteristics of the magnetic storm type. It is not possible to verify

Short-Wave Fade-outs—

this until astronomical records and further radio data become available.

It may also be of interest to note the remarks of an observer in the U.S.A. with regard to the way in which European short-wave circuits were affected by a magnetic storm which occurred a few years ago.

The first evidence of some abnormality in the circuits under observation from New York was the disappearance of signals from the German station, whose bearing from New York is N47E. The next to fade out were the English and French stations, bearing respectively N52E and N54E. The Italian circuit faded out some time later, followed by that to Madrid. Their bearings from New York are N58E and N66E. Lastly, the Lisbon station, bearing N70E, became affected by the fade-out.

In other words, the de-ionisation of the F layer seemed to proceed radially outwards from the North Pole.

Summarising we may say:

(a) Short-wave fade-outs are of two kinds: Dellinger fade-outs and those of the magnetic storm type.

(b) The former are characterised by a sudden deterioration of short-wave signals, usually amounting to a wipe-out in the case of the lower frequencies. The higher frequencies suffer least, only daylight routes are affected, and the fade-out does not often last more than an hour. The radio effect is one of excessive absorption in the lower layers, due to an excessive rise in the ionisation caused by an abnormal burst of radiant energy released by an eruption on any part of the sun's disc.

(c) The characteristics of the latter are a more gradual deterioration of short-wave signals, often amounting to a wipe-out on certain frequencies. Highest frequencies are most affected, the disturbance is more severe near the Poles and may last for a week. It is due to inadequate ionisation for refraction at the F layer, brought about by some form of de-ionising process, possibly as a result of corpuscular radiation from sunspots near the sun's central meridian.

Hints and Tips

PRACTICAL AIDS TO BETTER RECEPTION

The Beat Oscillator

OUR contributor, "Diallist," recently drew attention to the advantages of the beat oscillator, which makes it possible to receive continuous-wave signals without risk of causing interference to others. Although primarily used for reception of Morse signals, its use facilitates short-wave (and particularly ultra-short wave) working.

The ordinary modern superheterodyne provides no means of producing an audible beat note, and the usual way of overcoming this limitation is to add an oscillator valve; almost any kind of stray coupling between the added oscillator circuit and the existing IF amplifier will give results. As to the oscillator itself, all that is required is that its circuits should be turnable over a narrow range (a few thousand cycles) on each side of the intermediate frequency of the set. In improving an oscillator it will generally be possible to adapt for the purpose the IF coils of a transformer designed for the frequency used in the set. Alternatively, suitable coil assemblies for any standard frequency are available commercially.

Those who do not wish to set up a separate oscillator can often adopt an even simpler expedient. By partially removing one or more IF coil cans it is generally possible to provoke more or less controllable oscillation of the IF amplifier; as a very slight movement of the coil can will generally start or stop oscillation, means should be devised for propping up the can in the desired position.

"Shorting" Condenser Vanes

CASES of short-circuiting gang condensers are fairly common, both to the amateur and the professional service man. Even to the comparative novice the task of finding the cause of the scraping noise usually presents little difficulty, but often enough the real problem is how to remove it. Apart from vanes bent through accidental damage, the trouble is generally due to "whiskers" of metal adhering to one or more of the plates. These can be removed by inserting a thin strip of card, such as a cigarette card, but it has been found from experience that this method is not always immediately successful, and a handy tool made specially for the purpose is a great deal more useful. Nothing could be simpler than the one shown in the accompanying Fig. 1; it consists merely of a length of 16-gauge wire, with one end curled into a loop for holding or hanging purposes and the other flattened into a thin blade to a length of about 3in. by hammering it on a hard, flat surface. The "feeler" so formed can be inserted firmly between the vanes, while the handle can be bent to suit any particular conditions.

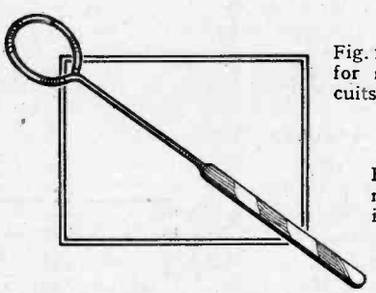


Fig. 1.—Home-made tool for removing short-circuits from condenser vanes.

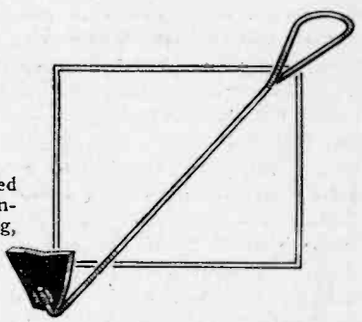


Fig. 2.—An improvised mirror for use in examining inaccessible wiring, etc.

Care of Switches

OPINIONS differ as to the desirability of lubricating current-carrying contact surfaces of switches, etc. One school of thought maintains that a film of oil or vaseline will reduce contact resistance and prevent wear, while others assert that, so far as a well-designed switch is concerned, the lubricant can have no beneficial effect, and will merely collect dust and dirt.

Be this as it may, lubrication of current-carrying bearings, etc., is often resorted to; incidentally, many manufacturers use a mixture of collodial graphite and oil for the purpose.

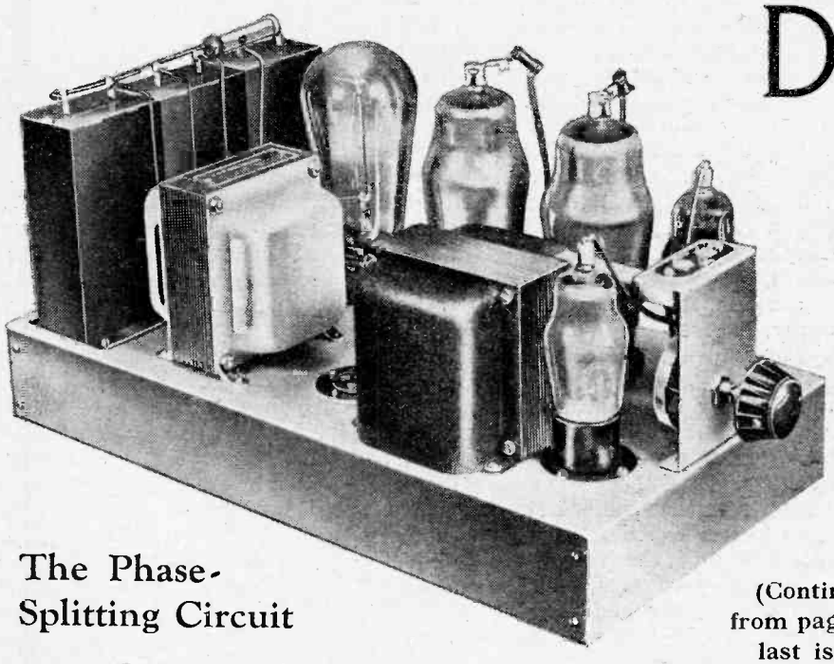
A correspondent, writing on the maintenance of switches, suggests that castor oil provides an excellent preservative film for contacts, as it has the property of preventing oxidation, which is one of the most prolific sources of trouble. Before applying the oil, contacts should be scrupulously clean, and, so far as modern wave-change switches are concerned, the cleansing operation may best be carried out with the help of trichlorethylene, obtainable from many chemists. The fluid is flooded into the body of the switch, and the spindle is rotated briskly while it is drying out. The same procedure may be used in dealing with the older type of cam-operated switch, but here the contacts are more robust and accessible; consequently, they may be cleansed by introducing between them a strip of thin, springy steel to which a fine file-like surface has been imparted by rubbing with coarse emery paper.

For Awkward Corners

ANOTHER very handy little gadget, this time, perhaps, of greater appeal to the genuine service engineer, whose time is spent in examining many different sets in a day, is a small mirror, suitable in shape and dimensions for inserting into dark corners for the purpose of revealing wiring, connections, etc., which would otherwise be hidden from the eye. A small triangular fragment from a broken mirror is excellent for the purpose. This should be attached by means of wax or similar adhesive to one end of a length of copper wire, or even cored solder, the other end being formed into a loop for a handle. Flexibility at the point of attachment is rather important in order to allow the mirror to be adjusted at will to the most convenient angle.

How a Receiver is Designed.—V.

DC Quality Amplifier



HAVING considered the output stage and decided upon the kind which will be used and its requirements, the next step in design is to work out the details of the penultimate stage. This problem is tackled in this article, and the design of the phase-splitting stage is completed.

The Phase-Splitting Circuit

(Continued from page 97 of last issue.)

THE output stage was treated in detail last week, and we must now consider the stage which must feed it. In the output stage each valve requires a maximum signal input of 4.4 volts peak in opposite phase, that is to say, when the signal is driving one grid in a positive direction the other grid must be driven negative by an equal amount. One way of obtaining this input is by means of a push-pull transformer, the secondary being centre-tapped and earthed, and the two outer ends feeding the two grids. If we were using a heavily driven Class AB stage so that the peaks of the signal caused grid current to flow in the output valves, then we should have to use a transformer, but as we are operating at all times outside the grid current region we can adopt resistance coupling if we wish.

The relative merits of resistance and transformer coupling from the point of view of quality reproduction have been argued many times in the Correspondence columns of *The Wireless World*. The main advantage of transformer coupling is that it is possible to drive the grids of the output valves momentarily positive on heavy peaks without such severe distortion as with resistance coupling; in other words, the effects of overloading the amplifier are not quite as bad. An amplifier used for high-quality reproduction, however, should be so operated that it is never overloaded, so that this advantage is not, in practice, as great as it seems. The old advantage of transformer coupling—a much greater stage gain—is, in fact, not obtained under modern conditions, for it is now the practice to damp the transformer windings with a shunt resistance across the secondary. This is done in order to secure a good transient response, and the step-up obtainable is then severely limited, the maximum step-up normally secured being about 1:2, and 1:1 ratio transformers being not uncommon.

The question of whether or not a transformer does, under these conditions, introduce more audible distortion than resistance coupling is not an easy matter to decide, for with either the distortion is very low. Resistance coupling, however, has the great advantage that it enables one easily to carry out an exact design to suit any requirements and is, on the whole, likely to be cheaper, in spite of the fact that an additional valve may prove necessary. There is also the advantage that there is no criticism against it on the score of quality which there may be with a transformer. Let us decide, therefore, to use resistance coupling throughout.

As the total input required by the output stage is only 8.8 volts peak, it is quite unnecessary to use push-pull in the penultimate stage, for a single valve will easily give the necessary output. This valve must be arranged to give two equal outputs in opposite phase and, in the writer's experience, the best method of arranging this is by using a triode in the circuit of Fig. 2. This circuit is very simple and reliable in operation and its action is best understood by considering Fig. 3 as a start. This is the same as Fig. 2, but the signal input is applied between grid and cathode instead of between grid and negative HT.

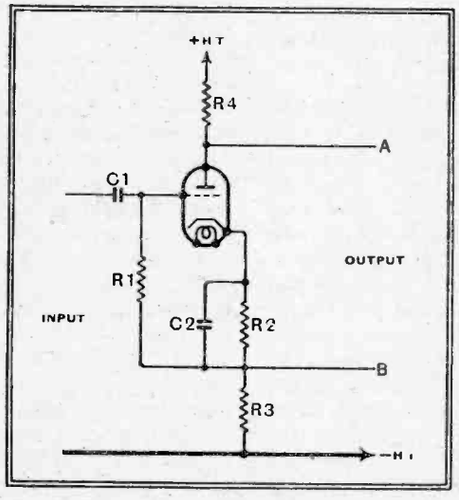


Fig. 2.—The basic circuit of the phase-splitting stage is shown here.

Consider the conditions with no signal. The valve is passing anode current so that there is a voltage drop across R3 and the point B is positive with respect to negative HT, by perhaps 50 volts. There is also a voltage drop across R2 so that the cathode of the valve is positive with respect to B. The grid is returned to B through the grid leak R1, so that the voltage drop across R2 represents the negative grid bias of the valve. The anode current, also, flows through R4, with the result that point A is negative with respect to positive HT.

Now consider the case when a signal is applied to the input terminals. When this swings the grid in a positive direction the anode current increases so that the voltage drop across all the resistance except R2 increases. The voltage does not change across R2 because the signal is alternating rapidly and the variations are taken up by the shunt condenser C2. The increased current causes an increase in the voltage across R3, so that the point B becomes more positive than before with respect to negative HT. The increased current through R4 increases the voltage drop across this resistance and the point A becomes more negative with respect to positive HT than it was originally.

As regards alternating currents, however, positive and negative HT are at the same mean potential because they are joined together at some point in the HT supply system through a large capacity condenser. If R3 and R4 are of the same value, the changes in potential of the points A and B are equal, for it can be

D.C. Quality Amplifier—

seen that for the positive signal on the grid the point B has changed by a certain amount in a positive direction and the point A by an equal amount in a negative direction. When the signal on the grid swings negative, the anode current is decreased and the voltage drop across the resistances decrease also. The result is that the point B moves in a negative direction and point A in a positive. In other words, if R3 and R4 are equal in value, the output voltage developed at A is equal to that at B, but the voltage at B is in the same phase as that of the signal applied to the grid, while that at A

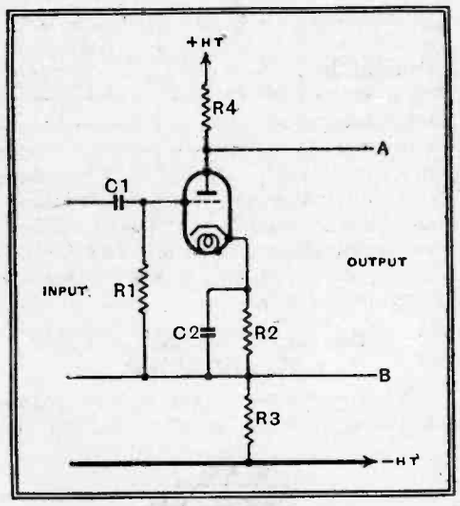


Fig. 3.—This circuit is the same as that of Fig. 2, but the input is here applied between the grid and cathode circuits.

is in opposite phase. The points A and B, therefore, can be connected through isolating condensers to the grids of the output valves.

The Cathode Resistance and Feed-Back

It is, however, only possible to use the exact circuit of Fig. 3 when it is preceded by a transformer coupling, when it is fed directly from the pick-up, or directly from a diode detector, because neither of the input terminals is at a non-fluctuating potential. In practice, therefore, we have in most cases to use the circuit of Fig. 2. This is the same, except that the input is applied between grid and negative HT. The performance is the same, except for one important difference, and this is that the voltage developed across R3 is also applied to the grid of the valve through the impedance across which the input voltage is developed. We have already seen that the voltage fluctuations of the point B with respect to earth are in the same phase as those of the grid. The voltage which actuates the valve, however, is that developed between grid and cathode, and to evaluate this we must regard the cathode, that is, the point B, as being of fixed potential. With respect to cathode, negative HT is fluctuating in opposite phase to the input signal and the output across R3 is actually applied in opposite phase to the grid. The actual signal effective in operating the valve is thus the difference between the true input and the output across R3. The result is that the stage gain is greatly reduced.

If the gain is measured between the input and one output pair of terminals, it cannot exceed unity with the circuit of Fig. 2, but may be ten times with the arrangement of Fig. 3. With Fig. 2, and taking the total output between A and B, the gain cannot exceed 2. We must, therefore, regard this stage as being not so much an amplifier, although it does give a little gain, as a phase-splitting stage. Actually, the feed-back across R3 is not always a disadvantage, for it is a form of negative feed-back and it greatly improves the linearity of this valve, so that it is actually possible to obtain quite a large undistorted output with a moderate anode voltage.

In designing a resistance-coupled stage there are three factors to be taken into account, the choice of the valve, the choice of its operating voltages, and the selection of the resistance and capacity values. These can all be done with sufficient accuracy from calculation, but it often happens that experience provides a short cut. This does not mean that some calculation is not required, but merely that by making an initial correct choice, which is dictated by experience, for some circuit value, one can eliminate a lot of computation. In this case we must first consider the phase-splitting valve operating with the circuit of Fig. 2. This is shown linked to the output stage in Fig. 4, and it will be seen that the coupling condenser C3 and C4 and grid leaks R5 and R6 have been inserted. In addition, series resistances R7 and R8 are included in the grid circuit of the output valves. These two are for the purpose of suppressing any tendency towards parasitic oscillation and perform the same function as R10 and R11 in the anode circuit. Their value is by no means critical and, since there is no grid current, they can be fairly high, 1,000 ohms being the minimum normal value.

The bass response of the amplifier de-

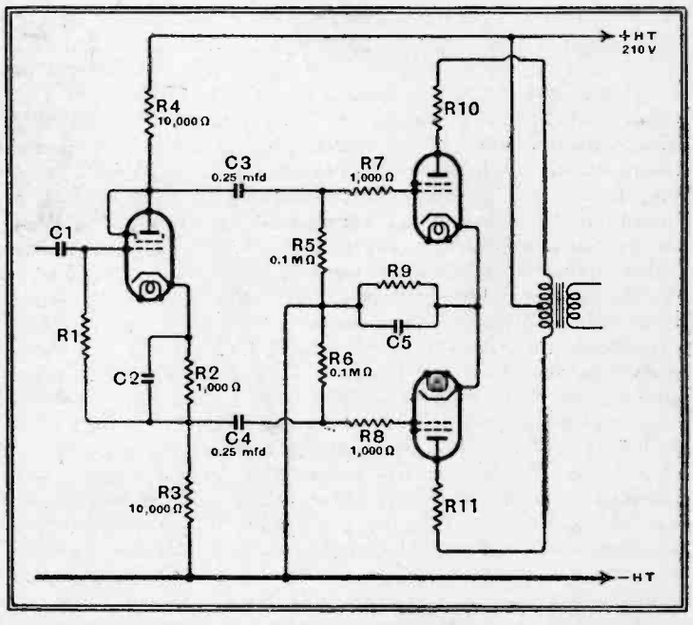


Fig. 4.—This diagram shows the phase-splitting valve linked to the output stage.

pends largely on the relationship of C3 and R5 and C4 and R6. It is actually the product of resistance and capacity which is important and for balanced operation in push-pull it is necessary that C3 R5 should equal C4 R6.

In the case of an output stage it is usually unwise to make the grid leaks of higher value than necessary, and valve makers usually place a limit to the maximum resistance which must be included in the grid circuit. For the KT31 valves this limit is placed at 0.5 megohm, but it is often advisable, where possible, to keep the resistance below this maximum. On the other hand, it is important that the value should be high in comparison with the coupling resistance of the preceding stage. Let us, therefore, tentatively fix R5 and R6 at 100,000 ohms each, and turn to the preceding valve.

Designing the Phase-Splitting Stage

Owing to the negative feed-back obtained in this phase-splitting system the type of valve used is not of great importance, and the effective gain varies very little for very large changes in valve characteristics. Experience shows, however, that a valve of moderate resistance and mutual conductance is the most suitable, and the MHL 4 is such a type in the range of four-volt AC valves. No equivalent triode is listed in the 0.3 amp. range, however, but it so happens that the KTZ63 RF tetrode has characteristics of the type which we require when operated as a triode by connecting the screen and anode together. It has, in fact, the normal rating of 10,000 ohms anode resistance with a mutual conductance of 2 milliamp/volts.

If we were using such a valve in a normal amplifier we should have to choose a load resistance which is several times the value of the AC resistance of the valve if linearity were to be obtained. Owing to the inclusion of half the coupling resistance in the cathode circuit, however, we need not do this, for the heavy negative feed-back effectively straightens the characteristics. When such a resistance is included in the cathode circuit it is, moreover, desirable to keep the voltage drop across it as small as possible, since this appears as a difference of potential be-

tween heater and cathode. Let us, therefore, choose a total value for the load circuit which is only twice the AC resistance. This will make R3 and R4 equal to 10,000 ohms. If this guess at the correct values is not a good one, we shall later have to make another try and then work out the performance in the same way as we shall now do for these particular ones.

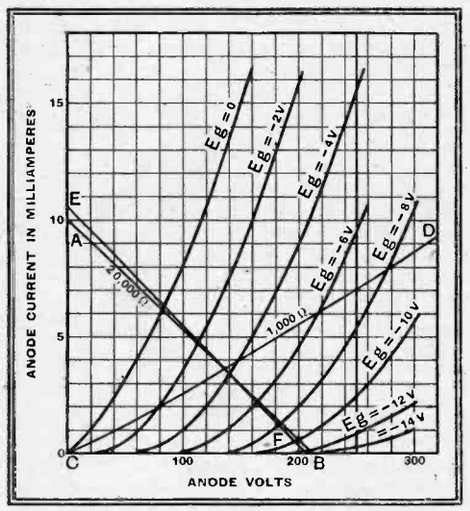


Fig. 5.—The anode-volts—anode-current curves of the KTZ63, connected as a triode, are shown here.

The first step is to obtain a set of anode-volts—anode-current characteristics for the valve, and these are shown in Fig. 5 for the KTZ63. The total resistance in the anode circuit is actually R2+R3+R4, or 20,000 ohms+R2. R2 is the bias resistance and will normally have a value of the order of 1,000 ohms. It is, therefore, fairly small in comparison with the rest of the circuit resistance and can be neglected in this case with quite a small error.

Choosing the Bias Resistance

Taking the total resistance as 20,000 ohms and the HT supply as 210 volts, we draw the line AB on Fig. 5 through the point on the anode-volts scale corresponding to the HT voltage and through the point on the current scale corresponding to the anode voltage divided by the resistance. This gives us the DC working load of the valve, and the dynamic grid-volts—anode-volts characteristic can be plotted from the intersections of this line with the valve curves. We want, however, for our first step to choose the bias voltage. This may be done by choosing the working point on the load line, and it can be seen that some three to four volts would be a suitable point to adopt, and then calculate the value of R2 from the corresponding anode current. This, however, often leads to a non-standard value of bias resistance, and it is usually more convenient to draw a series of bias resistance lines on the diagram for standard values and then to pick the nearest. Only one such line, CD, appears on Fig. 5, for it happened that the first shot was the right one. This is for a 1,000-ohm bias resistance and is plotted by taking the intersection of a bias curve with the anode current which is equal to that bias voltage divided by the value of resistance. Thus, the point on the zero grid volts curve always corresponds to zero anode current. For a one-thousand ohms bias resistance the point on the 2 volts curve corresponds to 2 mA; on the 4 volts curve to 4 mA., and so on. These points are then joined to form a line CD. It is not necessarily, and usually is not, a straight line. The intersection of AB and CD gives the operating point of the valve and, with the values shown, the anode current is 3.6 mA. and the bias is −3.6 volts.

The true DC load line is actually 21,000 ohms instead of 20,000 ohms for this condition, but the advantage of neglecting R2 in comparison with the other resistances can now be seen, for its value is not known until the operating point of the valve has been chosen, and this cannot be done until the load line has been drawn.

The dynamic characteristic of the valve to alternating currents is not, in general, the line AB, for this is the DC load line and the AC load is lower in value because of the grid leaks. In this particular case R3 and R4 total 20,000 ohms and R5 and R6 total 200,000 ohms. The AC load is consequently these two values in parallel and is computed by dividing their product by their sum, and is in this case 18,200 ohms. This is taken into account by drawing a new load line with this slope through the working point, and in Fig. 5 this is shown by EF.

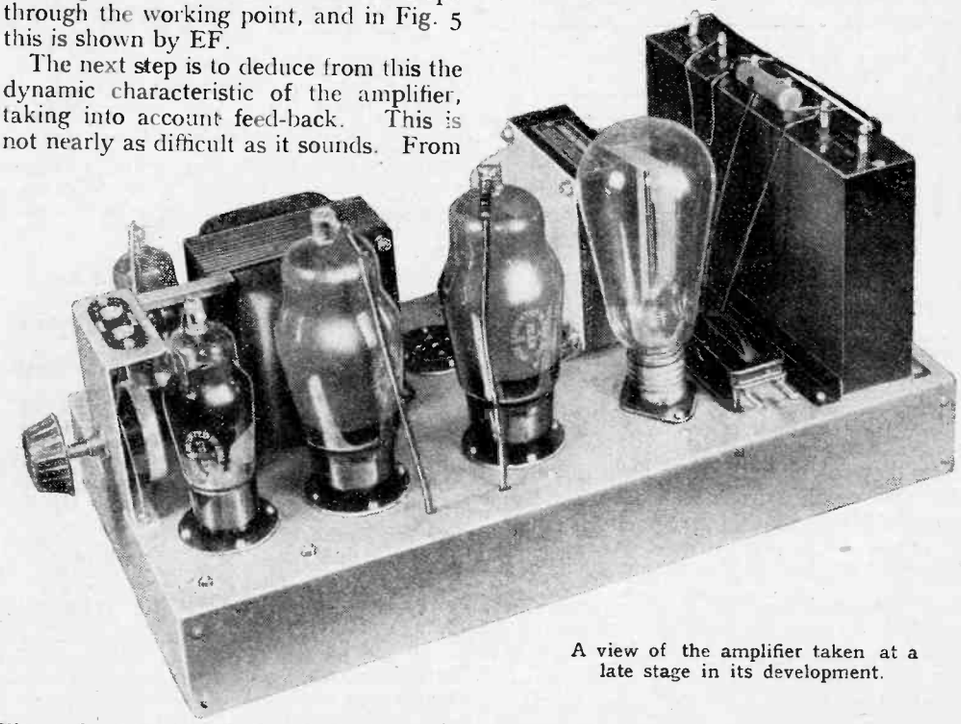
The next step is to deduce from this the dynamic characteristic of the amplifier, taking into account feed-back. This is not nearly as difficult as it sounds. From Fig. 5 for a series of grid voltage values write down the corresponding anode voltage values at the intersections of EF with the valve curves. These are shown by the first two columns in Table 1. Then take the bias point as the point of zero voltage, both for grid and anode circuits, and write down the third and fourth columns from the first two. These columns are, of course, prepared by taking the difference of the instantaneous values of the first two columns from the no-signal values determined from the intersection of the lines.

The figures obtained under the heading "Change of Anode Volts" correspond to the output voltages obtained across the 20,000 ohms resistance. In the circuit of Fig. 4 one-half this voltage appears in the anode and one-half in the cathode, and the latter voltage is fed back to the grid circuit. We thus prepare the fifth column by taking the figures of the fourth column, divided by two, and changing the sign to take into account the alteration in phase in feed-back. The last step is to add the third and fifth columns to give the total input voltage, and we can now plot the effective dynamic characteristic from the fourth and sixth columns, and this will show the total output voltage against input voltage. For this case it is shown in Fig. 6. It will be seen that it is a straight line over a range much greater than we require, for we actually need a total output of only ±8.8 volts. The effective gain of this stage is the change of output voltage divided by the change of input voltage necessary to produce it, and this comes out at 1.75 times. The input required by this stage, therefore, is the input of the output stage divided by 1.75, or 5.02 volts.

The Input Circuit of the Phase-Splitter

We are now in a position to complete the design of this portion, and the first step is to mark on the diagram of Fig. 4 the values of components we have found up to the present. As the total resistance in the cathode circuit is 11,000 ohms and the current will be 3.6 mA., the cathode will be 39.6 volts positive with respect to negative HT, and the anode will be 174 volts positive. The condenser C2 shunting the bias resistance must be of large capacity to have a reactance small compared with R2. 50 mfds. is a suitable value and an electrolytic condenser rated for 12 volts working is suitable.

The value of R1, the grid leak to this



A view of the amplifier taken at a late stage in its development.

D.C. Quality Amplifier—

stage, must be made as high as possible, otherwise there is a direct path for the signal from the grid of this valve to that output valve which is fed from the cathode circuit. Actually the proportion of the input voltage which can reach the output valve directly in this way is equal to $R3/(R1+R3)$. This is made small by making R1 large and R3 small. With a small valve, such as the KTZ63, R1 can be considerably greater than 0.5 megohm, but in general it is not wise to go beyond about 2 megohms. Taking this value, only 0.5 per cent. of the input can reach the output valve directly when R3 is 10,000 ohms, and this is satisfactory.

Taking now the values of the coupling condensers in relation to the leaks, the bass response is actually determined by the product of coupling capacity and total effective circuit resistance. In general, however, the grid leak is very large compared with the remainder of the circuit resistance, with the result that the error involved in taking into account only the grid leak is negligibly small. Moreover, the error is in such a direction as to make the actual bass response slightly better

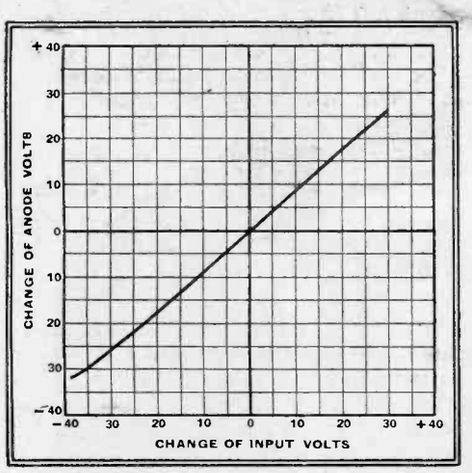


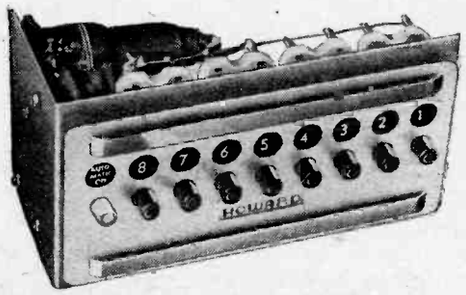
Fig. 6.—The dynamic characteristic of the phase-splitting stage. Its derivation is explained in the text.

than that calculated. It is easy to show that the response drops by 1 db. when the product of resistance and capacity is equal to $\frac{0.312}{f}$ where f is the frequency in c/s and capacity is in mfds. and resistance in megohms. As there are several low-frequency couplings and there will be a loss in each, we do not want the loss in any one coupling to be as much as 1 db. at the lowest frequency required, and the simplest way of taking care of this is to pick the values for a frequency of, perhaps, half the lowest needed, say, 15 c/s in this case. This gives us a value of 0.0208 for the product of resistance and capacity and, as the resistance R5 and R6 is 0.1 megohm, the capacity should be 0.208 mfds. C3 and C4, therefore, should be 0.2 mfd. or more, and we choose the convenient standard value of 0.25 mfd. In the case of C1 the resistance and capacity product is the same, but R1 is twenty times the value; therefore, C1 can be one-twentieth of the value and the standard capacity 0.01 mfd. is suitable. This completes this portion of the circuit and we have now to consider the preceding stage. This will be done next week.

(To be continued.)

TABLE I.

Grid volts.	Anode volts.	Change of grid volts.	Change of anode volts.	Cathode voltage change.	Change of input volts.
0	84	+3.6	−31	+25.5	+29.1
− 2	113	+1.6	−22	+11	+12.6
− 3.6	135	0	0	0	0
− 4	140	−0.4	+ 5	− 2.5	− 2.9
− 6	164	−2.4	+29	−14.5	−16.9
− 8	182.5	−4.4	+47.5	−23.75	−28.15
−10	196.5	−6.4	+61.5	−30.75	−37.15



PUSH BUTTON TUNING is becoming so popular in America that conversion units for adapting existing sets to that method of control are now being produced. The unit, which is shown with cover removed, may be connected directly to the receiver or used as a remote-control device.

Club News

Bradford Short-wave Club

Headquarters: Bradford Moor Council Schools, Leeds Road, Bradford.
Meetings: Fridays at 7.30 p.m.
Hon. Sec.: Mr. S. Fischer, 10, Highfield Avenue, Idle, Bradford, Yorks.

Mr. Perkins, of Belling and Lee, recently gave to members of the club a very lucid and interesting explanation of the principles involved in the suppression of electrical interference.

Wirral Amateur Transmitting and Short-wave Club

Headquarters: Beechcroft Settlement, Whetstone Lane, Birkenhead.
Meetings: Last Wednesday evening in the month.
Hon. Sec.: Mr. J. R. Williamson, 49, Neville Road, Bromborough.

An electric lamp to represent the sun and a globe for the earth were used by Mr. N. C. Hobbs to illustrate the second part of his talk, entitled "The Theory of DX." Another club member, Mr. Cumberlidge, has been granted his full transmitting licence and is now G3CK.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

A great deal of interest was taken in the recent talk by Mr. E. Cholot, of Lissen, entitled "Hi-Q Short-wave Components." The lecturer went into great detail in explaining the design and construction of coils and complete tuning units for short and ultra-short waves. Tuning dials also received a good deal of attention. Finally the lecturer demonstrated the Lissen "Monarch" radiogramophone, which, although inexpensive, put up a very good performance. Next Tuesday Mr. P. K. Turner will demonstrate a new "B" type negative feed-back amplifier.

Kettering Radio and Photographic Society

Headquarters: The Ivy Café, Gold Street, Kettering.
Meetngs: Mondays at 7.30 p.m. Short-wave section and Morse class, Tuesday evenings at 7.30 p.m.
Hon. Sec.: Mr. I. L. Holmes, "Miami," The Close, Headlands, Kettering.

In his talk entitled "The Use of Electronic Devices in Industry" Mr. J. S. Blair, of the research department of Stewarts and Lloyds Steel Works, Corby, referred to the uses of various types of thermionic relays, photo-electric cells, thyratrons and other devices of a like nature in modern industrial processes. At a later date Mr. F. E. Henderson and Mr. W. G. J. Nixon, of the Osram valve department, gave a talk and demonstration entitled "Developments in the Design of Valve Amplifiers." The highlight of the lecture was the demonstration of a remarkably effective contrast expansion unit. The secretary would welcome offers of talks on radio subjects.

Cardiff and District Short-wave Club

Headquarters: The Globe Hotel, Duke Street, Cardiff.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Mr. H. H. Phillips, 132, Clare Road, Cardiff.

Activities so far arranged are as follows:—

February 10th: Visit to Blackwood.

February 17th: Local section of R.S.G.B. meeting.

February 24th: A talk, the subject of which is to be announced later.

March 24th: The Cardiff "Hamfest." Full particulars will be announced later.

A monthly magazine is to be published and circulated to all members. It is intended that this shall include a digest of various foreign magazines and also articles by local transmitters. The first issue is due for publication on March 1st.

Radio, Physical and Television Society

Headquarters: 72a, North End Road, West Kensington, London, W.14.
Meetings: Friday evenings.
Hon. Sec.: Mr. C. W. Edmans, 17, Prince George's Avenue, Raynes Park, London, S.W.20.

Dr. C. G. Lemon recently gave an interesting lecture on transmitters suitable for use on wavelengths below 5 metres. The main difficulty on such frequencies is not the generation of oscillations, but the stabilisation of frequency. Crystal control, said the lecturer, is effective, but prohibitive in cost to most amateurs. Other methods of stabilisation were dealt with in detail, and a transmitter using short line grid control was demonstrated. The lecturer stressed the importance of using very thick wire without bends for leads, and he demonstrated the lighting of an 8-volt lamp by placing it across about 2in. of very thick wire bent at an angle. RF phenomena approaching that of diathermy was demonstrated by carefully insulating high-voltage portions of the apparatus and allowing members to experience the sensation of warmth by placing their hands near to the anode circuit.

Spen Valley Literary and Scientific Society

Headquarters: Healds Hall.
Meetings: Second and fourth Thursdays in the month at 7.30 p.m.
Hon. Sec.: Mr. J. Clegg, 38, Shirley Grove, Gomersal, nr. Leeds.

A radio section of the above society has now been formed, and the acquisition of a receiver is under consideration.

The West Sussex Short Wave and Television Club

Headquarters: The Waggon and Lamp, Chichester.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Leading Aircraftman J. Williams, H.Q. Flight 43 (F) Squadron, R.A.F., Tangmere, Sussex.

At a recent meeting Mr. C. G. Rockall took the place of Messrs. Webb's representative in lecturing on American amateur communication.

SUTTON, SURREY

Readers residing in Sutton, Surrey who would be interested in the formation of a radio club are invited to get into touch with Mr. N. H. Hanton, 6, Manor Court, Benhill Avenue, Sutton, Surrey.

Record-Cutting Equipment

HOME-MADE TRAVERSING MECHANISM FOR RECORDING ON DISCS

By D. E. OSMAN

HOME recording has attracted the attention of many radio enthusiasts during the last few years, and several manufacturers have endeavoured to meet the demand for inexpensive apparatus that will fulfil the requirements of the experimenter. Most of the disc-recording equipments and attachments are quite satisfactory, but the keen experimenter who likes to make things for himself and, incidentally, to save considerable expense, will, no doubt, welcome the opportunity of constructing a traversing mechanism on the lines described in this article.

In the writer's early experiments with traversing mechanisms of the simpler type several difficulties were experienced. Firstly, using a belt drive from a pulley fixed to the centre of the turntable was unsatisfactory because the shavings from the cutter caught up in the belt and caused the pitch to vary, due to building up the pulley with shavings and slightly altering the ratio of drive. Secondly, it was found that it was absolutely necessary to allow the turntable to function solely as the disc-turning device because the power developed, although adequate for even a deep cutting, could not be depended upon to provide the extra power required to drive the traversing mechanism without variation in pitch of the recorded sound due to motor speed variation.

A Simpson Recording Turntable was used for the experiments, and although the difficulties experienced could, no doubt, have been overcome by using a different type of mechanism with underneath belt drive to the traversing mechanism, and a more powerful motor, this would have proved more expensive besides complicating the construction because of the necessity of mechanical filters, whereas the Simpson turntable has all the filtering required in a simple compensator which is mounted in the bearing of the mechanism and gives very satisfactory results.

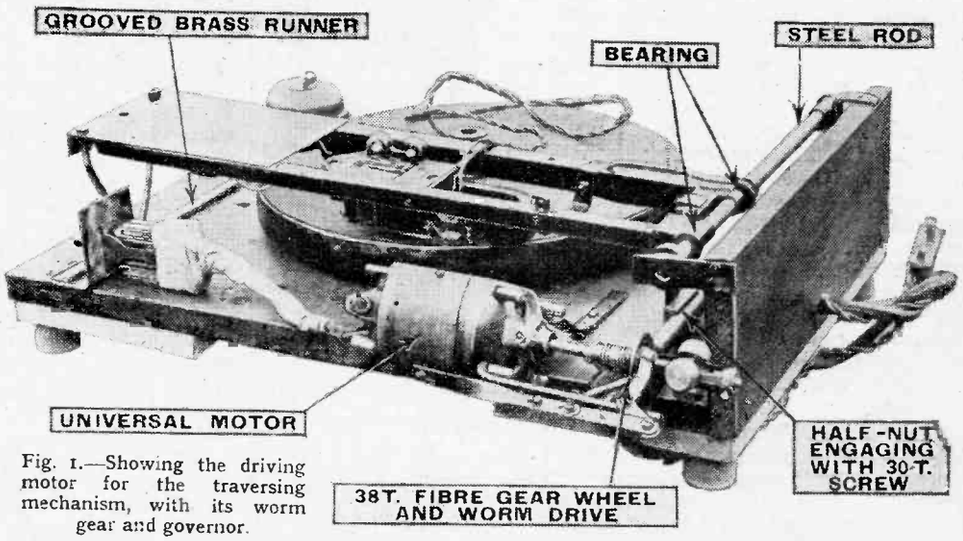


Fig. 1.—Showing the driving motor for the traversing mechanism, with its worm gear and governor.

Having regard to the aforementioned difficulties, the writer constructed a traversing mechanism which not only overcame completely the trouble experienced, but made the operation easier and allowed for greater facilities in so far as discs could be cut from centre to outside or vice versa, and pitch of cut could be varied by a governed speed control. A 30-thread screw was used for the drive screw, mounted in two bearings with a 38-tooth fibre gear attached to the end and driven by a worm wheel fitted to the extended spindle of a small universal motor, which also carried the governor and speed control (see Fig. 1).

The universal motor field and armature connections were extended and a reversing switch fitted to allow for traversing in either direction. The motor speed for 90 grooves to the inch is 988 r.p.m., which, transmitted through the reduction gear of 38 to 1, drives the lead screw at 26 r.p.m.

As the turntable synchronous speed is just over 78 r.p.m., the resultant cut is 90 grooves to the inch. The cut can be varied to over 100 grooves, but to allow for maximum modulation without echo effect, it is recommended that the grooves per inch be kept under 100.

Fig. 2 shows the traversing mechanism which slides on a silver steel rod $\frac{3}{8}$in. diameter mounted in two supports at one end. At the other end it is supported by a V-shaped 3/16in. round steel rod running in a brass grooved channel.

The whole of the traversing mechanism can be lifted as the bearings on the steel shaft form a hinge and the half nut which engages with the lead screw is disengaged when the mechanism is lifted.

It is not the purpose of this article to give constructional measurements, for the writer feels that the description and illustrations of the recording equipment given are sufficient to enable those interested to construct apparatus on similar lines to suit their own purposes, and with careful construction satisfactory results will be assured.

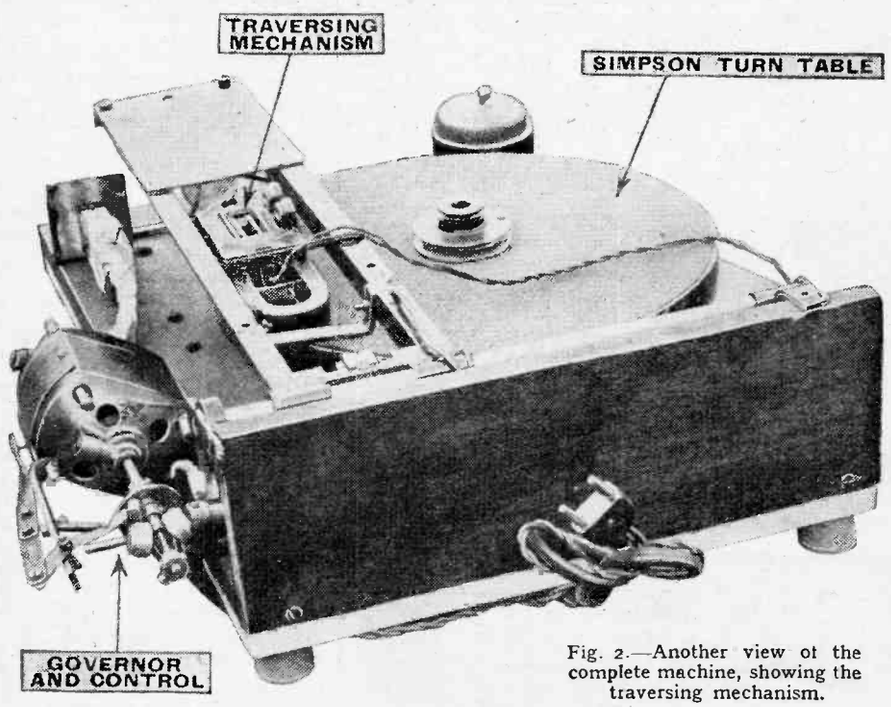


Fig. 2.—Another view of the complete machine, showing the traversing mechanism.

GIANT AIR-LINER

Wireless on the "Ensign"

THE first of the fleet of fourteen Armstrong-Whitworth "Ensign" air-liners for the Imperial Airways has just been completed and is undergoing tests. These "E" class landplanes, which are to be employed on European and Empire routes, when fully loaded weigh just over twenty tons. Each liner will be fitted with an automatic pilot.

It will doubtless be of interest to *Wireless World* readers to have some details of the wireless equipment with which, during test flights at Southampton, the operator established communication with Alexandria. The equipment is very similar to that on the Empire flying boats, consisting of long- and short-wave transmitter and receiver with provision for direction-finding on the medium-wave band. The transmitter, Marconi AD57, consists of separate short-wave and medium-wave sets contained in one aluminium case, the magnifier of which delivers approximately 65 watts to the aerial on full power. The short-wave transmitter can be used on CW only, but the medium-wave set is fitted for CW, ICW and radio telephony.

The receiver, Marconi Type AD5872, is a six-valve superhet arranged for short-wave or medium-wave reception, whilst DF can be carried out on the medium waves. Only five valves are in use at a time, as separate frequency changers are fitted for short and medium waves.

Transmitter power is obtained from a motor generator set, the motor of which is worked from the 24-volt main aircraft supply and runs at 3,500 r.p.m. A Nife battery of 24 volts 55 ampere hours is floated across the aircraft mains and kept charged by the main engine-driven dynamo. This supplies lighting and heat for cooking as well as the power for the wireless apparatus.

The plane is fitted with three aerials, that for the transmitter being 200ft. in length. This trails below the plane, passing out of the fuselage through a lead-in tube, and is wound on a hand-winch.

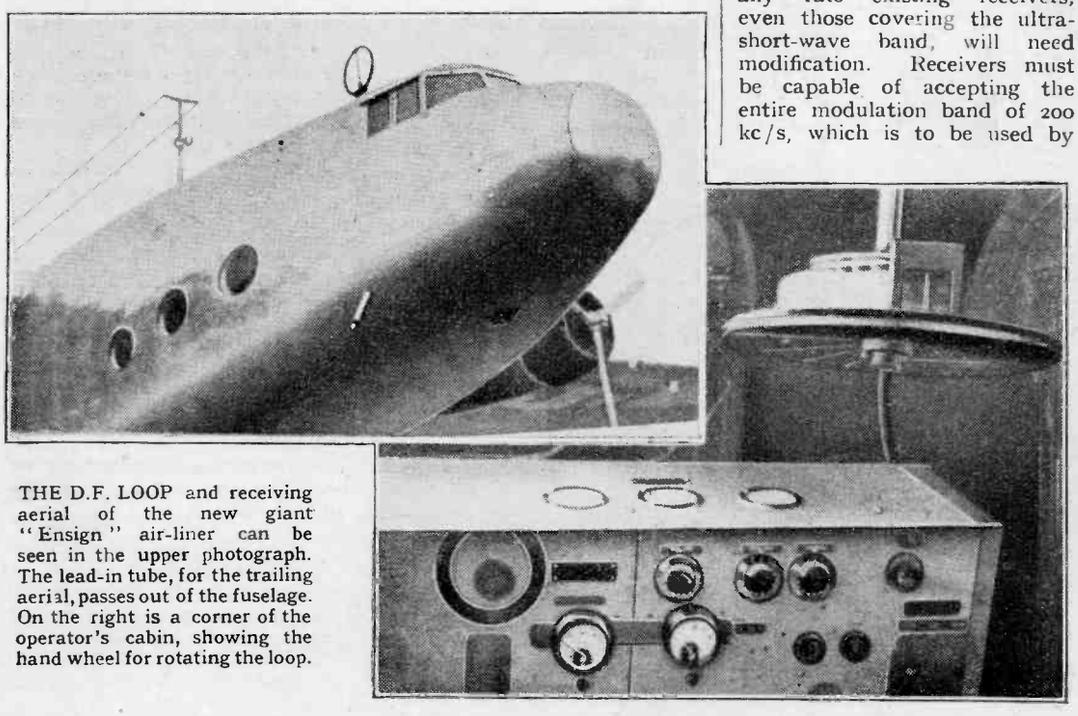
Slung on rubber insulating strainers between the rudder post and a short mast is the 80ft. two-wire "flat-topped" receiving aerial, which can also be used as a transmitting aerial for short-range working.

A rotatable loop for DF work, which can be swung directly by the operator or locked athwartships for homing, is fitted above the head of the operator on the starboard side, well off the centre line of the machine. Will the quadrantal error curve in consequence be lop-sided?

It is expected that these machines will be in use in about three months.

AMATEURS' LICENCES

IN order to qualify for a licence, Finnish amateurs must henceforward pass a military telegraphist test. Two classes of certificates are available, the military "A" certificate which calls for a Morse speed of 80 letters per minute, and the "B" certificate for which a speed of 60 letters is required. In addition, further tests on the Finnish Military Communication rules must be passed.



THE D.F. LOOP and receiving aerial of the new giant "Ensign" air-liner can be seen in the upper photograph. The lead-in tube, for the trailing aerial, passes out of the fuselage. On the right is a corner of the operator's cabin, showing the hand wheel for rotating the loop.

NEWS OF

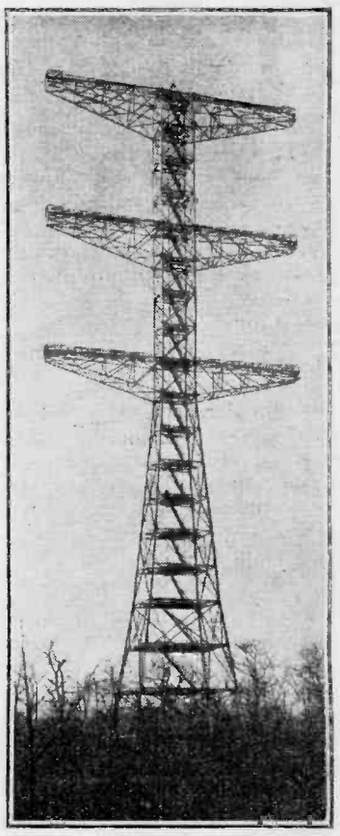
U.S.W. BROADCASTS FOR U.S.A.

New Modulation System

A STATION that, it is expected, will provide all metropolitan New York, as well as certain parts of New Jersey, with high-fidelity broadcast signals free from all kinds of interference is now being built at Alpine, New Jersey, under the direction of Major Edwin H. Armstrong. Technically, the feature of the station is the employment, in place of conventional amplitude modulation, of the new system of frequency modulation developed by Major Armstrong and described in our issue of July 16th last. As stated in that article, the new system has been proved by practical experiment as giving, under severe conditions of atmospheric and other interference, better reception from a 2-kW station at eighty miles than from a normal 50-kW station at fifty miles. The system is now to be tried on a full-size scale.

The new Alpine experimental station, call-sign W2XMN, which will have a power of 50 kW, is to operate in the band between 41.02 and 43.98 Mc/s, and will be used initially for making field-strength tests. A tower 400ft. high has already been erected on high ground, and the transmitter house near the foot of the tower is ready for installation of apparatus now being built by R.C.A.

For reception of the frequency-modulated signals, new receivers will be required, or at any rate existing receivers, even those covering the ultra-short-wave band, will need modification. Receivers must be capable of accepting the entire modulation band of 200 kc/s, which is to be used by W2XMN, and modifications will also be needed in the detector circuits.



400-FT. TOWER erected at Alpine, New Jersey, by Major Armstrong for conducting experiments on his frequency-modulation system of broadcasting using ultra-short waves.

According to our New York Correspondent, other frequency-modulated stations are being planned for the New England States; these experiments will be closely watched by broadcast engineers everywhere.

A MATTER OF KILOWATTS

THE National Broadcasting Company of America added forty-one stations to home networks in 1937, making a total of 143. These stations have a total daytime transmitting power of 1937.8 kilowatts. In Great Britain and Northern Ireland the B.B.C. home stations utilise a total of less than half this power, namely, 867.3 kilowatts, at the top of the scale being Droitwich with 150 kW, and, at the bottom, Plymouth, with only 0.3 kW.

THE WEEK

B.B.C. AND RECEPTION

Solving Dundee's Problem

FURTHER proof that the B.B.C. is seriously interesting itself in the receiving side of broadcasting is afforded by the recent receiving tests conducted by its engineers in the Dundee area. It is realised that the Corporation's responsibilities do not end at the transmitting aerial, and that the listener in a blind spot gets little consolation from knowing that the local station is using an output of 50 kW.

The trouble in Dundee started when Scottish National changed over from 285 to 261 metres to synchronise with the London and North Nationals. This resulted in a tornado of complaints from Fifeshire, so a B.B.C. signal strength squad was recently despatched to the district and tests were carried out with mobile apparatus. The engineers now admit that the field strength is "patchy," and recommend that listeners should try for reception from Droitwich.

Trouble with the Sync.

Initial difficulties in the synchronisation scheme were due to trouble on the Post Office line used to transmit the synchronising tone between Manchester and Westerglen, but this has been largely overcome. The effect is variously described as a "bubble" or "rumble," and it was unfortunate that it was most noticeable during the transmission of the Royal Command Variety performance.

One interesting discovery of the signal strength squad was that Scotsmen are inclined to economise in masts and aerial wire. Half the trouble in Fifeshire and other parts of Scotland would disappear if listeners were to erect higher and more efficient aerials.

TELEVISION

In the House

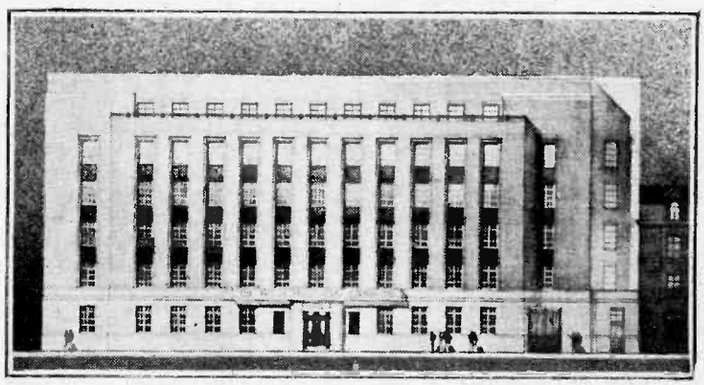
ONE section of the television speech made by Major Tryon, the Postmaster-General in the House of Commons last week, was particularly reassuring to the public and should be a great stimulus to the industry. It relates to the stability of the present system of transmission; he said: "I have decided, on the recommendation of the Television Advisory Committee, that the present technical standard of transmission from the Alexandra Palace station should remain substantially unaltered for at least three years from January 2nd, 1938, and the public might therefore purchase television sets without any fear that they would become obsolete or require substantial alterations for a very considerable time to come."

Another O.B. Unit

The B.B.C. has not denied the report that an order is about to be given for a new mobile television unit. In its construction it will have the advantage of a year's experience over the £20,000 unit at present in use, and it is considered to herald the inauguration of the long-discussed Sunday afternoon transmissions from outside the Alexandra Palace studios.

MARCONIPHONE'S large-screen television receiver, the lid of which, when raised, slides the vertical screen into position. In addition to the television equipment it includes a standard eight-valve all-wave receiver.

NEW REGIONAL H.Q.



BELFAST'S BROADCASTING HOUSE. Building will shortly begin on the Northern Ireland headquarters of the B.B.C., which is here shown as planned by the architect. The six-storey building will include a large studio, with an area of nearly 300 square yards, two studios for talks, two for drama, one for effects and a general purpose studio.

OPINIONS DIFFER

ON the same day appeared in two provincial papers the following opinions of wireless. A Yorkshire magistrate when admonishing an unemployed defendant for not having a wireless licence, declared that a wireless set is a luxury which an unemployed man has no right to enjoy. Commenting on this, the *West Lancashire Evening Gazette* drew attention to the recently expressed opinion of a Manchester magistrate who stated that "a wireless set is one of the best assets an unemployed man can have."

In the industrial supplement of the *Birmingham Gazette* of February 1st a writer stated that "To-day the wireless set is an absolute necessity to the home. It is as important as the chairs we sit on."

LARGE-SCREEN TELEVISION

THE first all-British projection-type large-screen television receiver to be available to the public was demonstrated to our representative last week by the makers, the Marconiphone Company. This receiver, which is primarily intended for clubs and hotels, has a screen measuring 22in. × 18in., and costs 200 gns.

A picture about 2in. square is obtained on an Emiscope projector tube, which is electromagnetically deflected and focused. This picture is projected on to the large screen through a special *f* 1.5 lens, which measures about 3½in. in diameter. These features are also embodied in an exactly similar H.M.V. televisor.

Viewed by artificial light the picture looks quite green, but in complete darkness it appears sepia with a slight greenish tinge, which is not objectionable. The Alexandra Palace transmission was received during the demonstration at the Waldorf Hotel, London, with excellent definition and clarity.

A LICENCE FOR EVERY SET

Canada's New Tax

FROM April 1st Canadian listeners are to pay a further 50 cents for their licence, that is, their fee will be $2.50. What is even harder is that, whereas the old $2 licence covered every set in the house and one in the car, under the new scheme each set in the house and that in the car must be licensed separately. Added revenue for the Canadian Broadcasting Corporation is the reason given for this increased tax by the Canadian Minister of Transport in his statement.

It is also announced that the activities of the C.B.C. in the world of commercial programmes will continue only within "reasonable limits"; this is because of the vigorous campaign by newspapers and periodicals against the growth of the use of U.S.A. sponsored programmes.

Germany's Concession

Until recently a full second licence was required in Germany if a listener had a receiver in his car as well as in his home. The German Post

News of the Week—

Office recently announced the introduction of a supplementary licence costing a quarter of the ordinary fee, 0.50 RM. for the set in the car, provided the owner has a licensed home receiver. Should he have only a car-radio, he is naturally liable for the full licence.

ELIMINATING INTERFERENCE

THE suppression of electrical interference has been carried a step forward in Sweden, where Mr. H. Angstrom, director of the Municipal Tramway Company of Uppsala, is reported to have invented a new type of bow collector, the use of which on the trams has been found to reduce interference to an inoffensive minimum. The main feature of the new bow is that it employs three-spring contact bars, of which at least one is always certain to be in good contact with the overhead line.

Practical experiments have been carried out for a year, and the results have been so excellent that the new Angstrom collector is now to be introduced in a number of larger Swedish cities.

RADIO ELECTION

LISTENERS in Denmark are divided into eight parties authorised to elect members to the Radio Board. The biggest party is represented by the majority on the Board, so in this way the listener has the opportunity of exerting his influence on the broadcasting organisation.

The election which closed last month shows little change in results from the previous one of 1934, but since only 300,000 of the 700,000 licence-payers voted, it is probable that the system will be discontinued after 1941, when members of the "Radioraad" will either be appointed by Parliament or by *all* the listeners.

CROCODILE AT LARGE IN TELEVISION STUDIO

A CURIOUS technical hitch occurred during the televising of Koringa, the woman Fakir, and her snakes a short time ago. The producer instructed the cameraman to track forward for a close-up, but there was no response. Explanation: a snake had entwined itself round the axle of the camera "dolly."

Later in the proceedings the crocodile got out of hand. Koringa's assistants edged away, and the cameraman, "when all but he had fled," was about to emulate their example when Koringa caught the creature by the tail and succeeded in mesmerising her pet just when it threatened to overturn the camera.

NEARLY 4,000 "HAMS"

SOME remarkably interesting figures are given in the annual report of the Radio Society of Great Britain regarding the number of amateur transmitters licensed in Great Britain. According to the latest available figures there are at present no fewer than 2,216 radiating permits and 1,734 artificial aerial permits. The object of allotting artificial aerial licences, incidentally, is to permit newcomers to obtain experience in handling apparatus before actually transmitting.

Of the 2,216 full licences issued, 1,539 permit the licensees to employ no more than 10 watts aerial input. The remaining 677 use more than this power. Aspirants to the use of high power are called upon to give the G.P.O. very good technical reasons for requiring to do so.

It is interesting to note that all call-signs prefixed by G2, G5, G6 and G8 have been completely allocated and a new series, G3, has been started. So rapid, indeed, is the increase in amateur transmission that the G8 series was exhausted in about eighteen months.

FROM ALL QUARTERS

Les Parasites Electriques

IN France, the responsibility of working apparatus causing electrical interference rests with the originator, according to a recent judgment of the civil chamber of the French Cour de Cassation (Supreme Court of Appeal).

French Pioneer Dies

THE French radio world mourns the loss of M. Victor Charpentier, well-known musician and director of the early Paris broadcasting station, Radiola.

Announcers' Union

FORTY-ONE male and ten lady announcers of French State stations have formed a society for the purpose of making collective provision against illness.

Police Wireless

FOR the next financial year the sum of £500 is set aside in the Leeds Corporation Watch Committee's police wireless estimate.

Education on the Air

THE Czechoslovakian broadcasting system, which now consists of seven stations, delivers about 9,000 educational lectures annually; courses in eight different languages are broadcast.

Coastline DF

A RADIO beacon is to be built at Flamborough Head near Flamborough lighthouse. This beacon will augment the already valuable chain of stations round the coast.

Under the provisions of a five-year scheme, the Finnish Department of Shipping are to erect nine new DF beacons along the coast of Finland. Two are now in the course of construction at Sommaro and Hogland.

Telephone Radio Link

As a result of successful experiments carried out by the Danish Post Office with 4-metre telephony transmissions, it is now probable that a telephone service will be inaugurated connecting the numerous small islands around Denmark to the mainland by ultra-short-wave radio link.

Swiss Television?

AT the Swiss National Exhibition, which is to be held next year at Zurich, will be erected a central radio tower. From this it is proposed to radiate the television transmissions during the period of the exhibition. As this exhibition is to be entirely of apparatus of Swiss manufacture, both the television transmitting systems and the receivers to be used will have to be designed and built in Switzerland. An appeal has been launched to provide the necessary funds to build the transmitter.

Going Cosmopolitan

WITH the introduction of foreign broadcasts from Daventry, the B.B.C. staff list is assuming a cosmopolitan aspect. New names include Saardani, Ritaru, Vinogradoff, Henricci, Rifaat, Sourour, Dasuki, and Nagib. The canteen authorities are wondering whether to start a hashish counter.

R.S.V.P.

THE B.B.C. has, among many strange requests, recently been asked:—

Where good feathers from different cockerels' tails can be sold;

The condition of the weather on August 29th, 1934, for purposes of a tapestry;

Whether "the world-famous pianest Padarwishie" is dead;

To reprimand, on religious grounds, a commentator on a football match who used the expression "hell for leather."

Australian Example

A NEW fleet of ambulances in Sydney are equipped with 10-watt transmitters, which give them a range of about 40 miles from the hospital, where a 200-watt transmitter adequately covers their service area.

Expense Unspared

Two members of the B.B.C. staff at Manchester left for Norway last week to collect information for a programme showing similarities between the people of Scandinavia and the North of England.

Slogan Wanted

AN interesting competition has been organised by the Automatic Coil Winder Company, of Winder House, Douglas Street, London, S.W.1, to find a slogan for their AVO valve tester. Cash prizes amounting to £50 are being offered.

Two Birds With One Stone

FARMERS near Regina, Saskatchewan, utilise thirty miles of barbed wire fence on their land for the inter-change of telegraphic communication.

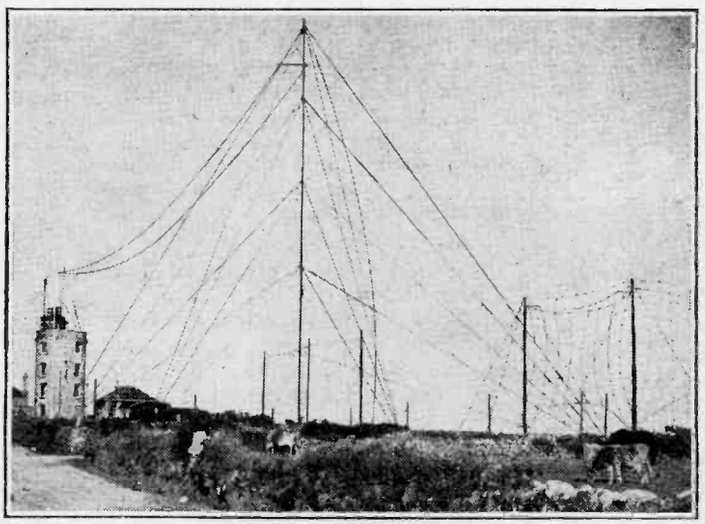
Static Detector

A STATIC detector designed to gauge the presence and volume of static electricity caused by electrically charged particles of rain and snow has been perfected by United Air Lines, of America. It will enable pilots to report on static conditions during their flights.

Records

DURING the past year more than 5,000 gramophone records which have been used for broadcast purposes were presented to London hospitals through the courtesy of the B.B.C. and record-manufacturing companies.

The King has decided that the proceeds from the sale of records of his speech to the Empire on Christmas Day shall go to the Not-Forgotten Association.



ANCIENT AND MODERN. The aerial for the old spark transmitter set at St. Mary's beside the arrays for the new 2-circuit micro-wave radio telephone service between Land's End and the Scilly Isles. This was opened, at the end of January, by the Postmaster-General, who put through a telephone call from Salisbury to the new Scillonia exchange.

UNBIASED

BY
FREE GRID

"He was just too late"

Should a Woman Tell?

I SUPPOSE that most of you who read the more "popular" of our great daily newspapers sometimes turn from the racing pages to what may be described as the domestic section of the journal in which readers discuss the various problems of their lives. I have often noticed that one of the most frequently debated of these problems is one entitled "Should a Woman Tell?" It has always puzzled me as to why this is such a popular subject for discussion, since it has been my experience that no matter whether she should or she shouldn't, Woman always *is* doing it, as very few of them can keep a secret about anything for long. What on earth, therefore, is the use of all this discussion about the subject?

"Few of them can keep a secret."

However, what I wanted to seek your opinion on is not whether a woman should tell or not, but whether a man should do so, the man in this case being myself. It so happens that in the course of my professional duties I have come across a flagrant infringement of the Law by a firm from whom I sometimes obtain certain American wireless parts.

These parts are not things which they would have normally in stock, but they have to be obtained specially from the U.S.A., and I have long been puzzled as to the manner in which this firm beat their rivals who normally take several days longer to obtain my wants. At first I naturally thought that they sent a telegram to the suppliers in the U.S.A., but enquiries showed me that this was quite impossible as the profit on my humble orders was far too small to permit of such expenditure.

It was purely by chance that I learnt the true explanation which is that the individual who runs this particular business has an arrangement with a colleague on the other side of the water to listen in at a certain hour every night for the day's orders to be wirelessed across on short waves. When I learned of this I naturally raised my hands in horror at such an abuse of the terms of an amateur transmitting licence and resolved to report the matter forthwith to the P.M.G. in order to get the licence withdrawn.

I first tackled the offender, however, in order to see if he had anything to say in his defence, and to my surprise he informed me that there was no chance of my getting his transmitting licence withdrawn as he didn't possess one. Furthermore, he said, detection of his efforts would be extremely difficult as both wavelength and the hour of transmitting were varied each night according to a prearranged schedule with his transatlantic colleague, and, in any case, the orders for goods were transmitted in a code very cunningly designed so that the chance ethereal eavesdropper would think that he had merely stumbled on some rather uninteresting routine test work.

Owing to these precautions taken by the offender there is obviously comparatively little chance of my story being proved if I reported it to the P.M.G., and, in fact, the authorities might view it with considerable suspicion. What ought I to do?

Secrets of Set Design

ALTHOUGH the next Olympia exhibition is still a very long time ahead, it must not be forgotten that the new year is now well on its way and wireless manufacturers have already started to think about the design of the sets which they will inflict upon us then. One manufacturer, at least, has in preparation an absolutely unique novelty, and it is only on condition that I do not mention his name that he has permitted me to disclose the details to you.

The manufacturer in question had invited me to his research department in order that he might prove to me that his firm at any rate was not guilty of a recent allegation which I made to the effect that set makers had replaced all their research engineers by furniture designers. Happening to pass a certain bench at which a bespectacled and white-coated research worker was extremely busy—or at any rate, pretending to be—I suddenly observed him whisking a dustcover over a certain piece of apparatus as he saw us approaching. He was just too late, however, and I insisted on knowing what was being hidden from me. The manufacturer, deeming that the naked truth would be less injurious to him than any wrongful surmise I might make, ordered the apparatus to be shown to me.

The experimental model of the set which was revealed to my gaze was a perfectly ordinary one except for one dial which to my astonishment was calibrated in years. This puzzled me exceedingly, and I at first wondered if an attempt were being made to recapture the broadcasts of bygone years on the principle of the old theory that ether waves never completely die away to zero and that, therefore, by employing a sufficiently sensitive receiver, it would be possible to pick up former programmes.

I was completely mistaken, however, for the true explanation was almost as astounding as my surmise. It appears that in recent months articles have been appearing in certain physiological journals discussing some new experiments concerning the well-known fact that the sensitivity of the human ear to high notes falls off quite sharply with increasing age. Apparently our perception of high notes is at a maximum at 20 years of age and then falls off gradually until the middle thirties when a much more rapid decline sets in.

Needless to say, the age-calibrated knob in this manufacturer's experimental model merely controlled an elaborate system of high-note compensators, the greater the age setting the bigger the high-note boost. There is, so far as I can see, only one defect in this arrangement, and I frankly told the manufacturer so, namely, what is going to happen when several people of different ages want to listen in to the same set? My criticism immediately threw the whole of the research department into a state of disorganisation and I understand that an urgent S.O.S. was sent to the local Labour Exchange for more research workers to cope with this new problem.

West Africa Calling

I SHOULD like to take this opportunity of thanking the reader from Calabar (unfortunately his name is indecipherable) who has been so kind as to send me a copy of our virile contemporary, *The Nigerian Eastern Mail*. I am pleased to note that this journal has taken a leaf out of my book in its frank and outspoken comments on current affairs.

Letters to the Editor

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

Improving Receiver Performance

MAY I be allowed to add a few remarks by way of extension to the excellent article on "Improving Receiver Performance" by Austin Forsyth? I have no criticism to raise, but can fully endorse the improvements which he explains.

I would like to point out, however, that similar advantages can be obtained in receivers which do not employ an RF stage by the use of regeneration in the frequency-changer itself. Most changers are not perfect converters of RF to IF energy, and amplified signal potentials exist in the anode circuit. If, therefore, the valve shown in Fig. 1 on page 59 be regarded as the frequency-changer of a superhetrodyne which employs no RF stage, then reaction can be obtained by exactly the cathode tapping arrangement shown. It will be necessary to employ rather more turns in the cathode portion of the coil, and naturally valves which are less efficient as converters into IF will be likely to pass the greatest proportion of unchanged and amplified RF energy, and will regenerate most readily. This is fortunate, since they will be the types most in need of assistance.

A frequency-changer loads the control-grid circuit just as seriously as does an RF stage. In many cases the loading is greater on account of grid current, and also increases just as quickly with frequency. All the advantages ably explained by Mr. Forsyth therefore take place, and I would venture to suggest that they are likely to be even greater, because a receiver using no RF stage will benefit more noticeably by reaction on account of its lower initial sensitivity. Probably such a receiver will include one less preselector circuit and will be subject to second-channel interference, particularly at high frequencies. The use of reaction on the aerial circuit is very helpful in overcoming this defect.

The writer has used this expedient in a broadcast receiver employing a TP4 frequency-changer and fitted with only a single RF tuned circuit. The sensitivity of this set was poor and second-channel effects very noticeable. The cathode was tapped one-third of the turns up the grid coil, which was fitted with a trimmer as advised in the article, and reaction was controlled by the screen-grid potential. The performance of the receiver was improved to such an extent that it compared favourably with one fitted with an RF stage and two preselector circuits. Second-channel effects were of the same order and not at all serious, whilst sensitivity was very little lower. The effect was more noticeable, however, because the original grid coil was of rather poor quality and damped by rather close coupling to a somewhat large aerial.

If such a useful improvement is possible in the broadcast band, I need add no more stress to the author's remarks concerning the still greater benefits at short wavelengths. It is interesting to realise that reaction reduces risk of cross modulation by strong local signals, whilst an RF stage tends to increase this defect. I have observed a material improvement in cross modulation interference through the use of reaction in place of equivalent RF amplification. Perhaps the principal defect of the system lies in the need for rather more skilled adjustment than is usual in broadcast receivers today, making it appeal more to the enthusiast than to the general listener. The writer is at present engaged in research along somewhat parallel lines and with a view to overcoming this defect.

ERNEST L. GARDINER (G6GR).

Northwood, Middlesex.

Standardisation !

I FEEL that sincere congratulations should be offered to the sponsors of the new British Octal valve base, and I cannot refrain from being one of the first to do my share.

The idea of changing the dimensions of the Octal base slightly without altering the general appearance is a stroke of genius.

A short time ago I myself designed a new non-interchangeable valve base with the intention of offering it to a British manufacturer, but I see that I have been forestalled. My new base was to be triangular in shape, with a square spigot and thirteen octagonal pins disposed irregularly round it in an ellipse. While my design was quite original, and would have, once and for all, quashed any question of uniformity among makers, it was clearly a very crude and obvious step to take.

The new British Octal base is a marvel of subtle ingenuity, the idea clearly being that the public is to buy valves thus fitted and then to bet on the possibility of whether or not the valves will fit the sockets in the receiver at home. If they do, then the purchaser will feel gratified; if they do not, then the manufacturer will get a little quiet laughter, as it is well known that the thought of another person in an awkward predicament is the basis of an extremely large proportion of jokes.

Uniformity and standardisation have always been abhorrent to British valve manufacturers, but one can now see that the policy of individuality and complexity has been adopted with the most laudable intentions.

It is abundantly clear that all other industries engaged in producing articles with standardised features, such as electric lamps, typewriters, sparking plugs, gramophone records, etc., should at once follow the example now set to them and produce ranges of products which all appear the same, but are, in fact, entirely dissimilar. Our lives would rapidly change from the dull monotony of the present day to a delightful era of exciting uncertainty when almost every action would be as thrilling as the sport of kings.

BM/B.J.F.J.

London, W.C.1.

A NEAT IDEA from Radio Geneva, photographed by our Swiss Correspondent. With the help of the transverse guide bar on which the pick-up arm rests, the needle may be placed accurately above any desired groove of the record. The pick-up is then lowered on to the record by means of the lever in the lower right-hand corner of the photograph.

Two Queer "Effects"

IN a recent issue "Diallist" refers to the reception by a Jersey reader of medium-wave stations on 750 and 1,500 metres. I suggest that the phenomenon may be due to cross-modulation between the second harmonic of the 200 kc/s and the fundamental of the 804 kc/s transmissions giving rise to an additional frequency of 404 kc/s. The 804 kc/s transmission would then predominate, and perhaps the two programmes may also be heard together on each of the two frequencies (200 and 804 kc/s).

The cross-modulation may be taking place either in the transmission path (probably via "E" layer) or perhaps in the receiver.

Sidcup, Kent. F. W. NEWSON.

Television Picture Size

MR. ASHWORTH, in his letter in the issue of January 27th, raises so many points that it is difficult to confine one's comments to letter size. I feel that most of them are wrong, not from any technical knowledge of optics, but from common-sense reasoning.

I have wrestled with the picture he mentions on page 629 of *The Wireless World* (December 23rd), my whole family have wrestled with it, and I am convinced that only by pasting a photograph of myself on the page could the distortion be eliminated. In other words, only by transferring my three-dimensional self to a plane surface could I appreciate the three dimensions transferred by your photographer to the pages of *The Wireless World*.

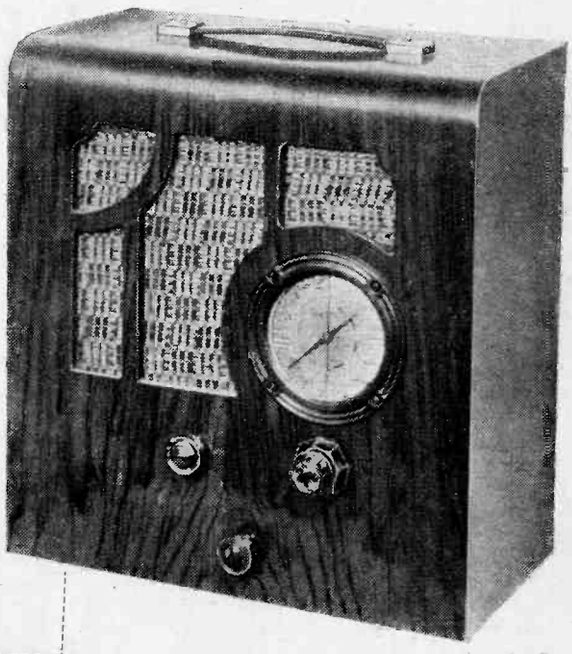
Then the statement that one must view the 10ft. × 15ft. picture from a distance of 6ft. establishes the conclusion that only the organist in a cinema can ever hope to see the pictures in true perspective. If Mr. Ashworth were in a position to see strangers to television approach a receiver and settle down to watch a transmission he would observe that, even when viewing alone, they automatically take up a position about 4ft. from the end of the tube.

Finally, is Mr. Ashworth, I wonder, seriously considering the possibility of a couple of cathode-ray tubes dangling in front of one's eyes from a glorified headband?

Gidea Park. "ENTHUSIAST."

Evrizone

MAGIC MIDGET TRANSPORTABLE



FEATURES. ***Waveranges.***—*(1) 16-45 metres. (2) 40-90 metres. (3) 215-550 metres. (4) 800-2,000 metres.* ***Circuit.***—*Triode hexode frequency-changer—var.-mu pentode IF amplifier—double-diode-triode second detector—pentode output valve. Half-wave valve rectifier and barretter lamp.* ***Controls.***—*(1) Tuning. (2) Volume and on-off switch. (3) Waverange.* ***Makers.***—*Evrizone Radio and Television Co., Ltd., 2, Southlands Road, Bromley, Kent*

An AC/DC Superheterodyne with Two Short-Wave Ranges

IF only for its neat appearance and small size, this inexpensive transportable is certain to attract the favourable notice of the general public. As it works equally well from AC or DC mains it can be used anywhere within reach of a 200-250-volt mains supply point, and there need be no delay in obtaining signals as a combination of "vertical" and frame aerials is incorporated within the set.

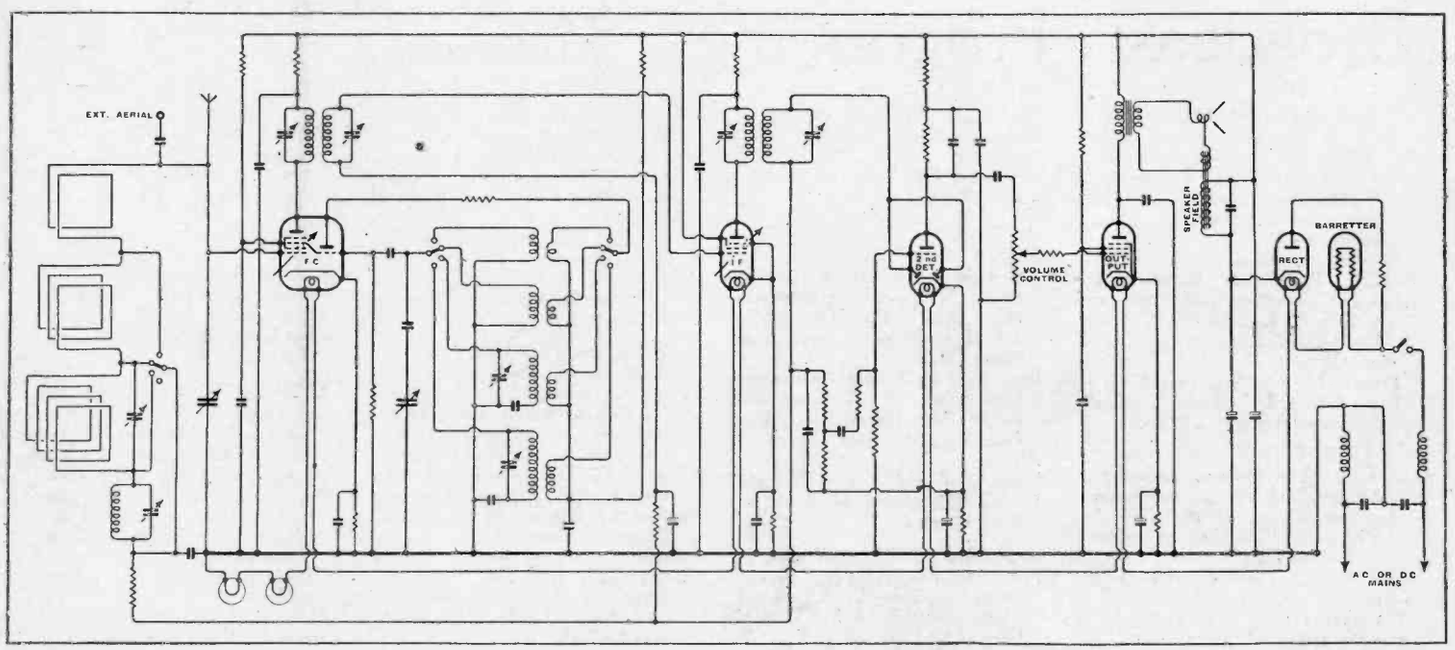
To the technically minded the discovery that *two* short-wave ranges are provided will be an incentive to make a closer inspection of the design. An unusual feature is the inclusion of separate tuned frame windings for each of the short-wave ranges as well as for the medium waveband. Reception on long waves is catered for by the addition of a loading coil in series with the remaining three frames in series. The winding mounted horizontally at the top of the cabinet is not an inductance but serves merely as a capacity aerial to reduce the effective directional properties of the tuned frames.

The first valve in the circuit is a triode hexode frequency-changer which feeds into a variable-mu pentode IF amplifier. Both these valves are controlled from the AVC line which derives its voltage from a double-diode-triode second detector and first AF amplifier. Resistance coupling is employed between this stage and the output pentode, which feeds a 6½-inch energised moving-coil loud speaker. The field winding is used for smoothing the current passed by a half-wave rectifier, and a barretter control lamp is connected in series with filaments and dial lights.

A filter is included in the mains leads to suppress RF interference which might otherwise enter at this point. The system of connections which has been adopted suggests that it might be advisable to try the effect of reversing the mains plug, at least as far as AC supplies are concerned.

A small, but legible, circular tuning dial is uniformly illuminated by two pilot lamps. Space has been found for approximately forty medium-wave station calibrations and the principal long-wave stations, together with broadcast and amateur bands on the two short-wave ranges, are also indicated. A two-speed drive with well-chosen ratios gives ease of control for both short-wave and normal broadcast conditions.

The first tests were carried out in a steel-framed building under much more severe conditions of reception than are likely to be met with in the ordinary dwelling house. Results on the medium-wave band were so good that there was no necessity to take the set out into the open for a "fair trial." In daylight, reception was by no means confined to the



Complete circuit diagram. The long-wave range is covered by a loading coil in series with the medium- and short-wave frame windings, and an auxiliary frame winding acts as a short "vertical" aerial.

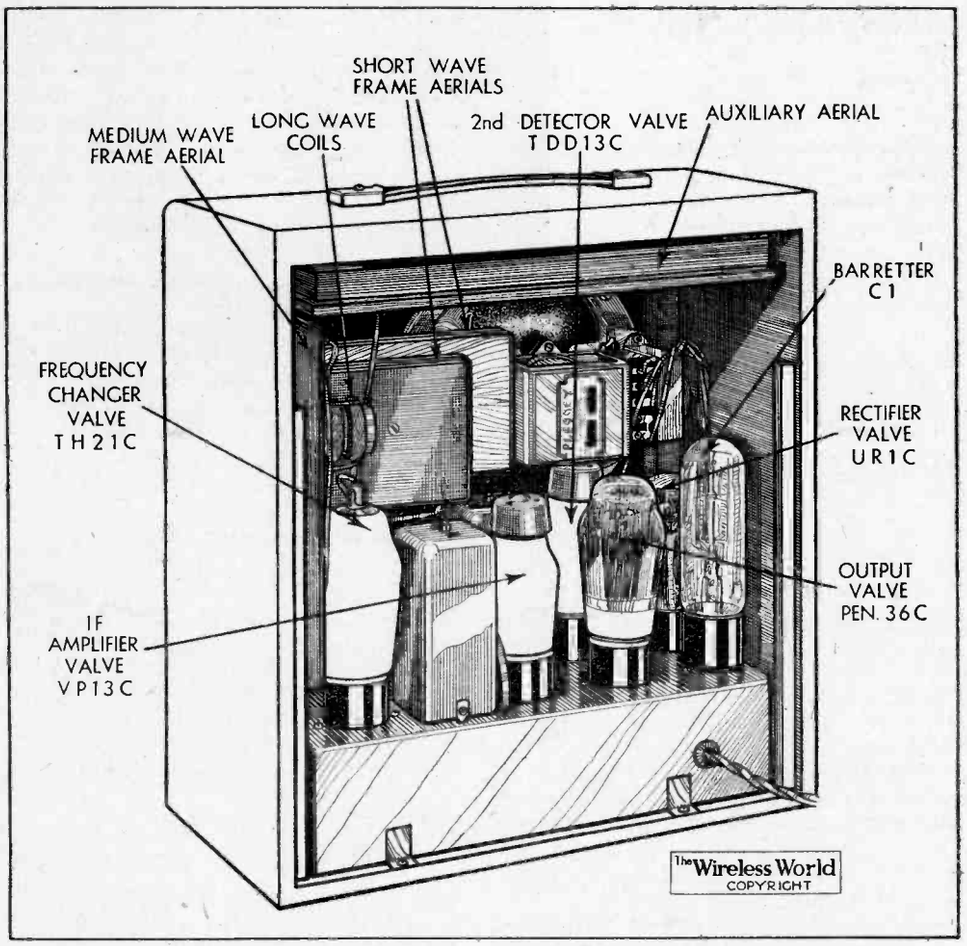
Evrizone Magic Midget Transportable—

B.B.C. stations, and Continental transmissions of the calibre of, say, Rome or Cologne, gave excellent programmes. After dark there is little doubt that good results will be obtained from the majority of the stations marked on the dial without resorting to the use of an external aerial.

No self-generated whistles could be found on the medium-wave band, but the effect of the shielding of the steel framework of the building must be held responsible for a fairly high background noise in relation to signal strength. This was more marked on long waves under the influence of a degree of deliberately introduced regeneration, but under more normal circumstances would not be sufficient to incur adverse criticism, and in any case could be instantly cleared up by the use of an external aerial and the action of AVC.

The performance on both short-wave bands is extraordinarily good, and two American stations were picked up first with the aid of an external aerial and then at somewhat reduced strength with the outdoor aerial detached. At the time conditions over the Atlantic were admittedly below normal and we have no doubt that, with the sensitivity which the makers have provided, direct location of American stations without any extraneous aids would be possible under favourable conditions.

The weight of the complete set is only 11 lb., and the dimensions of the walnut-veneer cabinet, which is fitted with a leather carrying handle, are 12½ × 13 × 7in.



The assembly of six valves and their associated components and frame aerial windings into a cabinet 12½ × 13 × 7in. is something of an achievement.

TROLITUL

THIS is a clear glass-like substance having particularly good insulating properties, especially at the very high radio frequencies.

It can be cut and drilled with comparative ease and does not flake. On the other hand, it shows a tendency to soften if heated, but apparently does not lose any of its good properties on cooling.

Short-wave experimenters requiring strips of Trolitul for trial might be interested to know that it can be obtained from the Premier Supply Stores, Jubilee Works, 167, Lower Clapton Road, London, E.5. Specimen pieces received by us, and measuring 2½ × ⅜ × ¼in. thick, cost 3d each. Strips or sheets in any reasonable size can, of course, be supplied.

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, FEBRUARY 10th.

Nat., 8, Variety including Elsie Carlisle and Cliff Warren. 8.30, The Way of Peace—V. Speaker, Wickham Steed; interlocutor, Lord Ponsonby. 9.20, Teddy Joyce and his Band.

Reg., 6, Adaptation of "Top Hat." 7.30, Strange to Relate—VIII. 8, The Microphone Visits Uttoxeter with S. P. B. Mais. 9.15, "St Louis Blues," a modern drama.

Abroad.

Prague, 7, "The Vagabond King."

Milan Group, 8, "Manon": opera (Massenet).

FRIDAY, FEBRUARY 11th.

Nat., 7, The Helsinki University Chorus. 8.15, Flotsam and Jetsam present "Signs of the Times." 9.40, British Film Music, played by the London Film Orchestra.

Reg., 7.30, "The Maid of Bath": dramatic feature. 8.15, B.B.C. Orchestra (D). 9.20, Victor Silvester and his Orchestra.

Abroad.

Beromunster, 7.5, "Turandot": opera (Puccini).

Hilversum, 7.55, "The Birth of the Royal Princess."

SATURDAY, FEBRUARY 12th.

Nat., 8, Music Hall, with Wee Georgie Wood and the Russian Choir. 9.20, American Commentary. 9.35, "Don Giovanni": Act II of Mozart's opera, from Sadler's Wells.

Reg., 8.10, Ice Hockey commentary from Prague. 9, The Cambridge Band. 9.40, The Munich Zither Clubs Orchestra from Munich.

Abroad.

Rome, 8, "Figaro": opera (Mozart).

Vienna, 9.25, Round the World on Short Waves.

SUNDAY FEBRUARY 13th.

Nat., 6.15, Family Papers. 7, Victorian Melodies—IV. 9.5, Sacred Music directed by Sir Walford Davies.

Reg., 6, Hungarian songs relayed from Budapest. 6.30, Sunday Orchestral Concert—XVIII, conducted by Constant Lambert. 9.50, Mantovani and his Tipica Orchestra.

Abroad.

Stuttgart, 6.30, "Tannhäuser": opera (Wagner).

Brussels, 1, Radio Paris, etc., 8, Contemporary French and Belgian music.

MONDAY, FEBRUARY 14th.

Nat., 6.20, Recorded commentary on the opening of the Singapore Naval Base. 6.30, Constant Lambert on "Instruments of the Orchestra." 9.20, "World Affairs."

Reg., 7.30, The Newcastle String Players. 8.35, Plymouth Madrigal Society's Concert. 9.35, "After Dinner": Cabaret.

Abroad.

Brussels II, 8, "The Flower of Hawaii": operetta (Abraham).

Lyons, 8.50, "La Belle Hélène": operetta (Offenbach).

TUESDAY, FEBRUARY 15th.

Nat., 7.30, Talk on Moral Progress, by John Macmurrey. 8, "Tiptoes": musical comedy. 9.20, Morals and Society: talk by Dr. L. P. Jacks.

Reg., 7.30, Horner's Corners—I: A Canadian village episode. 7.50, The trial amd death of Mary, Queen of Scots. 9.30, Jack Hylton and his Band from the Scala Theatre, Berlin.

Abroad.

Stuttgart, 8, Handel Cycle. The Peace Festival in St. Paul's Cathedral, London, July 7th, 1713.

Milan Group, 8, "Il Dibuk": opera (Rocca).

WEDNESDAY, FEBRUARY 16th

Nat., 7.15, Band Waggon. 8, W. H. Berry as Mr. Micawber. 8.15 and 9.25, B.B.C. Symphony Orchestra conducted by Sir Adrian Boult.

Reg., 7.30, "The World Goes By." 8.15, "Tunes of the Town," excerpts from "Hide and Seek" at the London Hippodrome, with Bobby Howes and Cicely Courtneidge.

Abroad.

Warsaw, 8, Chopin recital.

Mechanical Tuning System

AUTOMATIC CONTROL BY AN ELECTRO-MAGNETIC BRAKE

By ALAN COOKE

FOR many years now efforts have been made to simplify the tuning of radio receivers, and although a great number of different schemes have been proposed, comparatively few seem to have proved attractive enough to satisfy the general listening public.

The necessity for providing the public with some form of tuning indicator or automatic or semi-automatic tuning system was greatly increased when automatic volume control systems came into universal use, for it is a sad and notorious fact that the average member of the listening public cannot tune his receiver correctly when change in quality rather than change in volume is his criterion. This is also the obvious explanation of the poor quality of reproduction of so many receivers, for what manufacturer is going to spend money and increase the price of his receivers to provide good quality when it is so clearly not appreciated?

DEVICES to relieve the user of a broadcast set from the responsibility of tuning it precisely to the carrier wave of the required station may be either electrical or electro-mechanical; that described in the present article falls into the second category, as a magnetic brake is arranged to hold the condenser spindle at the point corresponding to exact tune.

The earliest form of tuning indicator was a small lamp which was made to glow more brightly when a signal was correctly tuned in. This was followed by a modified form of meter which was connected in the anode circuit of one or more of the valves controlled by the automatic volume control circuit, and the receiver had to be tuned for the minimum deflection of the meter. An extraordinary number of variations on these basic ideas were produced from time to time; dial lights were switched on and off, the colour of the illumination of the tuning dial was changed from red to green, shadows projected on a small screen were made to change in size and shape, and so on. The last-mentioned arrangement has recently been resurrected as the so-called "Magic Eye." This is merely a shadow of variable size produced in a small cathode-ray tube, and all the "works" are contained within a valve of ordinary size, the end of which has to be visible from outside the receiver cabinet. All these schemes, however, have the common defect of demanding that little extra which some owners of receivers have not got, for they only indicate correct tuning and their indications are often entirely ignored.

Working in another direction, many manufacturers have evolved methods by which a receiver could be adjusted to receive any one of a certain number of preselected stations, but very few indeed have ever reached the market, at any rate in this country. There does not, however, seem to be a tendency to reintroduce this receiver in America at the present time, so perhaps it may now be considered suitable for the English listener.

Delay in introducing automatically tuned sets is perhaps due to the difficulty of manufacturing on a mass-production basis mechanism of the necessary high order of accuracy. It is otherwise very difficult to understand why such receivers have not been sold in quantities.

It was thought recently that all the complications, visual or otherwise, of tuning for the listener and of preselection tuning for the manufacturer, had been solved by the introduction of "pull-in tuning." This system, which has been described at length in several articles in *The Wireless World*, is, theoretically, the solution of many troubles in receiver design, and also a cure for bad tuning on the part of the listener. In practice it is undoubtedly not an easy matter to design a successful arrangement, and one of the difficulties that might be mentioned is the annoying habit of tuning to another station when the original signal fades. On short waves, when pull-in tuning has to be designed to take care of a possible signal drift of at least 50 kc/s, this effect can produce the most surprising results and it may be even quite difficult to find the wanted station again.

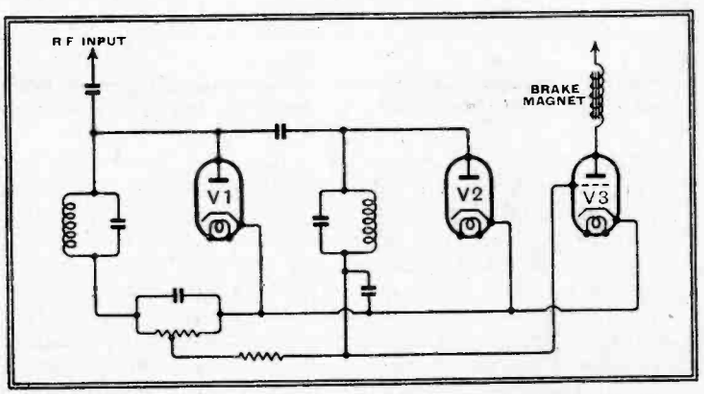


Fig. 1. Simplified circuit arrangement devised by Philips to control the supply of energising current to an electro-magnetic tuning brake.

One other rather different method of obtaining correct tuning may be mentioned here. That is the selective quiet tuning control systems which prevented any sound being heard until the signal had been accurately tuned in. These systems were not very complicated and certainly worked well, and why they have so entirely died out is something of a mystery unless it be that a receiver fitted with this system proved to be too difficult to tune.

Locking the Condenser Spindle

A new and very simple tuning system has now been introduced which has solved in a very elegant manner the difficulties of previous arrangements and which makes it very hard indeed to tune a receiver inaccurately. In this arrangement, as the tuning knob of the receiver is rotated by hand in the usual manner, a device comes into operation to prevent the tuning condensers being moved at the instant when a station is accurately tuned in. The device takes the form of an electro-magnetic brake operating on the driving shaft of the condensers to lock the shaft against rotation when a station is accurately tuned in, or an electro-magnetic clutch between the control knob and the condensers may be used, which disengages when a station has been tuned in and so prevents further rotation of the condensers.

The simplest way of operating the brake would be to connect it in the anode circuit of a valve whose grid bias was controlled by a diode rectifier connected with some part of the signal amplifier of the receiver. By adjusting a delay bias on the rectifier it could be arranged that on signals exceeding a certain level the rectifier would operate to reduce the bias on the amplifier and so allow current to flow through the brake magnet. Unfortunately, this simple arrangement would not be very successful in practice because a strong station would cause the brake to operate long before the station were accurately tuned in, whereas a weak station might never cause it to operate at all.

Of course, if a very good AVC system were used, this simple circuit should be

Mechanical Tuning System—

satisfactory. But, at any rate for a small receiver, this is unlikely to be the case.

An ingenious method of overcoming this difficulty, and one which does not depend on a perfect AVC system, has been evolved by Philips, and is shown in Fig. 1. In this arrangement the diode V1 supplies a delay bias to the diode V2, so that, whatever the signal level, V2 operates to control the bias on the brake control valve V3 always at the same distance from exact resonance, in terms of frequency, as the tuning knob of the receiver is rotated. A receiver fitted with a magnetic brake may very easily be modified to provide inter-station noise suppression by arranging that the operation of the brake also causes contacts to open which normally short-circuit the loud speaker. Hence until the brake has prevented the rotation of the tuning condensers no sound will be heard.

Trigger Relay System

A more elaborate circuit providing a number of useful refinements is shown in Fig. 2. Here V1 is an auxiliary radio-frequency amplifying valve connected with some point in the IF stages of a normal receiver; the amplified signal in the anode circuit is rectified by the diode V2 and the DC output is applied back as grid bias to V1. The arrangement is something like the usual circuit for amplified AVC, but there is an important difference. Under no-signal conditions the anode current of V1 is quite high, and, because the resistance R1 is large, the anode voltage on V1, and therefore the amplification, is low. When a signal is applied to V1 the bias is increased, the anode current falls, and the amplification increases. The change will be quite rapid, in fact the circuit operates as a kind of trigger relay reaching a steady state when the reduction in amplification due to the increasing grid bias outweighs the increase in amplification due to the increasing anode voltage. To make matters still more certain the tuned circuits in the anode circuit of V1 are tuned as sharply as possible to the intermediate frequency. The result is, assuming the AVC system in the receiver is a reasonably good one, that the anode voltage on V1 rises suddenly as soon as a signal is accurately tuned in. This rise in voltage is applied as a positive pulse through C2 to V3, which is normally biased to cut-off by the connection of its cathode with the potentiometer R3, R4. V3 then passes anode current through the windings of the brake magnet in its anode circuit.

The change in anode voltage of V1 is also used to operate a noise-suppression system. V4 is one of the AF amplifying valves of the receiver; it is normally biased to cut-off, but when the anode voltage of V1 rises the negative bias on V4 decreases to the proper working value. In order to ensure that the bias on V4 never goes positive, the diode V5 is provided to limit the minimum bias to the voltage at the point where its cathode is connected to R4.

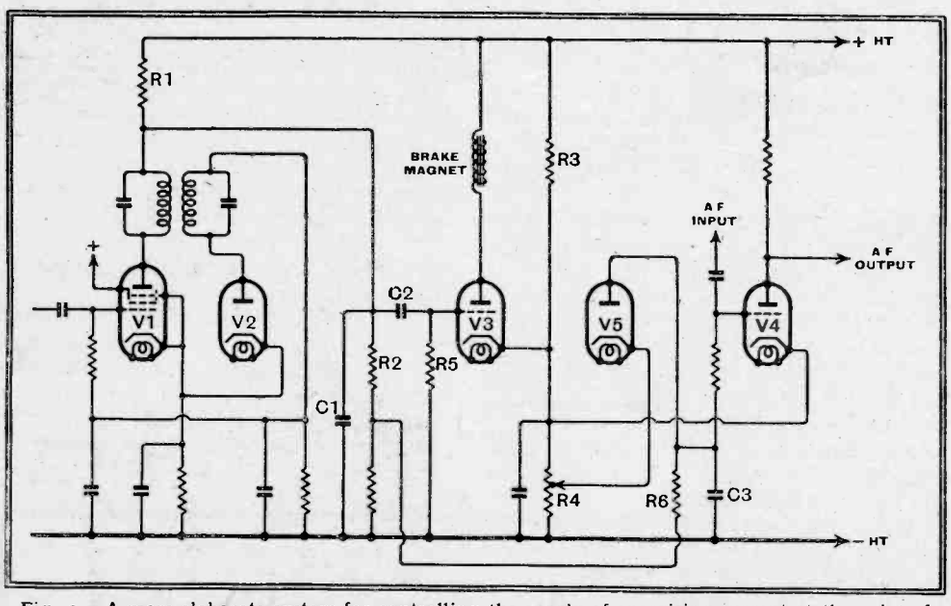


Fig. 2. A more elaborate system for controlling the supply of energising current at the point of resonance; by suitable arrangement of time-constants, various advantages can be obtained.

The most interesting features of this circuit are not at first sight very obvious. It is clear that if the brake remained on and had to be switched off again after each operation, tuning would be very tedious. But if the time-constants of the various portions of the circuit are properly chosen, tuning can be made very much easier. The initial charge on V3 leaks away through R5. By making the time-constant of C3, R5 quite short, say, half-second, the brake will "let go" very quickly, and one can tune on to the next station. Also in a large receiver tuning from a station at one end of the dial to one at the other end would still be a slow affair owing to the number of stations which would stop the tuning. If, however, we make the time-constant of R1, C1 long, we can arrange that C2 only becomes sufficiently charged to operate V3 if the tuning knob be turned slowly; turning the knob quickly will produce no braking effect at all. Finally, by making the time-constant of R6, C3 long we can arrange that the noise-suppression circuit only releases after the brake has been on an appreciable time. Thus, if the tuning knob be turned quickly nothing will happen and no sound will be heard. If it is turned slowly the brake will operate when a station is tuned in, and then and only then will the programme be heard.

There seem to be great possibilities for this device, and it certainly does seem to solve the tuning problem in no uncertain manner.

Television Programmes

An hour's special film transmission intended for the Industry only will be given from 11 to 12 daily.

Vision	Sound
45 Mc/s	41.5 Mc/s.

THURSDAY, FEBRUARY 10th.

3, "Jam Session," a programme of Swing Music. **3.20,** Gaumont-British News. **3.30,** 119th edition of Picture Page.

9, Amateur Boxing from the Concert Hall at Alexandra Palace: commentary by Howard Marshall. **9.30,** 120th edition of Picture Page.

FRIDAY, FEBRUARY 11th.

3, Marcel Boulestin prepares The Humble and Fashionable Mussel. **3.10,** British Movietonews. **3.20,** "Rossum's Universal Robots": play by Karel Capek. **3.55,** Preview.

9, Repetition of 3 p.m. programme. **9.10,** Gaumont-British News. **9.20,** Repetition of 3.20 programme. **9.55,** Preview.

SATURDAY, FEBRUARY 12th.

3, The Lanchester Marionettes. **3.10,** C. H. Middleton—How new flowers are produced. **3.20,** Gaumont-British News. **3.30,** "Queue for Song," including Monti Ryan and Ronald Frankau.

9, "Jam Session," a programme of Swing Music. **9.20,** British Movietonews. **9.30,** Jean Cadell in "The Grenadier": a West Highland play by G. Malloch.

MONDAY, FEBRUARY 14th.

3-4, "The Duenna": comic opera by R. B. Sheridan with music composed and arranged by Alfred Reynolds. Cast supported by the Television Orchestra and a section of the B.B.C. Singers.

9, Dr. Ludwig Koch presents records he has made of the songs of birds. **9.10,** "Intimate Cabaret" with Vic Oliver. **9.35,** British Movietonews. **9.45,** "Bridge"—Hubert Phillips.

TUESDAY, FEBRUARY 15th.

3, Starlight. **3.5,** Forecast of Fashion. **3.20,** British Movietonews. **3.30,** Billy Cotton and his Band.

9, Forecast of Fashion. **9.10,** Design III—by Anthony Bertram. **9.25,** Gaumont-British News. **9.35,** "Hands Across the Sea": one-act play by Noel Coward.

WEDNESDAY, FEBRUARY 16th.

3, "Intimate Cabaret" (as on Monday at 9.10 p.m.). **3.25,** Gaumont-British News. **3.35,** "The Grenadier" (as on Saturday at 9.30 p.m.).

9, Variety. **9.15,** Cartoon film. **9.20,** Experiments in Science—VII: Artificial Immortality by C. H. Waddington. **9.35,** British Movietonews. **9.45,** Ravel Harp Septet with Sidonie Goossens and ballet.

New Apparatus

Recent Products of the Manufacturers

FURZEHILL AF OSCILLATOR

THE well-known principle of mixing the outputs from two RF oscillators and then rectifying the beat frequencies to obtain audio signals is employed in the Furzehill AF oscillator. It is operated entirely from the AC mains and provides an AF output that is continuously variable from zero frequency to 16,000 cycles per second.

Four valves, excluding the mains rectifier, are used; two are RF oscillators, one is a mixing and rectifier stage, whilst the fourth functions as an AF amplifier.

An output transformer is fitted which gives 10 volts at audio frequency when working into a 1,000-ohm load, but any voltage from zero to the maximum can be obtained, as an output control is fitted. It is not, however, calibrated.

The initial adjustments of the oscillator to ensure that zero beat coincides with the zero frequency mark on the scale are very simple and easily effected with the help of the miniature CR tuning indicator that is included.

Having effected this adjustment, a further check can be made at 50, 100 or 15 c/s by depressing a switch and so injecting a small voltage from the mains into the final amplifier. If any flutter is then observed on the CR indicator it can be corrected by adjustment of the zero beat control, though generally this will be unnecessary.

Having done this, the scale of frequencies engraved on the dials will be substantially correct as we have verified by comparisons with a laboratory oscillator.

Two calibrated dials are fitted, one has a comparatively open scale and covers 0-500 c/s, while the other, which is the main control, covers 0-16,000 c/s.

When the main scale only is used the 0-500 c/s dial should be returned to zero, but it can be employed as a vernier and its readings added to that of the other.

Furzehill beat-frequency audio oscillator Type AF1.

The "Magic Eye" device also serves as an indicator of the relative output, for by adjusting the control so that at all frequencies the illuminated arms of the "star" are exactly the same size the output voltage will be virtually constant.

The waveform of the output is good at all frequencies, being free from mains hum, while a filter is included in the circuit to prevent RF reaching the final amplifying valve.

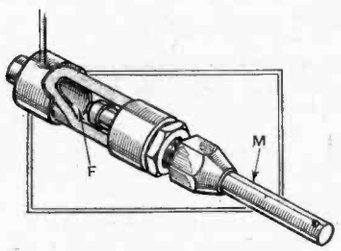
The oscillator is robustly made and entirely enclosed in a steel cabinet fitted with a carrying handle.

It is made by Furzehill Laboratories, Boreham Wood, Herts, and the price is £17 10s.

DUBILIER AIR DIELECTRIC TRIMMER

A NEW type of trimming condenser designed to have a high order of stability under all conditions has been developed by the Dubilier Condenser Co. (1925), Ltd., Ducon Works, North Acton, London, W.3.

It consists of a fixed tubular electrode and a moving plunger, the latter being centred in the former by a small ceramic bead. The plates of the condenser are, however, air-spaced.



New air dielectric trimmer condenser with ceramic body made by Dubilier. The moving and fixed parts are indicated by M and F respectively.

The two elements are mounted in a ceramic tube fitted with metal ends; that which supports the moving part has a fixing device for mounting the condenser on the chassis so that the variable member will be at earth potential.

Connection to the other, or fixed, plate, is made by means of a short length of No. 20 SWG tinned copped wire.

Variations in capacity are effected by sliding the plunger in or out, and when the required capacity is found, the plunger can be securely locked in position by means of a split chuck incorporated in the bearing.

Stability of capacity is obtained first by the mechanical design, and secondly by the choice of materials, the ceramic playing a very important part in this respect.

This trimmer will find many applications in a wireless receiver, but will be particularly valuable in oscillator circuits and in circuits that are pre-tuned, and where frequency drift due to changes in capacity with temperature or other causes cannot be tolerated.

It can be made in a wide range of values, and while at present supplied to the set makers only, there is the possibility that some models will, in the near future, be available to home constructors.

Hints and Tips for Motor Cyclists. Thirteenth Edition. Pp. 202. Issued by *The Motor Cycle*. Published by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 2s.

This book is as invaluable to the experienced driver as it is indispensable to the novice. All aspects of motor cycling are dealt with very comprehensively, and the subjects treated are arranged alphabetically for easy reference.

Random Radiations

By "DIALLIST"

The Water-Tap Problem

YOU may remember that I mentioned recently a perplexing wireless problem that had come my way: a receiving set with an earth connection to a buried copper tube was reduced to silence whenever the cold water tap in the adjoining kitchen was turned on. Two readers have been kind enough to send me suggested explanations of the phenomenon, and here they are—curiously enough, both come from Lancashire, one from Liverpool and the other from Manchester. My Liverpool correspondent argues that the tuning of the set is affected when the tap is turned on; hence you must look for the source of the trouble in something connected with the aerial-earth circuit. His idea is that owing to the lay-out of the water main, a closed loop is formed when the tap is turned on. This, he says, naturally affects the efficiency of the aerial-earth circuit. He believes that a remedy might be found if the set were earthed to the water main or if both main and set were earthed to a common point. I don't think the tuning of the set is affected: if it were one might expect a diminution in the strength of the incoming station with possibly the appearance of another station in the background. As there is a complete cessation of signals it seems that the aerial-earth circuit must be very heavily damped in some way when the tap is turned on—I'm not trying to be funny!

A Static Effect?

The Mancunian reader writes, "I seem to remember from the dim past a device for producing considerable charges of static electricity which was called the Kelvin Water Dropper. There is also the phenomenon of the frame of a steam lorry becoming highly charged electrically from the jet of steam when the safety valve blows. Is it possible that the turning on of the tap produces a static discharge powerful enough to cause the AVC of the set to fade the station right out?" He mentions that he has himself experienced the interference with the wireless set which can be caused by a jet of high-pressure steam from a nearby boiler. It produces, he says, a high-pitched hiss, and adds, rather unkindly, that this might easily pass unnoticed with some commercial superhets. There may possibly be something in this explanation, but I can't help thinking that if there were static manifestations of the magnitude suggested, those who handle the tap would detect their presence pretty quickly and perhaps rather painfully without the aid of any scientific apparatus.

Battery Standards Wanted

IN the old days, when every wireless set was battery operated, there was a more or less standard classification of dry HTB's. According to the sizes of the cells which went to make them up, they were known as single capacity or standard, double capacity, treble capacity or power and quadruple capacity or super-power. The respective cell sizes varied slightly from make to make, but generally speaking the cells of standard batteries measured $\frac{3}{4}$ inch by $2\frac{1}{8}$ inches, those of "doubles" 1 inch by $2\frac{1}{4}$, those of trebles $1\frac{1}{4}$ inches by $2\frac{1}{4}$, and those of quadruples $1\frac{1}{4}$ by $3\frac{1}{2}$ inches. Nowadays the terms power or super-power and double or treble capacity are still used, but they seem to have no fixed meaning. Cells are now usually measured in millimetres, that of standard capacity size being known as a 55-millimetre cell. Some of the so-called power batteries are now made up of what are known as 72-millimetre cells. These have the same diameter ($\frac{3}{4}$ inch, or a little under 20 millimetres) as standard cells, though they are 17 millimetres taller. In any event they don't deserve the term double capacity for their cubic content is little more than one-third greater than that of standard capacity cells. Nor, I think, should they be known as power batteries. The load under which they can be placed economically is little if at all greater than that for standard cells, though it is, of course, true that they last longer than the latter if both are tested under the same load.

State the Cell Measurements

It would, I feel, be a good thing if radio battery manufacturers had the actual size of the cells within printed clearly on the case. The reputable manufacturer could protect himself in this way because those of the other sort would be loth to follow suit if they were using undersized cells. I feel, also, that it is desirable that the number of cells that it contains should be shown on the case. The buyer would then know that he was getting his money's worth, so far, at any rate, as the size and number of cells were concerned. Until you come to pull large numbers of batteries of different makes to bits you don't realise how many tricks-of-the-trade there are. Some years ago when cheap Continental batteries were coming into this country in large quantities it was no uncommon thing to find that a battery labelled 108 volts contained actually not 72 cells, but 74 or 75. Well, the reader may ask, what was wrong with that. Could the purchaser complain if he got two or three extra cells thrown in? Perhaps not, but there is a good deal more than that in those make-weight cells. You see, batteries of that kind were often very poorly insulated and their shelf life was short. Those extra cells enabled them to show 108 volts on the volt-meter when they were tested beneath the purchasers' eyes when they were no longer really in very good form. Of course, when they were hot from the factory they might show 112 volts or more, and if the man in the street saw a volt-meter reading of that kind he was easily persuaded to part with the price of the battery, thinking that it must be something supremely good.

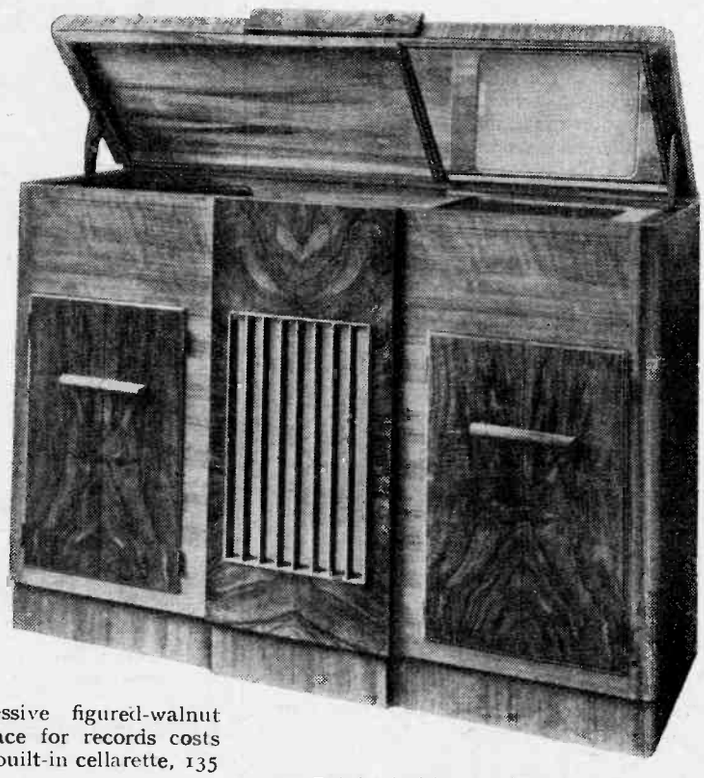
Bargains Not Always What They Seem

THOUGH I am not saying that there aren't good bargains to be found amongst receiving sets sold off at reduced prices, it certainly behoves the purchaser to look before he leaps. This warning applies perhaps particularly to some of the foreign-made receivers—usually unsold surplus of the previous season—which come into this country at almost any price. Many of them are ill-designed and worse made, and I have come across a few which, if not definitely dangerous, were getting on that way. Buy

NEW BAIRD TELEVISION RECEIVER

IN this latest product of Baird Television, Ltd., a black-and-white picture $13\frac{1}{2} \times 10\frac{3}{4}$in. is viewed on an inclined mirror from the vertically mounted 15-inch cathode-ray tube, and the image brilliancy is such that the programme can be viewed in daylight or with normal room lighting.

For general radio reception an all-wave superheterodyne is included, and a Collaro automatic record-changer is provided for gramophone entertainment. The instrument is housed in an impressive figured-walnut cabinet and with space for records costs 130 guineas, or with a built-in cellarette, 135 guineas.



Baird television receiver, type T14.

one of these dumped sets and you may be delighted at first with your bargain; but if anything important goes wrong the real fun begins. Circuit diagrams and service instructions are not usually available; nor are spare parts. And often it's not too easy to find a service man sufficiently versed in the oddities of design that some of these receivers contain to be able to deal effectively with them.

A Hard Case

Still more careful should those folk be who agree to buy marked-down sets on the hire-purchase system and sign agreements accordingly. An illuminating instance of the kind of thing that can happen has just come my way. My correspondent saw one day in a shop window a number of good-looking sets offered as brand new and unused for weekly payments of 1s. 8d. The sets undoubtedly were unused, but they were of a rather early 1936 vintage, though he did not know this. Having heard one, he decided to buy, and signed a hire-purchase agreement form binding him to pay 1s. 8d. a week for 104 weeks. This comes to a total of £8 13s. 4d. He was assured that with the set went something beyond all price, namely, first-rate free service. Actually, the thing broke down within a week, and when he applied for the vaunted free service he was promptly charged ten shillings, though no replacement was made. But the most unkind cut of all came when he passed the self-same shop a few days later. There in the window were several sets exactly like his own marked "Cash Price £5." I am not good at working out rates of interest, but considering that each weekly payment makes a reduction in the outstanding principal, the additional £3 13s. 4d. that he is to pay over two years seems to amount to something well over 40 per cent.

Like Hot Cakes

SOME months ago, when an American firm stepped in and started to make in this country the big and necessarily expensive wireless sets that our own manufacturers didn't believe were wanted, I predicted in these notes that within a very short time they wouldn't be able to turn them out fast enough to meet the demand. That has actually happened. Orders have recently been refused because no immediate date for delivery could be guaranteed. Part of the trouble has been that one quite large batch of sets proved, when assembled, not to be up to the very high standards of the firm. I was surprised to find—or was I?—how very high these standards were when I came to investigate. Actually, the tolerances are so small that not a single "ready-made" component could be used; all had to be specially turned out. That's the real way to make radio sets. Bring down prices to very low levels and you must perforce allow pretty wide tolerances in the parts that go to make them. But you can't have wide tolerances in a first-rate receiver, and if they're to be narrow the components are naturally going to cost more, from which it follows that the first-rate set cannot be cheap.

Self Defence?

IT'S rather a shock sometimes when you tune-in a foreign station and find a dance band at work to note that the words of the refrain are bleated in that queer travesty of the English and American tongues that the British crooner has made particularly his own, or, what is, if possible, worse, her own. You are hearing, of course, gramophone records, and I suppose that such must exist with French or Dutch or Swedish or Czechoslovakian words. But they don't seem to use them. My diagnosis is that the footling words that the average crooner is called upon to deliver in a voice which suggests that neither adenoids nor tonsils were properly attended to in youthful days can be borne by our Continental friends and neighbours only if they are emitted in words that are, to them, of a foreign tongue. There is a good deal in that when you come to think it over. I suggest to the B.B.C. for their earnest attention that they should in future permit no crooning in their studios save in Dutch (single or double according to the inanity of the words), Esquimo, Rumanian or Yiddish. Whether or not listeners understood, I am sure that the words would be equally meaningless.

SULLIVAN INSTRUMENTS

IN their latest publication, "Electrical Standards for Research and Industry," H. W. Sullivan, Ltd., London, S.E.15, have produced something more than a mere catalogue of instruments. The fundamental basis of design for high accuracy and thermal stability in inductance and capacity standards is admirably presented with ample illustration. Many of these components are used in complete instruments such as the Sullivan-Griffiths Screened Substandard Wavemeters with an accuracy of 0.01 per cent., and the latest Ryall-Sullivan Precision Beat Tone Oscillator, in which the stability is one cycle per day from the moment of switching on.

Full details with circuit diagrams are given of telephone cable-testing equipment, bridges for inductance, capacity and power factor measurement, and a new range of non-reactive screened resistances.

Prices of all instruments are given, and the book, which contains 194 pages, is well produced with numerous half-tone and line illustrations.

The Wireless Industry

A SOMEWHAT unusual application of sound reinforcement for the correction of faulty architectural acoustics has recently been made by Grampian Reproducers, Ltd., in a London church. By distributing a number of low-powered reproducers with low-pitched characteristics at selected parts, a distinct high-pitched echo has been successfully "filled in" to resemble a normal reverberation effect—with a considerable improvement in general intelligibility.

The Hushatone device, described as "the personal silent loud speaker," and designed to give the advantages of headphones without their discomfort, is described in a pamphlet just issued by R. A. Rothermel, Ltd., Canterbury Road, Kilburn, N.W.6.

A new leaflet dealing with the Marconi-Ekco signal generator, as shown at the recent Physical Society's Exhibition, is available from Marconi-Ekco Instruments, Ltd., Electra House, Victoria Embankment, London, W.C.2.

The Scott Insulated Wire Company's new factory at Queensbury, Middlesex, is to be known as Queensland Works; the building is now nearly ready for occupation, and it is expected that the company's offices will be transferred to it during the present month.

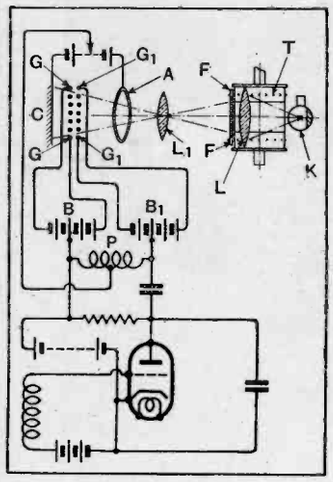
Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

SCANNING SYSTEMS

THE picture on a photographic film F, which is continually being moved upwards from the plane of the paper by a sprocket T, is illuminated by a lamp K, through a lens L, and the emerging light rays are focused by a lens L1 on to a photo-sensitive screen or cathode C mounted inside an evacuated tube, the envelope of which is not shown in the drawing.

The tube also contains a ring-shaped anode A and a pair of grids G, G1 interposed between the anode and the cathode. Each grid consists of a zigzag of resistance wire, the upper and lower terminals being connected across batteries B, B1 so that there is a uniform potential gradient along each wire. The gradients are opposed, so that if the top of G1 is made more positive than the bottom, the



Scanning system described in Patent No. 473166.

bottom of G is made positive relatively to the top.

Line-scanning impulses are applied to a coil P, which is centre-tapped to the cathode C. The effect of the combined voltages on the grids G, G1 is such that at any given moment there is only one point at which free electrons, given off by the cathode C, can pass through the two grids, to be collected by the anode A. This "free" point travels in successive lines over, in effect, the whole surface of the cathode.

P. M. G. Toulon. Convention date (France), November 6th, 1935. No. 473166.

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TONE COMPENSATION

THE high-note loss, due to side-band cutting in the RF input circuits, is restored or compensated in the AF stages of the set. For this purpose the effective ratio of resistance-to-reactance in the anode and screen-grid circuits of a low-frequency pentode is varied by applying a suitable bias to the suppressor grid. This alters the frequency-amplification response in the necessary manner.

The AF "control" can be made to vary automatically with changes in the overall selectivity of the RF circuits, or in accordance with the amount of interference that may be present when receiving any given station. In the latter case the regulating bias is derived from a series-tuned circuit, or low-pass filter, which is responsive to interfering signals within, say, 9 kc/s of the carrier wave of the desired station.

Murphy Radio, Ltd., and G. B. Baker. Application date March 11th, 1936. No. 475028.

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DIRECTION-FINDING

THE Adcock aerial, as used for direction-finding, consists of four vertical antennæ arranged, say, at the four corners of a square, opposite "pairs" being connected together through feed-lines to a common receiver. The feed-lines are crossed over or otherwise balanced to eliminate pick-up from horizontally polarised waves which have been reflected from the Heaviside Layer, so that the installation will give reliable bearings, free from the so-called "night error."

The invention consists in arranging two separate Adcock systems, one for handling waves of the order of 330 kc/s, and the other, waves of the order of 20 megacycles, so that the installation occupies the least possible space. The short-wave system is set up inside the long-wave system, and the individual aerials of the latter are "loaded" by coils which are alternatively reversed. This prevents the formation of any standing waves due to the short-wave signals, and so keeps each set of aerials from reacting on the other.

Marconi's W. T. Co., Ltd., S. B. Smith and E. Green. Application date, March 26th, 1936. No. 472651.

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TELEVISION RECEIVERS

PICTURE and sound signals are both received on the same dipole aerial and are fed, without separation, to a "duplex" valve having two grids and two anodes. The combined signals are applied to one grid of the duplex valve, whilst locally generated oscillations are applied to the other grid of the same valve. The two anode circuits are separately tuned, one to the beat frequency between the local oscillations and the picture signals, and the other to the beat frequency between the same local oscillations and the audible signals. The two sets of signals, therefore, build-up separately in the two differently tuned circuits, and each is then fed to its own amplifier in the ordinary way.

Baird Television, Ltd., and L. R. Merdler. Application date May 4th, 1936. No. 474684.

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LOUD SPEAKERS

AN electric clock is combined with a miniature radio set in such a way that the hands of the clock project in front of the loud-speaker diaphragm. The hands are driven by elongated spindles from a synchronous motor, which is mounted on the "pot" of the speaker-magnet, behind the diaphragm. The clock face serves as a tuning scale, the indicator needle (which may simulate a "seconds" hand) being driven by belt gearing from a control spindle at the base of the cabinet.

G. Briggs. Application dates, May 14th and October 7th, 1936. No. 475172.

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TELEVISION TRANSMITTERS

AN optical image of the picture to be transmitted is projected on to a photo-sensitive screen, and the electrons so set free pass to a semi-permeable grid, where they form a facsimile of the picture in electric charges.

This is scanned by the electron stream from the cathode, which is located at the opposite end of the tube to the photo-sensitive screen. The resulting discharges are collected on a second grid, which is located close to the charge-forming grid, and is sufficiently wide-meshed to allow the scanning beam to pass through. The collector is connected to an external coil across which the signal voltages appear.

Baird Television, Ltd., and V. Jones. Application date, April 4th, 1936. No. 473006.

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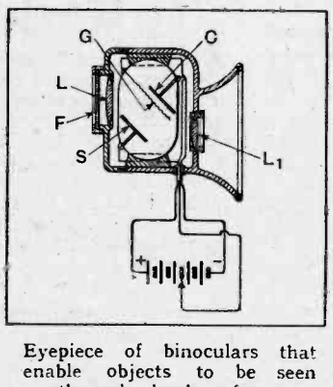
SEEING THROUGH FOG

THE Figure shows one eyepiece of a pair of binoculars which are designed to enable an aviator to view the surface of the earth through an intervening bank of



Eyepiece of binoculars that enable objects to be seen through cloud or fog.

clouds or fog, by making use of reflected infra-red rays.

The rays pass through an infra-red filter F and are focused by a lens L on to a photo-sensitive cathode C where they liberate a stream of electrons. The stream is accelerated by the grid G and creates a visible image of the obscured landscape upon a fluorescent screen S. This image is viewed by the aviator through a lens L1. The operating potentials are taken from a compact dry-cell battery which is carried in the observer's pocket.

Akay Electron Co. Convention date (U.S.A.), March 30th, 1935. No. 473183.

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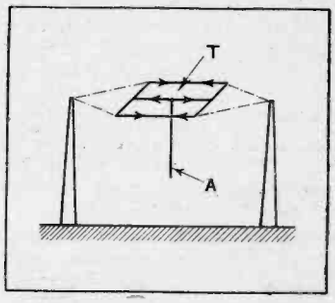
"INVERTED" AERIALS

THE term "inverted aerial" is applied to a dipole which although loaded with an artificial "top" really functions as a true half-wave aerial. The top carries a current and contributes definite



Aerial system comprising horizontal and vertical parts designed to function as a true half-wave aerial.

inductance to the aerial as a whole, as distinct from the action of the ordinary "capacity top."

According to the invention the "top" consists of a network of wires T arranged symmetrically with respect to the vertical limb A, as shown in the Figure, so that the current flow is balanced as indicated by the arrows. The downlead A is (electrically) not less than one-eighth and not more than three-eighths of the working wavelength.

Marconi's Wireless Telegraph Co., Ltd. and N. Wells. Application date April 29th, 1936. No. 474384.

o o o o

COLOUR TELEVISION

IN a receiver for a two-colour system of television, the light from a lamp is first passed through a doubly refracting crystal so that it is split up into an ordinary and extraordinary ray. These are passed respectively through blue and red filters, and are separately modulated in a Kerr cell by the signals containing the corresponding blue and red images sent out by the transmitter.

The two coloured beams are then passed through a second doubly refracting crystal which is suitably orientated relatively to the first crystal. Here the beams are recombined and thrown by a scanning drum on to the viewing screen.

Baird Television, Ltd., and J. L. Baird. Application date, April 9th, 1936. No. 473303.

The Wireless World

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CONTENTS

Editorial Comment

Two Sets

Choice of Programmes in the Home

THE B.B.C. post-bag is a constant reminder of the diversity of tastes amongst listeners throughout the country, and, whatever the B.B.C. may try to do in the way of providing variety in programmes, it still seems to be impossible to satisfy everyone.

When we consider the family as a unit, the same situation applies because in the family circle tastes will differ in the same way, so that the occasions must be comparatively rare when all the members of the household can be satisfied to listen to the same programme item, yet in spite of this state of affairs it is comparatively seldom that one comes across a home where more than one wireless set is in use. This is probably why wireless is so much more popular amongst those who live alone than it is in the family circle ; in fact, there must be many occasions when tastes differ so widely that the wireless set is not switched on simply because almost any programme, whilst pleasing one member of the family, would annoy another. There can be nothing more exasperating than to sit in a room with the wireless set switched on to a programme which is boring or irritating, and yet one hesitates to ask for it to be turned off if it is being listened to with interest by others in the room.

One Set—One Programme

It is, perhaps, not sufficiently realised that although we clamour for alternative programmes from the B.B.C. and alternatives may generally be available to us, there is still only one programme in the home and that the transmission selected by the member of the family who happens to tune in a programme to his liking.

Our contemporary, *The Wireless Trader*, is, we notice, urging salesmen of wireless sets to put the point of view to their customers that every home should have a second set if "harmony in the home" is to be assured. From *The Wireless Trader's* point of view, of course, the main purpose is to stimulate sales, but we feel that the idea is one which we can fully endorse in the interests of listeners, because we feel that so long as there is only one set the full advantage of any efforts on the part of the B.B.C. to provide alternative programmes can never be properly realised.

'Phone Listening

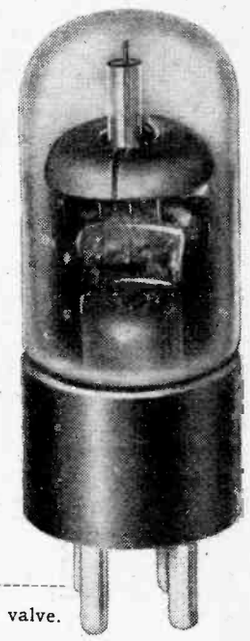
There is, of course, the objection which can be raised that the family generally spends most of the time in one living room, especially during winter months, and that two sets in the same room tuned to different programmes might produce discord. Much depends, however, on the position of the sets and volume can easily be turned down, if necessary, so that the two sets do not compete with one another.

Perhaps the idea may result in a boom for headphones for quiet listening, and for those who take their listening really seriously we believe there is much to be said in favour of 'phone as against loud speaker reception.

Remote Control by Wired Wireless

OPERATING A RECEIVER BY MAINS-BORNE RF IMPULSES

THE control of a receiver from a remote point, by means of RF impulses transmitted along the electric wiring, provides an attractive alternative to the use of a multiple connecting cable. A "wired wireless" system has now been developed in America, and one of the most obvious drawbacks—the necessity for at least one valve to be constantly "on watch" for the switching-on signal—has been overcome by the use for this function of a new cold-cathode valve, which consumes no current except at such times as it is actually working. In addition to acting as a guide to the controlling impulses, the mains wiring, of course, provides the energy for actuating the control devices at both ends.



The new cold-cathode valve.

By W. N. WEEDEN

THE most fascinating development of recent years has now been disclosed by the engineers of the RCA Licence Laboratory, who were responsible for its conception and development—S. W. Seeley, C. W. Kimball and H. B. Deal. Essentially, this development consists of an entirely new conception in the control of a radio receiver from any point in a house with no special connections between the remote unit and the receiver—a "wireless" remote control system at last! Any number of receiver functions can be controlled from any number of remote units, without one foot of messy multi-wire cable. The control system to be described actually depends on "wired" wireless, the controlling impulses being propagated along the domestic electric wiring.

At the time when the idea was conceived two major difficulties seemed to stand in the way of its realisation. These were the necessity for a number of oscillator frequencies to perform the several necessary control functions, and for keeping at least one valve operating continuously in order to receive the first impulse for switching on the receiver.

Fortunately for those engaged in developing the new control system, the Bell Telephone Laboratories announced at the end of 1936 the production of a new three-element gaseous valve of the cold-cathode type. This valve, the W.W.313-A, was designed primarily for use in landline telephony, but it immediately paved the way for overcoming the second and most serious of the difficulties mentioned.

This cold-cathode valve, which bids fair to substitute for the clumsy remote-control cable an invisible chain of electro-magnetic waves, consists of two semi-circular discs known as control electrodes, and an anode formed by a small nickel wire projecting above a glass tube which protrudes through the control electrodes. The control electrodes are coated with barium, and the envelope is filled with mercury vapour and a mixture of rare gases, neon in particular, to a pressure of several centimetres of mercury. This combination of electrodes and gases gives us a valve which resembles the well-known neon lamp and other gas-discharge devices, in that no current flow takes place between any two electrodes until the potential difference existing between them exceeds a certain critical value, whereupon ionisation of the gas takes place giving a conducting path of low and constant resistance which ensures a relatively constant current over a wide range of voltages. In this new valve, the "control gap" (between control electrodes in Fig. 1 (a)) breakdown voltage is 70 and the sustaining voltage is 60. The "main" gap (between anode and either control electrode) breakdown voltage is 175 and its sustaining voltage but 75. The sustaining voltage is the potential drop between electrodes when conducting.

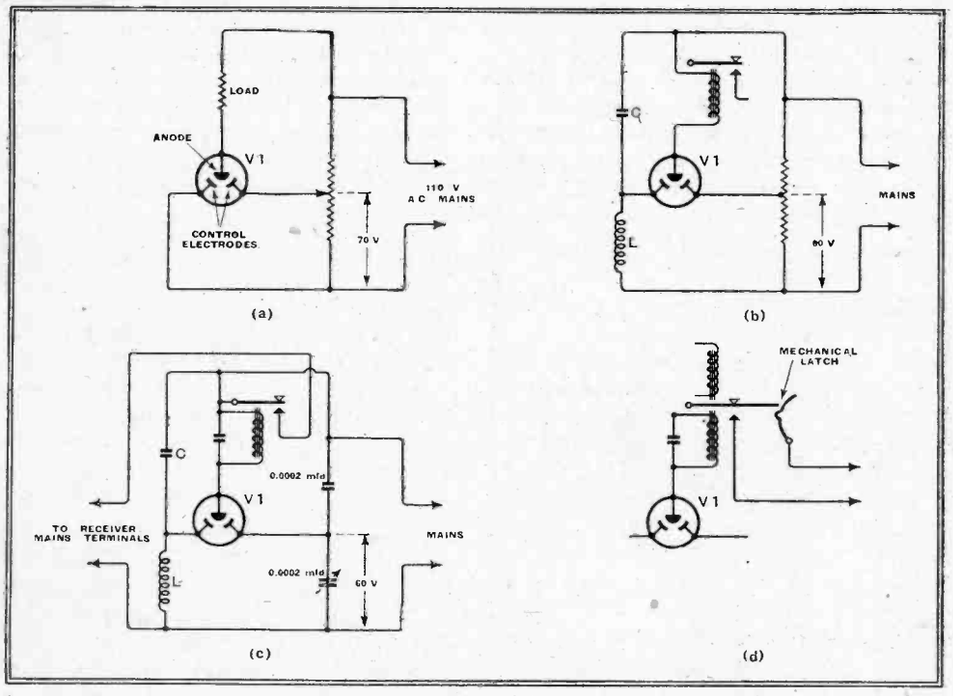


Fig. 1.—How the new cold-cathode valve is used in the starting unit.

Relay Action

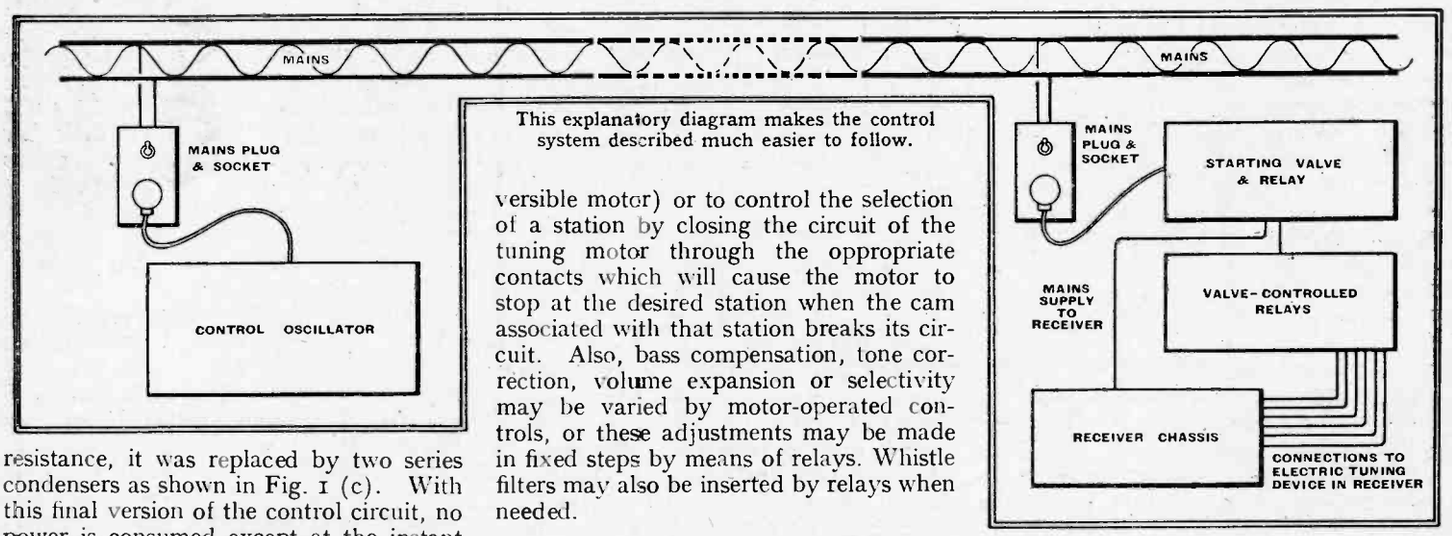
The current-voltage characteristic of the control gap is not affected by the polarity of the two control electrodes, but that of the main gap is entirely different for positive and negative anode potentials. When the anode is positive, at least 50 times the current flows in the main gap as under the influence of an equal negative voltage; thus the valve can be operated as a rectifier. Also of interest is the fact that the main gap becomes conductive at approximately the same potential difference as that existing across the control gap, once the control gap has "broken down," although 175 volts is required to break down this main gap if the control gap is not conducting. This feature of the 313-A's operation permits of its operation as a relay, and both of these characteristics are taken advantage of in the circuit to be described.

In Fig. 1 (b) a series resonant circuit, LC, is so connected that a voltage of 70 across C would cause the control gap to

break down, also breaking down the main gap. As it would hardly be feasible to use a control oscillator of sufficiently high power to impress 70 volts across C with the mains acting as a transmission line of low impedance, Dr. Kimball realised that if the electrode B could be biased to some 60 volts, only 10 volts would be required across C to break down the control gap. Originally this 50-volt drop was secured from a voltage divider connected across the mains, but because of the power that would be continuously consumed by this resistance, it was replaced by two series condensers as shown in Fig. 1 (c). With this final version of the control circuit, no power is consumed except at the instant when it is operating. The relay in the anode circuit of V1 is a low-sensitivity unit operating on some 30 mA, which is the peak current of the 313-A. In America, suitable relays are available at as low a price as 19 cents.

Although this arrangement is entirely workable for any control function, it would be somewhat extravagant for the duty of switching on the receiver, as the anode circuit relay would have to be energised during the entire operating period; this method would also monopolise the use of a remote control oscillator for that purpose alone. Fortunately, the substitution of a "latching" relay of the type shown in Fig. 1 (d) solves the problem by locking the armature in the closed position, so that only a short impulse from the remote oscillator suffices to close the primary (mains) circuit of the receiver power transformer, which remains in an operating condition until an impulse through the upper coil 1, which is energised by a second valve, attracts the armature upwards, freeing it from the latch which held it in the operating position.

The circuit of Fig. 1 (c) can be used to increase or decrease volume (if the receiver volume control is operated by a reversible motor) or to control the selection of a station by closing the circuit of the tuning motor through the oppropriate contacts which will cause the motor to stop at the desired station when the cam associated with that station breaks its circuit. Also, bass compensation, tone correction, volume expansion or selectivity may be varied by motor-operated controls, or these adjustments may be made in fixed steps by means of relays. Whistle filters may also be inserted by relays when needed.



Adapting Standard Valves

Having worked out a practical scheme for controlling any number of functions by means of an equal number of cold-cathode valves with associated relays and other components, Dr. Kimball next proceeded to design a circuit wherein all but one function—that of switching on the receiver—would be performed by conventional vacuum valves. This was deemed advisable because of the lower cost of these valves as compared with the new gas relays. The circuit for such an arrangement is shown in Fig. 2, and if the connections to the right-hand section of V3 be traced out it will be seen that its anode is excited by an AC potential supplied by transformer primary by the cold starting device of Fig. 1 (c) when the receiver is switched on.

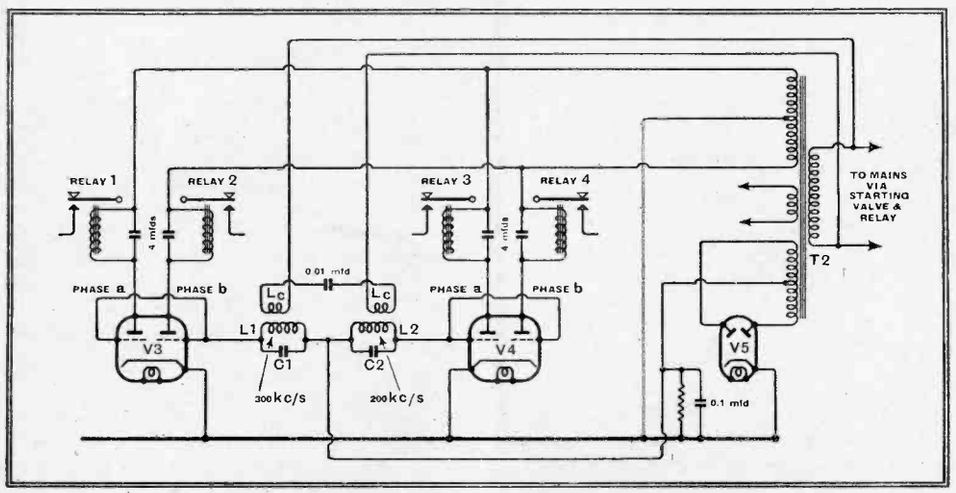


Fig. 2.—The receiving or actuating unit, installed in or near the receiver, performs all actuating functions except switching on, which is effected through the "cold start" unit.

For the ten control functions originally stipulated as necessary a control system operating as described would require a remote control box giving 10 oscillator frequencies, with 10 valves and 10 relays at the receiver end. Dissatisfied with such a complex and cumbersome system, Dr. Kimball next proceeded to simplify matters by utilising two-phase transmission, either singly or in combination, which with one or both of two frequencies provided 10 control functions. While it may seem quite a far cry from the simple oscillator already described to one operating as a two-phase device, all that is involved is the supplying of the oscillators' anode voltage from a centre-tapped power transformer. With this arrangement the phase of the oscillator may be shifted 180 degrees by shifting its anode from one end of the transformer secondary to the other.

Raw AC on the Anode

In other words, it simply involves the choice of the time during which the valve will oscillate; as it is fed with raw AC, oscillation will take place only during the half-cycle during which the anode is positive.

Fig. 3 is the diagram of the "working" remote oscillator and it will be seen that the two oscillator valves are contained in one envelope (double triode valve type 6N7, etc.), and utilise modified Hartley circuits. Switches 1 and 2 control the phase of the oscillators—both of which are tuned to 300 kc/s by C. The addition of

Remote Control by Wired Wireless—

C1, shunted across C by switches 3 and 4, lowers the frequency to 200 kc/s. Combinations of the settings of the switches thus transmit the various "signals" corresponding to the receiver function desired by the user. The RF output of the oscillators is coupled to the mains by the two coupling inductances which are connected from the oscillator grids to the "live" side of the mains. This method of coupling gives a good impedance match and suppression of harmonics. With about 350 volts (RMS) on the oscillator anodes, approximately 8V will be impressed on the mains.

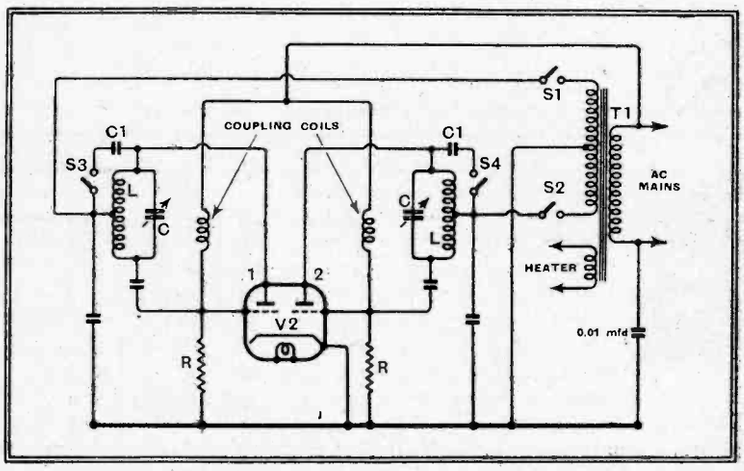


Fig. 3.—The remote transmitter or oscillator unit employs a Type 6N7 double triode valve. R indicates leak resistances for the grids.
S1 operates oscillator No. 1, phase a, at 300 kc/s
S2 operates oscillator No. 2, phase b, at 300 kc/s
S3 changes oscillator No. 1, phase a, to 200 kc/s
S4 changes oscillator No. 2, phase b, to 200 kc/s

In order to harness or apply this combination of phase and frequency, it is necessary to employ a "phase detector." In spite of the imposing name, this device merely calls for the application of AC of proper polarity to the anodes of the gas relays of Fig. 1 (c) or of the triodes of Fig. 2. In either case, no current can flow in the anode load (relay) during the half-cycle of the supply voltage during which the anode is negative. Thus, if the control valve is so connected that its anode is negative during the half-cycle when the oscillator is functioning, no current will flow through the relay regardless of the fact that its grid circuit is tuned by L1-C1 to the oscillator frequency. Thus V3 is a "double sided" phase detector, tuned to 300 kc/s, capable of operating either relay 1 or 2, according to the phase of the impulse transmitted from the remote oscillator. V4 and its associated circuits operate in the same manner as V3, except that its grid circuits are tuned to 200 kc/s.

With two frequencies and two phases used singly four control functions can be accomplished. In order to take full advantage of the 10 combinations of frequency and phase, it is necessary to employ relays having several contacts on both back and front (open and closed). These contacts are connected in series in such a manner that one circuit will be closed only when relay 1 is energised, a second when relay 2 is energised, and a third circuit will be closed when both relays 1 and 2 are operated. Relays 3 and 4 are utilised in the same manner, so that the tenth function may be accomplished only by closing the circuits through all four relays. Thus two double valves will perform the same number of operations as ten single valves with ten frequencies.

After the demonstration of this remote control system several engineers expressed the opinion that mutual interference might occur if several such devices were operated in adjacent apartments. Measurement confirmed the belief that little carrier-frequency energy would pass through a meter from house to house, as the attenuation introduced by the meter is normally 10 db.; of course, two meters are interposed in the wiring between any two houses or flats. However, under particularly bad conditions, an RF filter could be installed at the meter to add further attenuation to the signals passing out of and into that apartment. An alternative remedy (although the designers of the system were of the opinion that neither method would be required) is the changing of the frequencies of one of the systems which cause interference or is acted on by external signals. Investigation showed that no measureable RF radiation took place from mains wiring enclosed in metal tubing; this is standard practice in America.

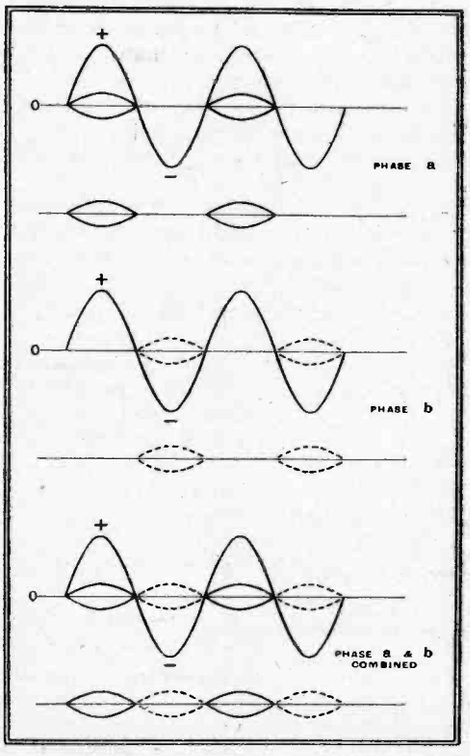


Fig. 4 (a) Anodes of both transmitting oscillators and "receiving" control valves are fed with raw AC, and thus are operative only on positive half-cycles. Economy in the number of valves and oscillator frequencies is thus possible by the use of various phase combinations.

In conclusion, it should be pointed out that the new RCA system of remote control has not yet been applied commercially, only one receiver having been equipped for demonstration. While it is probable that several American manufacturers will make use of this "gadget" in their new models, no figures on probable cost are as yet available. However, the writer believes that it should be possible to sell a control set of this sort as an accessory for "electric tuned" receivers at three to four pounds. To simplify its installation, it is probable that receivers designed for use with "wired wireless" remote control would be equipped with a multiple contact receptacle in which the control unit could be plugged, thus eliminating the installation problem entirely.

In addition to its control of radio receivers, Teledynamic Control by Selective Ionisation, as it is called, may be used to control any AC-operated device.

Wireless at the B.I.F.

AMONG exhibits of wireless interest at the British Industries Fair, opening on February 21st, is a comprehensive range of television receivers and equipment to be shown by Baird in the Olympia section. The new Model T14 will make its first public appearance, and demonstrations of television reception will be given. The New Baird Multiplier photo-electric cells, recently described in this journal, will also be on show, as will equipment for "communal" television installations in blocks of flats, etc.

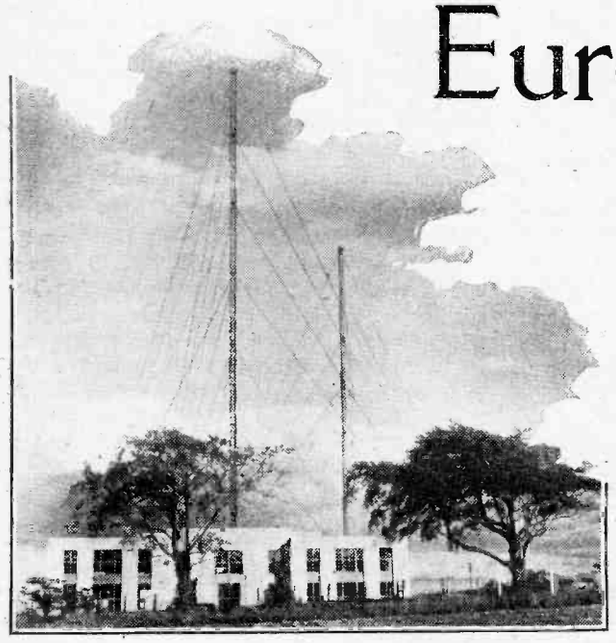
Demonstrations of interference suppression will be given by Belling and Lee on Stand No. Cb702 in the Electrical Section at Birmingham. In addition to anti-interference filters, chokes, set-lead suppressors and the "Eliminoise" aerial with which most readers are familiar, there will be specialised suppressor units for connection to various appliances. Apparatus for the measurement of "noise" voltages and field strengths is also to be shown.

Catalin, a new synthetic resin plastic material which is cast rather than moulded in the familiar manner, is to be shown in the Plastics Section. This material seems to have many applications in the radio industry as well as in other fields.

Another "plastic" exhibit of special interest is that of Combined Optical Industries, Ltd.; this firm has evolved a material for making lenses by a moulding process. It has been suggested that this substance may find a place in mechanical television systems, but perhaps of more immediate interest is the fact that it is to be shown in the form of illuminated dials, etc., for radio receivers. The company's new factory at Slough opens next month.

European Broadcast Channels

By R. W. HALLOWS, M.A.



DETAILS of the Lucerne Plan, the successor of the earlier Geneva and Prague Plans, for the regulation of European Broadcasting by international agreement were published in the summer of 1933. The Plan itself was put into operation on January 15, 1934, and had thus been in force for just over four years when the investigations into its working, which form the subject of this article, were undertaken.

It must be realised that the main object of the Plan was to distribute channels on the medium and the long waves amongst European countries, as well as those in Northern Africa and the Near East, in such a way that each might be assured of good reception by listeners *in the service areas of its station*. The Lucerne Plan was *not* concerned with long-distance listening; any improvement or deterioration that might occur in the reception of foreign stations was, so to speak, a by-product of the plan.

Were an investigation into its working made in the service areas of the stations, between 200 and 300 in number, which it covers, there is no question that reception would be found perfectly satisfactory in the great majority of instances: there would be still fewer cases of outside interference in service areas than there actually are had all European countries subscribed to the original convention, and had all those who did so subscribe carried out their obligations strictly.

ALTHOUGH the present Cairo Conference is not directly concerned with the allocation of broadcast channels, the time is particularly opportune for a survey of existing conditions, as many related subjects are likely to come up for discussion.

The Lucerne Plan, then, has been eminently successful in its primary object, particularly on the medium waves. Has it done a good turn or the reverse to those who listen, regularly or occasionally, to foreign stations? It has certainly been very much to their advantage. The Prague Plan was drawn up at a time when a 10-kilowatt station was regarded as a big one. Had it not been superseded by the Lucerne Plan, it is probable that few foreign stations would now be receivable in this country with any kind of entertainment value. The Lucerne Plan did two things that its predecessors did not. It took the output power of stations into account as an essential factor, and it also made the geographical position of stations an important consideration.

How the System is Working

In this last its originators were not always quite happy in their predictions, and their calculations. They did not, for example, foresee that a 20-kilowatt station at Jerusalem might cause background interference with the British North Regional in its own service area, or that Cairo might similarly affect Brussels. The Jerusalem-North Regional interference has been remedied, but that by Cairo on Brussels still remains.

There were two other important causes of interference between stations which those who drew up the Lucerne Plan did not foresee. They could hardly have done so since the first, the "Luxembourg Effect," was not observed until some time later—Luxembourg was only "testing" when the plan was worked out. This kind of interference may affect a station in its own service area.

The second was "sideband splash," otherwise known as "sideband splutter." This may also affect a station in its own service area, but is unlikely to do so, except possibly near the fringes of that area, unless the field strength of the interloping station is abnormally great. Sideband splutter is, however, a great nuisance to those who listen to foreign stations. A glance at the accompanying spectrum will show that in the locality (some twenty-five miles north-west of London) where the present investigations were made it was observed to occur between over twenty pairs of stations occupying channels in the waveband 549.5—261.1 metres (546-1,149 kc/s).

There are many amongst the uninitiated who put the blame on the receiving set, though it is guiltless. Sideband-splash may be caused (a) by the heterodyning of Station A's carrier wave by one sideband of Station B; (b) by a similar heterodyning of Station B's carrier by a sideband of Station A; (c) by mutual heterodyning of one sideband of each station.

It is interesting to note how much sideband-splash varies in its incidence between pairs of high-powered stations. In the spectrum the arrows start from the station causing the splutter, their heads pointing to the station affected. Sometimes the interference is mutual: Stuttgart-Athlone and North Regional - Cologne are examples. But not infrequently only one of the pair suffers and does not retaliate. Stockholm, for instance, suffers from splutter from both Paris P.T.T. and Rome, but does not appear itself to affect either. Sometimes again there is no detectable splutter between stations on adjacent channels, even though both are strongly received. Budapest is untroubled by Athlone and *vice-versa*; the same is true of Prague and Lyons PTT, Munich and Marseilles, Brno and Brussels No. 2, Breslau and the Poste Parisien and Hilversum No. 2 and Bratislava.

It is not to be expected that all readers will find sideband-splutter occurring between the same pairs of stations, or that their observations will agree entirely with mine; a good deal depends on the locality in which reception is done.

Discontinuous Interference

Fortunately, sideband-splutter is not what may be called a permanent form of interference. It is usually at its worst when the station responsible is transmitting speech and certain kinds of music, but there may be considerable periods in which it is either absent altogether, or so mild that it is hardly noticeable.

The results on which the spectrum is based were obtained during four evenings' listening between the hours of 8 o'clock and 10 o'clock. The set used was a commercial 6-valve superheterodyne with adjustable selectivity and a better-than-

European Broadcast Channels—

usual top-note response. Throughout these explorations of the medium-wave band the selectivity was kept only just high enough to ensure the separation of stations.

Little Heterodyne Interference

I was rather surprised to find so few audible heterodynes. The only ones recorded occurred in the channels shown as jammed, or marred by background. Had listening been done later in the evening some heterodynes due to American stations would no doubt have been heard, for these are by no means uncommon—another factor which was outside the calculations of those who formulated the Lucerne Plan!

In my locality I have never heard the Luxembourg Effect, though in other parts of the country it is frequently noticed on stations in the upper part of the medium-wave band. I shall no doubt make its acquaintance at first hand when Radio Paris comes into action in its new situation and with much increased power!

Spark signals are a great nuisance at times near the top of the medium-wave band. My aerial is about as far from the sea as one can be in this country, yet they interfere badly with reception of Budapest. I can imagine how dwellers on the coast must suffer. Fortunately, the spark nuisance is not likely to be with us for much longer.

A Wide Choice

Such then is the present state of the most useful portion of the medium-wave band from the point of view of the listener. All of the home stations are usually clear. On some foreign stations there is interference, which varies from night to night and according to the locality in which reception takes place. But there are always plenty to be found coming in well to ensure a wide choice of entertainment.

SPECTRUM OF MOST USEFUL PORTION OF MEDIUM-WAVE BAND

549.5 m (546 kc/s)—261.1 m (1149 kc/s).

Frequency. kc/s.	Wavelength. Metres.	Station.	Condition of Channel.
546	549.5	**Budapest**	✕ ✕ ✕ ✕ ✕
556	539.6	**Beromünster**	✕ ✕ ✕ ✕
565	531	[Klaipeda] / **Athlone** / Palermo	⋯ ✕ ✕ ✕
574	522.6	**Stuttgart**	↑↓ ✕ ✕
583	514.6	Alpes-Grenoble, P.T.T. / Madona	▪▪▪ ✕ ✕
592	506.8	**Vienna, No. 1**	✕
601	499.2	Rabat / Sundsval	▪▪▪ ✕
620	483.9	Cairo / **Brussels, No. 1**	⋯ Intermittent.
629	476.9	Lisbon / Tröndelag / Christiansand	▪▪▪
638	470.2	**Prague, No. 1**	
648	463	**Lyons, P.T.T.** / [Petrozavodsk]	
658	455	**Cologne**	↓↑
668	449.1	**North Regional** / [Jerusalem]	
677	443.1	**Sottens**	
686	437.3	**Belgrade**	↑
695	431.7	**Paris, P.T.T.**	↓
704	426.1	**Stockholm**	
713	420.8	**Rome, No. 1**	↑
722	415.4	Kharkov / **Hilversum, No. 3** / Fredrikstad	⋯
731	410.4	Tallinn / Madrid, EAJ2 / Seville	▪▪▪ †
740	405.4	**Munich**	
749	400.5	[Pori] / **Marseilles**	↓
758	395.8	**Katowice**	↑
767	391.1	**Westerglen** / Burghead	
776	386.6	[Stalino] / **Toulouse, P.T.T.**	↑↓
785	382.2	**Leipzig**	
795	377.4	Barcelona / **Lwow**	▪▪▪ †
804	373.1	Penmon / **Welsh Regional**	↑↓
814	368.6	**Milan, No. 1**	
823	364.5	**Bucharest**	↓
832	360.6	Kiev / Agen	▪▪▪
841	356.7	**Berlin**	
850	352.9	Sofia / Norwegian Relays / Valencia	▪▪▪ †
859	349.2	[Simferopol] / Strasbourg	
868	345.6	**Poznan**	
877	342.1	**London Regional**	↑
886	338.6	Linz / Graz	↓ ▪▪▪
895	335.2	Helsinki / Limoges	▪▪▪
904	331.9	**Hamburg**	↑↓
913	328.6	[Dniepropetrovsk] / **Radio Toulouse**	↓
922	325.4	**Brno**	

Frequency. kc/s.	Wavelength. Metres.	Station.	Condition of Channel.
932	321.9	**Brussels, No. 2**	
941	318.8	Algiers / Göteborg	▪▪▪
950	315.8	**Breslau**	
959	312.8	**Poste Parisien**	↓
968	309.9	Bordeaux S.O. / Odessa	▪▪▪
977	307.1	**Northern Ireland**	
986	304.3	Bologna / Torun	▪▪▪
995	301.5	**Hilversum, No. 2**	⋯ Sometimes background.
1004	298.8	**Bratislava**	↑
1013	296.2	[Chernigov] / **Midland Regional**	
1022	293.5	Barcelona, EAJ15 / Cracow / Oviedo	▪▪▪ †
1031	291.0	Parede / **Königsberg**	⋯ Slight backgrouud.
1040	288.5	[Leningrad, No. 2] / **Rennes Bretagne**	↑
1050	285.7	**West of England Regional**	↑↓
1059	283.3	**Bari, No. 1**	↓
1068	280.9	**Paris (Radio Cité)** / Tiraspol	↓ ⋯ Intermittent.
1077	278.6	**Bordeaux-Lafayette**	
1086	276.2	Zagreb / Falun	▪▪▪ or ⋯
1095	274.0	Madrid / Vinnitsa	▪▪▪ or ⋯ †
1104	271.1	Kuldiga / **Naples, No. 1**	⋯ Intermittent.
1113	269.5	Moravska-Ostrava / **Radio Normandie**	↑ ⋯ Intermittent.
1122	267.4	[Nyiregyhaza] / **North East Regional**	↑
1131	265.3	**Horby**	
1140	263.2	Turin, No. 1 / Genoa / Trieste	▪▪▪
1149	261.1	**London National** / **North National** / **Scottish National**	

Explanatory Signs Used in the Table

✕ Liable to "spark" interference—number of signs indicates severity.

▪▪▪ Jammed or severely heterodyned.

⋯ Interfering background.

↑ Sideband splutter. The arrowhead denotes the station affected. E.g.:

Stockholm ↑
Rome, No. 1

indicates that Rome splutters into Stockholm;

Toulouse, P.T.T. ↓↑
Leipzig

that each station suffers from splutter from the other.

† interference or background may be deliberately caused by one or other side in the Spanish conflict.

The dominant station on each channel is shown in black type.

Stations shown in light type may cause interference, except those in square brackets, as [Klaipeda], from which interference is not normally discernible.

Television Topics

WHEN a receiver is used at a great distance from the transmitter, it sometimes happens that the sensitivity proves insufficient. It is rarely possible to increase the RF, or if the set is a superheterodyne the IF, amplification without redesigning the whole equipment. Most sets incorporate only a single vision-frequency stage, however, and it is usually quite easy to add a second. With a suitable valve the gain can be increased by some 20 times in this way.

The addition of such a stage is not quite as straightforward as in the case of sound equipment because the phase of the signal must be taken into account. This is a difficulty which commonly besets the experimenter in television reception. When dealing with sound, a phase reversal of the signal does not make any difference, so that one can use any number of AF stages without giving the matter a thought. This most emphatically is not the case in television, because it is necessary for the signals to be in the correct phase, not only to obtain proper sync separation, but the correct picture on the tube. If the phase is wrong, the sync separator will not work and the picture will be a negative instead of a positive.

It is, however, quite easy to deduce the phase of the signal if it is remembered that each stage of VF amplification reverses the phase and that with a diode detector feeding the CR tube directly the correct phase is secured by feeding the grid of the tube from the cathode end of the diode load resistance. When two VF stages are used, each gives a phase reversal, so that the output is in the same phase as the detector output. The first VF grid must consequently be fed from the cathode end of the detector load resistance. With a single stage, however, this would give a negative picture, and we have to reverse the phase of the input signal by connecting the VF grid to the *anode* end of the diode load resistance.

These connections are shown in Fig. 1, where V1 is the detector, V2 the VF valve, and V3 the DC restoring diode. Normal values for C and R are 0.1-0.5 μF. and 1 MΩ respectively. Direct coupling from the detector is used, and V2 is biased only sufficiently to prevent grid current, for the signal always drives the grid in a negative direction.

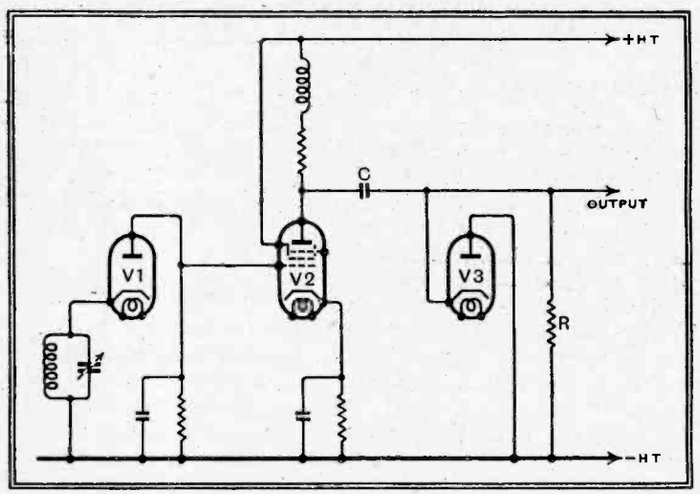


Fig. 1.— This diagram shows the conventional connections of a diode detector with one VF stage and a DC restorer.

When adding another VF stage the second stage can in its essentials duplicate the first, but the use of an RC coupling between the stages removes the DC component of the signal. If this is not restored the valve in the second stage must be capable of handling twice the input ever applied to it, because there is no fixed reference point from which the grid voltage excursions take place.

It pays, therefore, to restore the DC component in the coupling, especially as this can be done without an additional valve. To obtain an output of the correct phase, the signal must drive the grid negatively, and the sync pulses consequently represent a change of voltage in a positive direction. The grid-cathode path of the valve can thus function as a DC restoring diode if this stage is operated without grid bias.

The arrangement is shown in Fig. 2, and it will be seen that the second VF valve V3 is operated without a cathode-bias resistance. In order to obtain the correct phase of signal, the detector connections are reversed, compared with those of Fig. 1, and the signal now drives the first VF grid in a positive direction. The bias resistance here should consequently be increased. If 100 ohms is used for the VF valve of Fig. 1, some 200 ohms should be used for the first stage of Fig. 2.

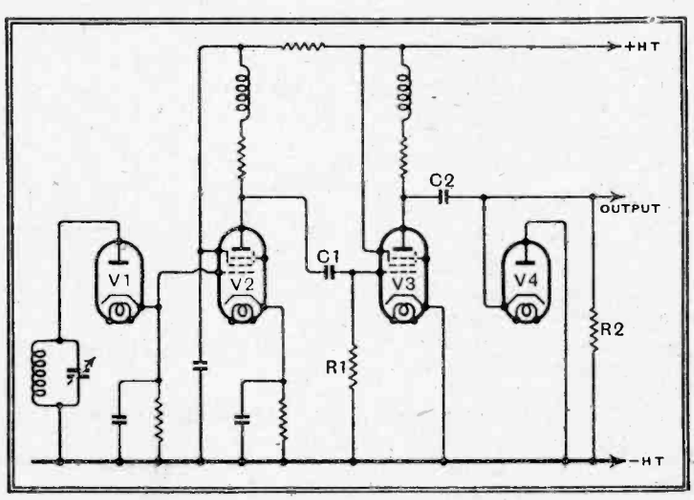


Fig. 2.—This circuit shows the connections adopted when two VF stages are used.

The values assigned to C1 and R1 should in general be such that C1R1 is greater than C2R2. Normally with R2 = 1 MΩ and C2 = 0.1 μF. one would make R1 = 1 MΩ and C1 = 0.5 μF. Decoupling in the anode and screen circuits of the first stage is advisable, and they may be decoupled together as shown. The resistance may be some 5,000 ohms with a condenser as large as possible, say 32 μF.

With two VF stages a somewhat higher degree of smoothing is often needed, so that when adding a stage it may also prove necessary to include an additional choke and condenser in the power supply unit. The need for extra smoothing must, of course, be determined experimentally, for it will depend upon how much was used originally.

ADDING A VISION-FREQUENCY STAGE

A New DC Radiogramophone

McMICHAEL RADIO, LTD., announce that the Model 375 six-valve twin-speaker AC radiogramophone is now available for operation from DC mains.

The general specification remains unaltered, and includes 6 watts output to twin moving-coil loud speakers, amplified AVC and a beam-tetrode output valve with negative feed-back in the final stage. The waveranges are 16.5-50, 200-550 and 850-2,000 metres.

Power consumption is approximately 75 watts at 200-250 volts, and the price is 31 guineas, or 38 guineas with automatic record-changer.

How a Receiver is Designed.—VI.

Continued from page 122 of last issue

DC Quality Amplifier

THE INPUT CIRCUITS

HAVING dealt with the output and penultimate stages in the previous articles in this series, the first stage must now be considered. This is dealt with in detail in this article and the calculation and arrangement of the circuit for negative feed-back are also treated.

IN Part V we finished discussing the penultimate stage of the amplifier which provides the phase-splitting for push-pull operation, and we now have to deal with the first stage.

As the phase-splitting valve requires an input of only 5 volts peak, a preceding gain of ten times would be sufficient were it not for the fact that we shall be using negative feed back, which will reduce the gain considerably. Before we go any farther we want some idea of how much we have to reduce the gain by negative feed back in order to obtain a reasonable value of output impedance for the correct damping of the loud speaker. In the maker's figures for the KT31 the output impedance of a single valve is given as 1,000 ohms when the feed back is adjusted, so that the signal input is 22 volts peak instead of 4.4. This means that the gain is reduced to $4.4/22 = 1/5$ of its normal value. In passing, it may be remarked that, since we shall be applying feed-back from the output of the amplifier to the input, the reduction in gain does not mean that the penultimate stage must give any greater output than it would have to do if no feed-back were used. This is one of the advantages of applying feed-back over the whole amplifier.

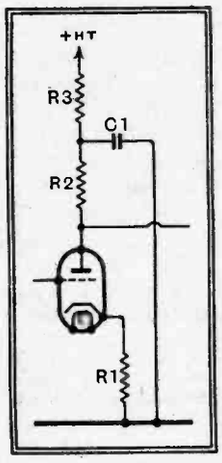


Fig. 7.—The basic circuit of the first stage.

Since we have to reduce the gain to one-fifth, we must provide five times the gain we shall need, so that our first stage must give a gain of not less than fifty times if we are to obtain full output for 0.5 volt input. The first valve, therefore, must be of a type capable of giving high gain, and one such is the H63 triode. The basic circuit of this first stage is shown in Fig. 7, and precedes that of Fig. 4. Here R1 is the bias resistance, R2 the coupling resistance, and R3 the decoupling resistance. Decoupling was not included in the penultimate stage because experience shows it to be unnecessary with a push-pull output stage of the type described, but there is no doubt that it is needed in the first stage. As the H63 is a high-resistance valve and we want high gain, R2 must be made of really high value, and 0.25 megohm is a suitable starting-off point. With such a high resistance the anode voltage will be quite low, and we cannot afford to drop much in decoupling. R3, therefore, should be made the minimum satisfactory for decoupling, with as large a capacity for C1 as is convenient. Let us arbitrarily choose 20,000 ohms for R3, and 8 mfds. for C1, values which experience shows are likely to be satisfactory.

The DC load is then R2 + R3, or 270,000 ohms, again ignoring R1 in comparison. Upon the valve curves of Fig. 8 we then draw the DC load line AB, and we now have to choose the operating point. It is unsafe to operate with a grid bias of less than about −1.2 volts, since grid current usually flows up to at least one volt negative with indirectly heated valves. We thus tentatively say that the bias point must be of the order of 1.5 volts, and we proceed to draw, as before, the line corresponding to the bias resistance. A few trials, which lead to the line CD, show that a resistance of 5,000 ohms is the nearest standard value which is suitable. This gives an anode current of 0.28 mA, and the bias is thus 1.4 volts, and we proceed to draw the AC load line through the intersection of these two lines.

The AC load is R2 in parallel with R1 of Fig. 4, or 0.25 megohm in parallel with 2 megohms. The resultant is 222,000 ohms, and we get the line EF. Plotting the intersections of the grid volts curves with this line gives us the dynamic characteristic of Fig. 9, and this is seen to be straight over the working range, since the output change of anode voltage need be no more than ±5 volts. The gain of this stage is 70, so that, without feed-back, the input required for full output is 0.0718 volts peak = 0.0508 volts RMS.

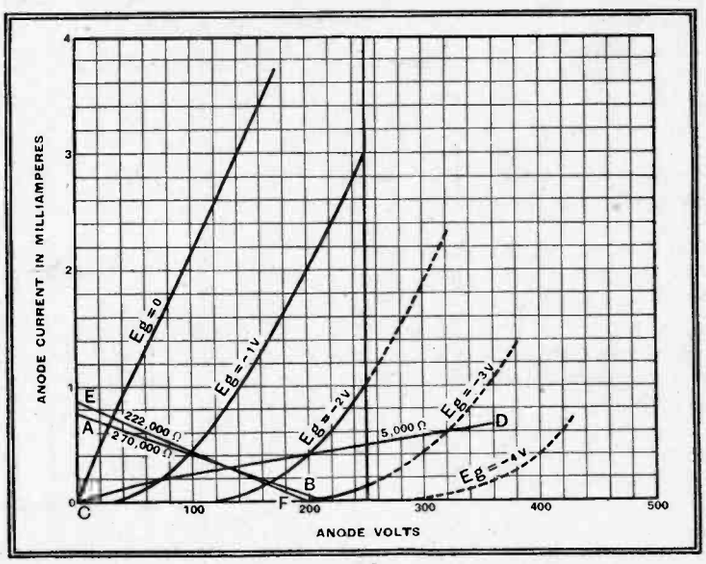


Fig. 8.—The anode-volts—anode-current curves of the H63 are shown here.

Normally, the next step would be to see whether the high-frequency response with these values is good enough. This is determined by the value of the AC load on the valve in shunt with the valve AC resistance, and the stray circuit capacities including the effective input capacity of the valves. Under normal circumstances the values selected for this first stage are rather high for a good high-frequency response. It so happens, however, that negative feed-back greatly extends the frequency response, and the net result is that we need not consider it in those stages over which feed-back is applied.

This naturally holds only in those cases where the frequency response is inherently good, although possibly not quite good enough. It certainly does not permit one to take extreme liberties in design and then to expect to get good results just by applying feed-back. It is, however, rather a waste of time to calculate the high-frequency response when it will be entirely changed by the application of feed-back.

We now put these parts together and come to the circuit of Fig. 10, and before we proceed to the mains equipment it is only necessary to calculate the feed-back required. It will be clear that this is derived from the output transformer secondary, for the simple reason that this is the only convenient method of obtaining it with a push-pull output stage. The phase of the feed-back can be controlled by the connections to the transformer secondary, and it is convenient to

DC Quality Amplifier—

inject the feed-back voltage into the cathode circuit of the first valve, utilising the bias resistance of 5,000 ohms in conjunction with a series resistance R1 to form a potentiometer across the output transformer secondary.

The output stage requires a load of 11,000 ohms, and will give an output of 5 watts. The total voltage developed across the primary is, therefore, the square root of the product of the power and the load, and in this case is 235 volts. The total input to the output stage is 8.8 volts peak = 6.24 volts RMS. The voltage amplification of the output stage is, therefore, 235 divided by 6.24, or 37.7 times. The total gain of the amplifier is the product of its individual stages, or $37.7 \times 1.75 \times 70 = 4,610$ times. Feed-back must reduce this figure to one-fifth, and it can be shown that the reduction of amplification due to feed-back is equal to $1 + AB$, where A is the gain without feed-back and B is the attenuation of the feed-back path. In this case $1 + AB = 5$, therefore $AB = 4$, and as $A = 4610$, $B = 1/1155$. The attenuation of the feed-back path is provided partly by the output transformer step down and partly by the feed-back potentiometer. The output transformer ratio chosen depends upon the speech-coil impedance, and, consequently, the values of the feed-back resistances will vary with different loud speakers.

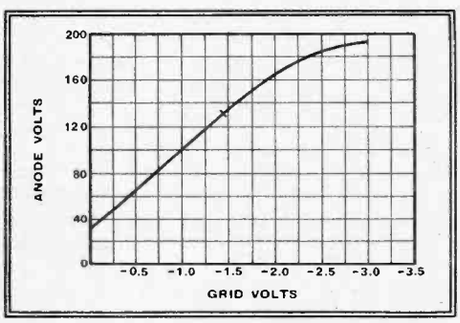
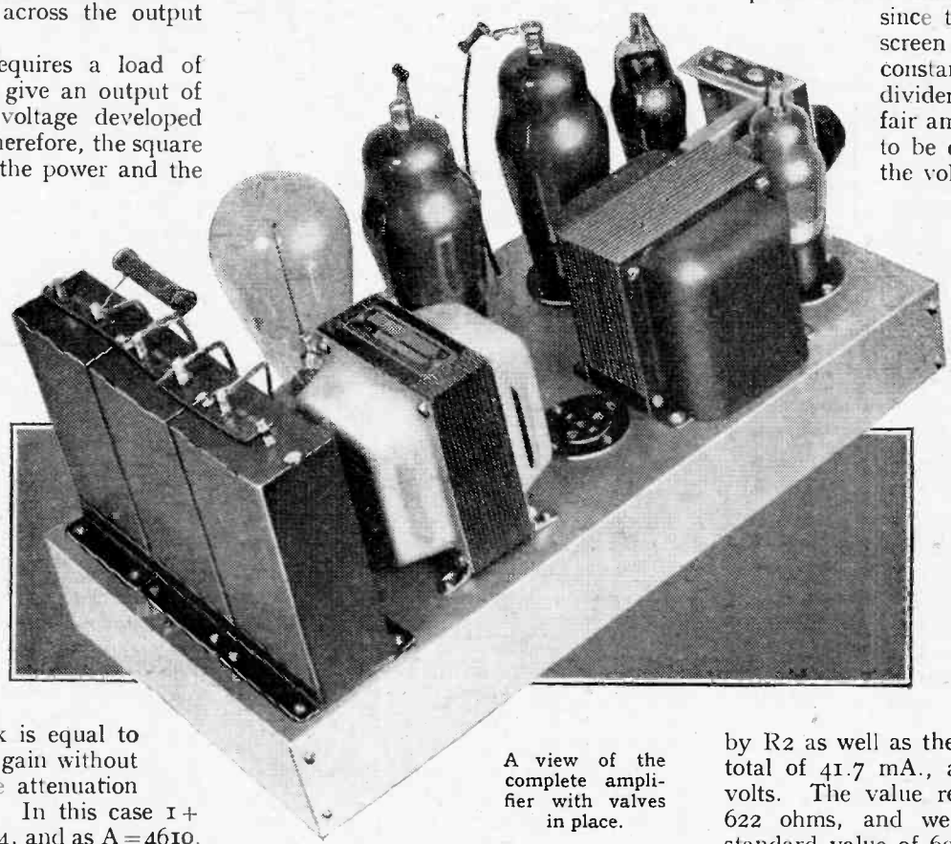


Fig. 9.—The dynamic characteristic of the H63 under the conditions given in the text.

Choosing the common speech coil impedance of 15 ohms, the output transformer ratio is 27 : 1, so that the attenuation provided by the resistance network becomes $27/1155 = 1/42.8$. Now, with the cathode resistance equal to five thousand ohms the attenuation of this network is equal to 5,000, divided by $R1 + 5,000$, and this must equal $1/42.8$, so that $R1 = 208,000$ ohms. We shall, naturally, choose the nearest standard value of 200,000 ohms.

The amplifier now requires an input of 0.5 volt for full output and has an effective output impedance on the primary side of the output transformer of 2,000 ohms for the two valves. It can be seen, therefore, that the conditions initially laid down have been met.



A view of the complete amplifier with valves in place.

The next step is to design the mains equipment. This falls into three sections: the smoothing equipment, the voltage dropping for the screens of the output valves, and the heater supply. We have seen that the main HT line should be 210 volts positive with respect to negative HT and the screens should be 184.4 volts positive. The total screen current is 21.2 mA., but as it may fluctuate slightly when a strong signal is applied, in spite of the Class A operation, it is rather better to use a potentiometer than dropping resistance, since this will maintain the screen voltage at a more constant figure. The voltage-divider should dissipate a fair amount of power if it is to be effective in stabilising the voltage, and we can say that it should take approximately the same current as the screen. This means a resistance of about 9,000 ohms. Actually, the voltage divider current will then be 20.5 mA. and the power dissipated in it will be 3.7 watts, so that a resistance of at least 5 watts rating should be used. This resistance is the one shown as R2 in Fig. 11. The resistance R1 is to carry the current passed by R2 as well as the screen current, or a total of 41.7 mA., and it must drop 26 volts. The value required, therefore, is 622 ohms, and we choose the nearest standard value of 600 ohms. The power dissipated is 1.08 watt, so that a resistance of 2 watts rating will be sufficient.

The total current drawn by the equipment then totals up to 125.6 mA., and we have to drop some 15 volts in the smoothing choke, so that this component should have a resistance of 120 ohms. Actually, of course, it is unnecessary to work to this degree of accuracy, for the simple

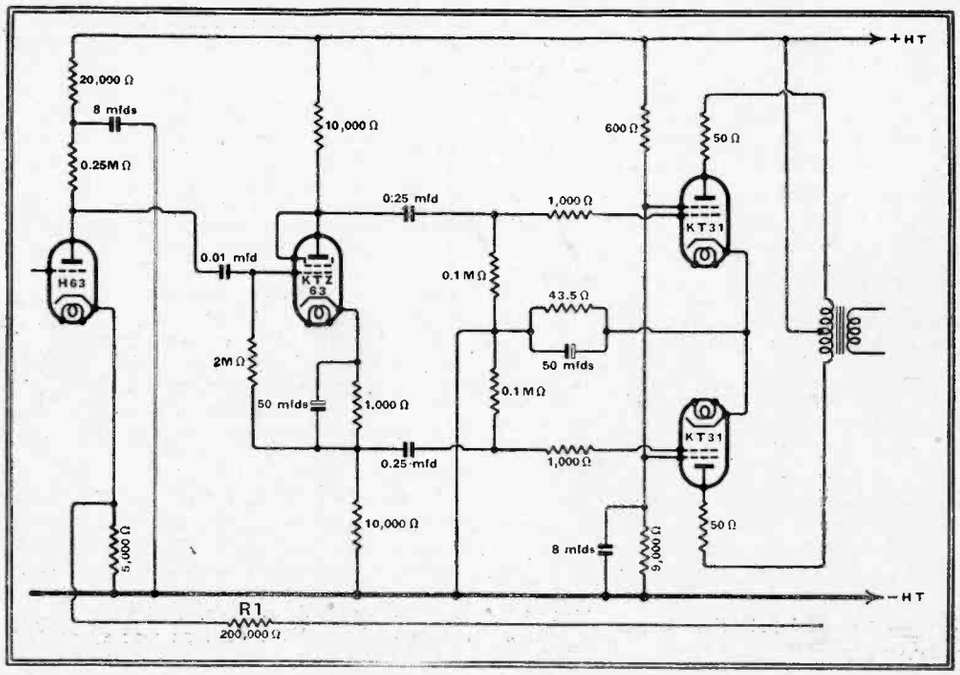


Fig. 10.—This diagram shows the circuit of the amplifier as so far developed. Negative feed-back is applied from the output transformer secondary through R1.

DC Quality Amplifier—

reason that the mains voltage will fluctuate considerably more, and, in any case, the precise operating voltages are not very critical. Consequently, we choose a choke

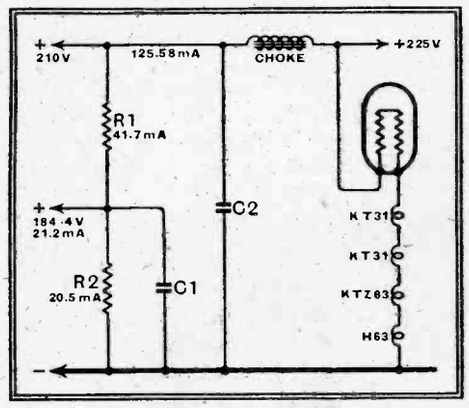


Fig 11.—The mains equipment with the current and voltage distribution are shown here.

which is in other respects suitable and has the nearest resistance to the one we require.

The choke Ch, in conjunction with C2, provides the smoothing, and a single stage is ample in view of the high ripple frequency with DC mains and because negative feed-back is employed. An inductance of some 8 H., therefore, is ample with an 8-mfd. condenser for C2. The component, however, must be constructed to carry the fairly heavy current of at least 125 mA. Actually, the component specified will carry more than this, so that its inductance will be slightly greater.

There remains the voltage dropping for the heater circuit to consider. The valves all consume the same current of 0.3 amp., and they will, therefore, be connected in series with the first stage at the negative end of the chain. The heater voltages total 65 volts, so that we have to drop 120 volts, and this is most conveniently done with a barretter, since it will correct for mains voltage changes over a large range. A glance at *The Wireless World* Valve Data Supplement shows that the Osram 302 Barretter is suitable.

Full constructional details of the DC Quality Amplifier will be given next week, and for the convenience of readers the list of parts is given below.

LIST OF PARTS.

1 Output transformer, push-pull, primary for 11,000 ohms anode-to-anode load, Secondary to suit speech coil of speaker. Ratio 27:1 for 15 ohms speech coil
Savage PP27/1

1 Smoothing choke, 6-8 H, 150 mA, 100 ohms
Sound Sales 68/150

Condensers:
2 0.1 mfd., 350 volts working, tubular **T.C.C. 341**
2 0.25 mfd., 350 volts working, tubular **T.C.C. 341**
1 0.01 mfd., 450 volts working, tubular **T.C.C. 451**
3 8 mfds., 250 volts working **T.C.C. 65**
2 50 mfds., 12 volts working electrolytic **T.C.C.FT**

1 Volume control potentiometer, tapered, 0.25 megohm **Reliance SG**

1 Valve holder, 4-pin (without terminals)
Clix Chassis Mounting Standard Type V1

2 Valve holders, 7-pin (without terminals)
Clix Chassis Mounting Standard Type V2

2 Valve holders, octal type, 8-pin **Clix V4**

1 Barretter holder **Bulgin ES2**

Resistances:
3 50 ohms, ½ watt **Erie**
1 350 ohms, ½ watt **Erie**
3 1,000 ohms, ½ watt **Erie**
1 5,000 ohms, ½ watt **Erie**
2 10,000 ohms, ½ watt **Erie**
1 20,000 ohms, ½ watt **Erie**
2 100,000 ohms, ½ watt **Erie**
1 *200,000 ohms, ½ watt **Erie**
1 250,000 ohms, ½ watt **Erie**
1 2 megohms, ½ watt **Erie**
1 600 ohms, 2 watts **Erie**
1 9,000 ohms, 10 watts **Bulgin RV11A**
(*See text*, value depends on output transformer ratio.)

1 Plug, 4-pin **Bulgin P9**

1 Skeleton terminal strip, 2-way, PU **Bulgin T10**

2 Plug-top valve connectors **Belling-Lee 1175**

2 Grid clips, octal type **Bulgin P96**

1 Fused mains input connector with 1 amp, fuses **Belling-Lee 1114**

Chassis, with brackets, etc. **Scientific Supply Stores**

Miscellaneous: **Peto-Scott**
6 lengths systoflex, 2 ozs. No. 18 tinned copper wire, 2 paxolin terminal strips, etc.
Screws: 4 ½-in. 6 BA R/hd.; 60 ¼-in. 6 BA R/hd., all with nuts and washers; 4 1-in. 6 BA R/hd., with 3 nuts and washers to each.

Valves: **Osram**
2 KT31, 1 KTZ63, 1 H63, 1 302 barretter

On the Short Waves

I AM pleased to report that excellent television pictures are now being received at Epsom on my receiver which is running from a rotary convertor. My position is not particularly favourable, as I am situated in a valley. The pictures are equal to the best I have seen anywhere, with the sole exception of a slight flicker, due to the fact that the frequency generated by the convertor is not exactly 50 cycles. The same effect in a less pronounced form was, it will be remembered by some, seen on the Wimbledon tennis broadcasts, the slow racking of "hum component" on the picture in this case being due to the same cause, i.e., the mobile generator was not producing quite the same frequency as the time-controlled 50-cycle mains.

Before this present performance was obtained, however, a rather obscure fault had to be eliminated. After the receiver had been running for a little while a strong hissing noise became audible from the sound loud speaker, accompanied by the appearance of a "snowstorm" on the screen, each line being modulated randomly by two or three small white arrow-heads.

The trouble was evidently associated with the time-base unit, which in this particular design also carries the cathode-ray tube and associated high-voltage circuits, since the character of the noise was susceptible to handling of the valves, etc., in this unit.

A thorough examination of the unit yielded no evidence of breakdown, but finally a clue was provided by the smell of ozone. The trouble has ceased now that more ventilation has been given to the underside of this chassis, and therefore it seems to have been due, as was suspected from the presence of ozone, to ionisation and accompanied partial insulation breakdown.

The site of the receiver is only a few hundred yards from Epsom High Street, and at 30 miles from Alexandra Palace brilliant white highlights are obtained with the tube set to black cut-off (with DC restored), and this with an aerial at chimney-stack level on a smallish cottage.

The receiver comprises RF, triode-hexode, two IF stages (7-9.5 Mc/s), push-pull IF in Class AB, double-diode and vision frequency stage, the DC restoring diode being on the tube itself.

The sync separation is as described in *The Wireless World* television receiver and has been found to be extremely effective.

Removal of the second DC restoration diode (for the sync separator) from its socket results in a complete loss of line synchronism, despite any other adjustments that may be tried.

If this is the sort of result that can be obtained at 30 miles, and on DC mains, with no trouble from synchronisation, and with thyratrons for both frame and line, then no wonder good results are being reported from much farther afield.

The next step, as far as I am concerned, is either to effect automatic speed control of my convertor, or to further smooth the HT and time-base supplies so as to completely eliminate all trace of flicker.

A final remark on this subject: I am just as pleased to receive letters and enquiries on television problems as on short-wave subjects (the Editor agreeing, of course?).

To return to our normal subject, short-wave reception continues to be relatively poor, with occasional days when conditions are excellent, such as Monday, February 7th, when everything was "in" from W3XAL on 17.78 Mc/s to the telegraphic transmitter WEU on 5.5 Mc/s, approx.

The following extract from a bulletin from the Westinghouse Company makes interesting reading:

"The improvements to W8XK which are being made include the construction of two new directional rhombic antennas, one to South America, beamed on Buenos Aires, and one to Europe, beamed on London.

"These antennas replace non-directional vertical doublet antennas and will operate on 6.14, 11.87 or 15.21 Mc/s. The 21.54 Mc/s channel will continue with a horizontal doublet antenna directed to South America.

"The expected power gain of the rhombic antennas is:—

25 times at 6.14 Mc/s
36 times at 11.87 Mc/s
50 times at 15-21 Mc/s

"Modernisation of the transmitter will provide the following carrier outputs, fully modulated:—

28 kW on 6.14 Mc/s
24 kW on 11.87 Mc/s
18 kW on 15.21 Mc/s

"The 21 Mc/s transmitter will not be changed and will remain at 6 kW."

It is also proposed to install directional aerials at W1XK and to increase its power.

My only comment on the above is that if the power gains for new aerials given are correct, then the original aerial must have been a comparatively poor one, possibly a low vertical half-wave doublet.

I am afraid, however, that unless the new rhombics at Pittsburg have been erected at least a wavelength above the ground on their respective frequencies we shall not notice a marked improvement in the signal. These arrays were apparently brought into use in November. It is, of course, easier to get the required height on 15 Mc/s than on 11 or 6 Mc/s; so, presumably, the most noticeable change will occur on W8XK on 15.21 Mc/s.

ETHACOMBER.

UNBIASED

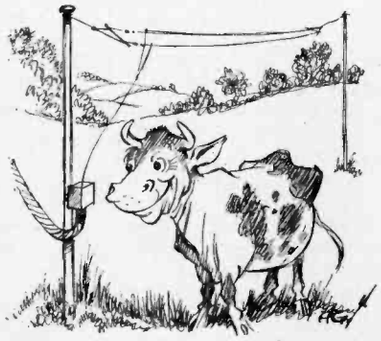
By FREE GRID

A Puzzling Problem

I HAVE been considerably troubled in my mind since Mrs. Free Grid's ultimatum to dismantle my aerial because, as I told you recently (February 3rd, 1938), it was leading to our social ostracism among the neighbours owing to the fact that the presence of an aerial is considered nowadays as *prima facie* evidence that you cannot afford a sufficiently expensive set to work without one. Since the dismantling of the aerial I have been tormented almost beyond endurance by the interference coming in on the makeshift indoor aerial which I have been permitted to conceal behind the picture-rail.

Fortunately, an idea has occurred to me which should provide a way out of my difficulties without jeopardising the social status of Mrs. Free Grid and myself in the neighbourhood. In brief, I have found a field in the countryside not so very far away from my residence, and have interviewed the farmer owning it concerning the possibility of my erecting two lofty aerial masts therein. He has consented to my doing this for a nominal sum annually, and my proposal is to make connection between my house and the field by means of a buried low-impedance transmission line.

As most of you will be aware, the usual anti-static arrangement consists of an ordinary aerial coupled to the primary of a step-down transformer, the secondary of which is connected to a screened low-impedance transmission line. This line runs from the garden to the house, and it is quite permissible to bury it at the point where it reaches the ground instead of tacking it untidily along the garden fence. At the "home" end another transformer is used to step up the impedance again. Now, theoretically, there is no limit, within reason, to the length of this cable, and so I can very well have my aerial well out in the country as I propose. If my



The peace of the countryside.

plan succeeds I shall probably get far better reception than from the very best of garden aerials, and so Good will, after all, have come out of Evil, as it so often does.

My present problem, however, concerns the burying of the connecting wire. It will need in its course to pass under several other people's gardens, and although I know that many of you would, if I appealed to you, willingly come and dig secretly and silently with me during the stilly watches of the night, I doubt if we should be able to do our work so effectively that keen eyes would be unable to detect it in the morning. Unfortunately, people are so fussy nowadays and make much more ado about a few trampled-down hollyhocks and other spring flowers than they do about things that really matter, like good wireless reception.

The only other thing to do is to try and rent an underground telephone line from the G.P.O., but I doubt whether this would be any good as a low-impedance transmission line, and here is where you technical highbrows may be able to advise me. Failing this, I shall be compelled to transfer the entire receiver to the field I have rented, a hired Post Office line being used as an extension loud-speaker lead and another similar line for remote tuning-control purposes. At present I am very puzzled to know what to do, and am hoping that you will have some useful suggestions for me.

Synthetic Summer

AS a result of my recent note concerning a friend who had scattered microphones in the branches of trees on his country estate to pick up the song of the birds, I have received a gratifying number of letters from people interested in this sort of thing. As I said then, my friend, by means of scattering mikes all over the wood, is able to pick up the songs of all sorts and conditions of birds which are duly fed (the songs, not the birds) via a mixing panel to an amplifier and thence to concealed loud speakers in his house. The effect is as though a large number of birds of different species were all singing together in unison.

One of my correspondents wants to know whether my friend employs a simple cable link between microphones and the house. The answer is that he did before I went down there, but I soon altered it, of course, and got him to substitute an ultra-short wave link, each microphone unit being entirely self-contained with its own low-power transmitter, the power for operating which is taken from the house mains via suitable cable links running to the woods.

Although I am no lawyer I am willing to bank on the fact that this arrangement

Knowledge obtained at the bar.

is a perfectly permissible one under the existing Wireless Telegraphy Acts, but I am, of course, willing to be corrected by any of you with specialised knowledge which you have obtained at the bar. The whole point is that my friend uses the arrangement for transmitting between points on his own land and in no way do the etheric waves have to traverse public territory. Naturally enough, even though the transmitters are of abjectly low power, there was nothing to prevent their signals straying out of the woods, but I have stopped all that by the simple expedient of erecting special reflector aerials on every tree situated round the periphery of the woods.

Another correspondent accuses me of being unfair to the B.B.C. insomuch that I suggested that if they were not so pig-headed they would enliven the gloomy winter hours by giving us relays from the woods of countries where summer reigned supreme, such as Brazil or Australia. My correspondent points out that the B.B.C. have already done this in the case of the nightingale broadcast, but obviously this is not the same thing, because these relays are carried out in mid-summer, whereas it is in mid-winter when we need this sort of psychological stimulant. In any case no attempt has been made by the B.B.C. to give us the delights of summer in winter by concealing microphones in the trees on the *Promenade des Anglais* at Nice, or in other winter-sunshine centres, so that we could get the gay and cheering summery atmosphere of these delightful resorts in the midst of winter's gloom.

I must apologise, however, for my "suggestion" that the gramophone companies at any rate might provide us with woodland and other summery recordings. Several people have written to point out that they already do it, and have been kind enough to give me the necessary references to the various records on which these summery effects are obtainable.

COLOUR TELEVISION

Large-Screen Demonstration at London Theatre

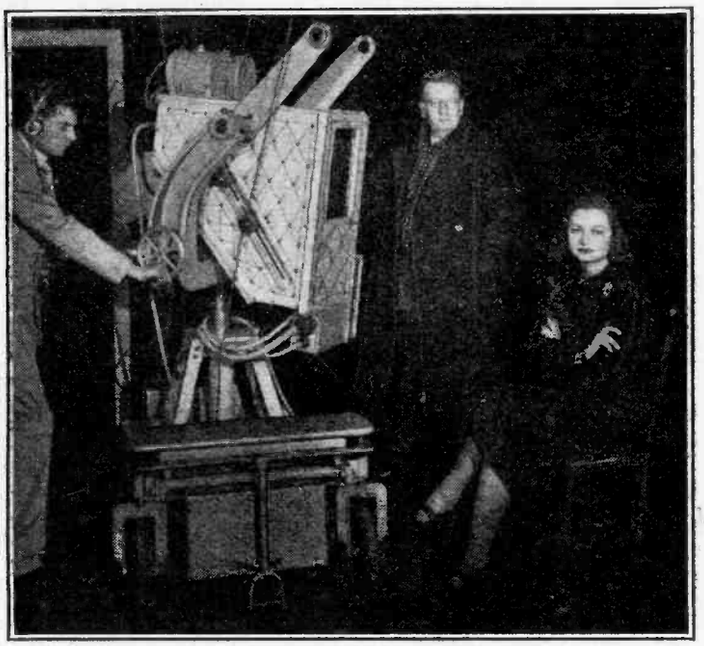
AT a recent demonstration of large-screen colour television staged by Baird Television at the Dominion Theatre, Tottenham Court Road, London, W.1, very interesting results were obtained. The screen, which measured 12ft. by 9ft., was viewed from the centre of the circle, but the picture could be seen clearly from all seats of the theatre, which has accommodation for 3,000 people.

Using a wavelength of 8.3 metres the transmission, which consisted of individuals, flags, and a coloured portrait of the King, was radiated from the south tower of the old Crystal Palace. A 120-line picture was transmitted, which at both the transmitter and the receiver was mechanically scanned.

The transmitter consists of a mirror drum with twenty mirrors inclined at different angles revolving at 6,000 r.p.m. These mirrors reflect the scene to be transmitted through a lens, causing an image to be formed on a rotating disc with 12 concentric slots at different distances from its periphery. By this means the field given by the 20-line drum is interlaced six times to give a 120-line picture repeated twice for each revolution of the disc. Each of the slots is covered with a light filter, blue-green and red being used alternately, the effect of this being to transmit alternate lines of the picture corresponding to a blue-green image and a red image.

At the receiving station a similar device is employed, the rotating drum in this case being 12in. in diameter instead of 8in., as at the transmitter.

The definition was very good, although the lines were, of course, very prominent. The effect caused by the lines can perhaps best be described as comparable to looking upon a scene from behind vertical bars which are slowly moving across one's view.



COLOUR TELEVISION. Mr. J. L. Baird, whose name is almost synonymous with television, is seen here beside his new camera, by means of which pictures in colour were transmitted from the Crystal Palace, and received at the Dominion Theatre, London, nearly eight miles away.

ENERGY FROM THE ETHER

OVER 400 house-owners living in the vicinity of the Hamburg station have been tapping the power discharged into the air by the 100-kW transmitter, for their domestic lighting. In this way about 5 kW of the radiated energy was absorbed, and an estimated loss of £1,000 per annum was sustained by the broadcasting authorities.

The judgment of the Hamburg court passed on three representatives of the inventive community imposes a fine of RM 10 on each of them, but this was only legally possible under one pretext: the clause relating to the infringement of the conditions under which a wireless listening licence is supplied, which states that broadcasting transmitters' energy is intended for broadcast listening only.

Question: Would similar offenders in countries where no wireless receiving licence is required be punishable under any existing law?

NEWS OF

EAST ANGLIAN STATION

B.B.C. Promise

THE first official promise of a station for East Anglia, forecast in *The Wireless World* some months ago, is contained in the B.B.C.'s "Guide to Reliable Broadcast Reception," which is to be issued as an aid to non-technical listeners. "Provision is intended," says the booklet, "for a station of moderate power in East Anglia," but no date is assigned. It is understood, however, that the site will be in Norfolk, and that the station will be ready towards the end of 1939.

Shortcomings of the London Regional station are interestingly explained by the statement that high masts are not permitted at Brookmans Park.

While admitting that there are some districts outside the service area of any main regional station, the B.B.C. attempts to console sufferers by stating that the listener may look forward to a progressive improvement in the scheme of programme distribution. "But the limitation to the range at which broadcast programmes can be received at all times without fading or loss of quality is imposed by natural laws which must remain."

QUESTIONS IN THE HOUSE

IN reply to a question on the suppression of electrical interference asked of him in the House of Commons, the P.M.G. stated last week that consultations were proceeding with commercial and other interests which would be affected by the introduction of a Wireless Telegraphy Bill to deal with the question of electrical interference with broadcast reception. The questions involved were, however, of considerable complexity, and the enquiries must of necessity take some time to complete.

TELEVISING A RUGGER MATCH

RUGBY football is to be televised for the first time on Saturday, March 19th. Viewers will see the whole of the Calcutta Cup match — the International game between England and Scotland—at Twickenham.

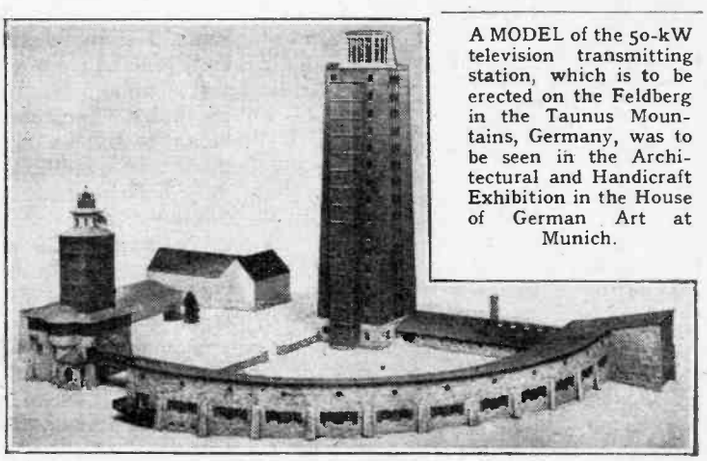
The arrangements provide for three cameras; one being on the north stand and one opposite each of the 25-yard lines. It will therefore be possible to cover the whole field by close-ups and plan views.

Captain H. B. T. Wakelam's commentary on the play for National listeners will be used as commentary for the vision transmission. This is just another short step toward what must ultimately come to pass, the merging of sound broadcasting and television.

GERMAN CONCESSION FOR GREEK BROADCASTING

THE Greek Ministry of Communications has signed a concession whereby the German firm Telefunken are to provide Greece with a modern broadcasting service. This concession, which is to run for twenty-five years from January, 1938, allows for the building of a 100-kW station at Athens, one of 15-kW at Salonica, one of 5-kW on the island of Corfu, and a 10-kW short-wave transmitter at Athens, with beams directed on the U.S.A. and Australia. At the termination of the concession the entire transmitting gear will become the property of Greece.

Programmes will be provided by a German-Greek company, and for the period during the building of the high-power station at Athens, a temporary 15-kW transmitter is to be erected.



A MODEL of the 50-kW television transmitting station, which is to be erected on the Feldberg in the Taunus Mountains, Germany, was to be seen in the Architectural and Handicraft Exhibition in the House of German Art at Munich.

THE WEEK

U.S.W. IN SWITZERLAND

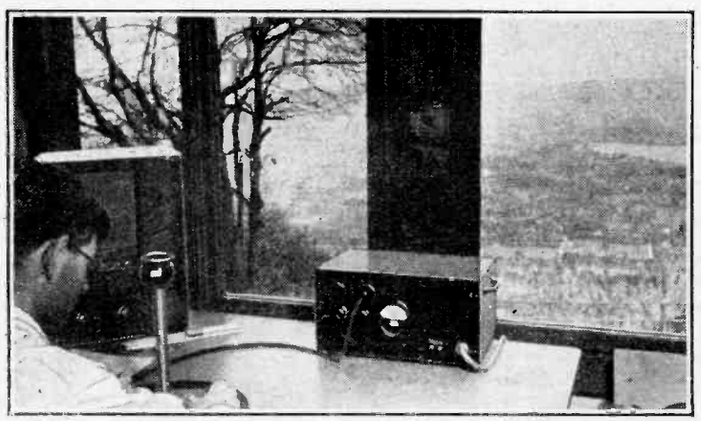
Results of Transmissions at 3,000 Feet

SWITZERLAND has been following ultra-short-wave development very closely, but before making decisions as to the erection of stations using ultra-short waves, the authorities have decided to gather their own material regarding the range and general behaviour of such transmissions in mountainous Switzerland. These tests, which were started a short while ago, will give results which can be equally well used when planning the sound broadcasting service or a future television scheme.

The Zürich Polytechnicum has constructed a 500-watt USW station on the Utokulm, above Zürich, and officials of the Post and Telegraph Administration are plotting field strengths with the help of a suitably equipped van. Distances of up to 100 km have been covered, and enough has already been learned to indicate that in a mountainous country like Switzerland a clear and unobstructed path is essential.

The transmitter is in a small room on the top floor of the Utokulm Hotel, and the aerial is on the top platform of the 100-ft. observation tower. As the Utokulm is about 870 metres above sea-level, the total height of the aerial is about 3,000ft. The centre of Zürich is about one-third of a mile distant as the crow flies.

Transmissions consist mostly of telegraphy, although occasionally concerts are broadcast and speech-transmission tests are also made. Results so far obtained would indicate that there is no great difference between the behaviour of transmissions on 7.5 metres and those on 5 metres.



FIELD STRENGTHS up to distances of 100 km. have been plotted round the 500-watt Swiss experimental USW transmitter at Zürich. The height of the station above the surrounding country can be gathered from this view seen through the windows of the studio.

NOW FOR "CHOLMONDELEY"

MANY of the staff of the B.B.C. are the possessors of names which present some phonetic difficulty, and so an invitation has been issued to them to achieve immortality by having such names, if they are at all "unusual," included in a handbook which the Advisory Committee on Spoken English is preparing. This booklet, to be called "British Family Names and Titles," will be designed principally to smooth the vocal path of announcers.

In an address to the Ayr Rotary Club last week, Mr. G. Burnett, Edinburgh, B.B.C. Public Relations Officer, stated that the Corporation's pronunciation policy only applied to announcers. In the case of talks, he said the Corporation did not in any way endeavour to alter the speakers' accent; in fact, he was of the opinion that there was a fair output of good vernacular, and in that way the B.B.C. was rendering a great service in keeping the vernacular alive.

NEWS BULLETINS

Press v. State

IT was announced in these pages on January 13th that, as the result of an agreement between French private stations and the Federation of French Newspaper Proprietors, definite limitations had been placed upon broadcast news. With the object of extending these limitations to State stations, secretaries of the Federation approached the News Section of the Superior Council of Transmissions.

When requested, the Federation, however, declined to produce graphs or figures indicating the level of newspaper sales before and after the private stations' agreement, and consequently the members of the Council decided unanimously to maintain the present flow of broadcast news.

PRIVATE TELEVISION BANNED

IN response to a request for permission to allow the Radio-Toulouse private station to transmit television programmes, the French P.M.G. has made it known that no such permit will be granted to private stations, and that television will be developed by the State services. In his reply he stated that this decision was arrived at in order to avoid difficulties analogous to those experienced during the development of sound broadcasting.

FROM ALL QUARTERS

Sofia Testing

THE new 100-kW Sofia transmitter, using the old transmitter's wavelength of 352.9 metres, is now testing on Sundays from 5-8.45 a.m., 10 a.m.-1 p.m., and 3-10 p.m., and weekdays from 5-6.30 a.m., 10 a.m.-1 p.m., and 5-9 p.m. The Sofia broadcasting authorities would welcome reports of reception, and these should be addressed to the Chief of the Broadcasting Section, Department of Posts and Telegraphs, Sofia, Bulgaria.

Control of Empire Communications

FINAL details are being settled for the formation of a semi-Governmental organisation maintained jointly by the Post Office and Cable and Wireless. The organisation will control the beam radio system and will be permitted to use it at a lower rental than is at present paid by Cable and Wireless.

Things Not to Come

IN the House last week the Prime Minister stated that the Budget speech would not be broadcast.

"Ally Pally" Sound Trouble

SOUND transmitter at Alexandra Palace gave serious trouble for the first time on Tuesday of last week, due to mercury vapour valve failure. Written apologies were transmitted by vision. Normal working was restored on Wednesday.

Amazonian Jungle Relay

BROADCASTS from VP3THE, a radio station on horseback in the wilderness of the Amazonian jungle, will soon be heard in the United States over the networks

EXPERIMENTAL USW transmissions are being radiated from the top of the 100ft. observation tower of a hotel in Zürich, Switzerland. Above is seen the transmitting aerial, which has an effective height of 3,000ft. above sea level.

of the National Broadcasting Company, when the Holden British Guiana Expedition of the American Museum of Natural History, first jungle expedition to be radio equipped, begins a report of its findings in the wilds of southernmost British Guiana.

Fire Down Below

BROADCASTING may soon be numbered among the dangerous professions. The National Broadcasting Company of America recently called for volunteers to broadcast from the New Straitsville coal mine, Ohio, where a fire has been raging unchecked for fifty-three years. The three men chosen — Tom Manning, N.B.C. announcer; E. Leonard, chief engineer of WTAM, Cleveland, and A. McMann, field engineer — went down the mine and gave a realistic sound-picture of the inferno, which was relayed over the N.B.C. "Red" network on February 5.

All-Arabic

THE B.B.C.'s Arab broadcasts at present contain a certain number of English announcements; but these may soon be eliminated, with the object of impressing upon Arab listeners that the transmissions are intended solely for them.

Radio and Press Liaison

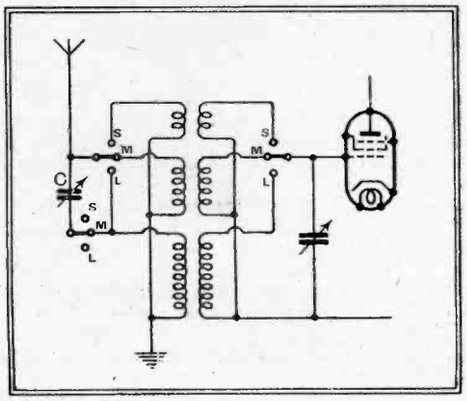
MR. CHARLES D. KIDD, better known as "Grid Leak" of *The Daily Sketch*, has been appointed Radio Relations Officer, to act on behalf of *The Daily Sketch*, *The Sunday Graphic* and Allied Newspapers in editorial matters relating to the radio industry.

THE Paris Components Exhibition

Prospects of Better Receivers for 1938-1939

By E. AISBERG (*Editor of "Toute la Radio"*)

AS in previous years, the Exhibition of Components for 1938 has been organised for the benefit of receiver manufacturers as a show of new components suitable for incorporation in the sets of the coming season. It is a trade exhibition and, as such, provides something in the nature of a guide

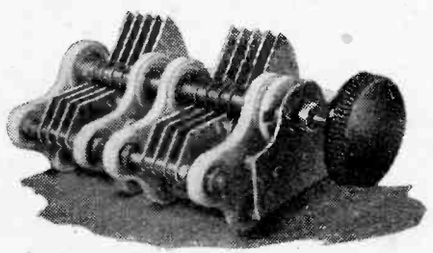


The A.C.R.M. "auto-rejector" circuit; the condenser C, in conjunction with the long-wave aerial winding, acts as a wavetrap tuned to the intermediate frequency. For medium-wave reception it is connected in parallel with the aerial input.

as to what will be the tendencies in set design in the coming season.

This year, in particular, there is good reason to think that receivers of 1938-1939 will offer considerable advantages over sets at present in use. So far as price is concerned, no marked change seems likely, in spite of the increase in manufacturing costs and prices of raw materials.

The centre of attraction at the Exhibition is the appearance of new electron beam valves. This principle has already



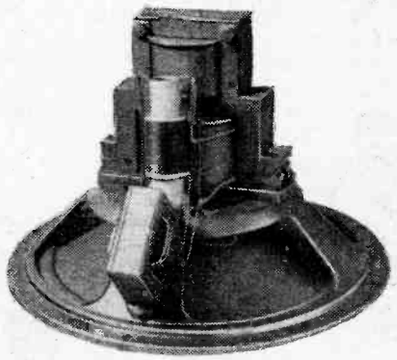
A variable condenser for short waves where the plates are corrugated to increase rigidity.

been used in power valves in America (as, for example, in the 6L6), and their development is a natural result of work in the field of cathode-ray tubes. To-day the principle is applied with great success to radio-frequency valves.

Several firms, such as Dario, Philips and Tungsram, have produced a new four-grid valve for amplification at high frequencies, specially applicable to amplification of short waves, with a minimum of valve noise. It is well known that the valve noise increases with frequency; at 15 Mc/s 90 per cent. of the receiver noise is due to the valve and 10 per cent. only to the tuning circuits.

It is the geometric arrangement of the electrodes of these valves, with the resultant effect on their fields which makes it possible to produce the reduction in the screen grid current which is so largely the cause of valve noise. The valve also has applications for normal broadcast wavelengths, where it has the advantage of being comparatively free from effects of cross-modulation.

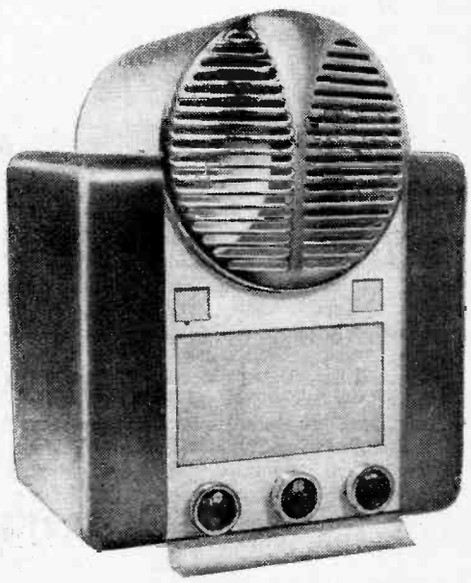
Amongst the new accessories, turning first to coils, the French component manufacturers are showing all sorts of



Loud speaker fitted with built-in correction circuit for high and low notes.

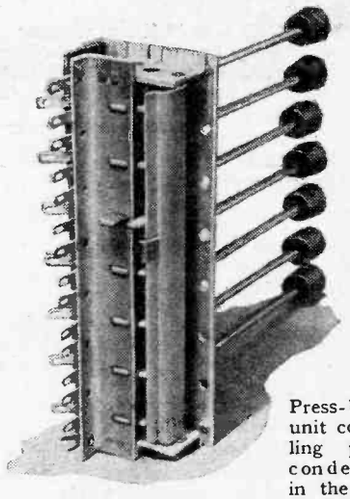
iron-dust cores for all purposes except in short-wave circuits. In multi-band sets the tendency is more and more in the direction of utilising separate coils for each waveband instead of coils with sections short-circuited as was the practice in France some time ago. Several manufacturers have produced complete tuning units, including the switching and ganged variable condensers. One firm arranges a coil unit so that certain tuning circuits can act as rejectors whilst tuning to other bands.

An interesting tuning unit, produced by the firm Gamma, simplifies the reception of short waves. The object has been to avoid the extremely fine tuning necessary on an ordinary tuning scale at very short wavelengths, and as it is only certain



French cabinet design; this exhibit is assembled from metal pressings.

wavebands which are really interesting from the point of view of reception, the Gamma tuning unit is designed to receive these bands only, which may be defined as 19-, 25-, 31- and 41-metre bands. In addition, the unit covers the medium and long-wave broadcasting bands. As limiting the number of bands in this way enables a much more open tuning scale to be employed, the short-wave tuning is greatly simplified, each short-wave station now occupying about 4mm. on the tuning scale. The result is achieved by placing a fixed condenser in series with the variable condenser of the oscillator so as to reduce the sharpness of tuning, and,



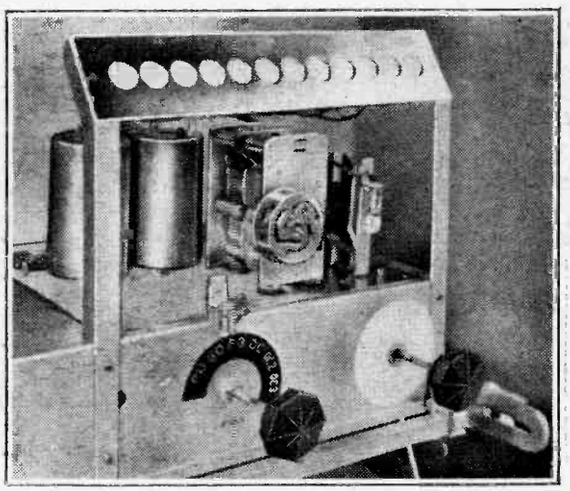
Press-button unit controlling pre-set condensers in the semi-automatic receiver of Radio-Consortium.

by inserting these fixed condensers suitably on the various bands, the same effect can be obtained on each band. It is, of course, very important that the fixed condensers should remain stable and un-

The Paris Components Exhibition—

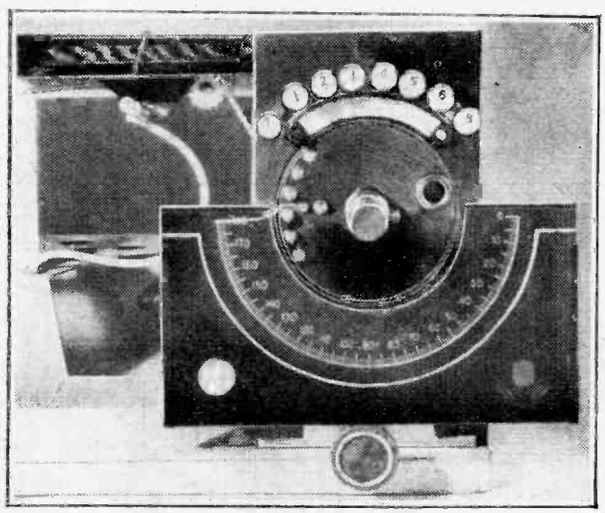
affected by variations in temperature because the slightest alteration would be enough to shift the tuning position of a station from one end of the tuning scale to the other. This principle of separating the tuning band seems to be becoming popular, as already a similar device to that employed by Gamma has been produced by other firms such as D.F.R. and A.C.R.M., the latter firm increasing band spread by adjusting the frequency of the IF transformers.

There have been a number of improvements in variable condensers and in trimming condensers, and these components have now reached a very high standard of reliability. The most popular method of constructing fixed condensers, in cases where the aim is to obtain the utmost stability, is that employing silvered mica plates. Permanent-magnet speakers are gaining ground at the expense of the energised type, even for mains sets.



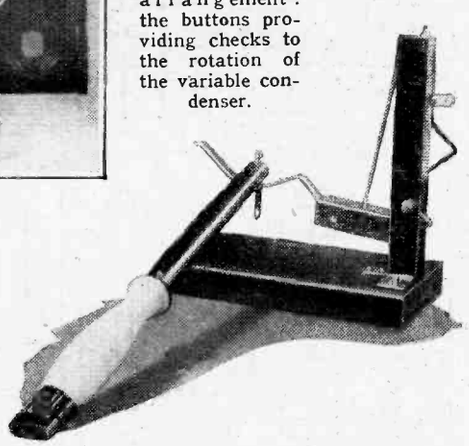
Rexa semi-automatic receiver with 12 press buttons and 11 pairs of adjustable condensers.

American practice has always influenced French designers to a large extent, and this is no doubt the reason why so much attention is now being paid in France to the development of receivers with automatic tuning, commonly described as "press button" tuning. In general, the aim seems to be to provide for automatic tuning for a few stations, whilst leaving the receiver tunable in the ordinary way when required. The various methods can be roughly divided into two systems; those where the ordinary ganged variable condenser is controlled so that it rotates to the correct tuning position, and those where the desired stations are obtained by means of a pre-tuned circuit which is brought into operation when the control button is depressed. In the latter class Audiola has produced one set where pre-tuned circuits are controlled by a rotating switch, and another with twelve fixed tuning positions is shown by the firm Rexa. Melody-Radio has developed a semi-automatic receiver using the normal variable condenser, but stops are provided to check the rotation of the condenser at various points, the condenser being rotated by means of a spring until it reaches the stop which is actuated by pressing the button corresponding to the desired station.



Melody - Radio eight - button arrangement: the buttons providing checks to the rotation of the variable condenser.

Quite a number of measuring instruments suitable for manufacturers were shown at the Exhibition, including some ingenious valve-testing instruments, but these are mostly similar to types well known in other countries. Amongst minor exhibits it is interesting to note a soldering iron by Baringolz, so designed that placing the iron in a rest introduces a resistance in series and so prevents overheating and current wastage during such time as the iron is not in use.



A soldering iron which, when placed on the rest, introduces a series resistance so as to prevent overheating.

The Exhibition as a whole indicates that, in spite of unfavourable economic conditions, France is keeping well in line with other countries in technical development.

NEWS FROM THE CLUBS

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne.
Hon. Sec.: Mr. J. P. Glickman, "Kersal," Brodrick Road, Hampden Park, Eastbourne.

At the recent general meeting it was announced that Mr. C. S. Taylor, the M.P. for the division, had accepted the presidency of the society. Mr. J. A. Penfold gave a lecture entitled "High Quality Amplifiers." Owing to the lack of a permanent aerial he was unable to demonstrate fully his home-constructed all-wave quality receiver. The next meeting will take place on February 28th, when a lecture will be given entitled "Principles of Amateur Transmission."

Surrey Radio Contact Club

Hon. Sec.: Mr. A. B. Wilshire, 14, Lytton Gardens, Wallington.

Recent lectures have included one entitled "Frequency Measurement and Calibration," by Mr. Gay, the chairman, and a talk on high-fidelity recording and reproduction by Mr. S. Davis, director of Davis Theatres. The latter included a demonstration in which the lecturer used a Telefunken pick-up in conjunction with *Wireless World* volume expansion and tone-correction units, and a Class AB push-pull amplifier feeding a Hartley-Turner Duode loud speaker. *The Wireless World* local station quality receiver was also demonstrated, and then a high-quality record was made on a Simplat disc which, five minutes after being hardened, was played back to the audience. The quality of the recording received very favourable comment.

East Dorset and West Hants Radio Club

Headquarters: "Lintlaw" Lodge, Wimborne Road, Poole.
Meetings: Alternate Wednesday evenings.
Hon. Sec.: Mr. D. M. Williams, "Amberley," Cornwell Road, Poole.

Mr. Hunt's recent demonstration was a great success, and it was decided to have another receiver night on February 23rd. Receivers representing the U.S.A., Holland and Great Britain will be demonstrated by members.

International Short-Wave Club

Hon. Sec.: Mr. A. E. Bear, 100, Adams Gardens Estate, London, S.E.16.

This club will hold its fifth annual dinner and dance at Maison Lyons, Shaftesbury Avenue, London, W.1, on Saturday, March 5th. The chief guest will be the French Consul-General. Tickets are 6s. 6d. each, and evening dress is optional. Early application for tickets is essential.

Robert Blair Radio Society

Headquarters: Islington Men's Institute, Blundell street, London, N.7.
Meetings: Wednesdays at 8 p.m. (Practical); Thursdays at 8 p.m. (Theoretical).
Hon. Sec.: Mr. A. R. Richardson, 24, Mercers Road, London, N.19.

The society has now formed itself into two groups, one for beginners and another for advanced and specialising members. The construction of a transmitter has been started and an artificial aerial licence applied for. The beginners' group has been entrusted with the construction of those component parts that can be tackled by amateurs. The morse class is fortunate in having a member who holds a first-class P.M.G. certificate.

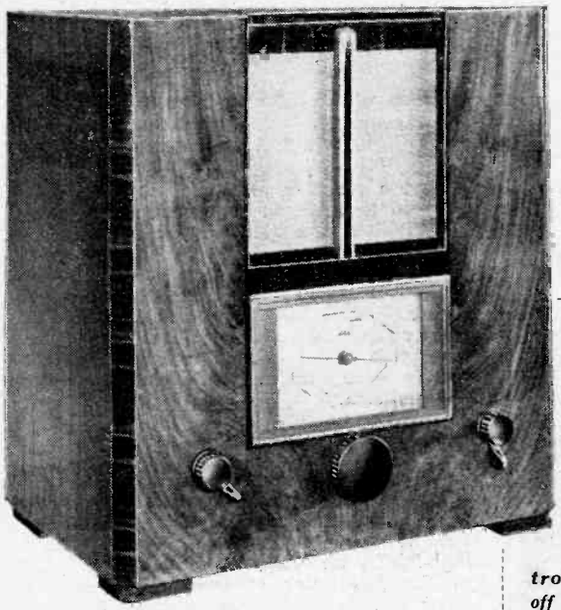
Edgware Short-Wave Society

Headquarters: Constitutional Club, Edgware.
Meetings: Wednesdays at 8 p.m.
Hon. Sec.: Mr. G. Yale, 40, Raeburn Road, Edgware.

The first lecture of the newly organised society was given by Mr. L. Brandt, who talked on the subject of "Low-powered Transmitters." Full details of a 10-watt transmitter were sketched out in stages. The lecturer promised to give a nine-valve 18-watt S.W. set to the first new member who had no A.A. licence and could do 12 words per minute by March 9th.

G.E.C. "6-Volt All-Wave 6"

"Mains" Performance from a Single LT Accumulator



FEATURES. ***Waveranges.*** *—(1) 13.6—30 metres. (2) 29.4—81.2 metres. (3) 73-200 metres. (4) 200-550 metres.* ***Circuit.*** *—Tetrode RF amplifier—heptode frequency-changer—tetrode first and second IF amplifiers—double-diode-triode second detector—push-pull pentode output valve. HT and grid bias from 6-volt self-rectifying vibrator unit.* ***Controls.*** *—(1) Tuning. (2) Volume and on-off switch. (3) Sensitivity. (4) Variable selectivity and tone. (5) Independent tone control. (6) Waverange.* ***Price.*** *—23 guineas.* ***Makers.*** *—The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.*

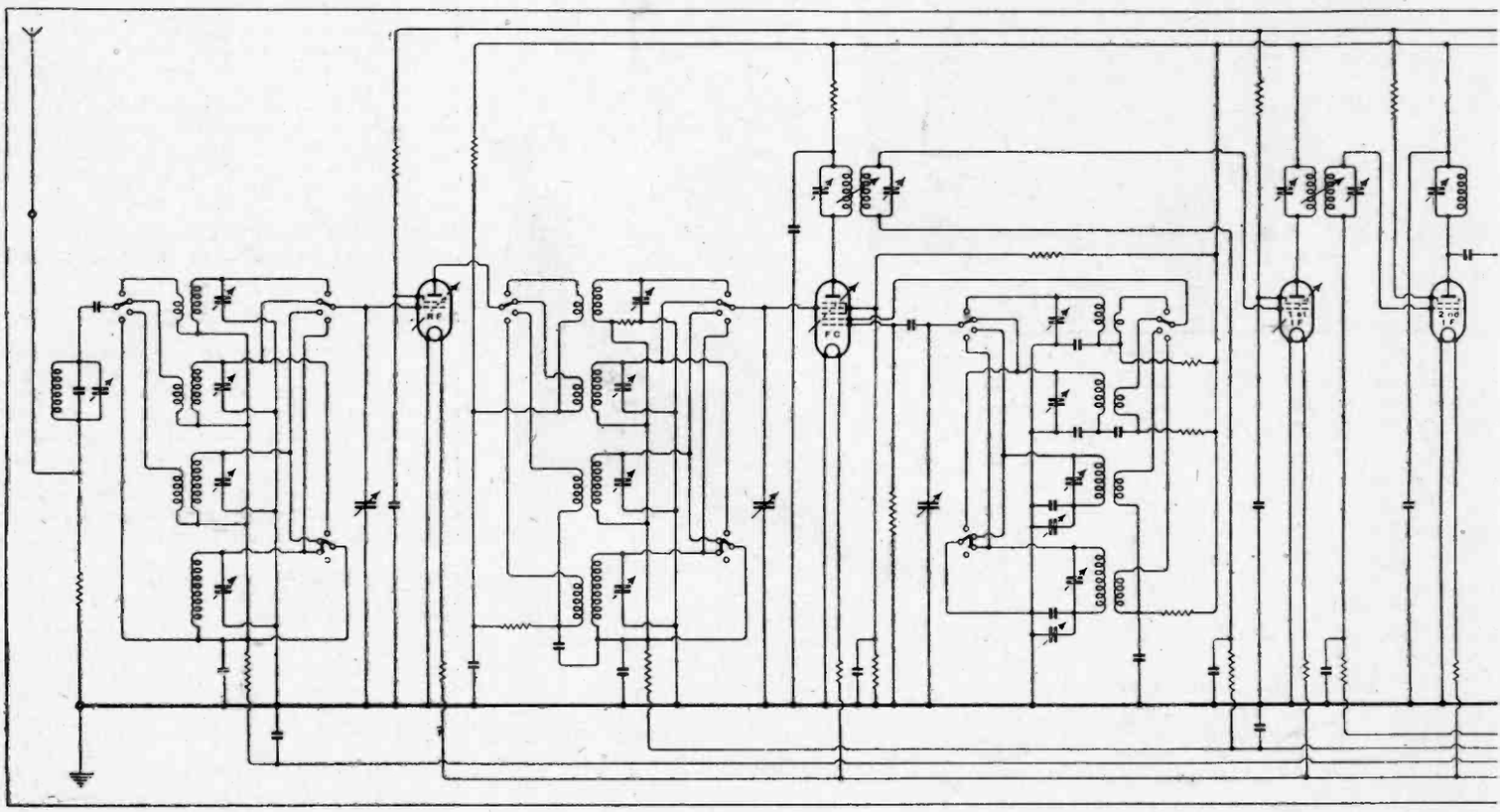
WHILE looking through the descriptive literature relating to this receiver two facts emerged which seemed likely to provide the topic of central interest for this review. In the first place, a strong leaning towards short-wave reception was noted—the set is specifically designed for "overseas listening," has three short-wave ranges, a medium-wave range, but no long-wave band; secondly, a vibratory rectifier was used to supply HT current from the LT accumulator. Could a high degree of sensitivity on short waves be reconciled with the potentialities—electrical and mechanical—of a vibratory unit for causing interference?

The first few minutes of testing were sufficient to supply an affirmative to this question. A slight vibration of the cabinet, which could be felt but not heard, gave the only clue to the source of HT power. A casual observer might have been led to the conclusion that he was listening to a conventional battery set, so silent is the background. The volume and quality, on the other hand, approach those of a mains receiver and are much above the levels economically obtainable from HT batteries of standard size.

The LT accumulator is necessarily of a larger size than usual, and as a guide it may be mentioned that the battery recommended by the makers has a capacity of 105 ampere-hours. A low-resistance ammeter showed the current under working conditions to be just 2.5 amps., which is a very reasonable figure and shows that the efficiency of the vibrator unit is high, since 1.2 amps. are accounted for by filament current alone. The mechanical vibration is not sufficient to provoke microphonic modulation, even in the presence of the strongest carriers on the lowest of the short-wave bands. Neither is there any electrical radiation at any frequency within the range of the set.

The two IF stages and the signal frequency RF amplifier provide all the sensitivity that can possibly be used. The lively performance is uniformly distributed over all four waveranges. A sensitivity control is provided with three positions varying

Elaborate precautions have been taken to ensure a smooth HT and grid bias supply from the vibratory rectifier, and additional smoothing is included in the filament circuit of the second detector stage to suppress the effects of any ripple which may be developed across the supply accumulator.



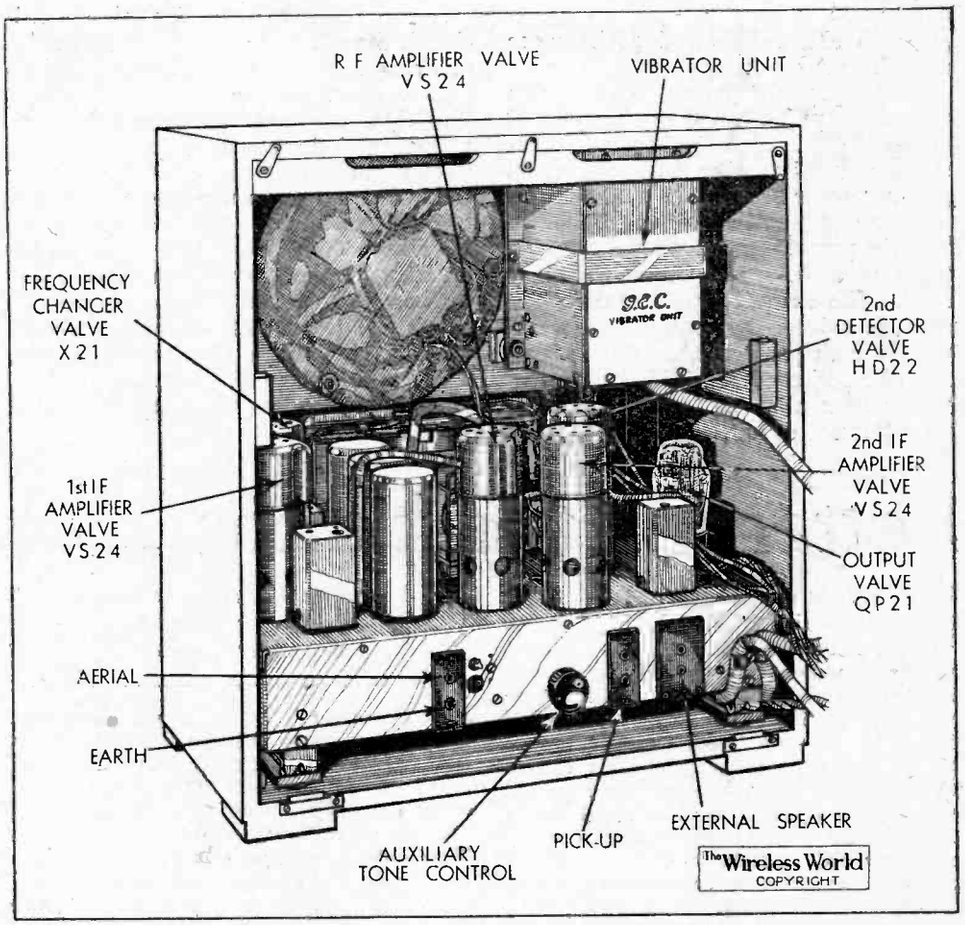
the initial bias on the RF and IF stages and also the AVC delay voltage. Under the conditions prevailing at the time of the test the second or intermediate sensitivity position gave the best results from the point of view of signal-to-noise ratio on all wavebands.

The frequency stability on short waves is good after a small initial drift during the first two or three minutes of warming up. Since the qualities of the receiver in other respects are eminently suitable for every type of broadcast reception, the inclusion of variable selectivity is fully justified. The control is combined with a tone control, and selectivity is decreased in a clockwise direction and high-note response decreased in an anti-clockwise direction from a central "normal" position, located by a notch in the control. An additional tone control is provided at the back of the set for exceptionally bad conditions from the point of view of interference.

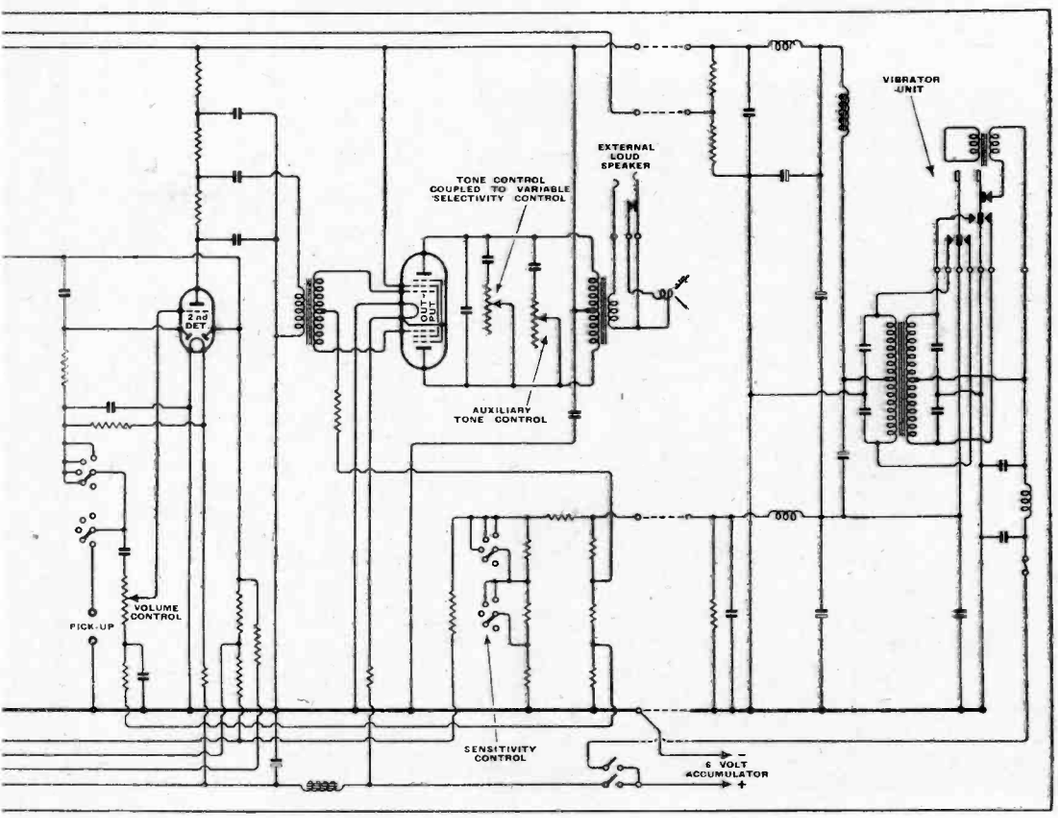
Fidelity Control

A striking quality of this set is that in spite of the number of ways in which quality of reproduction can be modified there is no position of the controls which, through careless handling, might give unpleasant results. This is a welcome change from the many sets which have to be nursed to avoid the full effects of some major resonance or other deficiency in the response, and in the "high fidelity" position really first-rate quality is obtained at all volume levels.

With the set working at maximum selectivity on the medium-wave band in Central London 1½ channels were lost on either side of the Brookmans Park stations. Elsewhere, adjacent channel separation should be possible, and except for a group of whistles just above the London Regional station, probably due to overloading of the frequency changer, self-generated interference was absent.



The vibrator unit is carefully screened and insulated mechanically from the receiver cabinet.



In general design the cabinet and controls are similar to the "AC Mains All Wave 6" reviewed in our issue of March 5th, 1937. Concentric controls are arranged to combine volume and sensitivity, waverange and fidelity. The central tuning knob is of large diameter and the control is of the two-speed type with reduction ratios of 15 : 1 and 75 : 1. Associated with the main pointer is a central micro-tuning pointer operating over a 100-degree scale. This is sensitive to the slightest movement of the main control and is, in practice, an excellent substitute for a tuning indicator as well as providing a means of accurately recording the precise settings of short-wave stations.

The principal calibrations on all four waveranges are in kilocycles and megacycles. Wavelengths and the bands occupied by broadcast stations on short waves are also indicated, but in this set, which is intended for use in all parts of the world, no station names have been included.

The circuit has many points of interest, and it will be observed that tetrode valves are used in the RF and IF stages instead of the more usual pentode types. The first IF stage is coupled by means of iron-cored transformers with variable coupling and the second stage, which is not controlled by AVC, is tuned-anode coupled to the double-diode-triode second detector. Although the valve used in the output stage was designed originally for QPP operation the removal of the restrictions on HT consumption have enabled the de-

G.E.C. "6-volt All-wave 6"—

signers to obtain improved performance under Class A conditions.

There is provision for the addition of a gramophone pick-up, and special external loud-speaker sockets are arranged to cut out the internal speaker if desired. Grid bias and two HT potentials are available from the vibratory rectifier unit, in which elaborate precautions have been taken to suppress audio- and radio-frequency ripple. The filament supply to the 2-volt valves is reduced by independent resonances in each positive filament lead, and it will be noticed that additional smoothing has been provided in the second detector filament circuit.

Apart from the heavily zinc-plated chassis there is little to distinguish this set in appearance from the ordinary broadcast receiver, but the long experience of the G.E.C. in supplying sets for the export market is a sufficient guarantee that in all essential details the mechanical and electrical design has been made suitable for tropical conditions. Special precautions have been taken in packing the receiver for long journeys, and from every point of view it is a well-turned-out product which one would not hesitate to recommend to friends in the Dominions and Colonies to uphold the reputation of the British radio industry in competition with foreign products.

Letters to the Editor

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

Short Waves and Aurora

REFERRING to "A. C. G.'s" letter in your issue of February 3rd on high-frequency conditions on January 25th, the night of the aurora display, I note that he makes no mention of the very unusual short skip which prevailed, for example, on 14 Mc/s. Even as late as 23.00 several Scottish and one Irish station were coming in at considerable strength with a rapid flutter fade. Under normal conditions no such signals are heard. Checks on various commercial and broadcast stations showed conditions to be more or less normal except for an almost entire fade-out to North America.

On 28 Mc/s at 18.00 my signals were reported R7 at Cheltenham, which is about 150 miles distant. At 19.00, long after frequencies over 20 Mc/s were dead for all other signals, the harmonic of LCJ in Norway was very strong on 30 Mc/s approximately. This signal was reported by several amateurs.

Two reports on my 56 Mc/s signals have been received from about 100 miles distance, one from Farnham, Surrey, and the other from Farnborough, Hants. The signals were reported R6/3 with fade and echo at around 22.00. Tests over the same distance since the night of the aurora have yielded negative results. In the ordinary way the ground wave limit, with my radiator, is somewhere in the region of 35 miles.

The above observations point to the fact that there was present on the night of the aurora abnormal ionisation of the atmosphere, presumably lower than the usual layers and capable of bending (somewhat spasmodically) signals of ultra high frequency, particularly from northern directions.

D. W. HEIGHTMAN.

The Best Recordings

IT has long been recognised that when one wishes to purchase a recording of a particular piece of music or other item it is often discovered that a large number of different recordings of the item is available, and, as it is usually impossible or inconvenient to hear all of them, the choice of a quality recording is speculative.

These remarks bring me to my point: For some years I have been compiling a list of high-quality disc recordings irrespective of the subject matter, *i.e.*, from classical music and singing to swing music, and I have often thought how useful it would be to know the favourite high-quality recordings of my fellow-enthusiasts, or of any organisation that has reason to pick out the best recordings. Apart from people directly concerned, either as amateurs or professionals, with sound recording and reproduction, who naturally have their special test records, I believe that almost all the readers of *The Wireless World* could recommend certain recordings that they have found to merit the description "high-quality." The practical uses of these discs are many, including testing pick-ups, amplifiers, loud speakers, and, of course, the æsthetic satisfaction of high-quality sound.

Therefore, with your permission, I would like to invite all readers who possess or know the names and numbers of high-quality (which does not necessarily mean the best artistic rendering) commercial records to contribute a list to these columns. Knowing your willingness to perform any service for your readers, I feel sure you would allow space for these letters, as I believe such lists would be of considerable value and interest to all.

I appreciate that the choice of these recordings being personal is thus open to dispute and, as a direct comparison with the original sounds is not possible, how is one to determine the fidelity or otherwise of the recording?

So for the present purpose the term "high-quality" must mean freedom from (1) amplitude distortion, evinced by *e.g.*, "muddy" recording or "blasting," (2) frequency distortion, (3) undue surface noise (needle scratch), and the positive qualities possessed by recordings should be (1) naturalness, *e.g.*, string tone should not be strident or "wiry," (2) wide volume or dynamic range (contrast), and (3) spatial effect. In fact, any recordings to be included in these lists must be really satisfying to critical ears. I must interpolate here that many complaints of bad quality recording are actually due to poor reproducing equipment rather than bad initial recording.

To start the list I offer the following:

"Funeral March of a Marionette." Columbia DX.269 (Military Band).

"Ride of the Valkyries." Columbia DX.66 (Organ).

"Teddy Bears' Picnic." Columbia DB. 955 (Dance Orchestra).

I have a large number (several hundreds) more of all types of performance and record makes, but the foregoing will indicate the idea.

DONALD W. ALDOUS.

Ilford, Essex.

Battery v. Mains

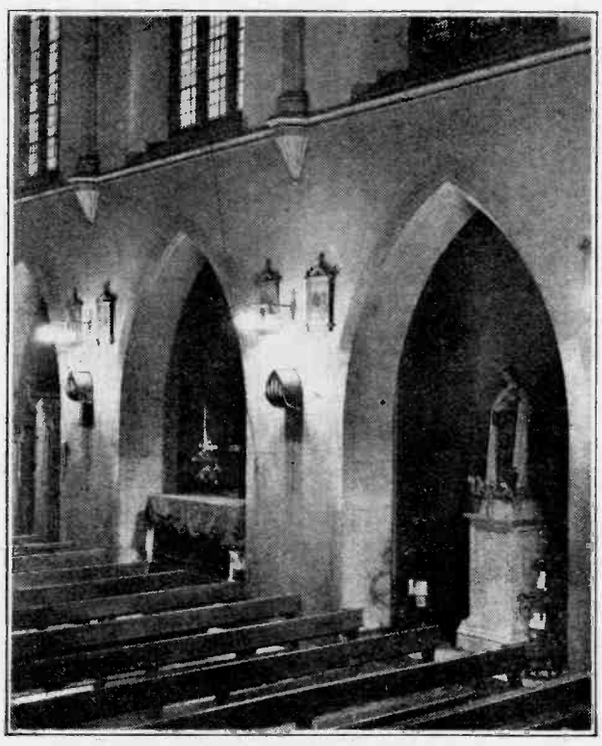
I WAS highly amused at Cathode Ray's apparent attempt to sum up the Battery *v.* Mains question. If the article had been written by Free Grid one might have passed it over with a good laugh, but since Free Grid had contributed on another page I assume that Cathode Ray is quite serious.

First of all, the points for and against, tabulated in that article, are like a comparison of specifications of two cars. One man buys a car for its speed, another for its comfort, and a third for its quiet running or accessibility; but this hardly applies to a musical instrument, since its very existence is only justified so long as it can produce good music.

I am aware that a wireless set may be bought solely on the score of its selectivity, but "Battery *v.* Mains" was essentially a quality discussion.

In building an amplifier, if quality is not the prime object, it at once ceases to be a musical instrument, and although it may have some technical appeal, it loses the interest of those who want music.

I would like to emphasise



HARMONIOUS DESIGN of the special Grampian Speakers used in a London church for a novel system of sound reinforcement devised to overcome a troublesome echo effect. The scheme was referred to in last week's issue

here that, on quality and realism, volume has very little bearing. For instance, a photograph or portrait may have all the characteristics and life of the model without being life-size. A good vignette is adequate and infinitely preferable to a life-size model that few can recognise; and Class A at moderate volume scores every time over Class B with its "watts" output. In reply to Mr. James Nicol, of Kirkcaldy, I must say that I cannot understand any quality enthusiast considering either QPP or Class B, seeing that both systems theoretically and in practice have such obvious shortcomings. Surely it is better to have reproduction that is basically as true as possible, and then increase the volume if it can be done without (a) any sacrifice in quality, (b) heavy expense.

Advertising an amplifier on so-called "undistorted output" is, I think, very misleading. For instance, the makers of my last set claimed only 230 milliwatts undistorted output, while makers of other sets with similar output valves were claiming 400 milliwatts output. My own set gave adequate volume of really life-like reproduction, while both quality and volume of its competitors were poor although their ratings were higher. A mains set which I tested, with a rating of 2½ watts, gave a little more volume with more distortion.

Outputs of sets are still assessed on the theoretical performance of their output valves, instead of on a scale of sound amplitude from the speaker. As soon as the output of an amplifier is increased the power handling capacity of its speaker has to be increased; this reduces sensitivity, and then very often one is no better off.

I have come to the conclusion that, for domestic purposes, no more than one watt is ever necessary, provided this power is handled with a really good speaker (the most important component of any amplifier). The average working level is more like 200 milliwatts; but feed a speaker designed for 15 or 20 watts with only 200 milliwatts and the reproduction will be backward, leaden and volume inadequate. Feed the same speaker with 2 or 3 watts, and quality may be better and your neighbours justly annoyed.

Lastly, mains power, which is either AC or a "ripple" DC supply at the best, is fundamentally unsuitable for quality reproduction—the terms "rectifier" and "smoothing choke" speak for themselves. I suggest that one is advised to make use of a power supply which is in itself eminently suitable by virtue of its naturally even output, such as a dry battery or HT accumulator, and although slow voltage drop, within limits, certainly means a drop in volume, quality need not be affected.

Hounslow. E. R. ROBBINS.

Stripping Litz

A RECENT paragraph in the *Wireless World* describes a machine for stripping the insulation off Litz wire. Coil manufacturers in France use a process which is most effective, and, if not generally known, may be of interest.

The Litz to be soldered is held in a clean methylated spirits flame until red hot; it is then immersed immediately in pure alcohol spirits or liquid methylated. After immersion it comes out with each strand quite clean and ready for soldering.

It is well to practise on an odd piece of wire before actually operating on coils, as the knack of gauging the right degree of heat has to be acquired. If heated too long the wire may melt, if not long enough the varnish is only partially dissolved. The immersion in the spirits must be immediate.

France. J. O. HARRIS.

Television Programmes

THURSDAY, FEBRUARY 17th.

3, "Hands Across the Sea," a one-act play by Noel Coward. **3.25,** British Movietonews. **3.35,** 121st edition of Picture Page.

9, Cabaret, including Walsh and Barker. **9.20,** Gaumont-British News. **9.30,** 122nd edition of Picture Page.

FRIDAY, FEBRUARY 18th.

3, "100% Broadway," including Evelyn Dall, Ken Harvey and the Merriel Abbott Girls. **3.35,** Gaumont-British News. **3.55,** Preview.

9, "Duenna," a comic opera by R. B. Sheridan with music composed and arranged by Alfred Reynolds. Cast supported by the Television Orchestra and B.B.C. Singers. **9.55,** Preview.

SATURDAY, FEBRUARY 19th.

3, "Fire Up Aloft." Demonstration of modern fire-fighting from the grounds of Alexandra Palace. **3.20,** Cartoon Film. **3.30,** Cabaret, including Horace Kenney and Naunton Wayne.

9-10, "Clive of India," by W. P. Lipscomb and R. J. Minney with Colin Keith-Johnson as Clive and Gillian Lind as Margaret Maskelyne.

MONDAY, FEBRUARY 21st.

3, Starlight. **3.10,** British Movietonews. **3.20,** Act II of "Awake and Sing": a play by Clifford Odets.

9, "Pas Seul," No. 3, with Michel Hambourg. **9.10,** Darts Match. **9.25,** Gaumont-British News. **9.30,** Variety, including Jean Colin, Pat Kirkwood and Marietta and Rudy D'Aix.

TUESDAY, FEBRUARY 22nd.

3, Music Makers: Michel Hambourg. **3.10,** Gaumont-British News. **3.20,** Cabaret, including Ann Zeigler, Jane Carr and Ian Grant.

9, Repetition of 3.20 p.m. programme. **9.40,** British Movietonews. **9.50,** Judo: the art of self-defence demonstrated by members of the Budokwai Club introduced by Lord Sempill.

WEDNESDAY, FEBRUARY 23rd.

3, Craftsmen at Work—III: Whiskit Making, compèred by S. P. B. Mais. **3.10,** British Movietonews. **3.20-4.20,** "Clive of India" (as on Saturday at 9 p.m.).

9, Repetition of 3 p.m. programme. **9.10,** Gaumont-British News. **9.20,** "Awake and Sing" (as on Monday at 3.20 p.m.).

The Wireless Industry

COPIES of the new Electradix sale catalogue are now obtainable from Electradix Radios, 218, Upper Thames Street, London, E.C.4. All aspects of wireless are covered, and much of the apparatus listed is of the kind that is difficult to obtain through ordinary channels. In addition, the catalogue deals with general electrical and scientific appliances.

◇ ◇ ◇

The fourth annual dinner and cabaret of the Radio Industry Golfing Society is to be held at Grosvenor House, Park Lane, on Friday, March 4th. Immediate application for tickets should be made to the Hon. Secretary, 29, Bedford Street, Strand, London, W.C.2.

◇ ◇ ◇

E. K. Cole, Ltd., have introduced a receiver, the Model PB199, which includes press-button tuning for eleven selected stations. The final adjustment of tuning is automatic and the average time taken to change from one station to another is 3 seconds.

◇ ◇ ◇

As from next Monday, the Head Office of the Cambridge Instrument Company will be transferred from No. 45 to No. 13, Grosvenor Place, London, S.W.1.

Random Radiations

By "DIALLIST"

The Earth That Wasn't.

THE other day I came across one of those cases which show how unwise it is to take the earth connection for granted. Many people, having rigged up an aerial of some kind, just take an earth tube and whack it into the handiest flower bed without bothering to investigate what lies beneath the surface. In many instances this comes off and the set works quite well; but every now and then there is some unsuspected snag, with the result that the receiver has no proper chance of doing itself justice. In this particular case a youngster had made himself a crystal set, which he had installed in a den of his own in a wooden outbuilding of a farm. To all outward appearances earth and aerial, though nothing to write home about, were good enough for results to be expected from the set. But there weren't any results: the set was completely mute, though it performed well on a neighbour's aerial and earth a few hundred yards away. I suspected the earth, which was a copper tube driven into the ground quite close to the building. "I shouldn't be surprised," I said, "if it is just in a pocket of light soil on top of the foundations."

All the Difference.

It was pointed out to me that the building was a wooden one and therefore unlikely to have solid foundations. However, I persisted and eventually the owner of the set was induced to do a little work with the spade. Sure enough, after going about two feet down through gravelly soil he came on to foundations that were solid enough for anything. There must have been an old brick or stone building on the site of the present wooden affair in years gone by. Another hole was dug four or five feet farther away from the walls and at about two-and-a-half feet down the right kind of heavy soil was encountered. The earth tube was buried with its point penetrating well into this, and the crystal set was promptly found to work as well as could be wished. Some valve sets seem strangely indifferent to the quality of the earth connection; I have come across not a few oldish sets which worked well with their existing earth connections and just as well if the earth wire was disconnected. But in modern valve sets of good design a sound earth is of real importance, for it means stability combined with maximum sensitiveness for the circuits employed and the greatest possible freedom from background noisiness. I am pretty sure that if people would dig a hole for the earth contact and make quite sure that they're getting down to the heavy subsoil instead of just driving in a tube and leaving the rest to chance, there would be far fewer complaints of poor sensitivity and noisy working.

Now We Know Where We Are

AT last the Postmaster-General has announced that transmission technique from the Alexandra Palace will remain substantially unaltered for at least three years from the 1st January, 1938. This should help to set doubts at rest: I know that there are a good many people who hesitated to buy television receivers because they were afraid that anything purchased now might soon be out of date. Well, now they know that it won't, and that's all to the good. Whether the Sunday programmes that are to start in April will make television attractive to a wider circle I don't know. One thing that crosses one's mind is that so many of those who live in London itself and can afford television receivers spend much of their week-end time either in the country or at the seaside. However, time will show. There has been a certain amount of agitation by writers in the lay papers for the erection at once, if not sooner, of relay stations at Birmingham and Manchester. They point out that the co-axial cable is already laid, and that, they seem to think, makes everything straightforward and plain sailing. They forget that even if the whole of the programmes are produced in London, full-blown transmitting stations would be required at each of the two places and that the erection, the maintenance and the running of these costs a lot of money. I can't see myself that there will be any justification for extending television into the provinces until it has made good in the London area. After all, nearly a quarter of our population lives within range of the Alexandra Palace and that quarter should be able to provide the acid test.

What is Wanted?

From time to time writers in *The Wireless World* have asked why it is that television isn't going ahead with the public so fast as it was expected to do, and have tried to find answers to the question. Correspondents, too, have taken a hand, but so far no one seems to have hit the nail on the head—you can't very well do that until you know exactly where the nail is, and I am not sure that we do at present. Personally, I am not at all convinced that the programmes must take the major share of the blame, which is so often handed out to them. I "look-in" at them pretty often and though you get some rather poor shows, the general level has certainly improved enormously and really excellent programmes are not infrequent. There's clearly nothing wrong with the quality of images reproduced on the televisor screen. Correspondents have pointed out that if you place the receiver suitably there is no need for a reshuffle of chairs when a television programme starts—so that objection goes by the board. Many of those who have television sets find the present screens quite large enough for ordinary purposes: it isn't, then, the lack of big-screen home television that is at the root of the trouble. Nor can it be the cost of the apparatus: both Murphy and McMurdo Silver have found that there are plenty of people willing to

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, FEBRUARY 17th.

Nat., 6.40, Debussy recital by Edmund Rubbra, pianoforte. 7, "Radio Pie," devised by the Two Leslies. 8, Variety Broadcast from the Holborn Empire. 9.20, His Majesty King George VI delivers an address to members of the National Fitness Council, at the Guildhall.

Reg., 8.30, John Snagge talking on Deep-sea Diving, from below the surface. 8.50, Carroll Gibbons and his Orchestra. 9.20, H.M. King George VI.

Abroad.

Beromunster, 6.30, "Boris Godunov" opera (Borodin).

Vienna, 8, Vienna Philharmonic.

FRIDAY, FEBRUARY 18th.

Nat., 7, "The Bartered Bride"; comic opera. 9.20, Talk on Germany: "Efficiency and Liberty."

Reg., 7.30, Nat Gonella. 8.30, George Robey and Nelson Keys in "The Man Behind the Melodies"—No. 2. 9.25, "Not One Returns to Tell": a ghostly adventure.

Abroad.

Radio Paris, 8.30, "The Constant Nymph": 3-Act play.

SATURDAY, FEBRUARY 19th.

Nat., 8, Palace of Varieties. 9.20, American Commentary. 9.35, Astrology discussion.

Reg., 8.10, Ice hockey commentary from Prague. 9.30, Hungarian Gypsy Party.

Abroad.

Brussels 11, 8.15, Beethoven concert.

Leipzig, 9.45, Dresden Opera Ball.

SUNDAY, FEBRUARY 20th.

Nat., 6, The Fortnight's Films. 9.5, The Leslie Bridgwater Quintet. 9.45, The Early Life of Madame Tussauds.

Reg., 6.50, "I Was There"—The Hong-Kong typhoon of 1906. 7.5, A musical play including Wynne Ajello and Denis O'Neil.

Abroad.

Stuttgart, 6.15, "Die Fledermaus": operetta (Johann Strauss).

Brussels 1, 8, "Samson and Delilah": opera (Saint-Saëns).

MONDAY, FEBRUARY 21st.

Nat., 6.30, Constant Lambert.—"The Instrument and the Orchestra." 7, Monday at Seven. 9.35, Speech by the Prime Minister, from the B.I.F. Dinner at the Mansion House.

Reg., 6.30, The Swift Serenade Concert Orchestra. 8.30, B.B.C. Orchestra (E), conducted by Constant Lambert, with Margaret Good, pianoforte.

Abroad.

Deutschlandsender, 8.20, Mengelberg conducting the Berlin Philharmonic.

Brussels 2, 9, The Belgian National Orchestra.

TUESDAY, FEBRUARY 22nd.

Nat., 7.30, Progress Talk by T. H. Marshall. 8, Music from the Films. 9.20, America Speaks—1. A Transatlantic relay. 10, Experimental Hour—V.

Reg., 7.30, Carroll Gibbons and his Orchestra. 8, "The Bartered Bride."

Abroad.

Brussels 11, 8, First Performance of opera "Anne-Marie."

Eiffel Tower, 8.30, Concert by the National Orchestra.

WEDNESDAY, FEBRUARY 23rd.

Nat., 7.15, Band Waggon. 8, W. H. Berry as Mr. Micawber. 8.15 and 9.40, B.B.C. Symphony Orchestra conducted by Sir Adrian Boult, with Egon Petri, pianoforte.

Reg., 7.30, "The World Goes By." 8.15, "Girl Missing": a story of Chicago in the spacious days of prohibition. 9, Northern Music Hall. 9.40, Ju-Jitsu commentary.

Abroad.

Brussels 1, 8.30, Contemporary Belgian Music.

pay a big price for a good radio receiver alone, and expensive radiograms don't sell too badly.

Screen versus Screen

I can't help thinking that television is very much under the shadow, so to speak, of the ciné screen. If a friend says to you, "What am I going to gain by investing in a televisor?" you will no doubt say that he'll see and hear plays, cabarets, sporting events and music-hall turns in his own home for the mere turning of a switch. And suppose that his retort is, "I can see all of those things on any evening that I feel so inclined by going to the nearest movie theatre and putting down a shilling or two. I haven't got to make any capital outlay and, if I live in a town, I can take my pick of the different programmes offered by several movie theatres." What have you to say to that? You may reply that he can have his entertainment without leaving his arm-chair. He will then probably argue that he doesn't mind leaving it if he feels like entertainment. My own view is that television is still working too much on movie picture lines. It's quite natural, after all, that it should do so in its early days; but I believe that it will have to develop an atmosphere and a technique of its very own if it is to have the wide popularity that it deserves.

More Oddities?

AT the moment of writing the big sunspot group which caused so many wireless adventures last month remains invisible, being still on the far side of the sun's disc. At least, I take it that it isn't in view. I have not been able to test the matter with my own eyes, for the sun has not emerged from behind the clouds for some days. By the time that you read this the sunspot group should be well to the fore, and on Monday or Tuesday, February 21st or 22nd, it is quite on the cards that there may be another display of the Aurora. Whether that happens or not, extensive disturbances are almost a certainty, and those who keep records of their short-wave or ultra-short-wave reception between the 17th and the 22nd may obtain some interesting and valuable data.

Sir John Reith, a Biography. By Garry Allighan. Published by Stanley Paul and Co., Ltd., 34, Paternoster Row, London, E.C.4. 15s.

AN irritating exuberance of style and a tendency to tautology may be forgiven in a biographer who has such a fascinating story as this to tell and brings such enthusiasm to the telling of it. Mr. Garry Allighan's history of Sir John Reith and wireless is of absorbing interest. He gives a really exciting account of the evolution of radio from its earliest stages. In this history, told side by side with a survey of the hereditary and other influences which went to the building up of the unique character of his subject, Mr. Allighan sees the hand of Providence manifestly bringing the hour and the man together. Few of us will quarrel with this point of view if we agree with Hamlet that "There's a divinity that shapes our ends, rough-hew them how we will."

Whether in gaining her Director of the B.B.C. England lost a great Prime Minister is a moot question. Mr. Allighan has a vivid imagination and is rather fond of dwelling on might-have-beens. Perhaps Sir John has too much of the Dictator in him to have made a successful head of the British Government, but there is no doubt about his being the right man for the work he has done and is doing. The enormous advance of radio, its penetration into every home and every school, gives the man at the head of it a greater power over the hearts and minds of the people, and consequently over the destiny of the nation, than has ever been possessed by a Prime Minister. That the man with so much power happens also to be a man of the highest ideals and deepest sense of his responsibility towards God and his fellows has made British broadcasting a public service untainted by commercialism, of which the whole Empire may justly be proud. If we could have a Sir John Reith at the head of the cinema industry its influence on the younger generation would be very different.

Mr. Allighan reproduces in this book for for the first time some of Sir John's own statements as to his policies and standards, and his conception of broadcasting as "an instrument of social well-being." These documents are, perhaps, the most interesting part of the book. One would like to quote largely from them. Mr. Allighan says: "Reith never faltered in his conception. He aimed at perfecting a broadcasting instrument that was a public service, run in the widest interests of the public, and not in the narrow interests of any one section of the public." Whether or not he has succeeded is for listeners all over the world to say. Of course, there has been much criticism of the programmes. "The amazing thing is the violence of the disagreement that is rife among listeners. I have repeatedly," says Mr. Allighan, "opened a letter from one listener denouncing a broadcast in terms as extreme as, in the very next letter, another has praised it. If the B.B.C. took any notice of correspondence Broadcasting House would be peopled with screaming lunatics."

Although Mr. Allighan evidently has a great admiration for Sir John, almost amounting to hero worship, he devotes many pages towards the end of the book to a scathing criticism of what he calls the "pulpit tone and bedside manner," the "snobbery and hypocrisy" which have been encouraged throughout the B.B.C. organisation. One cannot have things both ways, and it is extremely difficult to strike the happy mean. Without a constant endeavour to stand firm for right principles, broadcasting would inevitably drift into a habit of appealing to the lower tastes of the community, in company with many of our other forms of entertainment. Mr. Allighan is, however, fair to the character of Sir John. Though he considers him wrong in his "attempt to make the programme staff feel that they have a 'mission,'" he realises that this "wrong" point of view is a virtue. "Bigotry can be reckoned to some men for righteousness, and in so far as Sir John Reith is a bigot, his bigotry has been directed to progressive ends."

Seldom in the history of the world has it been given to one man to assist at the very beginnings of a great public service, when it does not even realise that it is a power at all, and to bring it to such a pitch of perfection as that to which broadcasting has attained, while he himself is still in the full vigour of his powers of body and mind. No one can afford to miss this book who wishes to know something of one of the great forces of our time, and of one of the great men not only of the day but of the future.

E. A. P.

Recent Inventions

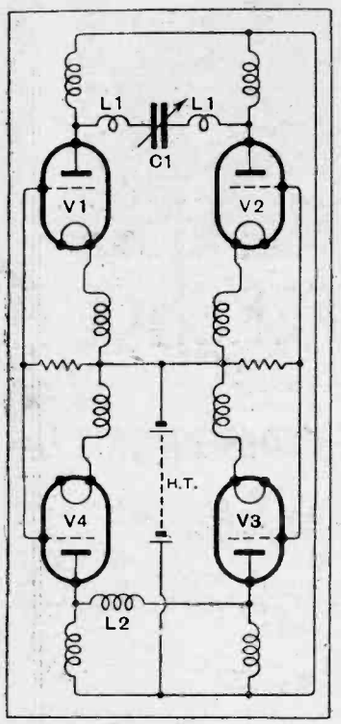
The British abstracts published here are prepared with the permission of the controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25 Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

SHORT-WAVE GENERATORS

TO generate short waves at a high level of power, it is desirable that the inductance of the circuit should be "lumped." In addition it is necessary to avoid, as far as possible, inter-electrode capacity coupling, since this tends to introduce phase-differences.

The Figure shows an arrangement of four valves V1 --- V4 in which the grids of V1, V4 and V2, V3 are connected by leads of negligible inductance, whilst the anodes of V1 and V2 are connected



High-power valve generator for the ultra-short waves.

by a tuned circuit which consists of half-turns of wire L1 with an interposed condenser C1. The anodes of V4 and V3 are connected by an inductance L2. The pairs of valves V1, V4 and V2, V3 are connected in series across the common HT supply, additional chokes being provided in the anode and cathode circuits.

Telephone Manufacturing Co., Ltd., and L. H. Paddle. Addition to 450967. Application date June 30th, 1936. No. 475673.

o o o o

AUTOMATIC TUNING CONTROL

IN a set fitted with automatic tuning control there is a tendency, should the signal strength be unduly reduced, say, by fading, for "noise" and other interference to predominate over the signal proper. The interference then "takes charge" of the automatic control and may drag the circuits out of tune with the signal carrier-wave.

To prevent this from happening, the tuning control is arranged to be automatically thrown out of action as soon as the incoming carrier-wave falls below a certain threshold value, so that there is no longer any link whereby the incoming "noise" can affect the tuning of the set. The latter accordingly remains fixed at the original setting.

Marconi's Wireless Telegraph Co., Ltd. Convention date (U.S.A.), April 16th, 1935. No. 473618.

o o o o

TELEVISION RECEIVERS

A SCREEN grid valve V is biased so that its characteristic curve has the form shown in Fig. 1, and in this condition is used to separate the "line" from the "frame" synchronising signals in television. The shorter "line" impulses L, for instance, are repeated over the portion AB of the curve, whilst the longer "framing" impulses F appear over the portion B, C, so as to produce an amplified signal of opposite sign to the first.

As shown in Fig. 2 the incoming signals of different time values are applied to a condenser C and are converted by the circuit R, C1 into corresponding impulses of different amplitudes.

The output signals from the valve V are taken off through the condensers C2, C3, one from the grid, and the other, of opposite sign, from the plate. They are then rectified before application to the cathode-ray tube (not shown).

Marconi's W.T. Co., Ltd.; R. J. Kemp and D. J. Fewings. Application date, April 29th, 1936. No. 472923.

o o o o

DIRECTION FINDERS

THE voltage picked up by a rotating frame aerial is fed to a cathode-ray tube so that the electron stream is deflected in accordance with the signal strength. A graduated scale is rotated with the aerial, and is provided with a lamp and a photographic film which makes a record of the orientation of the frame aerial.

Simultaneously the light from the fluorescent screen of the CR tube registers the strength of the received signal, thus giving both the factors required to indicate the bearings of a distant transmitter. The position of minimum signal strength can, for instance, be identified with the particular setting of the frame aerial. If the latter is continuously rotated, the two indications appear as two apparently fixed marks, which may be reproduced at a point remote from the directional installation.

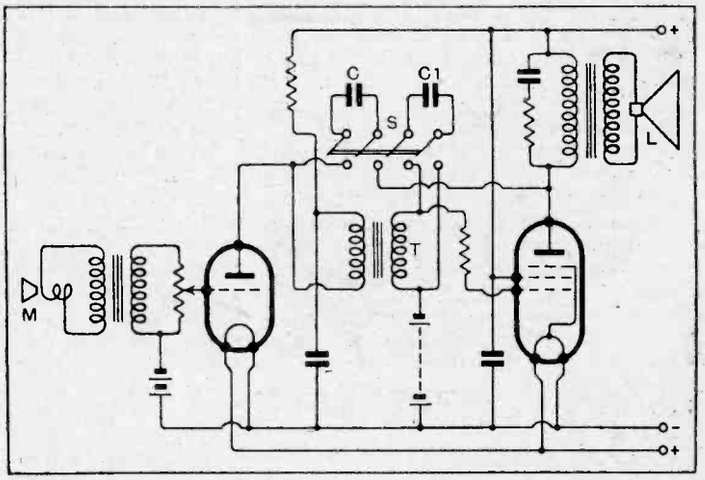
F. Johnske. Application date, April 14th, 1936. No. 472419.

o o o o

PUBLIC ADDRESS SYSTEMS

THE set is arranged so that on one setting of a switch it automatically emits a loud warning note, presumably to attract the attention of some trespasser against the Highway Code. On the other setting of the switch the equipment is restored to normal; ready to transmit whatever observations the police officer may have to make.

In the "open" position of the switch S, the equipment is ready for normal use, with the usual circuit connection between the microphone M and loud speaker L. When the switch is closed, a back-coupling condenser C is connected across the anodes of the two valves, to generate sustained oscillations, whilst a second condenser C1 is shunted across the intervalve transformer T to produce a high-pitched penetrating note in the loud speaker.



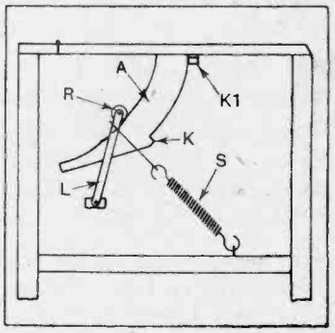
Method of producing an audible warning signal in a PA amplifier.

Receiver for the Metropolitan Police District; and E. C. Brown. Application date May 22nd, 1936. No. 473776.

o o o o

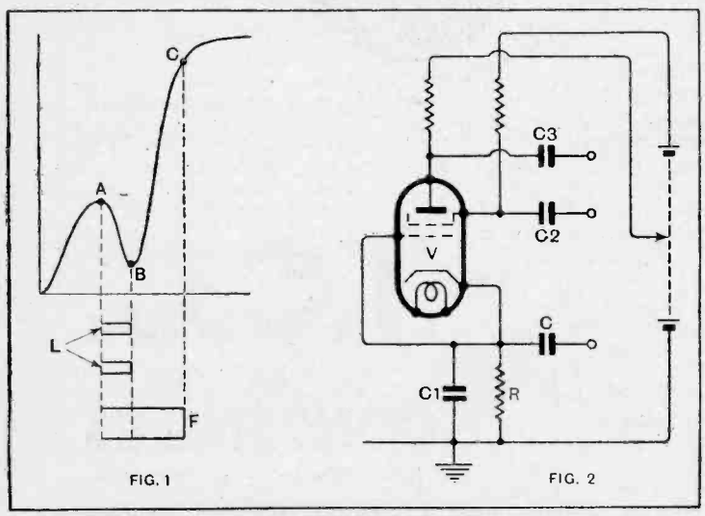
CABINETS

THE lid of a wireless cabinet, or television receiver, is "balanced" at all open positions, so as to give an easy movement and avoid slamming. A curved side-arm engages with a runner wheel R, which is carried by a pivoted link L and held in close contact with the run-way by a spring S. The end profile of the arm A is such as to exert a slight upthrust in the fully-open position, i.e., when a projection K engages a stop-plate K1. Similarly a downthrust is applied in the lowest position, so as to make the closure perfect.



Device for balancing the lid of a radio cabinet to prevent slamming.

Baird Television, Ltd., and E. J. Treasure. Application date April 23rd, 1936. No. 475735.



Characteristic curve (Fig. 1) of valve required for sync pulse separation. Circuit arrangement (Fig. 2) of sync separator in television sets.

The Wireless World

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EDITORIAL COMMENT

Facsimile Transmission

Radio Newspaper Possibilities

REMARKABLE reports have been circulating in America for some time, and have recently found their way also to this country, regarding developments in facsimile transmission by wireless.

We are familiar with the work carried out in different parts of the world to bring to a high state of perfection methods for reproducing still photographs by wireless. These facilities are extensively used by the Press to-day and, from a somewhat crude beginning some years ago, there are now reproduced in our newspapers photographs transmitted by wire or wireless which would have to be examined closely to detect that they were not reproduced by ordinary photographic means.

Facsimile reproduction has many uses ; by its means police can receive photographs of wanted persons, copies of instructions from headquarters, whilst maps and weather charts can be communicated to ships and aircraft, as required, for navigational purposes. All these are useful applications for this equipment, but when we see sensational reports that apparatus of this kind is to be sold cheaply for installation in every home and capable of turning out a voluminous newspaper which will completely oust the daily Press, it is time to look into the matter and see just what foundation there is for such reports.

In spite of statements to the contrary, the cost of the receiving apparatus is unlikely, because of its complexity, to come down to a very low figure unless there should be a big demand on the part of the public. To create such a demand it would be necessary, surely, to satisfy the public that this equipment provided a better service than the newspaper. The apparatus records text and pictures on a continuous roll of paper of something under a foot wide, and, although the operation has been speeded up considerably in recent models, it would take a very long while for the machine to reproduce the whole of the news contained in a daily paper. The design of the apparatus has to permit of automatic stopping and starting when the broadcast transmissions take place, and the proposal is to transmit the newspapers in the early hours of the day so that the reception would be finished by the time the paper was wanted. Apart from all the obvious difficulties which present themselves, we feel that there is one outstanding problem which it would be by no means easy to overcome.

Who Would Pay ?

Without a very substantial revenue it would not be possible even to contemplate the cost of providing a news service on the lines of a modern newspaper, and it is difficult to see where a broadcasting station is going to derive the necessary revenue from this apparatus as a result of undertaking to utilise some hours daily of its transmissions to radiating the daily newspaper. We cannot see how an alternative service of this nature can ever succeed in competition with the newspaper, unless it is capable of giving a better service than the newspaper and can compete also on the question of cost to the user.

In areas where there is no newspaper distribution the transmission of a simple news-sheet by this method offers a valuable service, but, even then, we wonder whether the convenience would be so much greater than a spoken news-message as to outweigh the objection of cost.

Magnetic Tuning Devices

NEW DEVELOPMENT IN REMOTE CONTROL SYSTEMS

IN this series of articles a new tuning system is described which is especially suitable for remote control. Briefly, it consists of varying the inductance of a tuning coil by changing the permeability of its powdered-iron core. This is accomplished with the aid of an electro-magnet, the current through which can be controlled at any distance by means of a variable resistance.

By L. de KRAMOLIN

COMMONLY occurring problems in alternating current, and particularly high-frequency, technique demand for their solution the continuous variation of AC impedances —capacities or inductances. Such continuously variable impedances, or tuning devices as they are usually known in wireless technique, are for the most part components in which the twisting of a knob produces the required variation of capacity or inductance, a range of capacity or inductance being obtained by an alteration of the relative positions of different parts of the device. Thus the carrying out of a *mechanical movement* is an essential factor in the working of such a tuning arrangement.

There are, however, quite a number of cases where it is desirable to carry out the variation of impedance in a purely *electrical* manner, so that a change of regulating voltage or regulating current may produce a capacity or inductance variation. An obvious solution to this problem is to adjust one of the above-mentioned tuning devices by some form of electromotive drive such as an actual motor, an electric ratchet-wheel device, or the moving system of some electric meter. Such methods, however, are complicated and correspondingly expensive, and often unreliable, so that they can be introduced only to a very limited extent into radio receiver design, where cost has to be considered carefully.

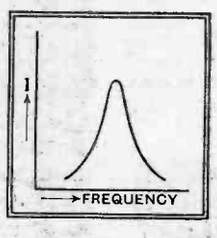


Fig. 1.—The resonance curve of an air-cored coil.

For a long time, therefore, other ways have been looked for to produce a direct electrical control of inductance or capacity. Theoretically, the following possibilities are available—no claim to completeness is made for the list. In the first place, our ubiquitous electro-technical device, the amplifier valve, can be turned to for help. A change of voltage can be used to produce a variation of the AC resistance between two valve electrodes, and thus, if that resistance is so connected as to have a capacitive or inductive character, to produce a variation of effective capacity or inductance. For covering a wide range of variation such an arrangement, however, is not suitable, for reasons which would take too long to discuss here.

Next we have the well-known condenser microphone or loud speaker as a possible device, since a voltage change at its electrodes produces a variation of capacity. But this is a return to the mechanical motion idea, which in many cases is undesirable in itself; moreover, the available capacity change is often inadequate, and further unpleasant features are the sensitivity to vibration and the fact that capacity changes are affected not only by the regulating voltage, but also by the signal voltages. Thus if a tuning device on the condenser-microphone principle were subjected to various different radio-frequency voltages (as would occur in a receiver when stations giving very differing field strengths were tuned in), strong signals would be liable to produce an electrostatic attraction between the condenser plates, so that the tuning would depend on the strength of signal. This objection would hold still more strongly if the device were used in a transmitter or other apparatus where the load voltages on the condenser would be much higher.

Magnetically Biasing the Core

Another possibility, already employed in power and low-frequency engineering, is the variation of the inductance of an iron-cored coil by regulating the magnetic bias of this iron core. But before this well-known and successful device can be adapted to high-frequency technique a number of difficulties must be overcome. Readers of this journal will understand at once that it is impossible to use, unchanged, the laminated iron-sheet cores ordinarily employed in low-frequency transformers and chokes. But by enormously reducing the thickness of the sheet it can be made suitable for radio-frequency working. For instance, tape or wire of ferromagnetic material, made as thin as is possible by mechanical methods, can be reduced still further in thickness by chemical corrosion of its surface;

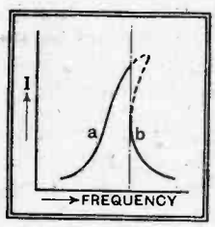


Fig. 2.—An iron-cored coil has a resonance curve with a tendency towards buckling.

such extremely thin elements can be built up into a core, interleaved with comparatively thick layers of insulating material of low dielectric constant so as to reduce as far as possible the capacity between the individual elements.

High-frequency coils wound on such cores actually give quite satisfactory values of damping and can be given a magnetic bias by means of DC windings, in the same way as the variable chokes used in low-frequency technique. In this way it is possible to obtain fairly large changes in inductance with comparatively small regulating inputs. The disadvantage of a mutual coupling between the high-frequency winding and the biasing regulating winding can be obviated by some well-known plan of differential working, the use of a three-legged core, etc. But other disadvantages remain, which lead to the discarding of this method also. In the first place, the construction of the core is expensive, so that the requirement of a simple and cheap tuning device is not satisfied. Secondly, oscillatory circuits embodying iron-cored coils of this type display a troublesome tendency towards what are known as "buckled" resonance curves, such as that seen in Fig. 2, which may be compared with the curve of a circuit with air-cored coil shown in Fig. 1. In plotting such a "buckled" curve, moving from the left towards higher frequencies, one passes along branch *a*, but at a certain point finds oneself in a region of instability (dotted portion) such that a further increase in frequency causes a sudden "jump" to the branch *b*. This effect is explained by the fact that during the plotting of the resonance curve the inductance itself alters its value. Before the resonant condition is reached the current amplitude in the oscillatory circuit is low, as is also the magnetic bias. In the neighbourhood of resonance, however, as a result of the increasing bias, the inductance is reduced by the oscillatory-circuit current (now much larger), and the resonance point is consequently displaced. Finally, such an arrangement has the defect already described in connection with devices on the condenser-microphone principle—namely, that the position of the resonance point depends on the amplitude of the signal oscillation.

An obvious method to try is to use the high-frequency iron cores, successfully

Magnetic Tuning Devices—

employed in high-frequency technique, made of very finely divided iron powder. An attempt to give a magnetic bias, by means of a suitable winding, to such a powder core showed, however, that, even with the use of a high biasing power, only small inductance variations could be obtained. The reason for this is easily seen: every reader of this journal knows what to do to prevent an iron-cored choking coil from having its inductance seriously altered by a DC component flowing through it—he introduces an air gap into the iron circuit and thus avoids an excessive increase of magnetic field strength at high current values. Considering now the construction of a powder core, made up of little particles of iron separated by insulating material, it becomes clear that the paths of the lines of force are broken by a large number of "gaps," so that the core must behave very much as the above-mentioned heavily loadable choke.

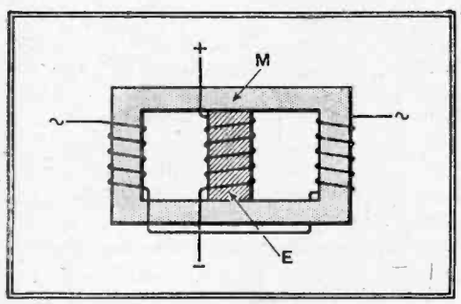


Fig. 3.—An early and unsatisfactory coil construction for magnetic tuning.

Such considerations have led to the idea of segregating the paths of the lines of force of the radio-frequency flux away from those of the flux produced by the regulating current. The first suggestion was to construct a three-legged core with the middle leg of solid iron or stamped sheets, and the rest of compressed-powder material, as shown in Fig. 3. This arrangement, however, brings no appreciable improvement, for the following reason. The cause of the unsatisfactory result of the attempt to bias an ordinary powder core by means of a winding round it was discussed above; put in other words, it was that the permeability—that is, the magnetic conductivity—of an HF powder core is very small compared with that of an ordinary transformer core. For the latter, one can count on a permeability of the order of 2,000 to 5,000, whereas for the material of a powder core that value is between 5 and 20—from a hundred to a thousand times smaller. That is to say, for the same magnetising current and with

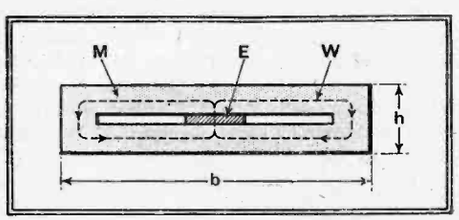


Fig. 4.—An extreme case of the core type of Fig. 3 with a very short centre-leg.

other conditions the same, the winding round a powder core would have to have 100 to 1,000 times the number of turns of a winding producing the same magnetic bias in an LF core, which is impossible on account of reasons of space. The behaviour of a composite core on the scheme of Fig. 3 is best considered by taking two limiting cases: Fig. 4 shows the first, where the breadth

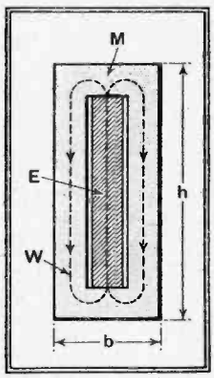


Fig. 5.—Another extreme in core construction; the centre leg is very long.

b of the whole core is made very great compared with its height h, so that the two horizontal parts of the core lie close together. The fact that in such a design there is no room left for the biasing winding we may neglect for a moment. The dotted arrows show the path of the lines of force of the biasing flux. Since the height of the solid-iron middle leg is practically zero, this leg has no influence on the magnetic resistance of the path; the effective permeability of the whole core is equal to that of the material M.

The other limiting case is shown in Fig. 5. Here the breadth of the whole is so diminished that the vertical surfaces are almost touching. Consideration of the arrows W, representing the path of the lines of force, shows that about half of this path

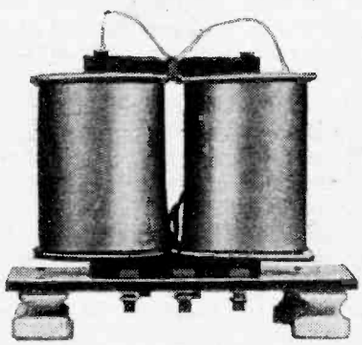


Fig. 7.—An experimental model with the core construction of Fig. 6.

lies in the material E and about half in the material M. The effective permeability along the whole path is thus given by the arithmetical mean of the two parts. Even assuming, as a limit, that the permeability of E is infinitely great (magnetic resistance zero), the best possible result would be a doubling of the permeability of the whole as compared with that of the material M; but such a core would be impracticable, since there would be no room for the HF or the regulating windings.

In practice, therefore, the best that can be hoped for from such a design is an increase of the effective permeability by about 50 per cent., whereas an increase of 10,000 to 100,000 per cent. would be needed if the conditions of LF cores are to be obtained. Even if one were disposed to allow a considerably higher expenditure of energy in regulating, this attempted solution appears hopeless.

However, an inversion of the arrangement shown in Fig. 4 has finally led to the development, in the writer's laboratory, of a method which has shown itself to be practicable. Fig. 6 shows the construction employed. The HF powder core M of low permeability lies between the poles of the outer magnet E. The path of the biasing flux is once again indicated by the arrow W. Here, as before, the biasing flux has to flow in succession through two

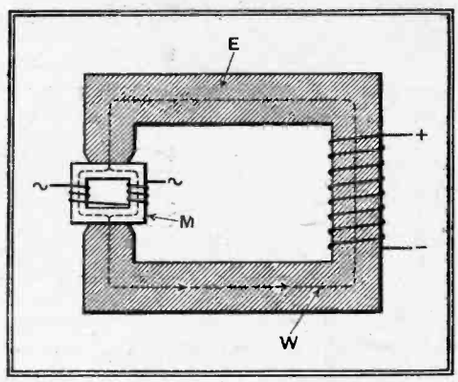


Fig. 6.—The final type of core construction is shown here.

materials, E and M, of very different permeabilities; but since the path in the high-permeability material E is long compared with the path in the low-permeability material M, a resultant effective permeability approaching that of the material E is obtained for the biasing flux. This gives the possibility of obtaining, with the expenditure of reasonable amounts of regulating energy, field densities in the HF powder core M high enough to produce strong saturation effects in this material, and consequent large inductance changes in a HF winding wound on M.

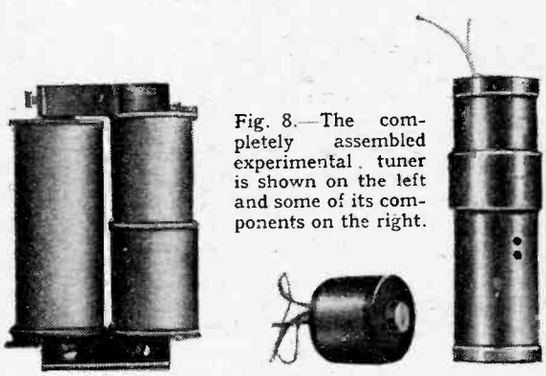


Fig. 8.—The completely assembled experimental tuner is shown on the left and some of its components on the right.

On the other hand, the lines of force of the HF field run almost exclusively in the small pressed-powder core. This, in the first place, means that the coil damping remains within reasonable bounds; in the second place, it ensures that the HF current itself can produce no appreciable change in inductance by an additional biasing effect. The value of inductance is thus practically independent of signal amplitude.

Figs. 7-10 show various designs in which

Magnetic Tuning Devices—

the scheme has been carried out. With the expenditure of maximum regulating

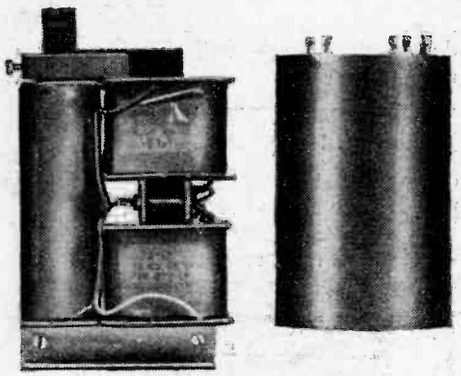


Fig. 9.—(Left) An unshrouded tuning unit made by Siemens and Halske with Fig. 10 (right) a shrouded model.

energies from 1½ to 5 watts, these designs have given inductance variations in the ratio of 1 : 9, corresponding to a frequency-variation ratio of 1 : 3 in an associated oscillatory circuit. By the use of an auxiliary bias by permanent magnets these amounts of regulating energy can, with a suitable circuit arrangement, be reduced by 50 or even 70 per cent.; but this is only rarely needed.

Experiments have already proved the suitability of such a "variometer" for wide ranges of frequency. Using specially developed materials for the HF core, types have been constructed for long waves and also for ultra-short. The units seen in Figs. 7 and 8 were made in the writer's own laboratory, those of Figs. 9 and 10 being constructed by Messrs. Siemens and Halske, Berlin. They are applicable to the solution of many problems, such as remote tuning, remote volume control, and remote selectivity control, as well as automatic tuning correction and automatic volume and selectivity control. Further information on the characteristics of these variometers will be given in a later issue of this journal.

Hints and Tips

Negative Feedback Tone Control

THE inclusion of negative feedback in any set or amplifier provides an extremely simple and convenient means of controlling tone. There is no difficulty in arranging for gradual variation, up or down, of both bass and treble independently, but for the sake of clarity the type of control illustrated schematically in Fig. 1 is of the simplest; in this case a single rotary switch having three positions is used. In spite of its simplicity it is none the less a control of tone in the fullest sense, for these positions correspond respectively to top boost, normal and bass boost. In order to obtain sufficient accentuation of top or bass compared with normal, it is necessary to have a fairly large amount of feedback—*i.e.*, a rather lower resistance for R than would normally be employed, but not so low as to allow motor-boating to occur.

The purpose of the various condensers is to discriminate in the amplification of either high or low frequencies by reducing the amount of feedback at those frequencies. For example, C2 reduces the feedback by presenting a higher impedance to low notes than C1, while C3, when switched across R, presents a low-impedance path to high frequencies and so cuts down the feedback of high notes. The values given are purely arbitrary, and must be chosen to suit the particular set for best results. A more gradual variation between the two extremes of bass and treble can, of course, be arranged by using a number of intermediate switch positions, with a corresponding number of series and parallel condensers; top cut may also be introduced at the same time as bass boost, and vice versa.

It might also be an advantage to include a dummy or "off" position, particularly for long-distance SW reception, as it would have the effect of making a noticeable increase in sensitivity without any very noticeable loss of quality.

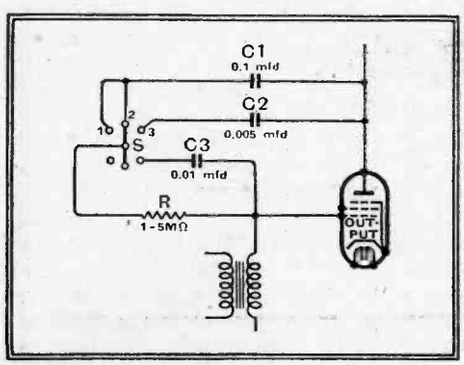


Fig. 1.—Tone control circuit providing top boost (position 1) normal (2) and bass boost (3).

Dust Covers

FOR various reasons—perhaps laziness, perhaps love of "tinkering," perhaps lack of funds—it seems that a large proportion of home-constructed sets never achieve the dignity of a cabinet to house them. Putting entirely aside for a moment the relatively unimportant matter of appearance, we should realise that this practice of leaving a naked chassis lying about indefinitely is hardly defensible; there is the ever-present risk of shock to the inexperienced persons, while the ravages of dust, and possibly damp, are left to do their utmost to mar an otherwise blameless performance.

It is suggested that rather than go to the trouble of fixing the set in some kind of makeshift cabinet in order to relieve one's conscience on these points, the same purpose can be served perfectly satisfactorily by making a "tailor-made" dust-cover from thick cardboard. The cutting-out and fitting of such a cover is explained by Fig. 2 (*a*) and (*b*), and it will be noticed that no screws or other fixing devices are used to hold it in place. A receiver in

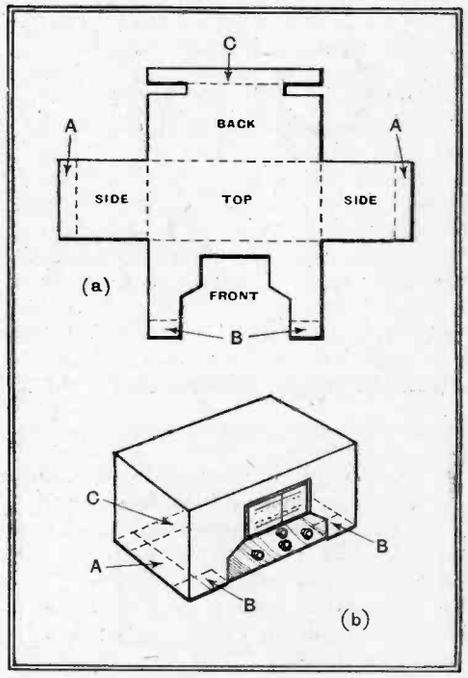


Fig. 2.—How to make a chassis cover of cardboard. The portions A, B and C are folded after scoring along the dotted lines.

chassis form is often the subject of experiments from time to time, and as by adopting this method the cover can be removed in a few seconds there can be no criticism on the score of inaccessibility.

4 Volts to 6.3

IT is usually quite a simple matter to obtain a heater voltage of 6.3, as required for the new-type valves, as it is only necessary to wind extra turns on to an existing 4-volt winding on the mains transformer. Provided that there is just room for the extra wire between the bobbin and the core, there should be no difficulty, once the laminations have been dismantled. Having found the outer end of the wire, a further 14 or 15 turns of the same gauge wire must be wound on, as tightly as possible, in the same direction. This will be about right for the average design of transformer.

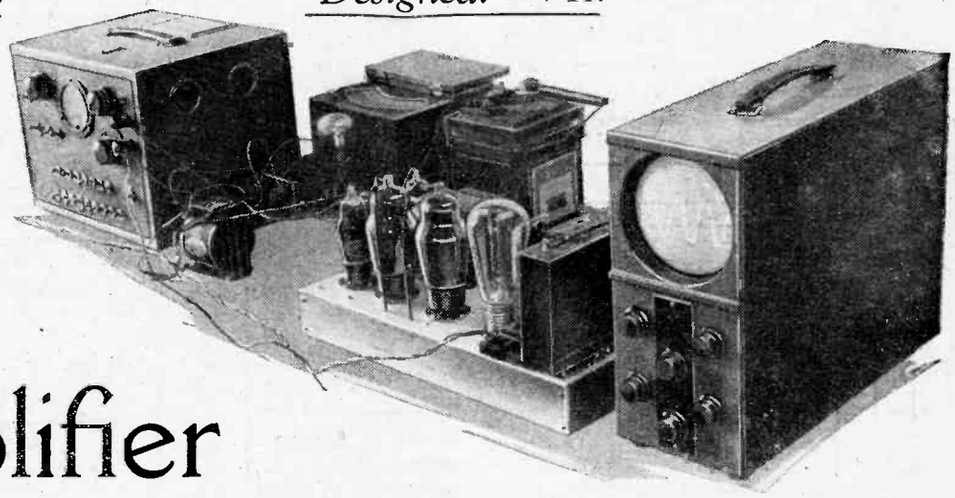
Invicta Model 500

IN this new AC superhet. (5 valves including rectifier) the normal functions of the wave-range switch are combined with pre-selection of five stations in a ten-position selector switch. For normal operation the Invicta spin-wheel drive is included. Special precautions have been taken to ensure stability of tuning, and in the case of the IF circuits a fixed spray-coated mica condenser is used instead of the usual variable trimmer.

The set will be available at the beginning of March and will cost £13 19s. 6d.

How a Receiver is Designed.—VII.

DC Quality Amplifier



(Concluded from page 146 of last week's issue)

THE FINAL CIRCUIT DETAILS AND CONSTRUCTION

IN the previous articles of this series the design of the Quality Amplifier has been dealt with in detail and the complete circuit diagram is given in Fig. 12. In this diagram one or two minor additions will be seen. The first is the inclusion of fuses in the mains leads, and the reason for this as a safety precaution is obvious. The total current consumption of the receiver is 0.425 amp., so that 1-amp. fuses should afford ample protection, while giving a reasonable factor of safety against blowing through surges.

The other addition consists in the inclusion of the two 0.1-mfd. condensers, C1 and C2, between the pick-up terminals and the volume control R1. These are included in order to insulate the pick-up from the mains, for it must be remembered that with DC mains equipment the circuits are all in direct connection with the supply, and it is consequently a wise precaution to insulate adequately any part, such as the pick-up, which will be handled. The pick-up leads should, in general, be screened, and in many cases it may be satisfactory to connect the screening to a local earth. It is often found, however, that this introduces serious hum because there is usually a difference of potential between the negative mains lead and local earth. In general, therefore, it is better to connect the screening to the earthy pick-up terminal and it can actually be used for this connection to the pick-up. It may be remarked that the resistance R13 (43.5 ohms) consists of two resistances in parallel, one of 50 ohms and the other of 350 ohms.

IN this article the design of a high quality amplifier for DC mains operation is concluded and its construction is dealt with. Details are also given of its performance on test; it was found to give an output of 5 watts and to have a frequency response flat within ± 0.4 db. over the range of 20 c/s to 20,000 c/s.

Little need be said about the actual construction of the amplifier, because this is fully shown in the drawings which accompany this article. A four-pin socket is provided for the speaker connections, two for the speech coil, and two for the field. If a permanent-magnet speaker is used no connection should be made to these two points, but with an energised model the field can be of any resistance suitable for direct operation from the mains.

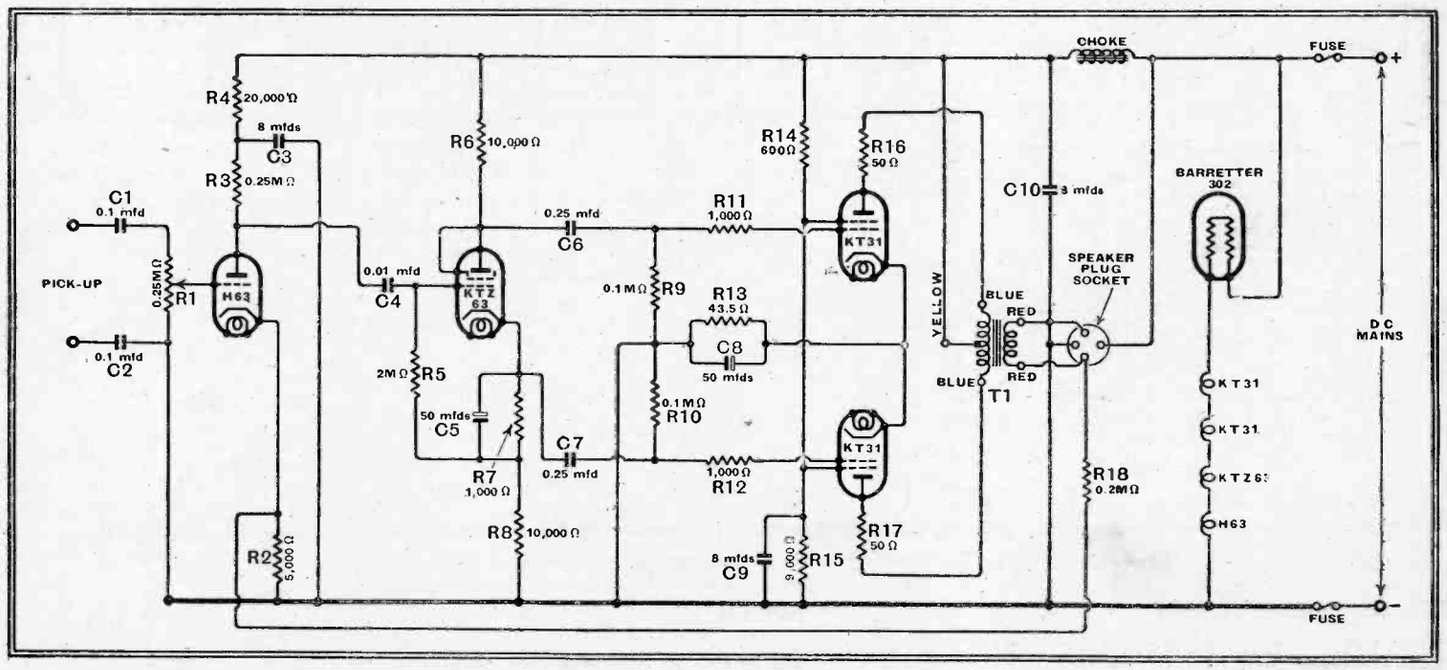
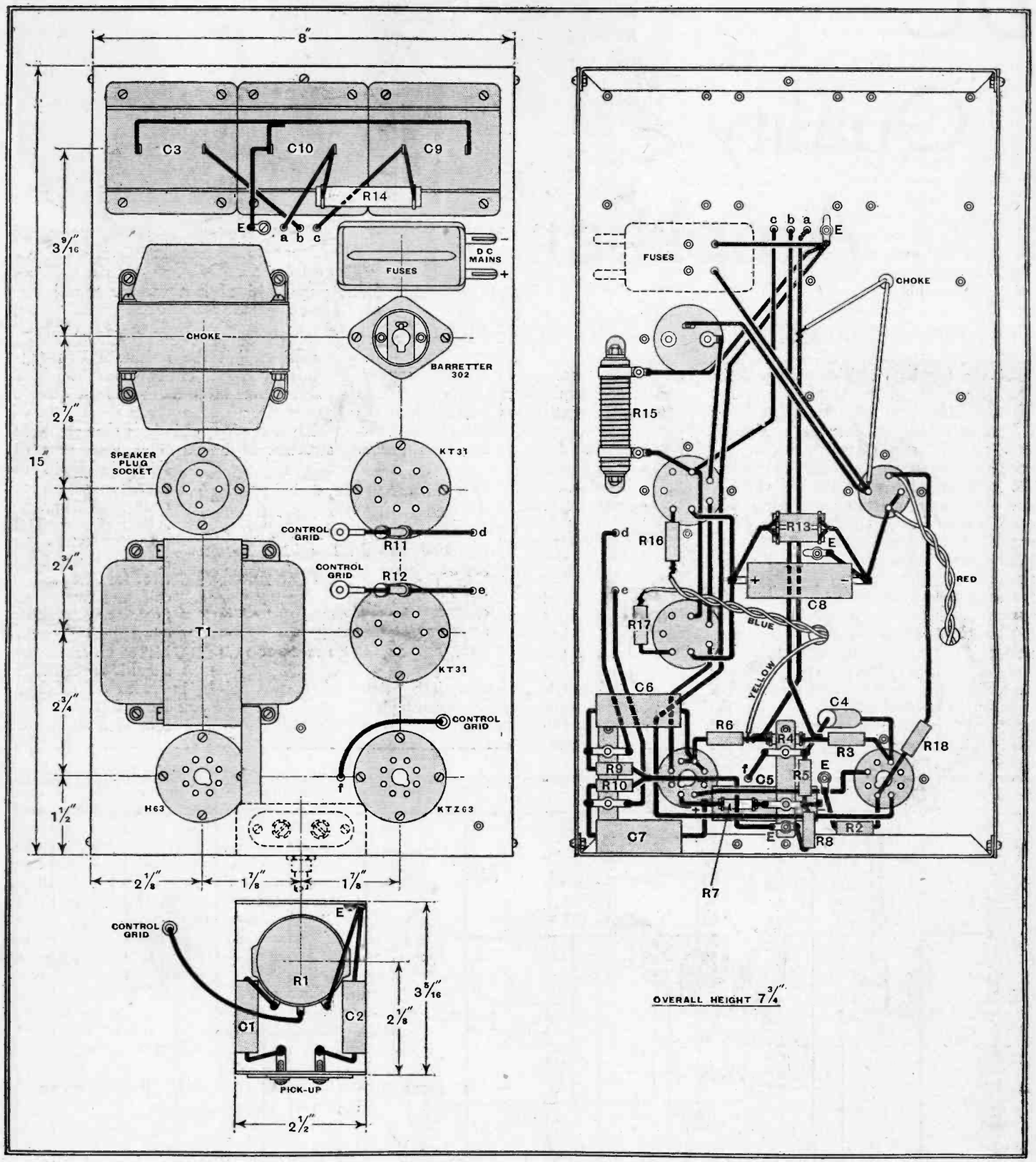


Fig. 12.—The complete circuit diagram of the amplifier is shown here. The condensers C1 and C2 are for the purpose of insulating the pick-up from the mains.

DC Quality Amplifier—

For the specified output transformer the loud speaker should have a speech coil impedance of 15 ohms and should not, of course, be fitted with a transformer. For a loud speaker of different impedance a different output transformer must be fitted, and as this forms part of the feedback circuit it will also be necessary to change the value of R18. A list of values for R18 for different output transformer ratios is given in the accompanying table. The volume control and input terminals are carried by a bracket above the chassis, since this gives a short connection to the top-grid of the first valve. It would obviously be absurd to place the volume control below the chassis, since this would entail a long grid lead, which would pick up hum and would nullify the advantage of the top-grid connection in providing a low-grid anode capacity in the valve.

In operation care should be taken to insulate the chassis, since all the metal work is directly connected to the mains. When the negative of the mains is earthed there is little danger of a shock, because the difference of potential between the negative of the mains and local earth is quite small, but there is such a risk when

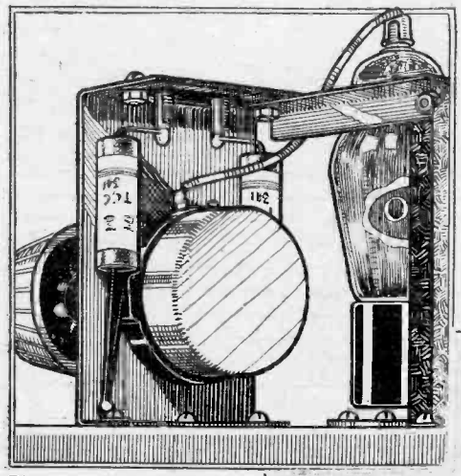


Full constructional and wiring details of the amplifier are given in these drawings.

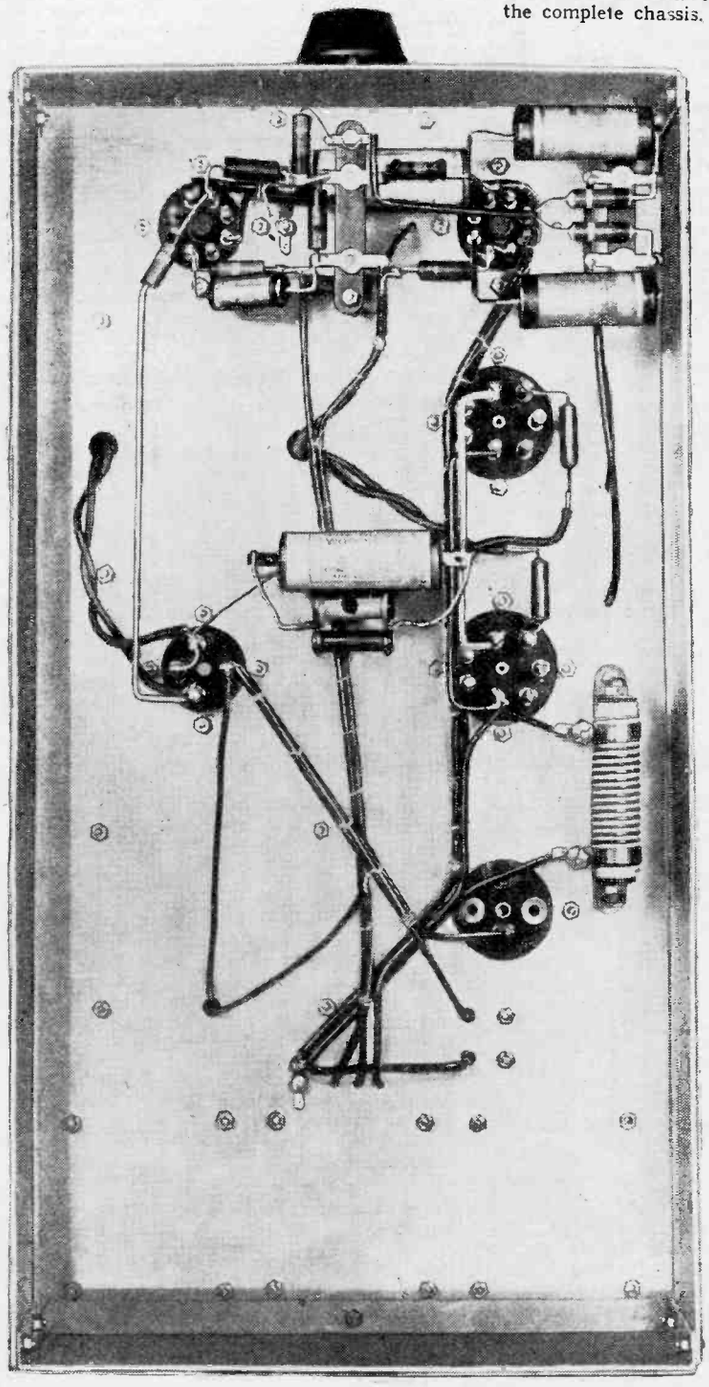
DC Quality Amplifier—

the positive of the mains is earthed, so that the amplifier should not be operated in an exposed position but enclosed in some form of cabinet which will, naturally, not be of metal. It is wise, also, to see that the grub screw in the volume control knob is sufficiently deeply countersunk to prevent accidental contact being made with it.

Turning now to the operation, the amplifier under test performed admirably and the response curve shown in Fig. 13 was obtained. This is an over-all curve from the input terminals to the output transformer secondary. The response is −0.7 db. at 20 c/s, and it rises to +0.1 db. at 10,000 c/s, falling again to zero db. at 20,000 c/s. Nothing better than this will ever be needed for sound reproduction, since the changes in response are quite inaudible.



The sketch and photo show the method of supporting the control panel. Below is seen an under side view of the complete chassis.



a cathode-ray oscillograph, the wave form remained good for outputs slightly exceeding 5 watts at 400 c/s and for outputs of up to about 5.5 watts at 2,000 c/s. At very high and very low frequencies the outputs obtainable were slightly less, but did not fall off to any great extent, the maximum output at 20 c/s being about 4½ watts, and at 20,000 c/s about 4.8 watts. An output greater than this at these frequencies is, of course, never likely to be required, since it is unlikely that the

The input-output curve is shown in Fig. 14 and is a straight line up to an output slightly exceeding 5 watts and for an output of 5 watts it can be seen that the input required is 0.47 volt RMS. This shows very good agreement between the calculated and the measured characteristics. Tested with frequency response of the transmitting equipment, of any receiver, or of the recording apparatus in gramophone work, will be good enough to maintain such frequencies at their full intensity. It is also unlikely that in the original performances notes of such frequency will occur with the same intensity as those towards the middle of the audible range.

The amplifier can thus be considered as practically perfect for the purpose for which it has been designed, and it has a performance which is indistinguishable from that of the original Push-Pull Quality Amplifier designed for AC mains.

Since the output transformer leads are

TRANSFORMER RATIOS AND FEED-BACK CIRCUIT CONSTANTS

Speech Coil Impedance Ω	Output Transformer Ratio	Value of R18 Ω	Nearest Standard Value Ω
15	27.1—1	200,000	200,000
8	37.2—1	146,000	150,000
4	52.5—1	103,000	100,000
2.5	66.4—1	82,000	80,000
2	74.4—1	73,000	75,000

DC Quality Amplifier—

not marked to distinguish the inner and outer ends of the windings, it is necessary to determine the correct secondary connections experimentally. When first setting up the amplifier, therefore, disconnect R18 from the secondary, so removing all feedback. With the amplifier operating, touch

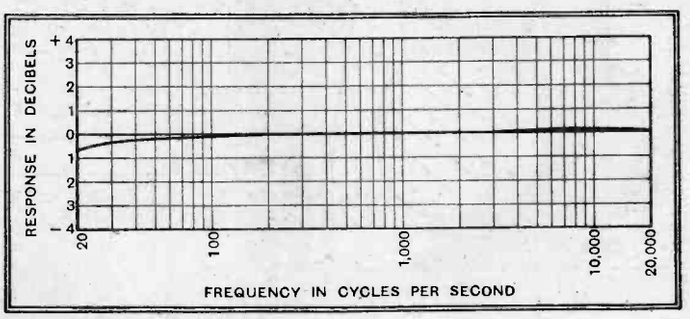


Fig. 13.—The overall frequency response curve is shown here. It is measured between the input terminals and the output transformer secondary.

the free end of R18 on to the unearthed end of the secondary. If the transformer connections are correct the gain will drop considerably, but if they are wrong the amplifier will oscillate violently. If the amplifier does oscillate, remove R18 at once and reverse the secondary connec-

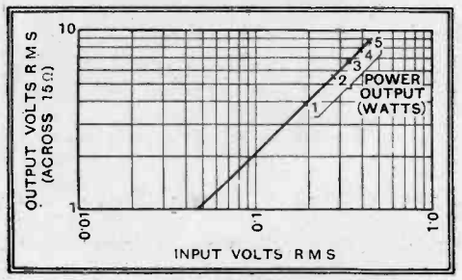


Fig. 14.—The input/output curve is a straight line for outputs up to 5 watts, indicating that there is negligible amplitude distortion.

tions of the transformer; R18 can then be permanently connected with the assurance that the connections are right.

The question of valves is of some importance. There is no alternative to the KT31 for the output stage, but the Marconi and Osram Z63 can be used instead of the KTZ63 without any change in the amplifier. Other alternatives for the H63 and KTZ63 are the 6F5 and 6J7 respectively in either British or American types; if the latter are used they can be metal, metal-glass, or glass valves.

LIST OF PARTS.

1 Output transformer, push-pull, primary for 11,000 ohms anode-to-anode load, secondary to suit speech coil of speaker. Ratio 27:1 for 15 ohms speech coil, **T1** — **Savage PP27/1**

1 Smoothing choke, 6-8 H, 150 mA, 100 ohms — **Ch** — **Sound Sales 68/150**

Condensers:

2 0.1 mfd., 350 volts working, tubular — **C1, C2** — **T.C.C. 341**

2 0.25 mfd., 350 volts working, tubular — **C6, C7** — **T.C.C. 341**

1 0.01 mfd., 450 volts working, tubular — **C4** — **T.C.C. 451**

3 8 mfds., 250 volts working, **C3, C9, C10** — **T.C.C. 65**

2 50 mfds., 12 volts working electrolytic — **C5, C8** — **T.C.C.FT**

1 Volume control potentiometer, tapered, 0.25 megohm, **R1** — **Reliance SG**

1 Valve holder, 4-pin (without terminals) — **Clix Chassis Mounting Standard Type V1**

2 Valve holders, 7-pin (without terminals) — **Clix Chassis Mounting Standard Type V2**

2 Valve holders, octal type, 8-pin — **Clix V4**

1 Barretter holder — **Bulgin ES2**

1 Plug, 4-pin — **Bulgin P9**

1 Skeleton terminal strip, 2-way, PU — **Bulgin T10**

2 Plug-top valve connectors — **Belling-Lee 1175**

Resistances:

3 50 ohms, ½ watt, **R13†, R16, R17** — **Erie**

1 350 ohms, ½ watt, **R13†** — **Erie**

3 1,000 ohms, ½ watt, **R7, R11, R12** — **Erie**

1 5,000 ohms, ½ watt, **R2** — **Erie**

2 10,000 ohms, ½ watt, **R6, R8** — **Erie**

1 20,000 ohms, ½ watt, **R4** — **Erie**

2 100,000 ohms, ½ watt, **R9, R10** — **Erie**

1 *200,000 ohms, ½ watt, **R18** — **Erie**

1 250,000 ohms, ½ watt, **R3** — **Erie**

1 2 megohms, ½ watt, **R5** — **Erie**

1 600 ohms, 2 watts, **R14** — **Erie**

1 9,000 ohms, 10 watts, **R15** — **Bulgin RV11A**

† R13 comprises 1×50Ω and 1×350Ω in parallel.

(* *See text*, value depends on output transformer ratio.)

2 Grid clips, octal type — **Bulgin P96**

1 Fused mains input connector with 1 amp. fuses — **Belling-Lee 1114**

Chassis, with brackets, etc. — **Scientific Supply Stores**

Miscellaneous: — **Peto-Scott**

6 lengths systoflex, 2 ozs. No. 18 tinned copper wire, 2 paxolin terminal strips, etc.

Screws: 4 ½-in. 6 BA R/hd.; 60 ¼-in. 6 BA R/hd., all with nuts and washers; 4 1-in. 6 BA R/hd., with 3 nuts and washers to each.

Valves: — **Osram**

2 KT31, 1 KTZ63, 1 H63, 1 302 barretter

News from the Clubs

Derby Short-Wave Radio and Experimental Society

Headquarters: Nunsfield House, Boulton Lane, Alvaston, Derby.
Meetings: Tuesdays at 8 p.m.
Hon. Sec.: Mr. H. Turner, Nunsfield House, Boulton Lane, Alvaston, Derby.

The society have a number of vacant dates for lectures and demonstrations, and would appreciate offers from firms willing to assist in filling them.

Recent lectures have included "Rectification," by Mr. L. Jackson, and "Reaction," by Mr. Eccles, the chairman, while at one meeting a debate was held on "Straight Sets *v.* Superhets." On March 1st Mr. E. V. R. Martin, the president, will talk on the subject of "Aerials."

Dollis Hill Radio Communication Society

Headquarters: Braincroft Schools, Warren Road, London, N.W.2.
Meetings: Alternate Tuesdays at 8 p.m.
Hon. Sec.: Mr. J. R. Hodgkyns, 102, Crest Road, Cricklewood, N.W.2.

Among the society's recent activities have been the following:—A visit to Dr. C. G. Lemon's laboratory for a lecture and demonstration of 2½- and 5-metre transmitters and receivers. A visit to the "Vitavox" factory, where a lecture and demonstration was given on PA by Mr. E. A. Young. A talk by Mr. E. Cholot, of Lissen, on the firm's 4-8-metre "Hi-Q" receiver and other apparatus. A lecture and demonstration by Mr. S. R. Wilkins, of the Automatic Coil Winder Co., on his firm's new signal generator and baby oscillator. On March 8th Mr. H. G. Menage, of Rothermel's, will give a lecture and demonstration entitled "Piezo Crystals and Their Application."

Radio, Physical and Television Society

Headquarters: 72a, North End Road, London, W.14.
Meetings: Fridays at 8 p.m.
Hon. Sec.: Mr. C. W. Edmans, 72a, North End Road, London, W.14.

At a recent meeting a lecture was given by Mr. C. W. Edmans entitled "Electrical Measuring Instruments." Special thanks are due to the Automatic Coil Winder and Electrical Equipment Co. for the loan of a demonstration model showing the mechanism of the well-known cut-out device used on the No. 7 Avometer. Thanks are also due to Dr. C. G. Lemon for the loan of a large collection of measuring instruments, including a special galvanometer of his own design.

Dr. C. G. Lemon recently gave another of his interesting lectures, the subject being "Ultra-short-wave Receivers." In the course of the lecture various types of receivers suitable for use between the wavelengths of 1½ and 5 metres were described, including several suitable for the society's proposed 2½-metre field day. The greater part of Dr. Lemon's lecture dealt with super-regenerative receivers, superhets being not yet of great utility on these wavelengths, according to the lecturer, on account of the poor quality of amateur transmitters. Various types of self-quench receivers were described, but the most useful set appeared to be a 3-valve separate-quench set in which the hiss—some is present in all super-regenerative sets—was found to be of insufficient strength to spoil reception even of weak signals having a carrier not strong enough to cause complete cessation of hiss.

British Sound Recording Association

Headquarters: 44, Valley Road, Shortlands, Kent.
Hon. Sec.: Mr. J. F. Butterfield, 7, Ernest Close, Beckenham.

A joint meeting was recently held with the Croydon Radio Society, and a lecture was given entitled "Sound Recording on Direct Playback Blanks" by Mr. L. Widger, who is recording engineer for St. Dunstan's and the National Institute for the Blind. Among the apparatus used at the demonstration following the lecture was a *Wireless World* recording amplifier and a portable recorder provided by Mr. O. Katz, of the V.G. Manufacturing Co. An amateur-constructed ribbon type microphone and an Epoch moving-coil instrument were employed for recording. Good results were obtained, the blanks employed being of the Phonodisc, Pyral and Simplat types.

North London Radio Society

Hon. Sec.: Mr. E. Jones, 60, Walmer Terrace, Firs Lane, Palmers Green, London, N.13.

The above society has been formed from the Tottenham Short Wave Club in order that people interested in all aspects of radio may become members and not only those interested in short waves. The society are holding three visitors' evenings at the New Trades Hall, Tottenham, London, N.17, on February 24th, 25th and 26th, for which tickets may be obtained on receipt of a stamped addressed envelope.

Exeter and District Wireless Society

Headquarters: 3, Dix's Field, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

At the first meeting of the Spring session Mr. H. A. Bartlett talked on the subject of "First Considerations for the Would-be Transmitter." At a later date Mr. E. Gibbs, of Bristol, gave a lecture entitled "The Evolution of the Superhet," in which he traced its growth from the time in which it was invented in 1917. At the next meeting a talk is being given jointly by Mr. and Mrs. Rumball entitled "Electricity in the Home."

Inter-Communication Systems

THE electrical amplification of sound finds many uses in everyday affairs; it is now being employed in loud-speaking telephones of which a brief description is given in this article.

PRINCIPLES AND OPERATIONS OF THE LOUD-SPEAKING TELEPHONE

By H. B. DENT

IT might be advisable at the outset to clarify the position and define what is understood by an inter-communication system, or, more to the point, what the present-day use of the expression connotes.

Telephones of the orthodox pattern wired for inter-office use either in one building or in a block of buildings but not connected to the Post Office telephones have for long served this purpose, and are often, and correctly, described as inter-communication systems.

When we speak of an inter-communication system to-day, however, it is generally understood to mean a form of loud-speaking telephone in which sound amplification is employed. Cinema patrons will know what is meant, for they figure very largely in almost every office scene in American films.

The idea is perhaps not new, for the writer believes some form of mechanical amplification was tried in connection with office telephone apparatus many years ago, but what became of it or why it failed to survive is not known.

The obvious advantage of the scheme is that anyone within a reasonable distance of the instrument can receive and reply to a message without interrupting or leaving whatever work he or she may be doing at the time.

Many examples of their applications could be given, but as most of them can be visualised by giving a little thought to the matter, it seems unnecessary to enumerate them here. What is, perhaps, of greater interest, at least to readers of this journal, is the apparatus itself and the manner in which it operates.

Loud speakers and valve amplifiers are used, so there is a close connection with wireless—or should it be public address?—practice. Anyway, the two are so closely interwoven that it is difficult to say exactly where one ceases and the other commences.

No radio frequencies are, however, involved, and the apparatus produced in this country operates exclusively at audio frequency.

One method of arranging a system of this kind would be as shown in Fig. 1. At each end of the line, assuming for the moment only two points are wired for communication, is a loud speaker and a microphone.

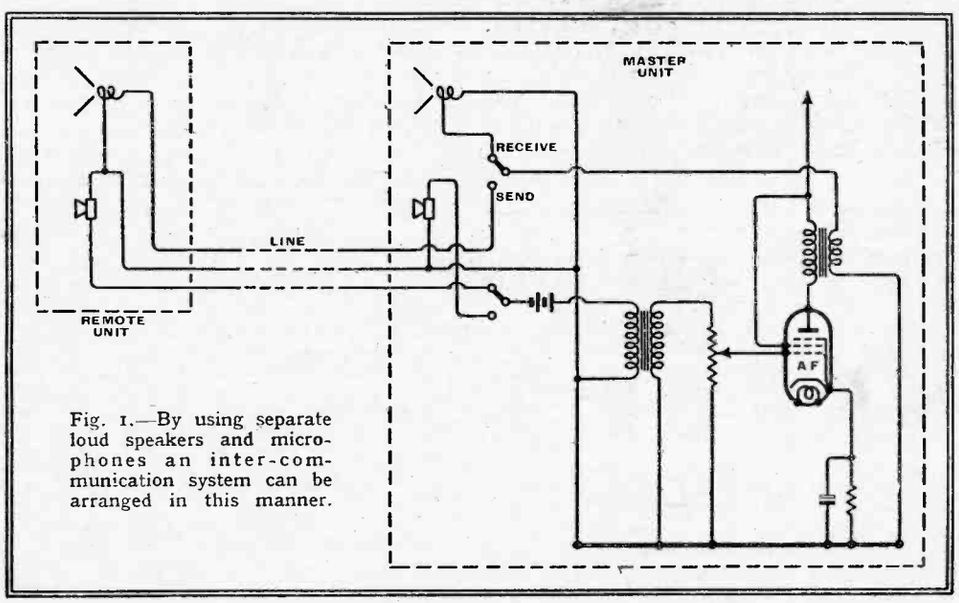


Fig. 1.—By using separate loud speakers and microphones an inter-communication system can be arranged in this manner.

An amplifier is employed, and by means of switching it is made to work alternatively from the home and from the distant microphone. Concurrently with this change, the appropriate loud speaker is switched into the output circuit. Switching to serve two remote points as well as the home position could quite easily be included, but all changes will have to be effected at the amplifier. In fact, this is the central station and the main unit containing the switching and amplifying equipment is generally called the master unit.

A single stage amplifier with one of the high-slope pentode valves, either battery or mains operated, should suffice in this case, as it is assumed that the microphone would be a carbon type giving a reasonably large output. It should be quite suitable for a small installation where no great distance separates the two points.

The system is, of course, for simplex working only; that is to say, a manual change-over from talk to listen has to be made. So far as the writer is aware, all such commercial systems are for simplex operation, and not duplex, which enables each point to break-in as required.

By installing one of the master units, that is, the one containing the amplifier and switching, at all locations it would then be possible for all points to communicate with each other.

This facility is not always needed, but it is useful to know that the system can be arranged to give this service should it be required.

Separate microphones and loud speakers are not essential for the operation of an inter-communication system, for, as is well known, a loud speaker will function quite as well as a sound transmitter. Its electrical output is much smaller than that of an ordinary carbon microphone, but an extra stage in the amplifier will, in most cases, make good this deficiency.

The difference in cost between a single-

Inter-Communication Systems—

and a two-stage amplifier is comparatively small, especially if the unit is mains-operated, since it adds nothing to the cost of the power supply equipment. On the other hand, a saving can be effected in the wiring as two conductors only are needed for the line, whereas three are shown in Fig. 1. Single-pole switches replace the two-pole type, so that it is possible this arrangement would cost no more, and might even work out cheaper when everything is taken into account.

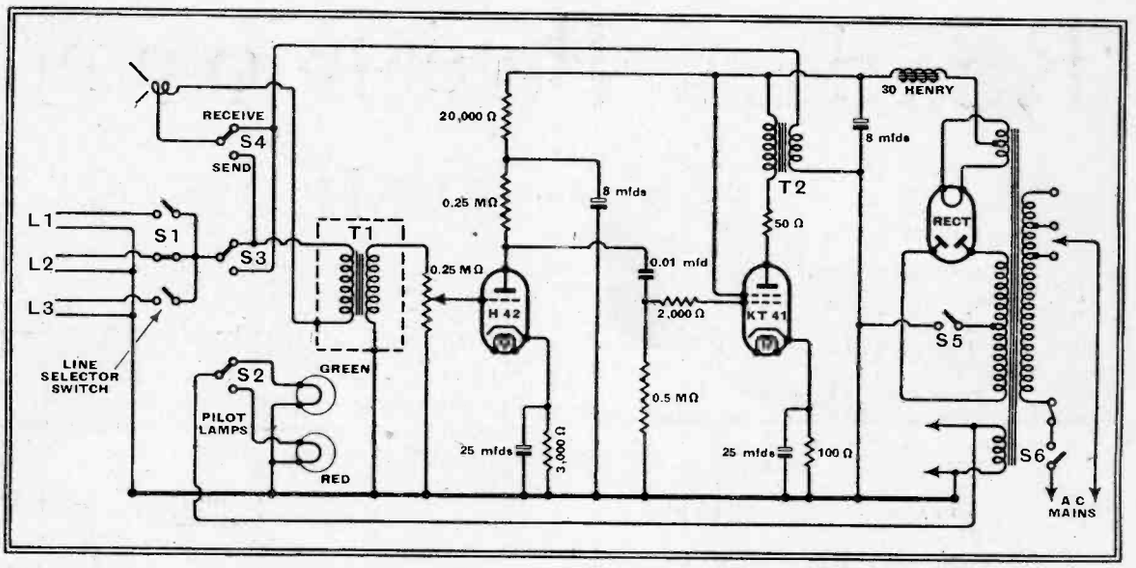


Fig. 2.—Suggested circuit arrangement for the master unit of an inter-communication system in which the loud speaker functions also as a microphone. It is AC operated and any number of extension lines can be included.

An inter-communication set of this kind would take the form shown in Fig. 2, which is the circuit of the master unit. As arranged it provides for communication with three remote points, but any number of outgoing lines can be included, and at each distant point one loud speaker unit only is required.

The entire system is controlled at the master unit, which in this case includes several useful, but not necessarily essential, features. For example, switch S2, which is ganged with S3 and S4, the send-receiver switch, controls two pilot lamps, one red, the other green. Red indicates that the switching is set for speaking at the master unit, while when listening or receiving, a green light shows.

The line selector S1 actually consists of a series of single-pole on-off switches, which individually select the line to the remote point required, but more than one can be put in the "on" position, and this joins all lines thus selected in parallel, and any message sent from the master unit will be heard simultaneously at all these distant points. Likewise, the replies from all points selected by S1 will be heard at the master unit when the send-receive switch is in the receive position.

Switch S5 is included to disconnect the HT supply when the system is not in use, but as the filaments of the valves are kept heated the set is ready for immediate use on closing S5.

It will be noticed that the customary reservoir condenser is not included after the mains rectifier, as it is felt that the sudden charging up of this condenser at full voltage on closing S5 might prove harmful to the mains rectifier. The initial charging current will be very high unless quite a small capacity is employed.

Its omission will entail increasing the secondary volts by about 20 per cent.; thus, if 250 volts HT is needed, the mains transformer should supply 300-0-300 volts RMS.

There are several points in a circuit of this kind where trouble might arise. Instability would be one if the input and output circuits couple by means of the switches and wiring, so that in a practical unit S3 and S4 ought to be reasonably well screened.

The input transformer T1, which, incidentally, will require to have a high step-up ratio, viz., about 1 to 100, is always a danger point so far as hum pick-up is concerned, and this can only be avoided by enclosing it in a metal box with thick walls.

Though the best ratio for the input transformer would be 1 to 100 for an average low-resistance loud speaker, quite good results will, however, be obtained with a microphone transformer of about 1 to 70 ratio, which is probably a more easily obtainable component than the former.

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, FEBRUARY 24th.

Nat., 6.20, A talk on the 17th Century Exhibition at Burlington House, by Leigh Ashton. 7.30, Scrapbook for 1900, presented by Leslie Bailey and Charles Brewer. 9.20, Teddy Joyce and his Band.

Reg., 6, Alfredo Campoli and his Orchestra. 7.30, The Hallé Orchestra, from Manchester. 9.35, "The King of Spain's Daughter"; play by Teresa Deevy.

Abroad.

Hamburg, 7, "Casanova"—opera (Lortzing).

Brussels I, 7.30, "Tristan and Isolde"—opera (Wagner).

FRIDAY, FEBRUARY 25th.

Nat., 6.30, "Lines on the Map"—2. Dealing with Empire Communications. 7, The Music of Franz Lehár: an International Concert from Vienna, with Richard Tauber. 8, Kentucky Minstrels.

Reg., 7.30, Swing Music from Denmark. 8, Billiards Commentary. 9, Repetition of "Scrapbook for 1900."

Abroad.

Milan, 8, Liszt and Debussy Symphony Concert.

Bucharest, 8.20, "I Pagliacci"—opera (Leoncavallo).

SATURDAY, FEBRUARY 26th.

Nat., 6.45, Morris Motor Band. 8, Music Hall, including Vic Oliver and Elsie and Doris Waters. 9.20, American Commentary.

Reg., 6, Yascha Krein and his Gipsy Orchestra. 7.30, "Lewis"—Life in the Outer Hebrides. 9.20, Billy Merrin and his Band.

Abroad.

Warsaw, 7, "Waltzes from Vienna"—operetta.

Alpes-Grenoble, 8.30, "La belle Hélène"—operetta (Offenbach).

SUNDAY, FEBRUARY 27th.

Nat., 7.20, Fact or Fiction?—An enquiry into the possible existence of Unicorns. 9.5, "I Was There"—The Battle of Majuba Hill by Sir Ian Hamilton. 9.25, A Potpourri of Music by Julius Offenbach.

Reg., 6.30, B.B.C. Orchestra (D), conducted by Sir Adrian Boult. 9.5, Fred Hartley and his Sextet. 9.30, Sonata Recital by Ethel Bartlett and Rae Robertson (two pianos) and David Wise (violin).

Abroad.

Athlone, 7.10, Thomas Moore Anniversary Concert.

Munich, 7.30, "Die Fledermaus"—operetta (Johann Strauss).

MONDAY, FEBRUARY 28th.

Nat., 7, "Monday at Seven." 8, Talk on the Structure of the Cinema Industry. 9.20, "World Affairs." 10, The Haigh Marshall String Orchestra.

Reg., 7.30, Edward Isaacs, pianoforte. 8, Swing Music from America. 9.15, Musical Reminiscences—"I Remember."

Abroad.

Frankfurt, 6.10, Rose Monday Concert.

Radio Paris, 8.30, "Gwendoline"—opera (Chabrier).

TUESDAY, MARCH 1st.

Nat., 7.50, "Aerbut and Gaertie": a Birmingham sketch. 8, Comic Opera. 9.20, Republican Thoughts from America.

Reg., 7.30, Tunes Old and New, from Northern Ireland. 8, An enquiry into some of the customs of Shrove Tuesday. 9.40, Commentary on Boys Boxing at the Royal Albert Hall.

Abroad.

Brussels II, 8, "The Three Waltzes"—operetta (Oscar Strauss).

Luxembourg 10.5 Pell Mell Music Hall.

WEDNESDAY, MARCH 2nd.

Nat., 7.15, Patricia Rossborough, pianoforte. 7.30, Band Waggon. 8.15 and 9.20, B.B.C. Orchestra conducted by Sir Henry Wood, with Wilhelm Bachaus, pianoforte.

Reg., 6, Comic Opera. 7.30, The World Goes By. 8.15, Caroll Levis and his Discoveries. 9.15, The history and people of the River Severn.

Abroad.

Brussels I. 5, "Lilac Time"—operetta.

Strasbourg, Rennes, 8.30, Grand Symphony Concert from Paris.

Readers' Problems

A Selection of Queries dealt with by the Information Bureau, and chosen for their more general interest, is published on this page.

Overloaded Speaker Field

AS a temporary measure, a querist has replaced his speaker with a smaller instrument having the same field resistance but evidently of a lower power rating; at any rate, the winding gets so hot that it is thought that there is a risk of the speech coil becoming warped. We are asked to suggest a simple way of temporarily reducing the wattage dissipated to the field coil without upsetting the HT voltage distribution throughout the set.

On the assumption that the receiver does not entirely depend for its smoothing on the choke action of the field coil, we suggest that the simplest way of putting matters right would be to reduce the loading of the field coil by connecting in parallel with it a by-pass resistance of, perhaps, the same ohmic value as the coil resistance. This will halve the energising current; if such a reduction is too drastic, a higher resistance should be used. To avoid a rise in HT voltage, the total resistance in circuit must, of course, be restored to its original value by connecting in series another resistance of suitable value.

Increasing AF Gain

A THREE-VALVE receiver having one RF stage does not appear to be giving quite the results it should, for, while the local station is good and a few of the more powerful Continental stations are receivable on the loud speaker at moderate volume, there are many that, though clearly audible, are too weak to listen to in comfort.

We are asked if an extra AF stage would improve matters, but our querist is reluctant to adopt this course if it can be avoided.

The circuit used is quite conventional, and has for its output stage a pentode which is resistance-capacity coupled to a triode detector, as shown in Fig. 1 (*a*).

Since the output valve is a high-efficiency pentode, and does not require a large input, a sufficient increase in AF amplification can be obtained by fitting an intervalve transformer giving a step-up of about 1 to 3.

One of the miniature kind intended for use with parallel-feed could, no doubt, easily be accommodated without moving any of the existing components, and it can be connected up as shown in Fig. 1 (*b*).

This will provide the necessary increase in amplification to bring up to comfortable loud-speaker strength those stations hitherto not received very well.

In cases where the set is operated from batteries it has the advantage that no additional load is imposed on them.

TRF or Superhet

THERE appears to exist an element of doubt in some quarters as to the relative merits of the straight, or TRF, receiver and the superheterodyne, it being thought that the former does not compare favourably with the latter in the matter of selectivity.

The TRF set is quite satisfactory for ordinary broadcast reception, even under the most exacting conditions, and adequate selectivity can be obtained with three RF stages such as were used in *The Wireless World* Straight Six receiver.

One of its greatest advantages is that all the circuits can be accurately ganged on actual broadcast signals, whereas the alignment of a superhet. is somewhat more complicated.

On the other hand, the TRF set is hardly suitable for all-wave reception, as it is incapable of providing sufficient selectivity on the short waves to satisfy those who look to this band for broadcast entertainment.

There is, however, a very simple solution, and that is to use a converter for short-wave reception. The TRF set will provide adequate selectivity as an IF amplifier for the converter, and it will have the advantage that tuning will be far easier, as quite small-capacity variable condensers can be fitted in the converter.

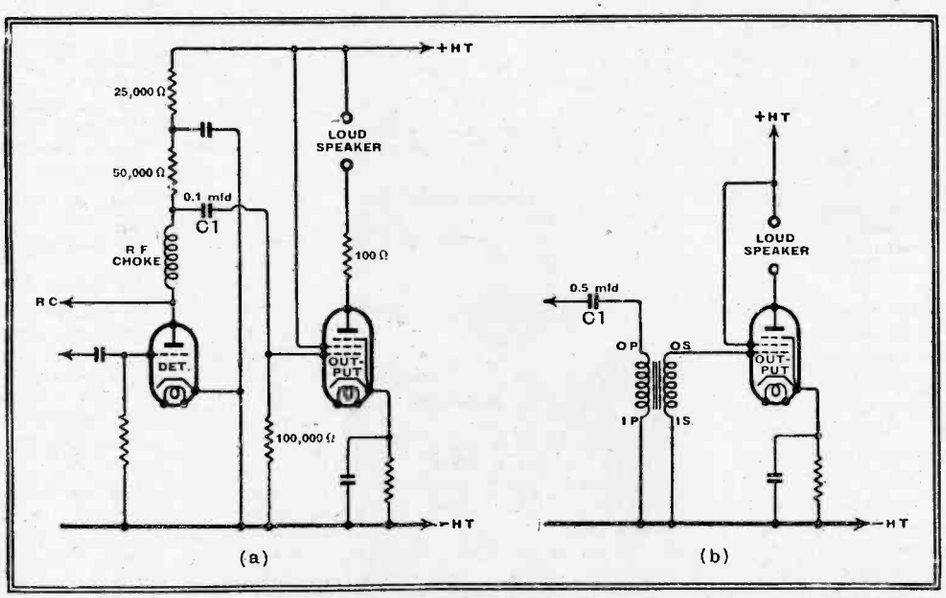


Fig. 1.—A useful increase in amplification can be effected in a set having a resistance-capacity AF stage, as shown in (a) by fitting in its place a transformer arranged as in (b).

"Ploppy" Reaction

RECEIVERS relying largely upon regeneration for their sensitivity are sometimes troublesome to operate close to the point where self-oscillation commences. A reader has experienced difficulty in this respect, the effect complained of being a "plop" followed by quite strong oscillation when the reaction condenser is advanced to the point where the set begins to show good sensitivity. He asks if there is any simple remedy for this.

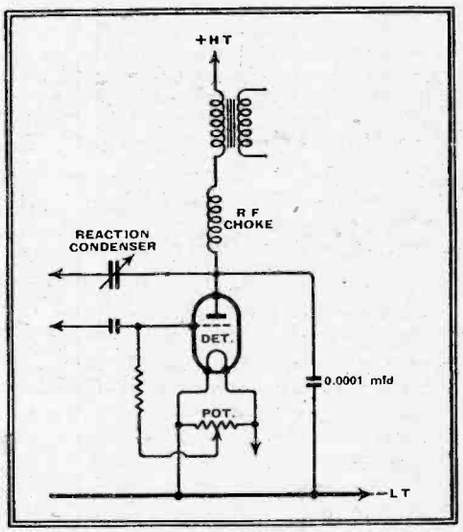


Fig. 2.—Smooth control of reaction can be obtained by returning the grid leak to the slider of a potentiometer joined across the filament of the detector valve.

From details of the circuit employed, it appears that the detector grid leak is returned to the positive leg of the valve, as is customary in battery sets.

Smooth reaction can be obtained by changing the grid leak over to the negative leg of the valve, but, unfortunately, it will have an adverse effect on the sensitivity.

The best and most effective remedy is to connect a potentiometer across the filament of the detector valve and join the grid leak to the slider, as shown in Fig. 2.

By varying the position of the slider, an intermediate point will be found between full negative and full positive where smooth reaction is obtained without any marked falling off in sensitivity.

The resistance of this potentiometer is not critical, and any value from 100 ohms to several thousand ohms can be used, though the kind generally employed in this position has a resistance of 500 ohms.

Defective Resistance Symptoms

WHEN a fixed resistance develops a fault the trouble generally manifests itself by a hissing or sizzling noise. A correspondent who suspects an incipient resistance breakdown describes quite different symptoms, which are audible as a series of clicks. Although these clicking noises might be due to a fault in the receiver, we think it unlikely that they are caused by a defective resistance; more probably they come from an outside source.

SOUTHAMPTON RADIO RELAY

Questions in the House

IN reply to questions on the subject of the Post Office Wired Broadcasting Service at Southampton, the Postmaster-General stated in the House of Commons last week that he could not forecast a date by which it would be possible to judge what measure of success had attended the experimental system which utilises both special wires and telephone lines for the local distribution of broadcast programmes. The experiment, he said, did not in any way commit the Government to accepting the recommendation of the Ullswater Committee with reference to relay services, and the object aimed at was to obtain more information before coming to a decision regarding a national wireless relay system. In accordance with the recommendations of the Ullswater Committee on Broadcasting, 1935, the B.B.C. would be responsible for the choice of programmes to be relayed to subscribers to the Post Office service, and he had no doubt that the Corporation would take what steps were necessary to exclude from the service any foreign programmes containing propaganda.

But Southampton Objects

That Southampton should voice any firm views on the subject seems to have been a development unprovided for in the London discussions and the action of the Borough Council in rejecting the Post Office scheme by 34 votes to 23 opens up possibilities which must claim the attention of an anxious industry.

SEEING TELEVISION

First Opportunity of Looking Behind the Scenes

AN outstanding feature of this year's *Daily Mail* Ideal Home Exhibition, which opens at Olympia on April 5th, will be the television demonstration which is to be staged there. This will afford the public the first opportunity of seeing television transmissions under working conditions. The exhibit, which is being arranged in co-operation with the B.B.C. and many of the leading manufacturers of television receivers, will include a glass-walled studio (where artistes will be seen acting before the camera), make-up rooms, and control rooms.

Demonstrations will be given on a number of receivers, and when the Alexandra Palace transmitter is not working reception on a closed circuit from the glass studio will enable visitors to enjoy television for at least 9 hours a day.

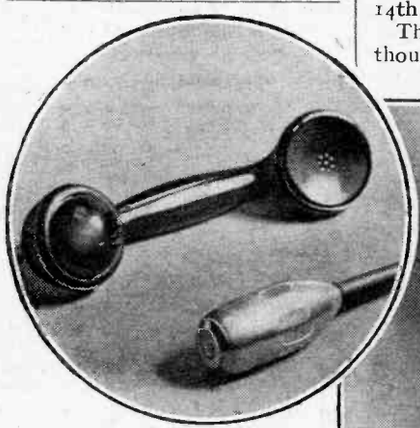
From April 14th to the 21st the B.B.C. television O.B. unit will visit Olympia and will radiate some of the programmes from the glass studio to Alexandra Palace for re-radiation in the ordinary programmes, which will, incidentally, be received at Olympia and viewed by the public on demonstration receivers.

ROVING COMMENTATOR

B.B.C. Innovation for Race Broadcast

NEW O.B. technique will be employed when the Cheltenham Gold Cup commentary is broadcast from Daventry and Droitwich on March 10th. "Tommy" Woodrooffe, who is giving a commentary, will use one of the non-sensitive coat lapel microphones with a length of cable allowing him a fair amount of liberty on the course. He is not, however, an expert on horse racing, so will be accompanied by a regular racegoer, who will whisper facts about the progress of the race to Mr. Woodrooffe while the latter is giving a word-picture of the scene.

If this method is successful it will be worth while considering whether roaming commentators should be equipped with knapsack ultra-short-wave transmitters, such as are used in America, enabling them to cover areas up to, say, a mile from the O.B. van.



THE LATEST sound-on-film recording outfit introduced in Germany justifies its name of Minicord, as this photo shows, for it can easily be carried by the operator. Using standard and sub-standard film it opens up new possibilities for recording events for broadcasting. The microphone is very small, as can be seen from the inset, where it is shown with a telephone handpiece.

NEWS OF

TRAVELLING EXHIBITION

B.B.C. Activities—the Whole Story

HOW the wheels of broadcasting go round is demonstrated in the B.B.C. travelling exhibition which will be opened to-day (Thursday, February 24th) by Sir Stephen Tallents at Charing Cross underground station, where it will remain on view until March 24th.

Working models help to tell the inside story of B.B.C. activities, from maintenance to recording and effects, from copyright to contracts and finance. Photography plays an important part in the exhibition. A recent drama broadcast is reproduced photographically on the centre of a screen that explains how such programmes are built from many studio sources, linked by a central control panel, and radio's evolution is photographically traced.

Visitors can see for themselves the three types of recording system employed—steel tape, film, and disc. One section of this exhibition which is eventually to visit the provinces, is devoted to the art of listening.

ANOTHER MERGER

A CABARET show is to be transmitted on the Regional wavelengths as well as from Alexandra Palace on March 14th.

There are two schools of thought in the matter of combining the television and normal sound broadcasts. Many people agree with the opinion expressed in these pages last week that the two must ultimately merge and consider that Alexandra Palace should make the utmost use of the material which sound programmes can provide. The other school contends that a good broadcast programme makes bad television, and conversely, a good television effort must fail as entertainment for the listener.

Sooner or later a battle royal will be fought on this question, but the issue can hardly be in doubt.

AUSTRALIAN WORLD BROADCAST

AN almost world-wide "hook-up" is planned for March 6th, when Australia provides the fourth of the series of concerts arranged by the International Broadcasting Union. British listeners will hear it on the Regional wavelengths between 4 and 4.30 p.m., and it is understood that practically all countries affiliated with the Union will relay the programme, which will be conveyed to Europe by the Post Office beam service, with the International Telephone Exchange in Carter Lane, London, E.C., as a distributing centre.

The broadcast will open with bird calls typical of the Australian Continent, including those of the kookaburra, whip-bird and lyre-bird. Aboriginal songs will be followed by recordings of the actual proceedings at an aboriginal corroboree.

EDUCATION TAKES THE AIR

AS the result of agitation on the part of the Federal Communications Commission of America, it is expected that transmissions from 25 high-frequency broadcast stations will be entirely of an educational and non-profit nature.

Need for school broadcasts is also expressed in France where 760,000 francs has been allowed for the purpose in this year's budget. About one hundred millions will, however, be necessary to equip the schools with receiving sets, and to organise the transmissions, so it is proposed that the required sum should be raised by the selling of a special postage stamp and the periodical drawing of a lottery. Suggestions for other means of rapidly realising a part of the money are invited by the radio press.

THE WEEK

INTERNATIONAL WIRELESS LINK

Plymouth via New York

FIVE women of world-renown will discuss "the rôle of women in the modern state" over the N.B.C. networks tomorrow (Friday) at 8 p.m. (G.M.T.).

The programme, which is given under the auspices of the International Federation of Business and Professional Women, will include Lady Astor, speaking from Plymouth, and speakers in Oslo, Rome and Geneva. Mrs. Roosevelt's talk, delivered in Washington, will close the broadcast.

Special facilities provided by the Post Office and broadcasting authorities in the four European countries taking part will enable the N.B.C. to pick up the transmissions direct from their origins and the relay from the American station W8XK, on 19.7 metres, should be well received in England.

GERMAN TELEVISION-TELEPHONE SERVICE

THE German Post Office are making efforts to further improve their television-telephone service, which is now operating between Berlin, Nürnberg and Leipzig, and which will shortly be extended to Munich, Hamburg, Frankfurt, and later to Cologne.

At a ball in Berlin the latest television - telephone scanner, built by Fernseh, was demonstrated to dancers, and they spoke to and saw a woman official at Nürnberg. Due to the successful application of secondary emission amplification the apparatus now uses an ordinary lamp in place of the carbon spotlight and is generally smaller and more compact. A Nipkow scanning disc is employed.

TELEVISING FROM THE OVAL

"NEVER miss an opportunity" seems to be the motto of the B.B.C.'s mobile television unit. During the week ending March 5th the unit will be carrying out transmission tests on the Oval cricket ground with a view to televising a Test match in the summer. It so happens that on Saturday, March 5th, the Women's International Hockey Match between England and Wales is being played on the ground, so this will be televised, using three Emitron cameras.

And the White City

The Oxford and Cambridge Sports at the White City on March 12th, will provide the biggest sporting event yet to be tackled by the mobile television unit, and on this occasion the radio link will be used. Three cameras will work in a limited area in the centre of the stadium, and in order to televise the whole of the mile race, which is the outstanding event, it is probable that one of them, equipped with a tele-photo lens, will be mounted on a central tower to give panoramic shots of the complete lap.

B.B.C.'s SOUTH AMERICAN SERVICE

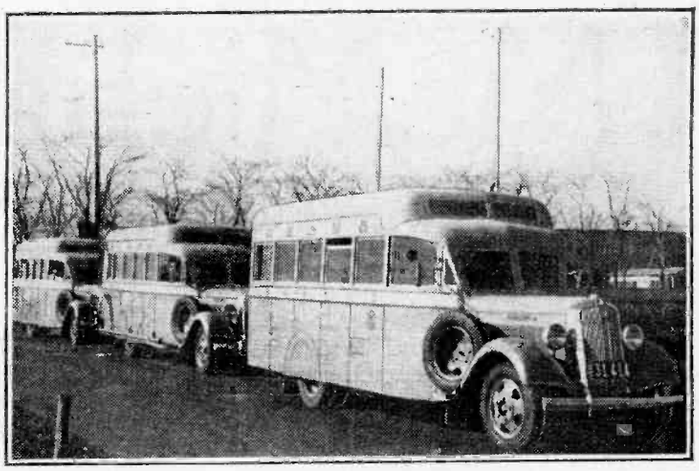
THE news that the B.B.C. will, on March 15th, inaugurate regular transmissions in Spanish and Portuguese for listeners in Central and South America comes at an opportune moment, when reception conditions on the 31.55-metre wavelength are steadily improving with the approach of spring. Under the call-sign GSB, two transmitters working simultaneously will radiate bulletins in Spanish and Portuguese at 1.30 a.m. and 1.45 a.m. (G.M.T.) respectively.

The arrangement must not be regarded as permanent. Early next year the two new transmitters recently ordered for Daventry may take over the service.

Reception reports on the new service will be awaited with interest.

NATIONAL PA

SIX thousand loud-speaker kiosks are to be erected in the large towns throughout Germany during the course of the next six years. A still greater number of small PA speaker columns are to be installed in villages and small towns. The kiosk, which includes advertising space and is surmounted by a clock, was mentioned and illustrated in *The Wireless World* soon after the German Radio Exhibition, where it was first on view. The National Socialist Party radio officers will be responsible for the operation and maintenance of the speakers, which are intended for use as ordinary broadcast programme diffusers as well as for political addresses.



TELEVISION IN TOKIO. Dr. Kenjiro Tagayanagi conducted the first television O.B. in Japan on February 11th, when scenes of the national celebrations were transmitted by the new mobile unit shown above.

FROM ALL QUARTERS

The Higher the Better

LESSEES of floor space in the big skyscrapers of America have noticed a sudden increase in the demands for top-floor accommodation. According to *Radio Retailing*, in almost every case the prospective tenants are well-known radio concerns whose object in securing the highest suites of rooms is to provide themselves with vantage points for reception of the television transmissions—*when* they begin.

Sark Sponsored Programmes

DAME Rumour was again busy a week or two ago on the matter of the erection of a station on Sark, one of the Channel Islands, for English sponsored programmes. We understand, from an authoritative source, that the Dame of Sark, Mrs. Sybil Hathaway, has definitely refused permission for the station to be erected, and that the matter is now closed.

SW Station for Ireland

THE Irish Department of Posts and Telegraphs has ordered from Standard Telephones and Cables a 1.5-kW short-wave transmitter to be erected near the Athlone medium-wave station. No details are at present available for this, the first Irish short-wave station.

Short Waves From Madras

DELHI'S 10-kW station VUD now operates on two wavelengths, 49.3 metres during daylight and 86 metres at night, tests having shown that the skip distance of the 49-metre wavelength increases to about 400 miles after dark.

People's Receivers

IN Germany the People's Set continues to flourish, and total sales since its introduction in August, 1933, numbered 2,652,223 at the end of last year; 64 per cent. of the owners of these receivers are workmen.

Apart from the People's Set the German radio industry produces two other "joint receivers": the PA receiver for the Workers Front and the export receiver, "Stuttgart."

The Norwegian "All People's Receiver," sponsored by the broadcasting authorities, is largely responsible for the enormous rise in licence figures last year from barely 200,000 to just over 300,000. The retail price has recently been reduced to £4, and school authorities are entitled to buy the set for £3 10s.

Swiss USW Tests

SWITZERLAND'S experimental short-wave transmitter on the Utokoln, above Zürich, which was described in these pages last week, is to transmit on 7.5 metres at 300 watts, and the Institut für Hochfrequenztechnik of the Zürich Polytechnicum, whose address is Gloriastrasse 35, Zürich 7, asks for reception reports. The times of transmission are from 2.45 to 4.45 p.m. on Saturdays (February 26th and March 5th) and from 7.15 to 8.15 p.m. on Wednesday, March 2nd. The programmes will consist of relays from the Beromünster station and records.

Russian Radio Industry

ACCORDING to the Russian paper, *Industrialisation*, the radio industry is still 75 per cent. behind the figures forecast in the Five-year Plan. Private listeners are few, but the high-power stations are necessary to feed the communal listening centres.

O.K. for Sound?

THIS is the title of an article in *The Autocar* of February 18th, which gives an analysis of sound in the interior of a saloon car, and identifies parts of the mechanism giving rise to various components of the general noise.

American Short Wave Schedule

IT will be of interest to short-wave listeners to note the revised schedule for two well-known American stations: it comes into effect on March 2nd:—

Aerial Directional on Europe

W2XAD, 21.5 Mc/s, 1 p.m. to 5 p.m., G.M.T.

W2XAF, 9.53 Mc/s, 9 p.m. to 5 a.m., G.M.T.

Aerial Directional on S. America

W2XAD, 15.33 Mc/s, 5.30 p.m. to midnight, G.M.T.

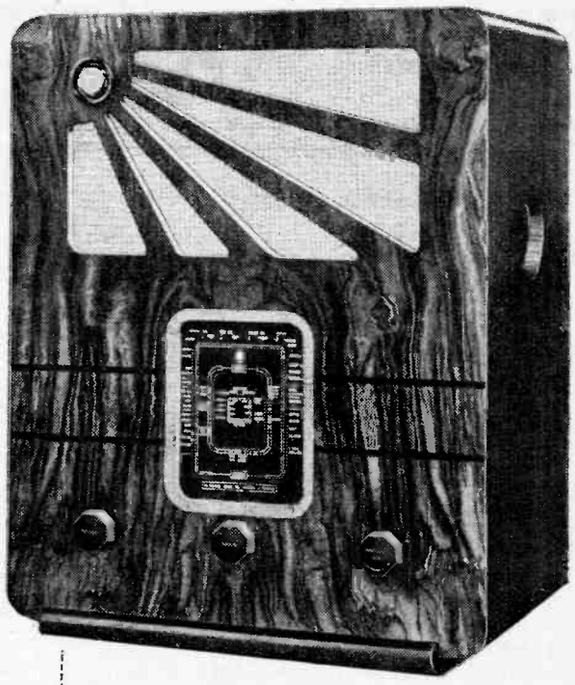
W2XAD, 9.55 Mc/s, 12.30 a.m. to 5 a.m., G.M.T.

I.E.E.

AT the March meeting of the I.E.E. Wireless Section, to be held next Wednesday, the 2nd, at 6 p.m., Mr. P. P. Eckersley will speak on, "A Quantitive Study of Asymmetric Sideband Broadcasting."

McMichael

ALL-WAVE TRANSPORTABLE MODEL 374



FEATURES.—***Waveranges.***—*(1) 16.5—50 metres. (2) 200-550 metres. (3) 800-2,000 metres.* ***Circuit.***—*Pentode RF amplifier—triode hexode frequency-changer—pentode IF amplifier and noise suppression valve — double-diode-triode second detector—pentode output valve. Full-wave valve rectifier.* ***Controls.*** — *(1) Tuning. (2) Volume and on-off switch. (3) Waverange. (4) Tone. (5) Sensitivity.* ***Price.*** — *16 guineas.* ***Makers.*** — *McMichael Radio, Ltd., Slough, Bucks.*

THERE will always be a steady demand for the self-contained transportable among flat-dwellers and others who find difficulties in the way of erecting an outdoor aerial. Evidence of the interest in this type of set was not lacking in the months immediately preceding the last radio exhibition when numerous enquiries were received by us for the name of any frame aerial set with provision for short-wave reception, such as is supplied in outside aerial receivers nowadays as a matter of course.

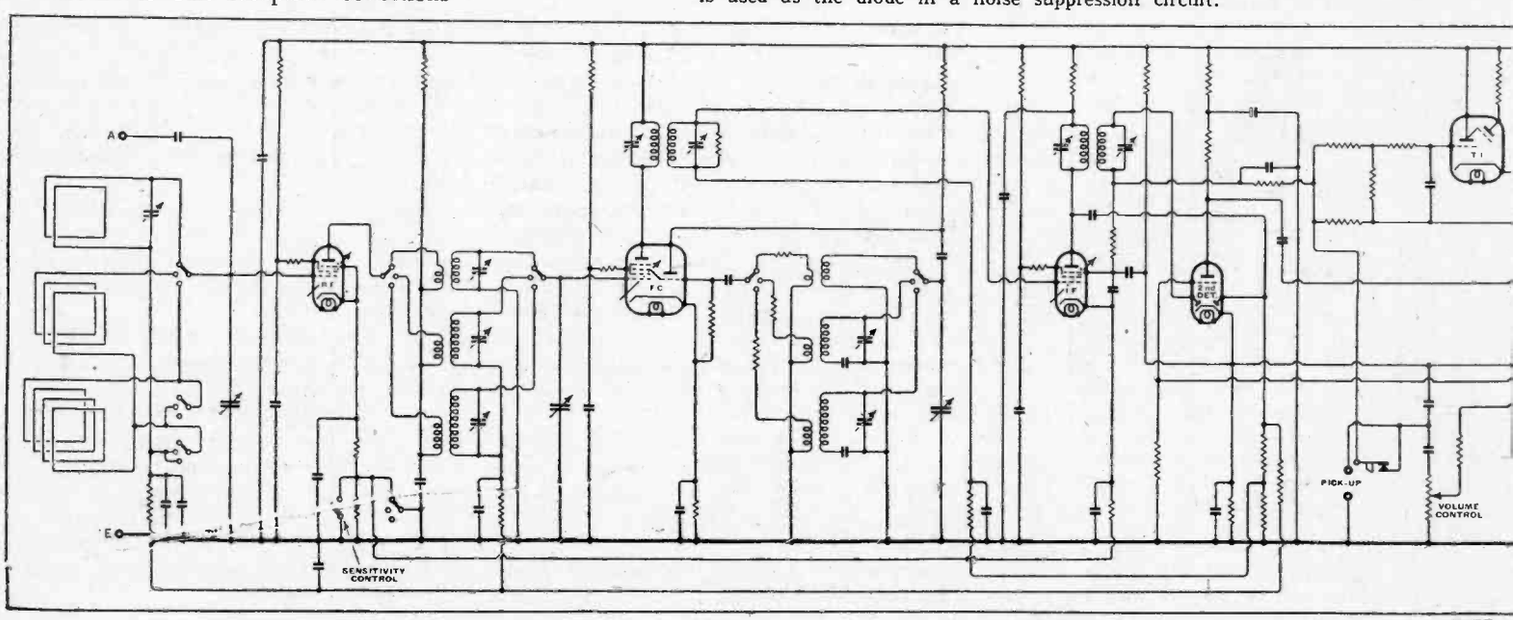
To provide a satisfactory short-wave performance without the very considerable help of an outside aerial presents something of a problem, but the design under consideration shows that a successful solution is possible. An RF stage and high circuit efficiency can be made to compensate for the reduced input, but the loss of an outside aerial is not necessarily felt to the same extent at all parts of the frequency range. One of the chief merits of this set is that considerable trouble has been taken to ensure a uniformly high performance on all three wavebands. On medium and long waves sufficient over-all amplification is available with the diode second detector feeding directly into the high slop pentode output valve, and the triode amplifying portion is brought into operation only on short waves. In addition there is a sensitivity switch at the back of the set which controls the initial bias on the RF and IF amplifying valves. On short waves the set is always in the position of high sensitivity, but on medium and long waves high or low sensitivity is available to suit reception conditions

Extraneous noise between stations is remarkably low in this receiver due to an ingenious noise suppression circuit incorporated in the IF stage. Instead of returning the suppressor grid of this pentode to the cathode it is connected through a circuit of suitable time constant to the signal rectification circuit. The suppressor grid's function is that of a diode, and the voltage derived from it in the presence of a sufficiently strong signal is used to cancel the excess bias applied to the cathode circuit of the double-diode-triode stage. The suppression circuit functions only on the medium and long waves, and switch contacts are arranged to put the normal working bias permanently on the second detector cathode in the short-wave position.

Useful Short-Wave Sensitivity on a Frame Aerial

Switching from radio to gramophone operation is effected by a special two-pin jack and sockets, and it is interesting to note that the degree of amplification available depends upon the setting of the wave-range switch. Thus, with a piezo-electric pick-up the switch should be set to medium or long waves, and for the less sensitive types of magnetic pick-up, to the short-wave band in order to bring into operation the triode amplifier. The external loud speaker connections are also taken through a special two-pin plug arranged to cut out the internal loud speaker when pushed fully home. The mains transformer is mounted clear of the receiver chassis, and

Complete circuit diagram. The triode portion of the second detector valve is used only on short waves, and on the medium- and long-wave ranges the suppressor grid of the pentode IF amplifier is used as the diode in a noise suppression circuit.



has a screened primary to reduce mains-borne interference.

In testing the set our first interest was naturally in the short-wave performance, and it was soon apparent that the set was well able to hold its own with the majority of table model superheterodynes working from an outdoor aerial. There can be no doubt that the amplification provided by the RF stage fully compensates for the lack of an outdoor aerial, but it does not confer the customary improvement in selectivity, and repeat points, due to second-channel interference, are prominent. In the presence of a strong carrier there is some microphony at a low frequency when the volume control is at maximum, but this is easily stopped by turning the control back slightly, and is not sufficiently serious to prevent the attainment of full loud speaker volume on any worth-while station.

Conditions over the Atlantic were poor at the time of the tests, but comparison of the performance on stations available with a receiver which was known to be capable of good reception from America indicated that when the conditions are normal, transatlantic reception should be possible with an ample margin of sensitivity in hand.

The performance on the medium-wave range if judged under daylight conditions is easily capable of being under-estimated. Due to the action of the noise suppressor circuit, only those stations which are of good programme value put in an appearance, and it is necessary to attach a large outdoor aerial if one wishes to hear those intermediate noises which subconsciously give the impression of liveliness in a receiver. The outdoor aerial adds little, however, to the strength of those stations which are satisfactorily received on the frame aerial, and it is certain that no station of the slightest programme value is lost through the action of the suppressor circuit.

With the frame aerials turned to give maximum signal strength from London Regional the intrinsic selectivity is sufficient to give clear reception outside one channel on either side of the correct tuning point for the station. Under the action of AVC the signal strength is maintained constant for most positions of the frame, and for this reason the makers have not thought it necessary to fit a turntable. If for any reason the highest possible selectivity is required the electron tuning indicator will show when the pick-up from the unwanted station is at minimum.

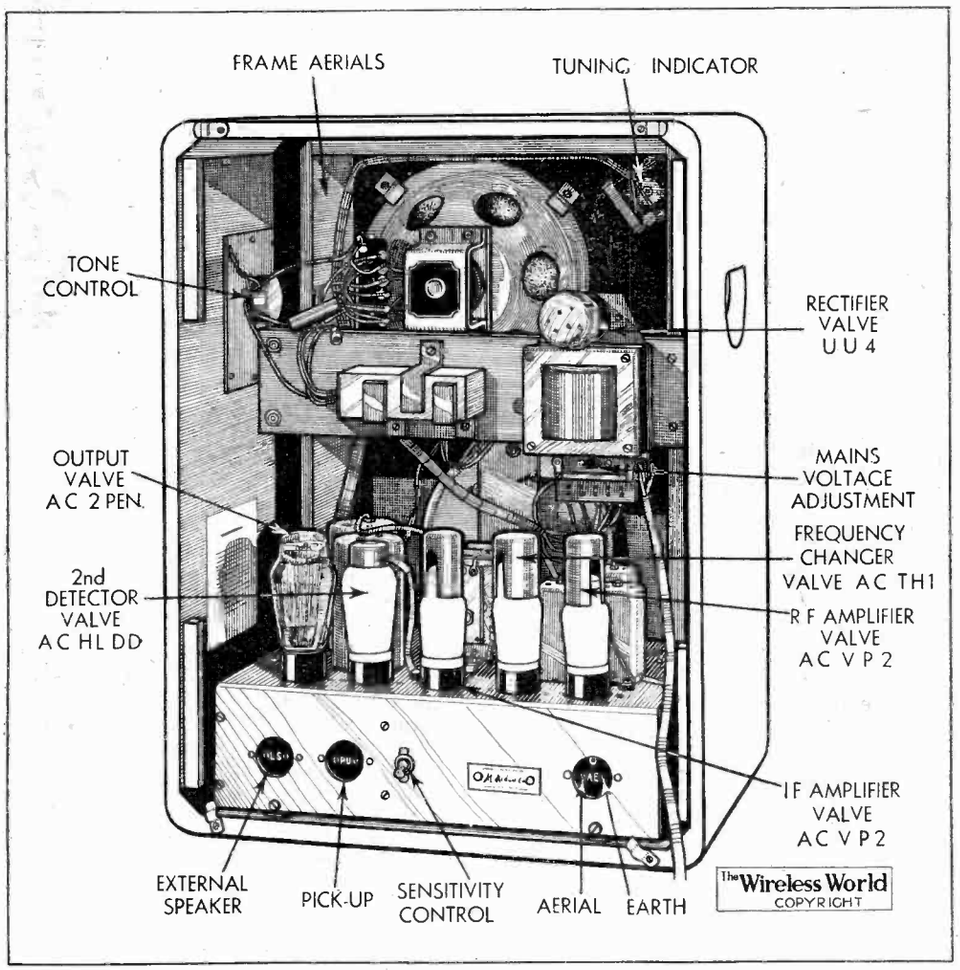
Selectivity on long waves is exceptionally high, and gives comfortable separation of the Deutschlandsender from Radio-Paris and Droitwich, whatever the orientation of the set. With the receiver turned to the position of minimum pick-up from Droitwich, isolation of the German station is childishly easy. In a steel-framed building the long-wave range calls for maximum sensitivity, but ample volume is available on all stations down to 1,000 metres. Below this the sensitivity falls off considerably. A tunable station was discovered near the bottom of the range, but this turned out to be London Regional, probably due to a harmonic of the oscillator.

The loud speaker is small but efficient, and gives a well-balanced range of tone. The upper register is free from resonances which might cause harshness, and, except on short waves, the tone control can be used to give full high-frequency response at all volume levels. The large cabinet presents a useful baffle area, and its depth from back to front no doubt contributes something to the full bass response.

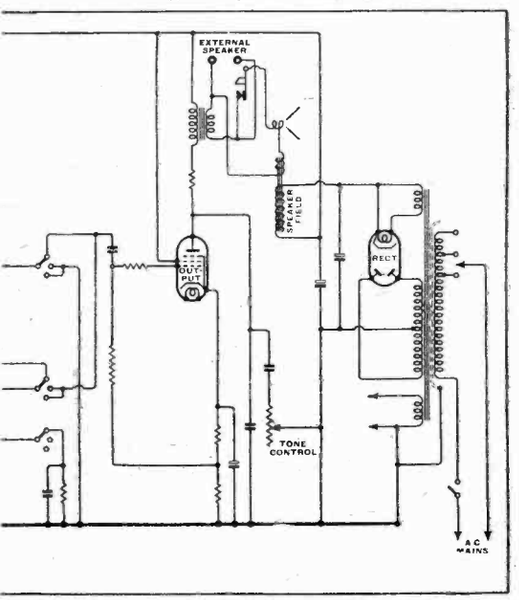
A single-ratio reduction gear is used for tuning, and the mechanism incorporates a flywheel which enables the operator to spin the pointer rapidly over large sections of the dial. Another attractive feature of the tuning system is the selective colour pointers illuminated by pilot lights attached to the tuning disc and operated from the waverange switch. The coloured slots appear through narrow channels adjacent to the appropriate waverange, and station names and calibrations on the three ranges are engraved in white on dark glass and illuminated indirectly from the side.

There are only two other controls on the front panel, namely, waverange and volume, and the tone control is mounted in one of the two recesses used as carrying handles.

In every respect the workmanship and finish are up to the recognised McMichael standard. The good quality of reproduction and freedom from background noise make the Model 374 an ideal set for those who are interested primarily in the programme value of a transmission. Nevertheless, the range is such that the distance which that transmission has travelled will on more than one occasion be a matter of agreeable surprise.



The large cabinet permits the use of frame aerials of efficient dimensions and enables the power supply equipment to be well separated from the main chassis.



Rectifiers—ARE NOT SO SIMPLE AS THEY SEEM

By "CATHODE RAY"

A SERVICE engineer's job is to rectify faults that occur in sets. To rectify is to put right. So he could be described, in a sense, as a rectifier. But if we go into a wireless dealer's and ask for a rectifier we get something quite different. As a technical term it means something that passes current in one direction but not in the other, or, at any rate, not nearly so readily. The mechanical equivalent is a *valve* (for example, the thing that lets air into a tyre but not out). That is how the radio valve got its name. Oddly enough, the rectifier is the only valve in a set that is not counted as a valve ("Superhet Seven de Whatnot—six valves *excluding* rectifier"). That is just one of the paradoxes of radio terminology. I could fill a page with them—and did, a year or two ago. Most of the things in the set that are called valves—those intended for amplifying—are arranged with immense care so as not to rectify at all, for rectification is distortion, and the name "valve" seems singularly inappropriate for them. Apart from the "rectifier," the only genuine valve is called something still different—the detector. Logically there seems to be no reason why it should not be called a rectifier, too, for that is what it is; but in practice it is very convenient to have a name—even if rather a silly one—to distinguish it from the power rectifier.

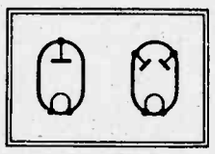


Fig. 1.—These symbols, for half-wave and full-wave rectifiers respectively (either power rectifier or detector), are deceptively simple . . .

To look at a rectifier valve or its symbol in a circuit diagram (see Fig. 1), or the data on it in *The Wireless World* Valve Data Chart, you would think it very simple and very dull compared with other valves having anything up to six grids apiece. But it has unsuspected depths of character, and to this day is still able to give the highbrow mathematicians something to do.

The object of a rectifier, of course, is to convert alternating current to direct. To use the tyre-inflation analogy again: in pumping, the hand (or foot) moves the piston backwards and forwards, and if there were no mechanical rectifier in the system the air would just do ditto, and one could go on pumping *ad lib.* without useful result. Remove the tyre valve and see. The valve converts the alternating air current into a unidirectional current capable of inflating the tyre. Take up any elementary chapter or article dealing with the rectifier, and as likely as not you will see something like Fig. 2, with some such explanation as "(*a*) is a sine wave representing an alternating current. The effect of a rectifier is to suppress the negative half-cycles, leaving only the positive (*b*), or if a second rectifier is used in a full-wave circuit both halves of the cycle can be used (*c*); to avoid excessive hum this current is smoothed by a suitable filter, giving nearly pure DC (*d*)." All very nice in its way, but quite unlike what happens in practice.

Fig. 2 (*a*) shows an alternating current all right, which is very simple mathematically ($i = I_{max} \sin \omega t$ is the equation); and (*b*) shows what would happen if a perfect rectifier working into a pure resistance load were used, though what one would do with it then I can't imagine. Even (*b*) is complicated enough mathematically; I certainly don't remember what it is, except that an infinite series or something is needed. But what happens in a mains power unit, for example, is not represented by any such simple process as rubbing out everything below the centre line in Fig. 2 (*a*). The good old bicycle pump is much more instructive. When the piston is pushed down for the working stroke there is not a current of air going into the tyre all the way (except, perhaps, during the very first stroke in blowing up a flat tyre). What actually happens is that you push against a constantly increasing pressure until you reach almost the end of the stroke, and then there is a sudden quick squeak as the air rushes in for a fraction of a second. Similarly with a rectifier. The smoothing condensers maintain a back pressure—like the air in the tyre—and it is only when that is exceeded by the supply voltage that current flows. When it does flow, it is for such a short part of the whole cycle that it has to be an extremely large current to get enough into the reservoir condenser for running the set throughout the cycle. The less hum-causing ripple that can be tolerated the closer the back-pressure is to the fully charged voltage of the condenser, and the shorter and more intense the current. A picture of it would look more like Fig. 3 than Fig. 2 (*b*).

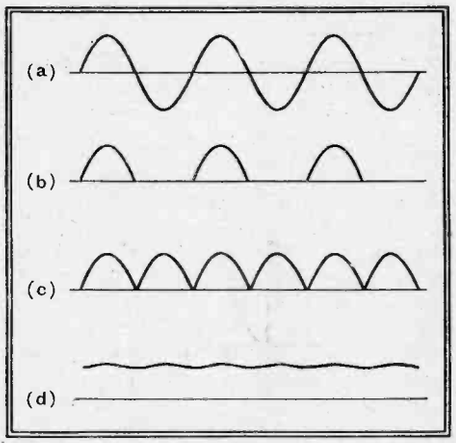


Fig. 2.— . . . and so are these diagrams so beloved by the writers of textbooks.

Obviously, then, one requirement of a rectifier for supplying a smoothed output is the ability to pass a very heavy momentary current. Other things being equal, a half-wave rectifier has to pass twice as much as a full-wave. Some of the early rectifiers for "AC/DC" sets had a short life for that reason. If the emission of the cathode is too small to carry the full required peak current, the supply voltage that should be pushing against the back pressure expends itself on the rectifier, which is rapidly destroyed. So it is more disastrous to under-run a rectifier filament than to over-run it. A long time ago, when such mistakes were, perhaps, pardonable, a manufacturing company put out a valve rectifier for battery charging in which the rate of charge was controlled by a filament rheostat. They all came back!

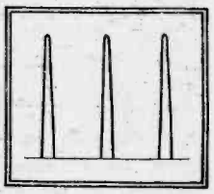


Fig. 3.—The waveform of rectifier current in practical cases is usually more like this.

The Reservoir Condenser

Modern rectifier valves are remarkably robust electrically, and can pass almost unlimited current in brief spurts, but even they cannot be expected to enjoy many happy returns of their birthday if the reservoir condenser (C1 in Fig. 4) is too large. Eight mfds. is normal, and if extra smoothing is required it is better to add it to C2. And for the reason already given it is important to see that the rectifier heater really gets its proper voltage.

The next thing is that measurements of current and voltage are very tricky in circuits where rectifiers work. This is no place to enlarge on the whole subject of peak, mean and RMS values; but granting that they are all different, one or

Rectifiers—Are Not So Simple as They Seem—

two things stand out. The peak voltage of a supply is over 40 per cent. more than the RMS voltage (which is what is marked on the household meter, and counts for things such as lamps and heaters and wireless sets). But current is squirted past the rectifier into the reservoir condenser *at the peak voltage*. So on paper it looks as if one is getting more out than one puts in—always a very unlikely proposition in the long run. For instance, you pay for electricity from the mains at, say, 200 volts, and, without any step-up transformer, you get—well, not 280 volts DC, for there is always some loss, but probably quite a lot more than 200. Where is the catch? Just that electric power is reckoned by voltage × current, and it necessarily happens that the conditions that enable the output voltage to be higher than the input (namely, a large reservoir condenser, so that the rectifier current only occurs near the voltage peak) lead to a highly peaked current as shown in Fig. 3. And the RMS method of reckoning goes against one here, for it leads to a higher figure than the smoothed DC output. Swings and roundabouts!

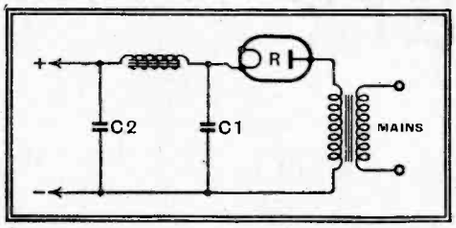


Fig. 4.—Simple half-wave rectifier and smoothing circuit. If the condenser C1 is excessively large it puts a strain on the rectifier.

Measurement Difficulties

If you put two milliammeters of different types in series with the rectifier R (Fig. 4) you may get considerably different readings. This does not mean that one or both of the meters is inaccurate. One instrument may read mean values and the other RMS, and with a waveform like Fig. 3 they differ quite a lot. Voltmeters—especially valve voltmeters—used for measuring the output may similarly show discrepancies. And there are other complications. Rectified current is neither AC nor DC, but a sort of hybrid of both. So be prepared for funny business when measuring rectifier circuits.

So much for meters. The other rock on which the partially informed technician stands is Ohm's Law. And that, too, crumbles into loose sand where rectifiers are concerned. If one draws a graph of current against voltage for an ordinary resistance obeying Ohm's Law, it is a straight line such as Fig. 5 (*a*). The slope of the line indicates the resistance—a steep slope means a small resistance. A perfect rectifier would have a characteristic as shown at (*b*), which indicates an infinite resistance to negative voltages and zero resistance to positive voltages. Obviously, Ohm's Law knows nothing about this. In an actual rectifier of the vacuum-valve type the infinite resistance is nearly true, but the forward resistance is generally of the order of a few hundred ohms, and the type of characteristic is very familiar (*c*). The characteristic curve of an amplifying valve is usually much the same, which may be thought to mean I was wrong in saying that it is not a real valve (i.e., rectifier) at all. But an amplifying valve is normally worked at some such point as that marked X, so for a limited distance on each side it approximates to the Ohm's Law resistance (*a*).

A metal rectifier, made of oxidised copper discs, has a perceptible leakage in the negative direction, but this is so small that it hardly shows on a diagram if the scale is the same as for the forward direction.

An ordinary neon lamp passes different currents according to their direction, and therefore is intermediate between Fig. 5 (*a*) and (*c*); it is a partial rectifier, and hardly good enough as such for any practical purposes. Anything with a resistance characteristic that departs at all from absolute straightness is to that extent a rectifier. However carefully an amplifying valve is adjusted to the "straight" part of its characteristics, they never are perfectly straight, and so there is a certain amount of rectification of the signal. Rectification is distortion, as I said before; and that is why one puts a moving-coil milliammeter in series with the anode circuit of an amplifying valve to indicate distortion. A moving-coil meter responds only to DC—that is to say, the rectified part of the valve's output. Unless distortion is excessive, therefore, the pointer should remain nearly motionless. This does not apply to "Class B" systems, where two distortions are balanced against one another. Obviously, if two rectified outputs such as Fig. 2 (*b*) were put together, not as at (*c*) but with the second series below the line, the original form of wave shown at (*a*) would be reconstructed.

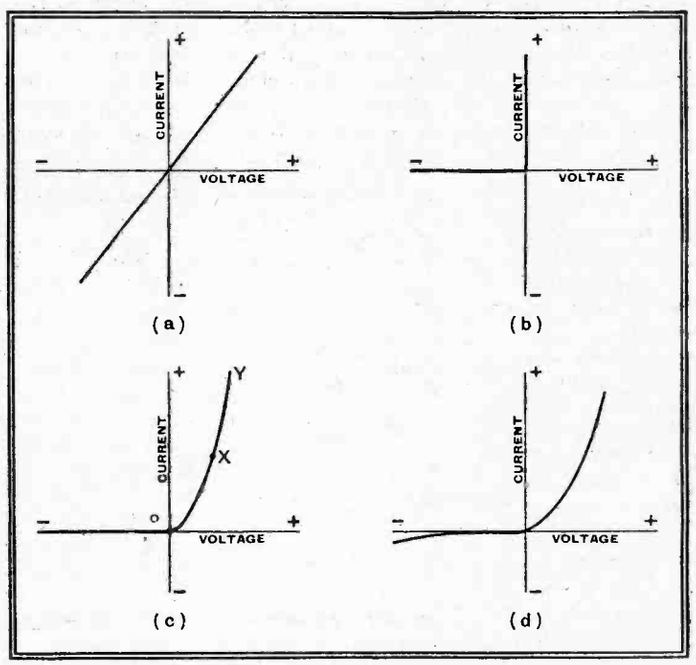


Fig. 5.—Characteristic curves of (a) an ohmic resistance, (b) a theoretical perfect rectifier, (c) an actual rectifier, (d) an enlarged view around the point O in (c).

No doubt some of you are putting two and two together—"the detector is a rectifier," "rectification is distortion"—and saying, "What, then, is a distortionless detector?" No, I am not caught out by that, for the input to a detector is *radio frequency*, and this is distorted most fearfully—harmonics are not limited to the usual 5 per cent., but are more like 50 per cent.; but, in spite of this, the precious modulation will emerge pure and clean so long as the part O Y of the curve (Fig. 5 (*c*)) is straight.

Other Rectifiers

Apart from "*the* rectifier" and the detector, there is another sort of rectifier commonly used in receivers, though not everybody might know it as such. The two sorts already mentioned are the valve and the copper-oxide. The latter is quite often used for power rectification, and more rarely as a detector. The difficulty about it as a detector is that, unless the discs are very small, their capacity upsets the circuit. A third type of rectifier that was considerably used at one time for HT supply, the electrolytic, has a very large capacity indeed. It turned out to be a bad rectifier, compared with the other types, but quite a good condenser, so is now made in millions for that purpose!

The story of rectifiers is far from complete, but my space is. I only just mention the popularity of the metal rectifier in AC test meters, and, by magnifying the bit of its characteristic near the starting point (Fig. 5 (*d*)), show how for very weak currents it is a high resistance, and for strong currents a low resistance; so by putting a pair of rectifiers of suitable size in parallel with an ordinary DC milliammeter it still reads small currents nearly as well as before, but can also take a very large current—perhaps 1,000 milliamps. or more—without being driven violently off the scale and sent to the makers for repair. Moreover, no range switch is needed. Some day people will discover how useful this idea is; information on how to put into practice was given in the issue of January 11th, 1935.

Can Broadcasting Prevent War?

DURING the first thirty-odd years of its brief history wireless has proved itself, unlike so many other scientific discoveries, to be mainly an agent for good to mankind. It has speeded up, cheapened and made more easy communication between one part of the world and another. It has saved innumerable ships from disaster and has brought aid that could otherwise never have come to those that were already in difficulties. It is largely responsible for the safety of aircraft; without it the world's great air routes could probably not have been developed. In the form of broadcasting wireless has brightened the lives of millions by bringing entertainment into their homes. Short-wave broadcasting is to-day one of the strongest links of Empire.

Can wireless add to the benefits that it has already conferred upon us by becoming an important factor in the prevention of war? I believe that it can, though at first sight it might seem that broadcasting was more likely to cause war than to prevent it.

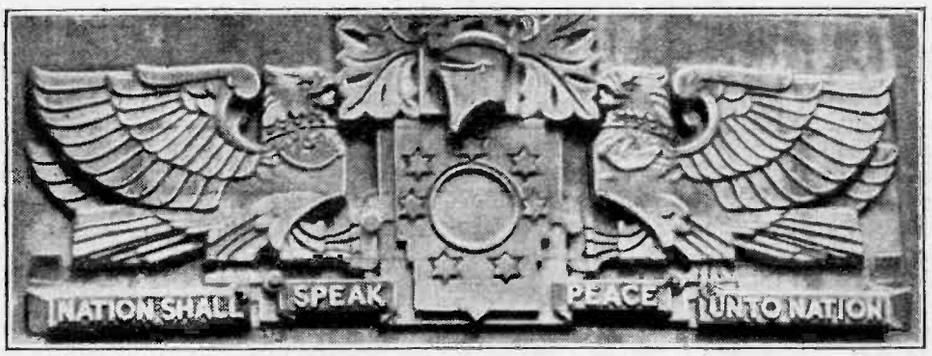
In many countries the possibilities of broadcasting for political purposes have unfortunately been realised and exploited to the full. If Ruritania dislikes the manners, the customs and the general goings-on of its neighbours in Urbania, it is a simple and not over costly matter to erect a high-power station near the frontier from which a flood of oratory, highly objectionable to the Urbanian authorities, can be poured into their country.

Urbania protests, and Ruritania replies in terms of the utmost courtesy that she is merely giving her subjects lessons in the Urbanian language with a view to cementing the friendship between the two countries.

Retaliation

Urbania then discovers that her own people are being provided with an inadequate entertainment service by the broadcasting existing within her borders. A high-power station is necessary, and the local equivalent of Parliament eagerly votes the money, which they have been assured is necessary to provide their countrymen with the entertainment for which they crave. Curiously enough, the Urbanian engineers discover that the only suitable site for the new station is one not far removed from the Ruritanian frontier and at no great distance from Ruritania's high-powered station.

When the new station comes into operation Urbania proceeds to give lessons in Ruritanian to her citizens. Through some strange concatenation of events the only time at which language professors (all of whom prove to be remarkably good orators) are available is just that at which



Decorating the Western façade of Broadcasting House, Portland Place, is to be found the arms of the B.B.C. in stone. The motto, read to-day, has an additional significance.

Ruritania is giving her lessons in Urbanian. It is, of course, particularly unfortunate that the Urbanian station should have been compelled, in order to cover its own country, to have an output power about three times that of Ruritania's; still more unfortunate that the wavelengths of the two stations are so close to one another that the Ruritanian transmitter is heterodyned, jammed or drowned.

Purely in self-defence the Ruritanian Parliament votes the money required for increasing ten-fold the power of the Ruritanian station. And so it goes on.

The picture is not over-drawn. There are several parts of Europe in which such war in the ether exists, and it was very largely the political and propaganda aspects of wireless that prevented a completely satisfactory wavelength distribution from being reached at the conference which produced the last wavelength plan.

Scraps of Paper

Further, though most European countries did eventually sign an agreement, there were several who did so with reservations or with their tongues in their cheeks—the two are very much the same thing in the end. In any event, we find that not a few countries whose representatives did sign the agreement have shown by their subsequent actions that they did not take very seriously either the clauses about wavelength wandering or those which limit output power.

So far so bad. Europe is continually squabbling over broadcasting, and all is by no means peace in America, where Mexico and other South American authorities have found themselves unable to see eye to eye (or should one say to listen ear to ear?) with those of the United States. Even the Far East in these progressive days is not without its problems of wavelength allocation.

But when all is said and done, wireless—and particularly broadcasting—is far more likely to produce peace than war. In ancient days warfare was merely one of the manly sports. The Spartans made the peace-time life of their young men so unutterably boring that all looked forward to war as a relief from the horrors of peace. But nothing of the kind prevails in the modern world. Your Alexander, your Julius Cæsar, your Attila simply do not exist, because it is realised nowadays that such a thing as complete conquest is impossible.

Almost every modern war has arisen as the result of a misunderstanding or a series of misunderstandings. That is where broadcasting comes in. It is the finest means that the world has ever possessed of enabling civilised nations to understand events and to understand one another. And, very definitely, through the medium of the wireless set civilised nations are coming to understand one another better and better.

Towards a Better Understanding

In these days of sensitive all-wave receiving sets and high-powered transmitting stations the great majority of listeners are able to hear programmes from a dozen or more European countries, to say nothing of America. France, Germany, Holland, Italy and Denmark are no longer, even to the stay-at-homes, countries which exist only upon the map. Evening by evening the receiving set brings us into the closest contact with them, for we enjoy in our own homes the entertainment which their stations provide. Somewhat to our surprise, perhaps, we find a Shakespeare play coming from Kalundborg, or one by Bernard Shaw from Vienna. We have, too, lessons in German, French, Italian and Spanish from our own stations, whereby thousands of listeners have acquired, at any rate, a speaking acquaintance with these languages. And this is not all. The man-in-the-street who has never left his

home town assimilates through the medium of the wireless set something of the life and of the atmosphere of foreign countries. There is no doubt that broadcasting is drawing the nations of the world much closer together.

I am not saying that wireless can in every case prevent a war from breaking out. Sometimes events move so rapidly and international hatred is so quickly aroused that the beginning of hostilities may be almost inevitable. But I do believe that even if war is started wireless may hasten its conclusion.

There can be little doubt that the Great War ended when it did not so much on account of feats of arms as on account of a gradual change of mind amongst the nations concerned. This change of mind was brought about mainly by propaganda—and that was before the days when broadcasting existed.

To-day rather more than two-thirds of the homes of our own country have their wireless sets, and the proportion is not a very great deal less for most of the countries of Europe. As month follows month the number of receiving sets increases by leaps and bounds. Towards the end of the Great War propaganda reached a few people by means of leaflets dropped from aeroplanes and similar expedients. In any future war it would reach the great majority of the population through the agency of the wireless receiving set.

No country could possibly call in or cause to be dismantled all wireless sets belonging to its population, nor would it desire to do so, as it would lose a valuable means of communicating with the people. No matter how strict the censorship upon the Press, it would be a matter of complete impossibility to prevent news from leaking through to the populace.

Broadcasting may not be able to prevent the outbreak of war, but, personally, I believe that it will be one of the most potent factors in bringing to a rapid end any war that may occur in the future.

R. W. H.

Letters to the Editor

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

The Octal Base

IN the excitement of the attempt to practise some fourth-form irony at the expense of the British Octal Base, your reader forgot the facts. Let reader BM/B.J.F.J. acquaint himself of these:—

1. The existing standard base in Great Britain is the resilient pin base. Four volts is the standard heater voltage for AC mains valves. The British Octal Base is totally different in appearance from the resilient pin base.

2. The British Octal Base is similar in appearance to the American Octal Base because both have a spigot; to the discerning user the differences are apparent. Moreover, the valves to which these bases are fitted are different from American valves in many other respects, e.g., size, intelligence of connections, efficiency of operation, filament voltage, etc.

3. (a) The percentage of valves made and sold in Great Britain in 1937 with American Octal Bases was less than 5 per cent.

(b) The equivalent percentage of battery valves was nil.

(c) The equivalent percentage of 4-volt AC mains valve was nil.

It would appear that irony attempted under cover of a nom-de-plume enables facts to be ignored. BRITISH.

Recordings

I READ with interest the editorial comment in the February 10th issue. You state that "quality of a very high order is obtainable from the very best modern records"; I agree, but only a few are really well recorded; some are absolutely fearful—in fact painful to listen to. This is quite a common occurrence.

Quite a large number of records that I have purchased (*definitely* brand new, of course) remind me of "pots rattling," and also have an enormous amount of "wave."

It might be advisable to point out that the reproducing amplifier and all equipment is absolutely first class, and the above results are simply due to very poor recording.

On the other hand, a very limited number of records are certainly "tip-top" as regards recording, but they certainly *are* limited.

I wonder what other readers' views are?

Manchester. J. A. HARTLEY.

Battery v. Mains

IT is gratifying to have been the means of affording Mr. Robbins some light entertainment over and above that provided by Free Grid, even though my article "Battery *v.* Mains" was not designed primarily for that purpose. No doubt an undertaker would find a Morris catalogue amusing if he insisted on regarding it as the manufacturers' description of the ideal motor hearse. For some reason that I have been unable to trace, Mr. Robbins assumes that "Battery *v.* Mains was essentially a quality discussion"! and so it is not surprising if he gives way to uncontrollable mirth on encountering references to such things as reception of amateurs.

With regard to his belief that the volume at which a programme is reproduced has nothing to do with the correctness of its proportions, I had supposed that the republication of the Fletcher-Munson loudness curves, in articles by McLachlan, Foster, myself and others had destroyed this fallacy. There will be an opportunity of studying the curves once again in an article, "Loud Speaker *v.* Orchestra," which may appear about this time; and I want to emphasise that they are not theoretical, but are the average of tests on the hearing faculties of real live persons.

I am in hearty agreement with the latter half of the letter, referring to the futility of "watts output" rating of receivers, and have, in fact, more than once contemplated bursting into print about it myself, but have been deterred by Free Grid's revelations about the Radio Manufacturers' secret service system from risking my life over it.

Bromley. "CATHODE RAY."

Hum in AC Receivers

I HAVE noticed an interesting fact in connection with AC receivers which may be of interest to other readers. The nominal voltage here is 230, but, due to bad regulation, this often rises to 250 and sometimes falls to 220.

With the set adjusted for 230 v. and when the mains are this voltage there is no hum, but if the voltage rises there appears a pronounced hum even if the mains voltage is reduced by a resistance.

Adjusting the transformer tapping does not cure it, and I wonder whether the wave form changes on light load? A *low* voltage makes no difference. R. E. DARNTON.

Cranbrook.

The new Cossor Model 3952 may be used either as a table or "armchair" receiver.

New Cossor Models

THE Model 3952 has a 5-valve (including rectifier) superhet circuit for AC mains with directly heated triode output valve, and is equipped for pre-set tuning of eleven selected stations by means of a "Teledial" finger-operated dial of the telephone type. An interesting feature of this set is the cabinet which has been specially designed so that it can be used vertically as an armchair "Lowboy" or horizontally as a normal table-model receiver. The price is 10 guineas and the set will work with a mains aerial if desired.

Two new radiogramophones have also been introduced with 8-valve (including rectifier) circuits and push-pull triode output stages. Two short-wave ranges are provided and the price of the Model 3974 is 33 guineas. The Model 3974A, with automatic record-changer, costs 40 guineas.

Television Topics

Frequency Response in Synchronising Circuits

THE television experimenter is familiar with the need for maintaining the response of the vision equipment up to very high frequencies, but in concentrating on this he is often apt to overlook the channel which the sync pulses follow to the time-bases. The vision channel must have a response well maintained up to 2-3 Mc/s, and it is true that the response of the sync channel need not be nearly as good. It must, however, be much better than that of any audio-frequency equipment.

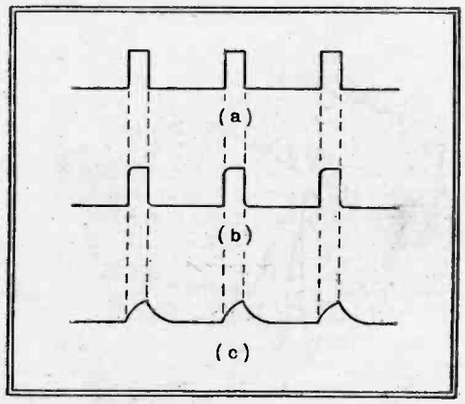


Fig. 1.—The ideal line sync pulse waveform is shown at (a) and a practical waveform at (b). At (c) is shown the severe distortion which occurs when the signals are passed through circuits with a poor high-frequency response.

Ideally, after separation from the vision signal the line sync pulses would have the rectangular shape indicated in Fig. 1a. Such a waveform, however, involves frequencies up to infinity, and in practice the contours are slightly rounded. It can be shown that if the time taken for the voltage to rise or fall is delayed by 5 per cent. of the time occupied by the pulse, the equipment must have a frequency response extending to 0.5 Mc/s.

The waveform then obtained is of the form shown in Fig. 1b, and it will be seen that the corners are slightly rounded. If the frequency response is not sufficiently well maintained, the shape of the pulse is seriously distorted. Fig. 1c represents an extreme case where the values of coupling resistances are much too high in comparison with the stray capacities. Not only is the shape of the pulse seriously distorted, but it is prolonged after it should have ceased.

This delay can be regarded as a phase shift, and in severe cases affects the fly-back time. Where the fly-back time is for other reasons on the slow side, this distortion of the sync pulse may prove sufficient to hold up the fly-back to such an extent that the extreme left-hand side of the picture appears to be folded back on itself.

The coupling circuits used in the synchronising pulse channel naturally vary with the type of amplitude filter employed. In general, however, there is at least one resistance coupling on the lines shown in Fig. 2. The stray circuit capacities represented by C1 should be estimated, and if

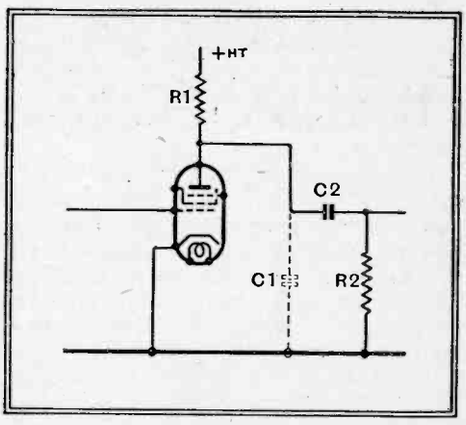


Fig. 2.—A typical resistance-coupled circuit which is generally used in some part of the sync channel is shown here.

there are not more than two such couplings it is satisfactory to make R1 equal to the reactance of C1 at 0.5 Mc/s. The loss at this frequency will then be 3 db. per circuit.

Circuit Values

With the usual values for stray capacities, R2 works out at some 7,500 ohms, and the use of a higher value causes a noticeable deterioration in the shape of the pulses. Where several circuits are used it is well to make the coupling resistances rather lower in value, and 5,000 ohms is usually suitable.

At low frequencies the values of C2 and R2 affect the top of the pulse, but there is usually no difficulty in maintaining a good shape. Actually, the combination should have a large enough product for the condenser to be able to hold its charge within about 5 per cent. for the time of one line. On a frequency basis this is equivalent to a drop of 3 db. at 90 c/s. It is, therefore, sufficient to make R2 equal to the reactance of C2 at 90 c/s.

If C2 is 0.1 μF it has a reactance at this frequency of 17,700 ohms, and theoretically R2 need be no higher. The value of R2 will usually be chosen to suit the following circuits, and C2 must be chosen afterwards. It is clear, however, that no difficulty will normally be found in securing the correct response here.

Television Programmes

Vision 45 Mc/s	Sound 41.5 Mc/s

THURSDAY, FEBRUARY 24th.

3, Derek Oldham in "Intimate Cabaret." **3.25,** Gaumont-British News. **3.35,** 123rd edition of Picture Page. **4-4.15,** The Invisible Ray—it causes people and things to vanish!

9, "Re-view," including Queenie Leonard and Richard Murdoch. **9.20,** British Movietonews. **9.35,** 124th edition of Picture Page. **10-10.15,** The Invisible Ray.

FRIDAY, FEBRUARY 25th.

3, Friends from the Zoo, introduced by David Seth Smith. **3.15,** British Movietonews. **3.25,** Leon M. Lion in "Black Magic," a play by Nesta Sawyer. **3.55,** Preview.

9, Fashions from the B.I.F., described by Alison Settle. **9.15,** Cartoon Film. **9.20,** Friends from the Zoo. **9.30,** "Old Kentucky": cast includes Jane Connard, Vivien Lambelet and Geoffrey Dunn. **9.55,** Preview.

SATURDAY, FEBRUARY 26th.

3, Judo, the art of self-defence. **3.10,** Cartoon film. **3.15,** Talk by C. H. Middleton on Gardening. **3.25,** Gaumont-British News. **3.35,** "Re-view" (as on Thursday at 9 p.m.).

9, Derek Oldham in "Intimate Cabaret." **9.25,** British Movietonews. **9.35,** "The Immortal Lady": Scene 2, Act 2, from the play by Clifford Bax.

MONDAY, FEBRUARY 28th.

3, Gillie Potter. **3.10,** Jean Norris, pianoforte. **3.20,** Gaumont-British News. **3.30,** "On the Highroad," a play in one act by Anton Chekhov.

9, Comedy Cabaret, including George Robey and the Music Hall Boys. **9.35,** British Movietonews. **9.45,** Artists and their work.

TUESDAY, MARCH 1st.

3, Theatre Parade. **3.20,** British Movietonews. **3.30,** "Old Kentucky" (as on Friday at 9.30 p.m.).

9, Starlight. **9.5,** Design IV—at the B.I.F. **9.15,** Gaumont-British News. **9.25,** Black Magic (as on Friday at 3.25 p.m.).

WEDNESDAY, MARCH 2nd.

3, Music Hall Parade. **3.35,** "The Immortal Lady" (as on Saturday at 9.35 p.m.).

9, "The Rivals": a play by Richard Brinsley Sheridan. **9.40,** Cartoon film. **9.45,** Experiments in Science X.—Demonstration of some of the properties of solid carbon dioxide, by Mary Waller.

The Wireless Industry

IN the current issue of *The Bulgin Bulletin*, obtainable from A. F. Bulgin and Co., Ltd., Abbey Road, Barking, Essex, the topical subject of push-button tuning is discussed, and, among other matters, the various uses of vibratory HT rectifiers are described. A list of Bulgin parts for *The Wireless World* Tone Control Unit, described in our issue of January 6th, is given.

B.T-H. sound amplifying equipment is being used at the Birmingham section of the B.I.F., Castle Bromwich, for amplifying speeches at functions held in the Bradford, Royal and Conference Rooms.

Makers' Agents, Ltd., of High Holborn House, High Holborn, London, W.C.1, are showing various apparatus for home recording on Stand A742, at the Olympia Section of the B.I.F.

RANDOM RADIATIONS

By "DIALLIST"

Taps, Doors and Wireless Sets

A BLACKHEATH reader suggests that the set which became silent whenever a water tap in the next room was turned on may have had a loose internal connection somewhere which opened under the effects of vibration caused by a water-hammer in the pipes. In support of his theory he mentions yet another instance of queer behaviour on the part of a radio set. This one was in a room at the back of the house and "packed up" whenever the front door was slammed. No other kind of vibration seemed to have any effect; the door alone would do it. A faulty connection was suspected, but it took a great deal of tracing, for it turned out to be not in the set at all. Actually the earth lead was corroded away at its junction with the earthing switch. Another suggestion put forward by an Antrim correspondent is that the house which contained the set that was so susceptible to water-tap influence may itself have been properly earthed only when the tap was turned on. This, he holds, might silence the set owing to the difference in the capacity between the aerial and the building when the tap was turned on.

Explained at Last

The other day I heard of an almost exactly similar instance and was able to have a chat with the service man who had dealt with it. Here the turning on of the hot-water tap in the bathroom caused any station that was coming in to disappear. The problem proved to be a very puzzling one. It was found first of all that the earthing of the lighting system was none too good. This was improved, but the tap still had unwelcome effects upon reception. Eventually, after a good deal of experimenting, the water system was earthed at several points, after which all was well. It seems, therefore, that the Liverpool reader who advanced the idea (*The Wireless World*, February 10th, 1938) that a closed loop was formed when the water tap was turned on and suggested earthing the water system was not far from finding the solution of the problem.

A QPP Problem

WE don't seem yet to have found a satisfactory method of measuring high-tension current in sets with QPP or Class B output. It is fairly easy with nothing more elaborate than a milliammeter to make a useful estimate of the average current when the set is reproducing with the volume generally used. Or, with more elaborate apparatus, you can find the total current over a definite period and so work out the average value. But neither of these methods gives results of real practical value when it comes to worrying out the proper size of dry battery to use with such a set. Suppose, for example, that the average current was found to be 10 milliamperes; it would be quite erroneous to conclude that a dry battery which can just comfortably stand up to a 10-milliampere load would be satisfactory for the job.

From the battery's point of view a steady load of 10 milliamps is a very different thing from a load which averages 10 milliamps, but may include "kicks" up to 30 milliamps or perhaps more. Every time one of these kicks occurs—and they occur pretty frequently in practice—the battery suffers a serious momentary over-load, and there are few things worse for a dry battery's health than an over-load of any kind. Here is a method which I have just evolved of discovering what may be called the equivalent steady HT load of a QPP set. I would be glad to have any suggestions or criticisms from readers. The *modus operandi* is this: Two or more HT batteries of the same make and batch are selected which show as nearly as possible the same initial EMF. One of these is connected to the set, which is tuned-in to the local station and run for, say, six hours at normal volume. At the end of that time the voltage under load is read and noted. A comparison between this and the initial reading shows what the set has done to the battery in six hours. The next thing is to find the steady load current which will have the same effect on a similar battery.

How It Works Out

This must be done by trial and error methods. If, for example, the average current was estimated at 10 milliamperes one might expect that the widely fluctuating load actually imposed might take as much out of the battery as a steady load of between 11 and 15 milliamps. One's first attempt, then, will be to obtain a "bracket," hoping that the actual figure is going to be more than 11 but less than 15 milliamps. To this end discharges of six hours' duration at these rates are made through fixed resistances from a fresh battery. There is no need to use the whole of this battery for each test: resistances of appropriate value can be connected between two pairs of tappings, the EMFs and therefore the numbers of cells concerned being previously ascertained by the voltmeter. Thus, if a nominal 120-volt (or 80-cell) battery was used for the first test by being connected to the receiving set, it is convenient to take for the second test tappings between which the EMF is 12 volts from eight cells. Battery No. 1 may have shown 122.6 volts to begin with on open-circuit and 110.8 volts after six hours' work. With tappings covering eight cells we want to find the value of a fixed resistance, a six-hour discharge through which reduces the EMF from 12.26 to 11.08 volts. Unless we are very unlucky, the series of cells under the 11-milliamp load will show more than 11.08 and those under the 15-milliamp load something rather less. If this is so, we can try for a "short bracket" by increasing the load on a new set of eight cells to some appropriate figure above 11 milliamps, and that on another set of eight cells to something suitably less than 15 milliamps. It will then not be difficult, making one further test if necessary through a resistance, to work out what steady load has the same effects on the HTB as the fluctuating load to which the receiving set subjects it. It seems to me that the results obtained in this way are of genuine practical value, for they do show how a QPP set treats its HTB. If what I have called the equivalent steady HT load is found, it becomes a fairly straightforward business to ascertain what capacity dry HTB will provide economical working—or whether the set under test is not more suited to the accumulator HTB.

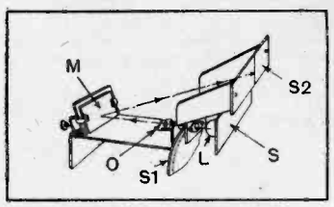
Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

TUNING INDICATORS

AN all-wave set is provided with a viewing-scale, showing the long-, medium-, and short-wave stations, over which an indicator needle is first moved until it is brought into approximately the right position. Behind the viewing scale is a second scale marked in degrees only, and an enlarged image of the "degree" divisions is optically projected over the first scale so as to facilitate subsequent fine-tuning.

The figure shows a simplified arrangement. A single lamp, L, mounted behind the "station" scale S, throws an image of the "degree" markings on the second scale S1, through a lens, O, and inclined mirror, M, on to the fine-tuning scale S2. The latter is mounted immediately above the "station" scale S, so that the indicator needle (not shown) can



Method of superimposing a degree-graduated scale on to a station names' scale by optical means.

conveniently be adjusted to the exact tuning point.

Ferranti, Ltd., and A. W. Edwards. Application dates, May 14th, 1936, and February 24th, 1937. No. 475121.

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NAVIGATING AIRCRAFT

A TERMINAL system for guiding an aeroplane to its destination, particularly in foggy weather, consists of two overlapping short-wave beams, which are so modulated as to give a constant note only along the centre line of the overlap. In addition, a second beam is radiated on the same wavelength, down which the machine can glide safely to earth.

The first pair of beams have a range of from 12 to 30 miles and keep the pilot on his correct horizontal course. The second beam is also modulated to indicate the proper line of approach, and, in addition, is so "shaped" as to guide the pilot down to ground at the proper landing angle, provided he flies along the path of equal field intensity as shown by his receiving indicator.

Standard Telephones and Cables, Ltd. (assignees of Le Materiel Telephonique). Convention date (France), December 31st, 1935. No. 473807.

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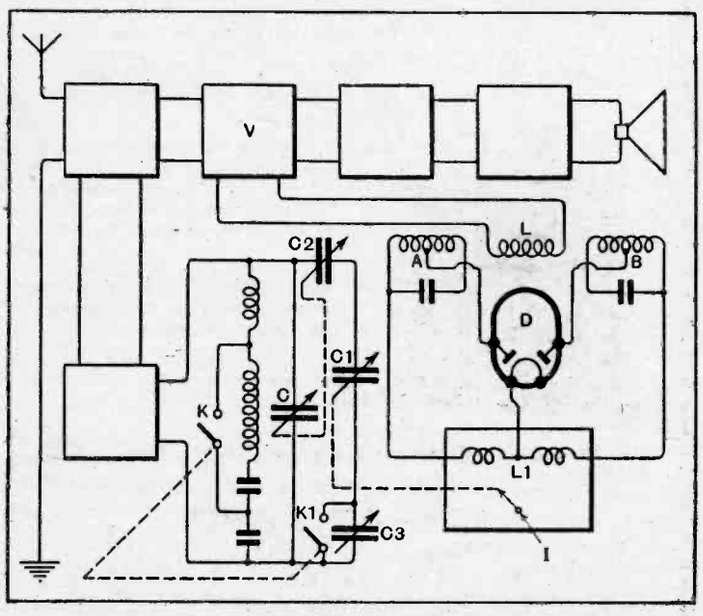
AUTOMATIC TUNING CONTROL

WHEN applying automatic tuning control to a receiver designed to operate over a wide band of wavelengths, the "regulation" of the control is found to vary considerably between the highest and lowest points on the tuning scale, so that if it is effective at one setting it is probably too "elastic" at another.

The figure shows a circuit in which the correction applied is equally effective throughout the whole tuning range. The correcting voltage is derived from the two monitor circuits A, B, one tuned a little above, and the other a little below, the intermediate frequency. Both are coupled to a coil L from the IF stage V and are connected in opposition across the double diode D. The differential current flowing through the load coil L1 will be proportional to the initial error in tuning, and as this coil forms part of a voltmeter the needle I is deflected accordingly. The needle is ganged, as shown in dotted lines, to a fine-tuning condenser C1, which is shunted across the main tuning condenser C of the local oscillator circuit and serves to apply the required tuning correction.

In addition a compensating condenser C2 is ganged to the main condenser C, whilst another condenser, C3, is cut in and out of circuit by the wave-change switch K, K1. These serve to vary the effect of the automatic correction according to the wavelength of the particular station to which the set is tuned.

E. K. Cole, Ltd. Convention date (Sweden), July 13th, 1935. No. 474771.



Automatic tuning control circuit in which the regulation is virtually constant over a wide band of frequencies.

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DIRECTION-FINDERS

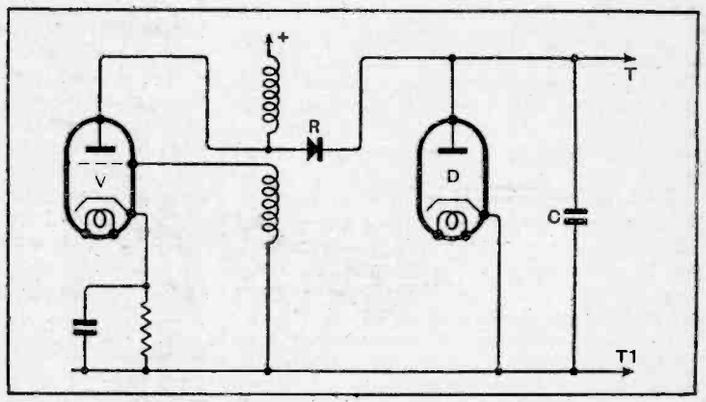
IT is pointed out that the pitching and rolling of a ship at sea is liable to affect the accuracy of a pair of crossed frame aerials, say, of the Bellini-Tosi type, as used for direction-finding. For instance, if the pick-up on to the frames is equal when the ship is on an even keel, then a rolling movement will reduce the effective area of the fore-and-aft frame, and so upset the balance. Similarly the area of the athwart frame is reduced when the ship rolls.

In order to compensate for this source of error a variometer, consisting of two coaxial coils, is inserted in one or both of the aerial circuits, one of the coils being rigidly connected to a spindle which carries a short pendulum. When the ship pitches or rolls the action of gravity on the pendulum displaces or "swings" one of the coils relatively to the other, and so alters the effective inductance of the variometer, in the sense required to correct the resulting field in the radiogoniometer coils.

Marconi's Wireless Telegraph Co., Ltd., and G. M. Wright. Application date April 29th, 1936. No. 474380.

GENERATING SCANNING VOLTAGES

THE back-coupled valve V generates "peaky" oscillations, which are applied to charge a condenser C, through a contact rectifier R, the latter being conductive only to comparatively high voltages. During the interval between successive impulses the condenser is discharged, through a saturated diode D as shown, or through a constant-current pentode, the cathode in either case being at approximately the same potential as the cathode of the valve V.



Time-base circuit for television receivers.

The saw-toothed oscillations produced at the terminals T, T1 are substantially independent of the "peaky" wave-form applied from the valve V and are of constant frequency.

Baird Television, Ltd., and P. W. Willans. Application date, May 4th, 1936. No. 474683.

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RADIO "LANDING" SYSTEMS

IN a wireless system designed to guide the pilot of an aeroplane towards the aerodrome, and to allow him to make a "blind" landing in foggy weather, two non-directional transmitters are arranged, one before the boundary of the landing field, and the other nearer the actual landing point. Each operates on different wavelengths, to which the receiver carried on the aeroplane is alternately tuned. In addition a "marker" beacon radiating a vertical beam of energy is located near each transmitter.

The pilot first aligns himself with the two non-directional transmitters by observing when the indicator needle remains at zero as the receiver tuning is changed over from one wavelength to the other. From the spacing between the two transmitters, and the indications given by the "marker" beacon, the pilot is able to land automatically at the normal gliding speed from a given altitude.

A. F. Hegenberger. Convention date (U.S.A.) January 12th, 1935. No. 473420.