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Editorial Comment.

Is It Revolutionary?

IN our issue of January 7th, 1931, in a critical comment on the Stenode receiver, we expressed the hope that an opportunity would be given for a full explanation of the performance of the instrument to be acquired, and we concluded: "If the instrument can perform all that has been claimed for it the chief reception troubles of the future, due to the congested state of the ether, will be removed by one revolutionary stroke."

When a little more than two years ago Dr. Robinson announced the Stenode receiver, and made astonishing claims for the degree of selectivity obtainable and the quality of reproduction, his claims were, we think it would be true to say, regarded in technical circles as "fantastic." Following that announcement a great deal of time was taken up and much ink used in argument as to why the claims were inadmissible, and in attempts at explanation of his claims on the part of Dr. Robinson. As we have indicated, and as also letters published in this issue go to show, the principle of tone correction after selective tuning is not new—it has been known for many years—yet it is interesting to observe that the application of the principle to broadcast receivers has been used only to a very limited degree. As we view the position, it was with the Stenode that the suggestion was put forward to push selectivity to an extreme case, coupled with the claim that even in such circumstances correction in the low-frequency amplifier would restore to their proper proportion the high notes lost as a result of extreme selectivity in the H.F. stages and would not necessarily reinstate interfering modulation of adjacent transmitters.

A number of investigators have since devoted attention to the problem of selectivity viewed from the new angle of ultra-selective circuits followed by tone correction, and several important contributions have appeared in *The Wireless World* and in our sister journal, *The Wireless Engineer*, which have gradually thrown light upon the subject and provided a practically complete explanation of the performance of the Stenode and circuits of similar type without, it must be noted, having to modify existing theory.

The Wireless World has focused attention upon the importance of this new aspect of receiver design, and claims to have brought to a head a question which has been the subject of controversy for a considerable time.

The view taken by *The Wireless World* as to the importance of the use of these principles in the design of sets of the future is amply supported by the volume of correspondence which we have received on the subject. It is impossible to undertake to print more than a selection of the letters received, but frank endorsement by such authorities as Capt. H. J. Round and Dr. N. W. McLachlan in this issue is in itself sufficient to justify us in suggesting that the effect on future receiver design of these investigations is likely to be of a revolutionary character.

The End of the "Little Joke."

THE sequel to the attempt on the part of the Grimsby Electricity Supply authorities to impose a special charge on electricity users for employing wireless apparatus connected to the mains is now announced. The Grimsby Town Council has rejected the scheme.

Attention was drawn to this matter in our issue of January 20th, when we expressed the hope that the regulation would be killed by ridicule, and that those responsible for having proposed it would be well satisfied to have had their "little joke."

Power Radio-Gram

A self-contained A.C. radio-gramophone for home construction. Designed on straightforward and simple lines, this receiver provides realistic reproduction of both radio transmissions and gramophone records.

Constructional and Operating Notes.

By A. L. M. SOWERBY, M.Sc., and H. F. SMITH.

(*Concluded from page 84 of last week's issue.*)

FOR the sake of convenience and ready accessibility the eliminator and the set proper have largely been separated from one another and built up upon separate baseboards. As a result of this it will be found that construction is exceptionally easy, and that every wire and every component can be got at without difficulty.

The makers of the cabinet will have done practically all the carpentry, including cutting the holes and slots on both panel and motor board. The first task will probably be to wind the coils (unless these, too, are purchased complete) and mount them on the screen which serves as a safeguard against too close a coupling between them. All dimensions and windings are specified in detail in the sketch reproduced last week; it only remains to point out that all windings are to be made in the same direction, and that the lettering of the terminal points is the same on the constructional diagram, the practical wiring plan, and the theoretical circuit.

The tuning condensers, together with the wave-change switch, the volume control, and the reaction condenser, are first mounted on the panel, after which the coil-assembly may be added. The wires to the switch should be connected at this point, as they will be a little awkward to get at after the panel is screwed to the base.

The coupling condenser may be mounted on the screen as in the original set, or it may be transferred to the panel if it is preferred to have it handy for adjustment during reception. Similarly, the present aerial condenser may be replaced by a 0.0003 mfd. bakelite dielectric condenser of the same type (shaped vanes) as that used for reaction and transferred to the panel, where it will make a very satisfactory pre-detector volume control. If the constructor himself is to use the set, the extra controls will probably be appreciated in view of the extra flexibility which they provide, but if non-technical members of the family are to operate it they may be bewildered by the multiplicity of knobs.

When such wiring as can be done between panel-components is complete, the panel may be laid aside in favour of the baseboard of the set. The work here is exceptionally straightforward, components being few and space ample. The Dubilier resistances, which require no other support than their connecting wires, contribute considerably towards simplifying construction. R_3 consists of two 1-watt resistances of 1,500 ohms in parallel, while R_8 comprises two of 50,000 ohms rated at 2 watts and connected in the same way. The output bias resistance R_5 is made up with a 500-ohm 3-watt

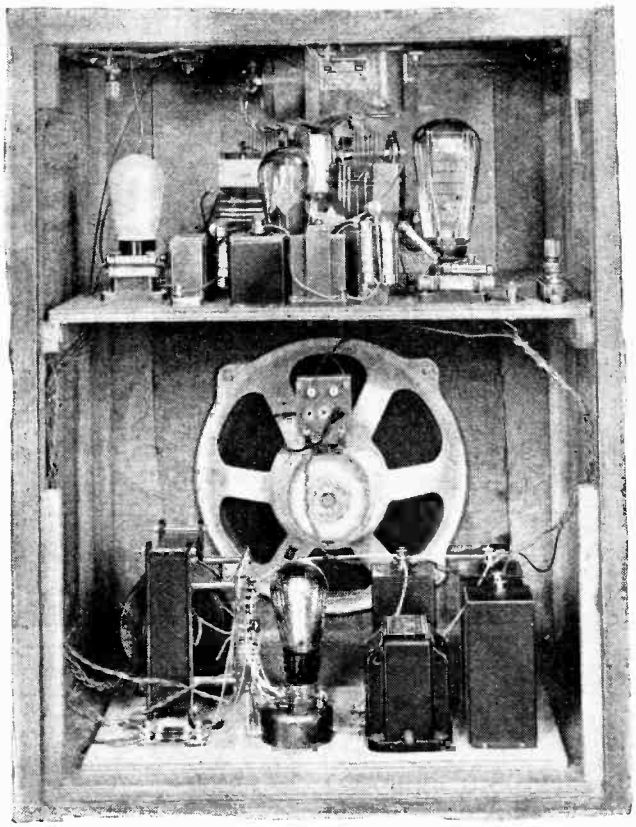
Power Radio-Gram.—

element in parallel with one of 100 ohms, 1 watt rating.

All other resistances are of the 1-watt type, except R_6 and R_9 (3 watts) and R_7 (2 watts). Economy, so far as it is consistent with a fair margin of safety, has been considered in choosing the various resistors.

The grid-lead of V_2 is rather long, since it has to run to the volume control on the panel; screened wire has therefore been used to make sure that the lead in question shall not pick up stray hum. The screening should be earthed.

Both construction and wiring of the eliminator baseboard are so simple that there is nothing that can usefully be added to the information contained in the diagrams. A switch might perhaps be added in the mains lead; this will be useful if there is no switch controlling the socket from which the set is to be driven, but is otherwise unnecessary, and even undesirable. Such a switch may best be mounted on the side of the cabinet. The mains fuses should be rated to blow at half an ampere, or 1 ampere if the mains supply is rated at less than 240 volts. If desired, a 100-milliamp. fuse may be inserted in series with each anode of the rectifying valve to prevent serious damage in the unlikely event of a short-circuit across the H.T. supply.



The radio-gramophone comprises four units — receiver-amplifier, eliminator, loud speaker, and gramophone equipment—of which the relative positions are clearly shown in this illustration.

Switch Alterations.

After mounting the motor and pick-up according to the directions supplied with them, the speed-regulator should be set with the aid of one of the many stroboscopic indicators available, this preferably being viewed, for the first time at least, by the light of a neon lamp. The frame of the motor is earthed by a wire attached to the tag provided, the actual earth connection being made to any point that is convenient.

It should be noted that waverange switching has been simplified by making an extra connection to the moving triple-contact blade of the Telsen 3-point switch. This lead, which must, of course, be flexible, is joined between the switch and the most convenient earthing point. Illumination for the condenser scale is provided by a dial light, of which all the parts are discarded except the bracket and lamp holder, which are secured in a suitable position behind the front panel with the help of distance pieces. Current for this lamp is drawn from the L.T. secondary which feeds V_1 and V_2.

Before switching on, the builder of the set is asked to remember that this receiver employs voltages high enough to deliver an extremely unpleasant shock to even a hardened user of mains sets; 500 volts, received fairly and squarely, is no joke. This is no argument whatever against the use of such voltages, but it provides the best possible reason for making an unbreakable habit of switching off the set before touching any part of its interior. Every part of the set is completely dead within a second or two of switching off.

Since the instrument requires the least preliminary adjustment when used as a gramophone, a record should be tried first to see that all is in order. An earth should be connected to the terminal provided, the volume control turned about half-way in, and the amplifier switched on. After a pause of some forty seconds the delay-action switch will operate, a click from the speaker announcing the arrival of the anode voltage. If on playing a record it is thought that high notes are too weak or too prominent, the pre-set condenser C_4 across one arm of the input potentiometer should be adjusted. Screwing it in increases high notes, unscrewing it diminishes them.

Tuning Procedure.

Switching over to radio, one of the local stations may be tuned in with the coupling condenser at zero. With the aid of the trimmer, both circuits should be accurately tuned, and the series aerial condenser C should be adjusted until signals are faint, retuning after each alteration. Using a screwdriver with a wooden handle, and touching nothing but the wood, the coupling condenser may now be turned—again retuning as necessary—until signal strength, which at first will rise, just begins to fall off again. This is the position of optimum coupling, combining a flat-topped resonance curve with good selectivity.

The aerial condenser is now screwed in until volume ceases to increase, and then is unscrewed again until volume falls just a trifle below the maximum obtainable. The detector is now correctly loaded, and will be giving practically distortionless rectification. The volume

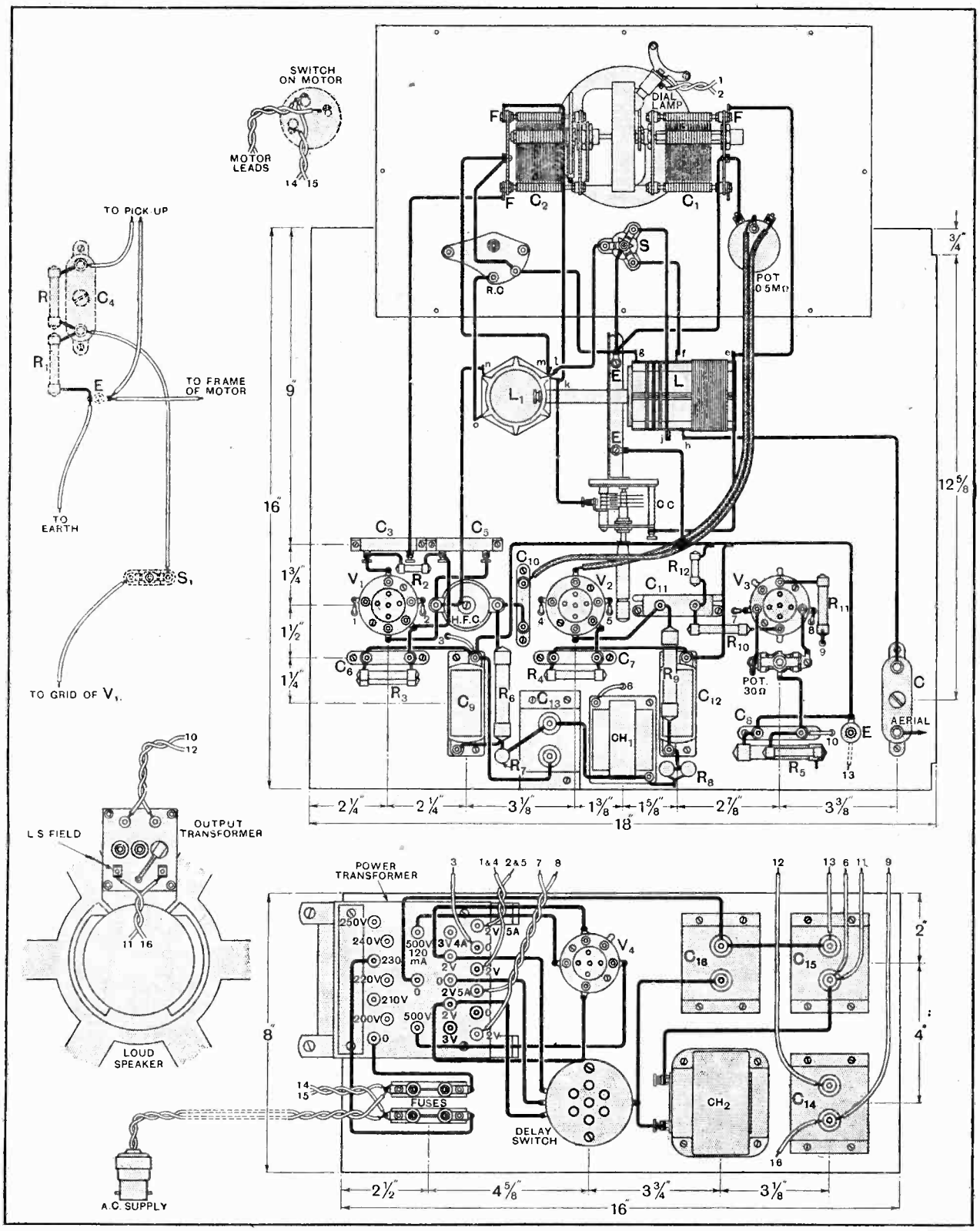


Fig. 1.—Complete practical wiring plan, showing principal dimensions and positions of components. Earth connections to screen, etc., are indicated by E; fixed vanes of tuning condensers by F. A screw on the underside of the motor board makes a convenient anchorage point for all earth connections.

Power Radio-Gram.—

control on the panel will serve to adjust the loudness to the desired level; any attempt to do this at the detector will lead to a certain amount of distortion.

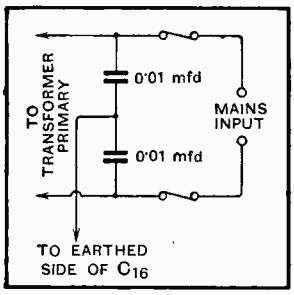


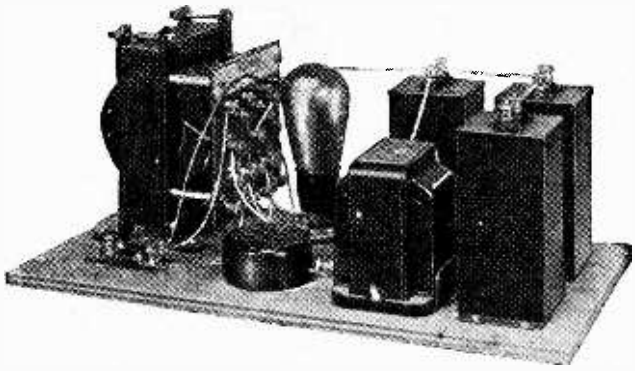
Fig. 2.—An additional precaution against modulation hum.

Noting the settings of both aerial and coupling condensers required for this station, repeat the process on the other local transmitter. The coupling condenser should finally be left set for the station that requires the larger capacity; the aerial condenser, on the other hand, should be set to suit the station requiring the lower capacity. A trace of reaction will bring up the volume on a weaker station.

Once these controls are set they may be forgotten, the transference from one station to the other being carried out by the tuning knob and a touch on the reaction control. Less precise methods of tuning may be used, but the method suggested will bring the quality up to the highest pitch of perfection that detector and tuned circuits can give.

As a final touch, the proportion of high notes from the gramophone may be adjusted, by comparison between a record and a broadcast of similar type, to match the tone of radio transmissions.

As it stands, the set contains no precaution against modulation hum, which may arise if the earth connection is a poor one. The fault is present if hum, normally absent, appears when a signal is tuned in or if the



The power unit (which includes the loud speaker feed condenser C_{14}) is mounted in the base of the cabinet.

detector is made to oscillate. By connecting a pair of 0.01 mfd. condensers in series across the mains and earthing the junction between them, as in Fig. 2, this trouble, which is the only one of which the writers have had even a hint in extensive trials of the instrument, can be completely removed.

If there is any trace of ordinary mains hum, it is worth while to screen the connections to the radio-gramophone switch (mounted on the motor board) as well as the leads to R, R_1, and the pick-up itself.

A 13

De Amplificatoribus.

THE issue by Siemens of the Latin pamphlet bearing this title (on loud speaker installations in churches) may serve to remind wireless readers of the hopeless chaos of technical terms at present existing: of radio and wireless, loop and frame, earth and ground, of reaction and regeneration and back-coupling and feed-back, of high-tension batteries that become B batteries in America and A batteries in Germany, and of lamp and valve and tube.

Incidentally, this last example is further complicated by a recent suggestion that a rectifier should never be counted as a valve. In France this component is the one and only "valve," all others being "lamps"; we shall thus have this word reserved in French for just that item which in English is not to be so designated! In the writer's opinion, the only hope is to devise an entirely new term to cover all "tubes" (to use a neutral term), such as the hideous "polyode" or the like, and then to make the distinction between them either as diode, triode, etc., or by their applications as rectifier, detector, amplifier, etc.

Conflicting Terminology.

Among the most annoying obstacles to reading foreign technical literature are the variations in the terms used for valve constants, especially in German practice. "Internal resistance" appears in the normal way, but "Durchgriff" and "Steilheit" and "Güte" continually make their appearance, and are liable to hold up the English reader completely until he can trace their meanings (which, it may be added, is by no means easy, since everyone is supposed to know them already). "Steilheit" is easy, corresponding to the term "Slope" often used in America, or to the French "Inclinaison"; it merely means "Mutual Conductance." "Durchgriff" can be correctly regarded as the reciprocal of μ; but it is often better to think of it in terms of its fundamental expression, the relation between change of anode voltage and change of grid voltage, since in this way such a phrase as "the durchgriff through the screening grid" can be more readily understood. "Güte" appears to be a purely German concept; it is the product of μ and the Mutual Conductance (or the Mutual Conductance divided by the Durchgriff, as a German would express it).

Another annoying point is that of condenser values; in French literature they are often expressed in thousandths of a microfarad without any indication of what the unit is, and in Germany in "cm." "As everyone knows" (except at the moment when one wants the information), the centimetre of capacity is nine-tenths of a micromicrofarad, so that for most purposes the "cm." of a German text or diagram can be simply read as "micromicrofarads" with little error.

Perhaps the Siemens innovation may lead to a revision and an internationalisation of our technical vocabulary; at any rate, their "pronunciator" or "clear-speaker" is a welcome substitute for the ambiguous "loud speaker," and one which, thank heaven, the majority of modern apparatus deserves. R. R.-H.

The FIXED CONDENSER

Its Uses in the Completed Receiver.

By A. L. M. SOWERBY, M.Sc.

THE preceding instalment of this article discussed the properties of the condenser, and showed how it can, in effect, allow an alternating current to flow quite freely through it in spite of the fact that the two terminals are completely, and very carefully, insulated from one another. It will be remembered that the study of its behaviour brought us to the conclusion that the impedance offered to alternating current by a condenser is less the greater the capacity of the condenser, and is lower for currents of high frequency than for those of low.

Bearing these facts in mind, we will go through the complete circuit of the all-mains set shown in Fig. 1, which contains no fewer than twenty condensers, and will see why each condenser is required, and will discuss what its capacity should be, and why.

The circuit shows a four-valve receiver, containing two stages of high-frequency amplification using indirectly heated screen-grid valves, followed by a power detector resistance-coupled to a transformer, and an output stage using a choke filter. It is fully representative of modern practice, except perhaps that variable-mu valves might be required to make it the last word in modern design. No reaction is used, as that should not be required when two H.F. stages precede the detector.

To avoid unnecessary complication, the receiver is shown as though it were built for reception on one wave-range only; the addition of coils for long-wave reception, together with the necessary switching, would render the diagram more difficult to read without conferring any benefit in compensation. For much the same reasons, the heater circuits are not shown connected to the secondary four-volt winding on the mains transformer. Neither of these convenient simplifications will have any bearing on the subject of condensers, which is our present subject.

IN the second article on the fixed condenser, the complete circuit of a simple four-valve mains receiver is examined to discover the purpose of each of the twenty condensers which it contains, what the capacity of each should be, and why.

The condensers C_1, C_2, C_3, and C_4 are the four tuning condensers which, as this is a modern set, may be considered as being ganged on a common spindle. It will be noticed that they have been so connected that the lower side of each (meant to represent the moving plates) is joined to the common earth line, so that ganging is not complicated by requiring the rotors to be insulated from one another. The reason for the inclusion of these condensers will not be discussed; it would be an insult to the reader to inform him solemnly that tuning condensers are included for tuning, while a full discussion of the theory of resonance, which is the only alternative treatment of the subject, would occupy far too much space. Those who would like to know more about the subject are referred to "Wireless Theory Simplified," Part XIII and onwards (*The Wireless World*, December 18th, 1929, and subsequent issues), where they will find the matter fully and lucidly discussed.

Tuning Capacity.

In most modern sets the capacity chosen as the maximum for the tuning condensers is 0.0005 mfd., and this is the value that the writer would adopt if he were called upon to build up a set to the circuit of Fig. 1. The set will have to tune from 200 to at least 550 metres on the medium waveband; for this to be possible the ratio of maximum to minimum capacity in the tuned circuits as a whole needs to be $7\frac{1}{2}$ to 1; the minimum capacity must therefore not exceed about 0.00007 mfd. Taking into account the effect of the valves in adding stray capacity, and remembering that the coils will almost certainly be separately screened in small screening boxes, which again tends to increase the "strays," it is not likely that the tuned circuit with the highest minimum

The Fixed Condenser.—capacity will fall far below the figure suggested. Since ganging is adopted, the minimum in the other circuits will have to be brought up to the same value by "trimmers" placed in parallel with the tuning condensers so that all circuits may tune satisfactorily together. (To avoid complicating the circuit diagram, these trimmers are not shown in Fig. 1.) The circuit with the highest minimum capacity therefore settles the tuning capacity necessary.

To make it possible to cover the required wave-range with a tuning condenser of the next smaller standard size, 0.00035 mfd., it would be necessary for the minimum capacity to fall below some 0.000055 mfd. in all circuits; this value, while readily attainable with some forms of construction, is lower than can easily be had where screened coils are used. If, therefore, tuning condensers of this lower capacity were used, the tuning range would be restricted, and it would either be found impossible to get down to the lower wavelengths, or impossible to tune up to the higher. The value assigned to the inductance of the tuning coils would decide which of these two limits actually became effective.

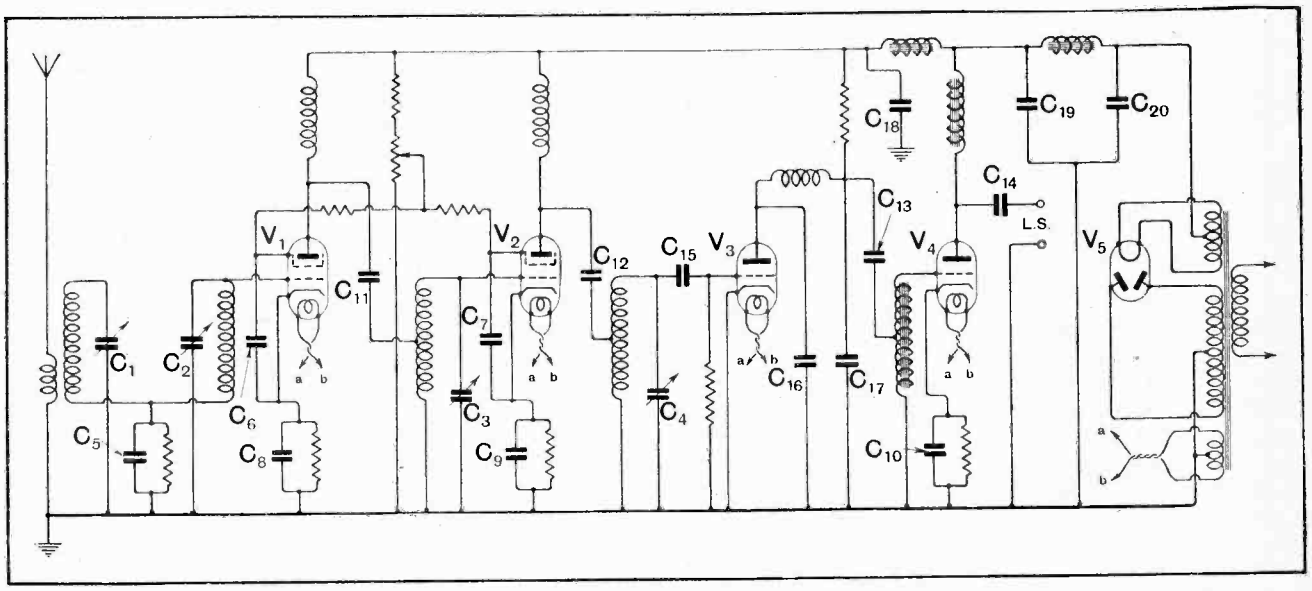


Fig. 1.—Complete circuit of a modern all-mains receiver. The uses of the twenty condensers, together with reasons for the capacities chosen, are discussed in the text.

The Input Filter.

On the long waves the tuning range required is smaller (in terms of ratio of maximum to minimum wavelength), so that, in spite of the fact that the self-capacity of the long-wave coils will in most cases be greater than that of the medium-wave coils, a tuning capacity great enough for the medium waves will be more than adequate for the long. The maximum value of 0.0005 mfd. that we have chosen will therefore be as suitable for the long waves as for the short.

The first two tuning condensers, C_1 and C_2, are shown tuning the two halves of a capacity-coupled filter; energy is transferred from the first tuned circuit to the second by way of the condenser C_5. The mechanism of this transference will be more readily seen by reference to Fig. 2, where the filter is shown by itself, with the components arranged with a view to making the point clear rather than to fit in with the general scheme of the receiver as a whole.

The first tuned circuit of the filter is made up of C_1, C_5, and the coil L_1, all in series; the current induced into L_1 from the aerial circulates round this circuit. In doing so it has to pass through C_5, and, as this condenser offers a certain impedance to the current flowing, a voltage is set up across it. But C_5, as inspection of the diagram will reveal, is also in series with the second tuned circuit, which is made up of C_5, C_2, and the coil L_2. The voltage across it therefore drives a current round this second circuit, thereby providing the signal-voltage necessary to operate the first valve of the receiver, which is connected across C_2.

The greater the capacity of C_5 the less will be its impedance, and therefore the less will be the voltage set up across it by the passage of the current flowing in the first tuned circuit. A large condenser at this point will therefore weaken the coupling between the two halves of the filter, and by so doing will increase selectivity at the expense of signal strength. A small condenser, on the other hand, will make the coupling tight, thereby decreasing the selectivity and, at the same time, increasing the separation of the two peaks of the filter's composite tuning curve. Fig. 3 shows three typical resonance curves of a capacity-coupled filter; the effect of increasing the size of the coupling condenser can clearly be seen from this. In practice, a suitable capacity for the medium waves is found to be 0.015 mfd., this giving an approximation, over most of the wave-range, to the best tuning curve.

The Fixed Condenser.—

The two condensers C_6 and C_7 are provided to ensure that the screening grids of V_1 and V_2 are kept at earth potential so far as high-frequency voltages are concerned. Their function was fully discussed in the first instalment of this article, and the reasons for choosing a non-inductive condenser of capacity 1 mfd. were elaborated. There is therefore no need to go into the question again.

By-passing Bias Resistances.

The next condensers on the list are those which are placed in parallel with the auto-bias resistances of the various valves; they are C_8, C_9, and C_{10}. If these condensers are omitted there remains only the resistance across which each is placed; and these, since they are common to both grid and anode circuits, as can be seen from the skeleton diagram of Fig. 4, would have the effect of feeding back energy from anode to grid. Unlike the usual reaction feedback, this would not tend to cause instability in the high-frequency stages or motor boating in the output valve, because the returned energy bears a relation to that already in the grid circuit such that it tends to damp out signals. The result of omitting the condensers, which provide an easier path for the signals, is therefore a decrease in amplification.

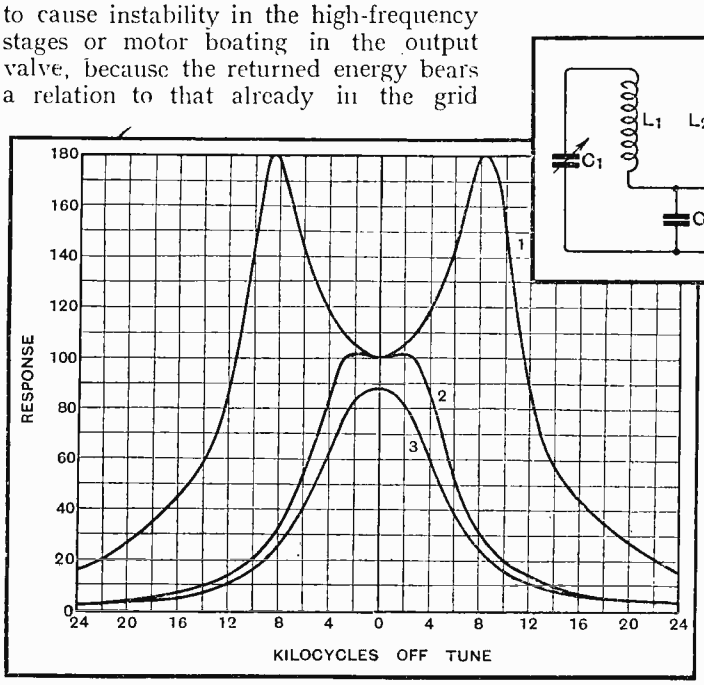


Fig. 3.—Response of filters using different coupling condensers. (1) Too small. (2) Correct. (3) Too large. The importance of choosing the correct value for C_5 is thus shown.

In the case of the condensers C_8 and C_9, which have to deal with high-frequency currents, quite a small capacity will suffice. A paper condenser of 0.1 mfd. is very usually employed in this position. As the duty which this condenser has to fulfil is simply that of short-circuiting the resistance, any value greater than that suggested may be substituted without harm; the use of smaller capacities will tend to decrease amplification, but its effect would certainly not be noticed until a much smaller capacity than that suggested was reached.

Matters are rather different in the case of the last condenser of the trio, for this has to pass low-frequency currents of all the different frequencies handled by the amplifier. As the impedance of the condenser is greater for low notes than for high, the decrease of amplification that would occur if the condenser were omitted altogether will be greater, whatever the capacity chosen, for the deeper notes. If the capacity is not less than 2 mfd., it is unlikely that the preferential treatment given to high notes will be detectable by ear; a smaller capacity is likely to lead to a certain diminution of bass response. If the suggested capacity of 2 mfd. is exceeded, it is unlikely that the increased response to bass notes which is theoretically certain to follow will be appreciable; as microfarads are expensive, one usually compromises on the 2 mfd. suggested.

The tuned-grid circuit, using a tapped coil, is used in the high-frequency stages of the receiver shown; this is commonly adopted in ganged receivers to enable the rotors of the tuning condensers to be earthed. Although, from the point of view of the signals alone, it would be quite satisfactory to connect the anode of the screen-grid valve direct to the desired tapping on the coil, this would have the unfortunate effect of shorting the H.T. supply, through the H.F. choke, to earth. The condensers C_{11} and C_{12} are therefore inserted.

Fig. 2.—The input band-pass filter of the receiver, rearranged to show more clearly that the condenser C_5 is common to both the tuned circuits C_1L_1 and C_2L_2.

Since their duty is simply to provide a free path for the signals, any condenser that is large enough for this purpose may be used. Moreover, this condenser is, in effect, in series with the A.C. resistance of the screen-grid valve that precedes it, so that unless the impedance of the condenser is as high as, or higher than, this value—perhaps 250,000 ohms or more—at the longest wavelength to be handled by the amplifier, its introduction will cause no diminution in signal strength. The smallest condenser commonly sold, 0.0001 mfd., has an impedance of a shade over 10,000 ohms at 2,000 metres, the longest wavelength with which the amplifier is likely to have to deal; since this impedance is small compared with the 250,000 ohms of the valve, there is no need to choose a larger capacity than this. There is, indeed, a danger in choosing large condensers for C_{11} and C_{12}, for if too large they may pass hum from the H.T. supply with inconvenient readiness. The suggested capacity of 0.0001 mfd. is not found to cause trouble from this source, and therefore stands as the best possible choice for these two positions.

Condensers in the L.F. Amplifier.

A very similar duty, but this time on the low-frequency side of the receiver, has to be undertaken by C_{13}. The considerations governing the choice of this capacity,

The Fixed Condenser.—

which has to deal with all audible frequencies, are rather more complex, but it is found that most valve-transformer combinations require about 1 mfd. for best results. C_{13} really requires an article all to itself; those who would like to read one are referred to "The Parallel-fed L.F. Amplifier" (*The Wireless World*, December 11th, 1929).

The condenser C_{14}, which forms part of the choke output filter, is charged with the duty of allowing signals of all frequencies to pass from the anode of the last valve through the loud speaker to earth, while restraining the H.T. supply from sending a current along the same path. 2 mfd. is usually considered large enough for this purpose, but 4 mfd. is preferable in most cases; too small a capacity will result in restricting the passage of the bass notes, while an increase of capacity above 4 mfd., though desirable on paper, will, in most cases, be found to have no audible effect at all.

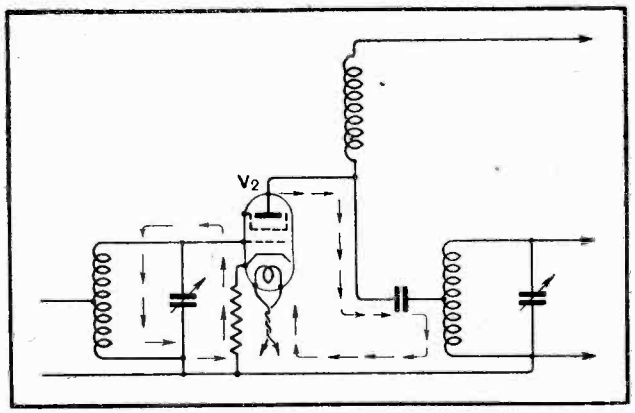


Fig. 4.—The arrows show the path of the main signal-circuit in both grid and anode circuits of V_2. It will at once be seen that the bias resistance is common to both circuits.

The next condenser, in numerical order, is C_{15}, the grid condenser of the detector valve. It has to be considered from both the high-frequency and the low-frequency point of view, for it must pass high-frequency currents through to the grid of the valve with reasonable freedom, while, at the same time, it must not permit the low-frequency voltages generated by the detector action of the valve to pass back to earth through the tuning coil. Its value will depend to a certain extent on the resistance chosen for the grid leak with which it is associated; in a modern receiver, in which the high notes are adequately looked after, the combination will usually consist of a grid condenser of 0.0001 mfd. and a leak of a quarter to half a megohm. If the condenser is very much larger than this it will offer an impedance to the highest audio frequencies which is appreciably less than that of the grid leak; as a result, music will be lacking in those highest notes which give individuality to the instruments of an orchestra. A condenser smaller than 0.0001 mfd. will tend to cut off the grid of the valve from the tuned circuit, and so will reduce the signal strength, though the effect will not become serious enough to matter unless the capacity is reduced considerably below that suggested.

Detector By-pass.

The by-pass condenser from anode of the detector valve to earth, C_{16}, will depend for its capacity upon a number of factors. Since, when the high-frequency currents are once rectified by the valve, we have no further use for them, we really require C_{16} to the lowest practicable impedance to them. But we cannot choose too large a condenser, or we shall find that the higher notes of the music, which, in the form of rectified current, have to pass the high-potential end of this condenser, will also be conveyed to earth instead of proceeding through the set to the loud speaker. A compromise has therefore to be sought, and a condenser large enough to provide a reasonably easy path for high-frequency currents, while at the same time offering a high impedance to those of low frequency, has to be chosen. In practice, a condenser of capacity 0.0005 mfd. offering an impedance of 2,000 ohms at 2,000 metres (the lowest high frequency) and some 60,000 ohms at 5,000 cycles (about the highest low frequency) is usually found satisfactory. If the detector valve has a high impedance a smaller capacity will be better, while if its impedance is exceptionally low the capacity may be made somewhat larger. The effectiveness with which any condenser by-passes either high or low frequencies depends largely upon the relation borne by its impedance to others with which it is in parallel.

It is usual for C_{17} to have the same capacity as C_{16}, since the two of them, in conjunction with the high-frequency choke sandwiched between them, form a filter for removing the unwanted high-frequency currents. Since, however, the capacity of the transformer primary and of the anode resistance are in parallel with C_{17}, a rather smaller capacity—say 0.0003 mfd.—will often suffice. Or, if trouble arising from the passage of high-frequency currents into the latter part of the set is not experienced, C_{17} may be left out altogether.

There now remain to be considered only the three condensers, C_{18}, C_{19}, and C_{20}. All three of these are associated with the smoothing of the anode current derived, by way of the transformer and rectifying valve, from the mains; none of the three have any particular duties to perform in connection with the signals. It follows that the larger each of the three is made the greater will be the freedom from hum exhibited by the completed receiver. In the case of C_{18} and C_{19} there is no need to specify a limit to the capacity, for no possible harm can result no matter how large they are made. In practice, it is unusual to find a greater capacity than 2 mfd. in the position occupied by C_{18}; if greater smoothing than this capacity can provide is required it is usually preferable to increase the inductance of the choke that immediately precedes it; since this carries a comparatively small current, the size and cost of this component will not be unduly increased.

In the case of C_{19}, which follows a choke that has to carry the whole current consumed by the set, 4 mfd.

The Fixed Condenser.—

is generally employed, for an increase in inductance in this choke would lead to a very big component. Where necessary, higher capacities can be used in either of these two positions.

There is a limit to the size of condenser that can be used for C_{20}, which is the reservoir condenser immediately following the rectifier, for if the capacity is unduly increased the rectifier will be overloaded. 6 mfd. is about the maximum usually recommended for this position, while 4 mfd. is the usual value. The choice of this latter capacity has the advantage that it is on the assumption that this value will be chosen that the "regulation curves" of rectifier valves, showing the voltages to be expected at various currents, are compiled.

Our deliberations have now led us to assign a value to every one of the twenty condensers contained in the receiver shown in Fig. 1; as a summary of the whole, the values decided upon are given in the following table:—

Condenser.	*Capacity.*
C_1, C_2, C_3, and C_4	0.0005 mfd.
C_5	0.015 mfd.
C_6 and C_7	1.0 mfd. non-inductive.
C_8 and C_9	0.1 mfd.
C_{10}	2.0 mfd.
C_{11} and C_{12}	0.0001 mfd.
C_{13}	1.0 mfd.
C_{14}	4.0 mfd.
C_{15}	0.0001 mfd.
C_{16}	0.0005 mfd.
C_{17}	0.0003 mfd.
C_{18}	2.0 mfd.
C_{19} and C_{20}	4.0 mfd.

Nuts to Crack.

Instructive Problems and their Solution.

THE present series has been started by *The Wireless World* for the benefit of readers who like to work out little problems for themselves and be sure that the results they obtain are correct. At frequent intervals wireless problems are set, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Last week problems 13 to 15 were given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

Problem No. 13.—**A five-valve receiver using a 2-volt filament supply (accumulator) takes 1.2 amperes of filament current. What is the total power expended in lighting the filaments? If a 40-ohm potentiometer were placed across the accumulator terminals, what would be the increase in the L.T. power consumed?**

Answer—2.4 *watts;* 0.1 *watt.*

Since we are here dealing with direct currents, the power in watts is given by the product of the voltage and the current in amperes. The power is thus 2×1.2, or 2.4 watts.

The current taken by the potentiometer is easily found by Ohm's Law. This gives I (in amps.) $= \frac{E}{R}$ i.e., $\frac{2}{40}$, or 0.05 amp. As before, the power taken is equal to the product of the voltage and this current, i.e., to 2×0.05 or 0.1 watt. A quicker method is to make use of the formula, Power $= \frac{E^2}{R}$ watts, in this case $\frac{4}{40} = 0.1$ watt as before.

°°°°

Problem No. 14.—**What is the effective or R.M.S. value of an oscillating grid voltage whose peak values are 7 and 22 volts negative, and what is the grid bias?**

Answer—5.3 *volts R.M.S.;* 14.5 *volts negative.*

Since the extreme values of voltage variation are -7 and -22 volts, the total amount of grid "swing" will be their difference, or 15 volts, while the amplitude of an oscillation will be half this, or 7.5 volts. Now, the R.M.S. value is always 0.707 of the corresponding amplitude; hence the R.M.S. value of the grid voltage oscillations will be 0.707×7.5, or 5.3 volts approximately.

The grid-bias point or mean potential of the grid will obviously lie half-way between the extreme peaks of potential attained in the cycle; it will, therefore, be $\frac{1}{2}(7+22)$ or 14.5 volts negative.

°°°°

Problem No. 15.—**An L.F. alternating current of amplitude 10 milliamperes and frequency 750 cycles passes through a resistance of 50,000 ohms. What amount of power is expended in the resistance? What power would be expended if the frequency were increased to 1,000 cycles?**

Answer—2.5 *watts. No difference.*

The first thing to find here is the R.M.S. value of the current, because a knowledge of this value is very useful in estimating the power taken in A.C. circuits. The R.M.S. value is, of course, 0.707 times the amplitude, i.e., in this case 7.07 mA. It is a sound rule in working out electrical problems to express the quantities always in fundamental units; in this case we should express the R.M.S. value in amperes, i.e., 0.00707 amperes. Now, if an R.M.S. current of I amperes flow through a resistance of R ohms, the power expended is given by I^2R watts. Here we have, therefore,

$$\text{Power} = (0.00707)^2 \times 50{,}000$$
$$= 0.00005 \times 50{,}000$$
$$= 2.5 \text{ watts.}$$

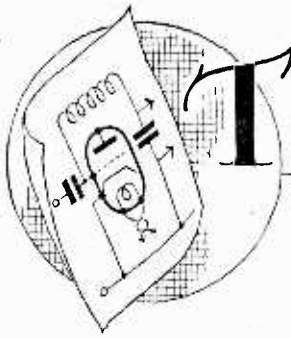
NEXT WEEK'S PROBLEMS.

Problem No. 16.—**A condenser of 0.0002 mfd. is placed in series with one of 0.002 mfd. What is the value of the resulting capacity, and what would the capacity have been had they been placed in parallel?**

Problem No. 17.—**It is desired to use a milliammeter whose maximum reading is 5mA. to measure currents up to 100 mA. If the meter resistance is 50 ohms, what value of external resistance will it be necessary to use, and how should it be connected?**

Problem No. 18.—**With 100 volts on the plate, a certain valve passes a steady current of 17.5 mA. when the grid has a negative bias of 10 volts. If the magnification factor of the valve under these conditions is 15, and the mutual conductance 2.5 mA. per volt, what will be the approximate current taken by the valve if the grid bias is increased to 12 volts negative?**

NUTCRACKER.



The Diode

Distortionless Rectification with the Non-amplifying Detector.

By H. L. KIRKE.

THE technique of distortionless amplification, both at radio and audio frequencies, has occupied attention for a considerable time, but it is only recently that the limelight has been turned on linear rectification. Articles have now appeared showing the advantages of the power grid detector used alone and in push-pull, while several articles by the writer have discussed the diode with neutralised space charge. There is no doubt that, using this type of detector, very perfect rectification can be obtained, but the method is far from economical. About 10 R.M.S. volts are required to operate it correctly, and its impedance is of the order of 10,000 ohms (depending upon the output load), so that the R.M.S. value of current into the detector will be 1 milliampere, while the peak value of current will be very much higher than 1 milliampere. An R.M.S. voltage of 10 means a peak voltage of between 25 and 28 for maximum values of modulation, and the preceding valve and circuit must be capable of supplying such voltages without distortion; therefore it is desirable to use a semi-power valve, either three-electrode or pentode.

READERS already familiar with the author's "Kirkifier" or distortionless diode with neutralised space charge, which was described three years ago, will welcome an article in which he deals with a new form of diode detector having additional advantages.

High Anode Voltages.

There are two further disadvantages: first, the damping of the circuit is very heavy, consequently the tuning will be flat. This is desirable from the point of view of flat frequency characteristic, but in these days of severe interference one must be prepared to cut some sidebands in order to be free from interference, even at the expense of a loss of quality. Consequently it would be desirable to have greater selectivity. The second disadvantage is in the use of a 12- to 20-volt battery supplying about the same number of milliamperes for polarising the grid. This last disadvantage can, however, be overcome by using one of the modern types of rectifier valve which has low impedance, so that the working curve is sensibly straight.

The straightforward grid leak detector can be arranged, as has been described in other articles (see *The Wireless World*, January 9th, 1929, and the B.B.C. Handbook for 1931, pp. 299-317), to give linear rectification up to quite high degrees of modulation of the order 80 per cent. to 90 per cent. In fact, to all intents and purposes, a grid leak rectifier is equivalent to a diode which is the grid-filament path, followed by an L.F. amplifier which is the anode-filament path, without any steps taken to filter the high-frequency from the L.F. valve; consequently the curvature of the working characteristic depends upon the ratio of grid leak resistance to grid-filament path resistance for small amplitudes, and upon the straightness of the anode current grid volt curves of the valve for high amplitudes; that is to say, the straightness of the curve for high amplitudes obeys more or less the same laws as that of an L.F. amplifier and requires high anode voltage, with the difference that a high-frequency voltage is superimposed upon the grid whose amplitude is equal to or greater than the maximum variation in voltage at low frequencies.

The use of a power grid detector is thought to overcome some of these difficulties by increasing the length of the straight portion of the characteristic. In practice, however, the resistance of the grid-filament path of a power-grid detector is in general higher than that of a high magnification valve, so that while higher inputs can be used for reducing the curvature of the higher amplitudes, the curvature for small amplitudes is increased, due to increase of grid filament resistance. The overall result in regard to maximum voltage output is not very greatly different, but in a power grid detector more volts have to be applied to the grid to get a given voltage output. On the other hand, of course, if a step-up transformer is used with the power grid detector the overall output voltage can be increased, as the valve impedance is lower and greater step-up is obtainable, and the overall magnification (we can refer to the ratio of output L.F. voltage to input H.F. voltage as a magnification) will be about the same for both types of detector, with the exception that the power grid detector operates at higher level. Whether this is an advantage or disadvantage depends upon a number of other details of design and requirements.

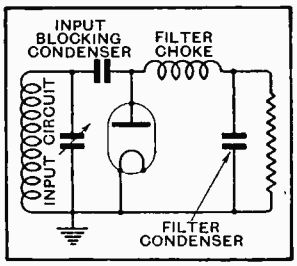


Fig. 1.—A diode rectifier together with the essential input and output components.

The Diode.—

One of the disadvantages of the grid detector is the damping introduced into the previous circuit. This is partly due to the damping of the grid leak itself, partly to the damping of the grid-filament path and the valve when conducting, and partly due to what is frequently called "Miller effect," which is nothing more or less than anti-reaction introduced by the capacity between the grid and anode of the valve. In general the damping due to the grid leak is not serious, although it is a factor. That due to the grid-filament path of the valve is also small, because in the operating condition the grid-filament path is only conducting during a portion of the positive half-cycle (the term "conducting" is meant to be read in a relative sense) so that the major portion of the damping is due to the Miller effect. One method of overcoming this is to use some form of neutralisation, which may take the form of ordinary reaction of some sort, but in many cases it is undesirable to use reaction, and in any case if reaction is going to be used it is more effective on a circuit which already has low damping.

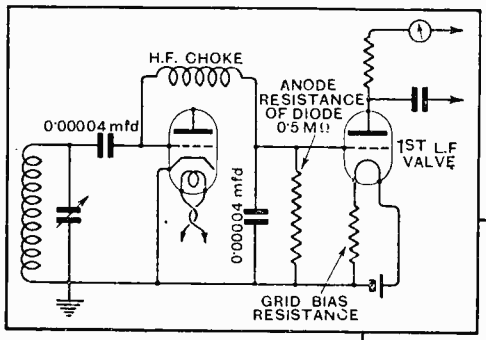


Fig. 2a.

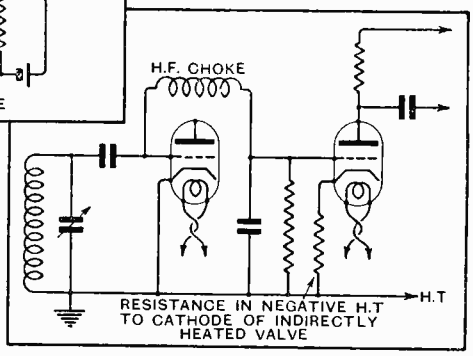


Fig. 2b.

Fig. 2.—(a) and (b) Diode detector followed by a single stage of L.F. amplification showing two methods of obtaining automatic negative bias.

It has been suggested to the writer that two valves used in such a way as to separate the functions of rectification and amplification into two distinct stages provide many advantages.[1] The disadvantage of heavy damping due to Miller effect is eliminated; the L.F. amplifier has no high-frequency voltages superimposed upon the L.F. voltages, and consequently the length of the straight portion of the characteristic is practically doubled, and yet the input circuit to the detector may have one pole earthed, which facilitates design and construction. The first valve, or detector, must be a diode of some description, and in order to keep the damping due to this diode low its output resistance, that is to say the resistance in the anode circuit, should be high—of the order $\frac{1}{4}$ to $\frac{1}{2}$ megohm. With such a resistance, of course, the rectification efficiency will also be high. Unless severe loss of high frequencies can be tolerated the total capacity effectively across the anode resistance as regards low frequencies must be made small. The input condenser, which in a grid leak rectifier is normally the grid condenser, is in shunt with the anode resistance as regards low frequencies; consequently its capacity must be made small.

Avoiding Stray Coupling.

In order effectively to filter high-frequency currents from the L.F. valve, a choke having a very high inductance must be used, and in order to complete the filtration the anode resistance itself should be shunted by a small condenser. It is necessary that the choke should have very low self-capacity, and that its natural wavelength, when shunted by the condenser across the anode resistance, should be much higher than any wavelength to be received. The essential circuit for rectification becomes that shown in Fig. 1.

It has been said that the blocking condenser must be made small, which means, in turn, that the capacity of the valve itself must be much smaller than the input blocking condenser capacity, otherwise a considerable high-frequency current will occur, which will cause a considerable voltage drop in the blocking condenser. The result of this is that the actual voltage developed across the valve is much less than that across the circuit, whereas it should be very nearly the same. With this in mind, it is probably advisable only to use the grid-filament path of a valve and to leave the anode free. The anode can be strapped to the grid, but this tends to increase the capacity, and it is doubtful whether strapping the anode to the grid materially decreases the valve resistance for the small currents which occur in practice. The same remarks apply to the use of a "Kirkifier" at very low inputs. It is also highly desirable to keep the capacity of all leads associated with the anode at high frequency as low as possible, so that it would be preferable to mount the blocking condenser very close to the valve holder, to mount the valve holder away from any metal panel if used, and to avoid screwing down the blocking condenser to a metal panel. In this way the length of lead between the blocking condenser and the valve can be made to have negligible capacity to earth. The lead between the valve and the high-frequency choke is also important, and should be kept as short as possible, and for the same reason the mounting of the high-frequency choke should be carefully chosen and the choke itself should have very small self-capacity. Care should also be taken to avoid any coupling between the filter choke and any of the high-frequency circuits, so that it is probably better to house the detector valve, blocking condenser, choke, output resistance, and filter condenser as a unit, and screened from other units. If the usual blocking condenser and grid-leak resistance is used to couple the detector circuit to the first L.F. valve, the grid-leak resistance will be effectively in shunt to the output resistance of the detector. This will tend to reduce the efficiency unless the grid leak is made to

[1] Since this article was written, it has been pointed out by Mr. F. M. Colebrook in the June 10th, 1931 issue of this journal that there are many advantages to be gained by dividing the functions of rectification and amplification. EDITOR.

The Diode.—

have a resistance very high in relation to the detector output resistance.

One may ask, "But what about grid negative?" The reply to this is quite simple. When the detector is functioning there will be a drop of D.C. voltage across the output resistance due to the rectification of the carrier wave, which, when applied to the grid of a valve, will afford the necessary value of grid negative. The value of D.C. voltage drop due to the carrier will always be greater than the peak value of any signal, since the co-efficient of modulation cannot exceed 1. Care must be taken, however, that grid current in the following valve does not occur when the grid is negative in regard to the filament. In some valves grid current starts at about −1 volt. If a valve of this type is used it will be necessary to supply some form of grid negative, but many of the forms of free grid bias will be suitable and will readily occur to the reader. Two forms suitable are shown in Figs. 2a and 2b.

Sensitivity of the Arrangement.

It may be thought that it is rather a waste of a valve to use it in this way, but actually this is not the case, and there are certain definite advantages to be gained. Where it is undesirable to use reaction and to keep the number of tuning controls as few as possible, then the use of this method is undoubtedly an advantage, because it does reduce the damping on the circuit, and consequently improves the selectivity. Although an additional valve is used, its presence improves sensitivity, and therefore the valve is not completely wasted. For instance, the damping of an ordinary grid-leak detector may be as low as 20,000 to 30,000 ohms in addition to the circuit of the detector, whereas the damping due to the proposed form of diode is of the order of the anode resistance, that is to say, if an anode resistance of $\frac{1}{2}$ megohm is used, the input impedance of the detector will be between 0.3 and 0.5 megohm, so that straight away there will be a considerable gain in sensitivity. Where a good aerial is used, and the field strength from the transmitting station is good, it is quite possible to operate the detector without any high-frequency magnification. For instance, if the aerial is, say, 35ft. high, and has an effective height of, say, 7 metres, and the field strength is 15 mV/metre, the total voltage induced into the aerial will be 15×7 millivolts, i.e., $=0.105$ volt. If the resonance step-up of the circuit (equivalent value of $\omega L/R$) is 20, then the voltage applied to the detector will be 2.1 volts R.M.S., and the output voltage will be of the order of 2 volts D.C. This is a convenient value for application to the grid of a high magnification L.F. valve, particularly if an indirectly heated cathode valve is used, where a valve having a μ of about 35 will be satisfactory. A resistance-coupled valve of this type will have an actual magnification of over 20, so that the output voltage available at the anode will be over 40, which is sufficient to work a power valve at considerable volume, so that we have an arrangement using three valves for local station reception which gives excellent quality and good selectivity. The selectivity is practically sufficient, provided good circuit arrangements are made, for separation of the London National and Regional programmes in London unless the separation requirements are very rigid; that is to say, with a good aerial circuit and well-arranged input circuit, when one programme is tuned in the other should be only just audible with the head fairly close to the loud speaker. With the addition of one H.F. valve—particularly an indirectly heated screened valve of the very high-efficiency variety—the sensitivity will certainly be all that is required for most people. With a good aerial stations like the North Regional can be received in London in daylight; that is to say, field strengths of the order $\frac{1}{4}$ mV/metre upwards are receivable on a fairly good aerial. Fig. 3 shows the circuit arrangements used by the writer with considerable success, both as regards quality and sensitivity. The details of decoupling are omitted for convenience, but these are quite normal.

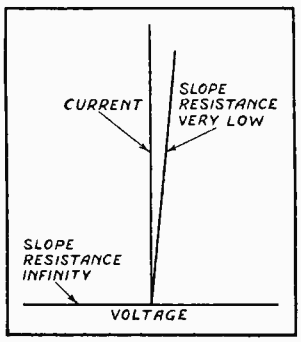


Fig. 4.—The static characteristic curve of a perfect diode.

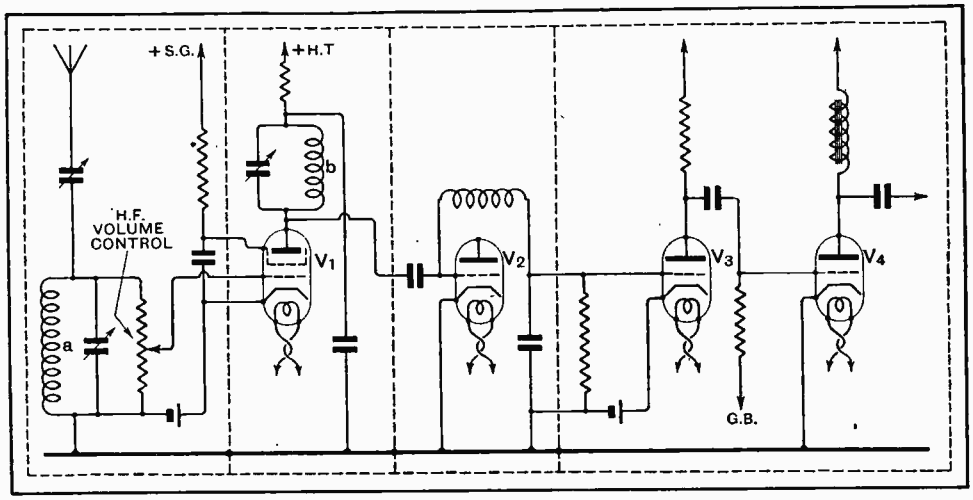


Fig. 3.—Skeleton circuit diagram of a four-valve receiver including a screened H.F. stage, a diode and two L.F. valves. Decoupling details are omitted.

With regard to the high-frequency choke, rather better filtration is required than that provided by any of the very good makes of high-frequency chokes and single condenser. Either a much larger choke or two chokes

The Diode.—

in series must be used, or else a proper low-pass filter employed. It is, of course, highly important, as stated before, when very large chokes are used, to see that these have negligible self-capacity and negligible capacity to earth.

Note on the Damping due to a Diode.

The damping due to grid current in a grid detector or anode or grid current in a diode has been mentioned, and it has been stated that the effective input resistance of a detector (neglecting Miller effect) is of the same order as the load resistance. This may need a little explanation. The simplest explanation is to consider for a moment a perfect detector, i.e. one which has very low resistance to voltage in one direction (usually considered positive) and a very high resistance to voltage in the other (usually considered negative). The curve for such a detector is illustrated in the ideal form in Fig. 4.

Now consider what happens on the application of a signal. The first positive half cycle of the signal will cause current in the detector which will charge the blocking condenser. The voltage of this charge will depend on the frequency of the signal, i.e., time the charging current lasts, the resistance of the valve during the time of charging, and the capacity of the condenser. If the load or leak resistance is sufficiently high, very little charge will leak away during the time between each positive half cycle.

If the valve resistance is low enough and the condenser small enough, the condenser will be charged up to the peak value of the H.F. during the first positive $\frac{1}{4}$ cycle. This is rarely the case, and usually several cycles are required before the voltage on the condenser reaches a steady value, and the time taken to reach a steady value depends upon the charging time constant of the circuit, which is CR, where R is the valve resistance. When the voltage on the condenser has reached a steady value (it will be negative with regard to the filament), charging current will only flow through the valve during the time when the anode is positive, i.e., when the voltage of the positive half cycle of the signal is greater than the negative charge on the condenser. The damping of the detector is due to the loss of energy in the valve during the time the condenser is being charged, and power absorbed by the detector is roughly equal to the signal voltage multiplied by the R.M.S. value of the charging current. The total discharge of the condenser must be equal to the total charge. The mean value of current in the leak must be equal to the mean value of the charging current, and total loss of energy is the loss during charge $I^2(R.M.S.)R$, plus the loss during discharge (I^2R). R = leak resistance, so that the effective resistance of the detector will always be less than that of the leak

The Effective Resistance.

But there will be an additional loss of energy due to the H.F. current in the leak unless a filter circuit is provided as shown in the diode circuit (Fig. 2), so that in a grid-leak circuit the effective resistance is likely to be somewhat less than half the leak resistance (in addition to the Miller effect damping), whereas in the diode and filter circuit the input resistance will be nearly equal to the leak resistance if an efficient detector is used.

It is interesting to note that when the detector is far from perfect and the curve is nearly straight, the equivalent resistance of the detector approaches that of the leak in parallel with the A.C. resistance of the valve, as the valve curve approaches a straight line, i.e., when the detector ceases to detect.

Two Hundred Valves.

NO fewer than 208 specimens of valves were exhibited and described by Mr. Largen at a recent meeting of the Ilford and District Radio Society, when the history of the valve was dealt with from the appearance of the original carbon lamp to that of the latest Mazda and Osram types.

Members learned from the display the remarkable improvements made since the advent of the A.C. valves of 1927, and the slow progress made before that year, whilst a comparison was made between a 1908 Audion, an Osram DA60, and the latest Mazda A.C./S2 with a magnification factor of no less than 3,000, as instances of these improvements

Details of the Society may be obtained from the Hon. Secretary: Mr. C. E. Largen, 16, Clements Road, Ilford, Essex.

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Valves in the Making.

AN unusually interesting lantern slide depicting a collection of graphs from which one could learn almost anything about a valve's characteristics was shown by Mr. Parr, of the Edison Swan Electric Co., Ltd., in the course of his lecture on "Current Valve Practice," at a recent meeting of the South Croydon and District Radio Society. The lecturer sang the praises of A.C. valves, enumerating the merits of indirectly heated filaments. A new type of valve was shown with special cooling fins designed to prevent the valve from becoming so hot that current leakage would tend to occur across the hot glass. Of special interest was the Ediswan film showing operations in the valve factory.

Hon. Secretary: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

CLUB NEWS.

S.G. Valve in L.F. Stage.

THE use of an S.G. valve in an L.F. amplifier was discussed by Mr. D. McDonald, B.Sc., at the last meeting of Slade Radio, Birmingham. After the circuit of the amplifier had been described and various response curves shown, a demonstration was given. With an R.K. Senior permanent magnet type of speaker the reproduction proved very good. The lecturer showed how, by the use of various resistances, needle scratch could be almost eliminated.

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

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How Sets Have Changed.

MR. G. A. ADAMSON, of Philips Lamps, Ltd., gave members of the Bristol and District Radio and Television Society some idea of modern methods of mass production of wireless sets in a lecture entitled "The Economic Production of Modern Receivers." He showed how the technique of production had changed of recent years in order to cope with the price problem, one-knob control and compactness.

Hon. Secretary: Mr. G. E. Benskin, 12, Maurice Road, St. Andrews Park, Bristol.

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The New Wavemeter.

AT a meeting of the Golders Green and Hendon Radio Scientific Society on January 15th, the Society's new wavemeter was on view for the first time.

Mr. Maurice Child, who has been mainly responsible for this fine piece of apparatus, described the circuit, and explained the choice of a polarised buzzer. He then demonstrated how it should be used to test a transmitter and to check the wavelength of a station, or set a receiver to pick up any desired programme. Many successful tests were made.

Hon. Secretary: Mr. W. A. Hudson, 22, The Parade, Golders Green, N.W.11.

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Plate Current from 12-volt Accumulator.

ROTARY converters, both for converting D.C. to A.C. from mains, and accumulators, and also A.C. into D.C., formed the subject of a lecture given recently before the Bradford Radio Society by Mr. R. H. Woodall, of Rotax, Ltd. A practical demonstration was given with an A.C. radio-gram, worked from 230 volts D.C. mains and also a short-wave set with an anode current derived from a 12-volt accumulator.

Hon. Secretary: Mr. E. P. Burgess, 23, Baslow Grove, Heaton.

○○○○

Scope of the Short-wave Receiver.

SHORT-WAVE receivers were dealt with by Mr. T. A. F. Iserbyt in a talk at the annual general meeting of the Croydon Wireless and Physical Society. Mr. Iserbyt showed what interesting results could be obtained with a short-wave receiving set, and displayed many cards which he had received from short-wave amateurs in remote corners of the globe.

Following the election of office bearers, the hon. secretary read a satisfactory annual report, recording that attendances, although not large, were being well maintained.

Hon. Secretary: Mr. H. T. P. Gee, 51-52, Chancery Lane, London, W.C.2.

PRACTICAL HINTS AND TIPS.

SIMPLIFIED AIDS TO BETTER RECEPTION.

SOME builders of the Super-Selective Six have experienced difficulty owing to the withdrawal from the market of the U.5-type rectifier valve, which was specified for the mains equipment. Owing to the standardisation of new types with filaments requiring only 4 volts (the U.5 needed 5 volts) none of them is directly suitable as a replacement.

As regards its H.T. characteristics, the U.12 is a suitable valve, and should, in fact, have a longer life than the U.5, for in this receiver it will be considerably underrun. Now, it is obvious that as this valve requires one volt less filament potential than the U.5, we can employ it with satisfactory results, provided that a resistance of suitable value is inserted in its filament circuit.

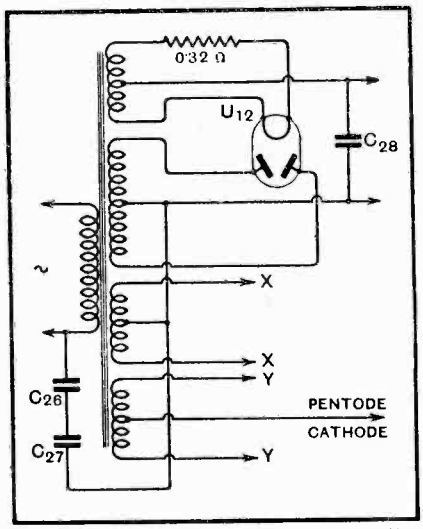
THE "SUPER-SELECTIVE SIX" RECTIFIER.

Unfortunately, however, we cannot calculate the required value of resistance. This valve takes a much larger filament current than the U.5, and the voltage output of the mains transformer will no longer be 4 volts when it is used. It will be an unknown figure which will vary with different makes of transformers owing to their different voltage regulation.

The only way of finding out the required resistance is to connect up the circuit with a variable resistance of higher value than will be needed, and to connect an A.C. voltmeter across the valve filament. The resistance value can then be adjusted until the meter reads exactly 4 volts.

In the case of the transformer specified for the Super-Selective Six, this operation has been carried out experimentally, and it has been found that the series resistance must have a value of 0.32 ohm for the U.12 rectifier. Those who have used this transformer, therefore, can readily adapt their sets for this valve, and a resistance of 0.32 ohm capable of carrying a current of 2.5 amperes, must be inserted in the rectifier filament circuit, as shown in the illustration. The Igranic 2-ohm "Pre-Set" rheostat is a convenient component for this purpose, for it is fitted with a paper scale showing the value of resistance in circuit, and so can be set to give the required value without any measurements.

The value of H.T. voltage and current with this rectifier may not be exactly the same as with the U.5, but the variation will not be large, and will be insufficient to affect in any way the working of the receiver.



Modifying the "Super-Selective Six" for a U.12 rectifying valve.

❖ ❖ ❖

AERIAL grid-coupling coils are invariably designed on the assumption that they will be used in conjunction with a full-sized aerial. This means, in practice, that when the set in which such a coil is included is operated with a short inside aerial, coupling will be unduly weak, and signal strength will probably be weakened to an unnecessary extent; admittedly, apparent selectivity will at the same time be enhanced.

SHORT AERIALS.

In such cases it is worth while to make provision for closer aerial coupling; if the coil be of the auto-transformer type, the aerial tap should be moved to a position more remote from its earthed end, while the same effect is obtained with a double-wound transformer by adding primary turns.

When an exceptionally short aerial is employed, it is almost always best to join the aerial, possibly through a small condenser, to the "grid" end of the winding.

Coils of a type that were originally intended for use in single-circuit tuners are sometimes used in band-pass filters, where closer aerial coupling can generally be tolerated, due to the high inherent selectivity of such devices. In this case the above suggestion may sometimes be carried out with good results, even though the aerial may be of full size.

❖ ❖ ❖

ALTHOUGH it is easy enough to calculate the voltage absorbed in a resistance used, say, for the purpose of decoupling, those of us who do not shine at mental arithmetic generally have to take a pencil and paper to the task, at any rate, if we are not dealing with round figures. The procedure, of course, is to multiply current, expressed in amperes or fractions of an ampere, by resistance (in ohms), the product being the voltage lost in the resistance.

ESTIMATING VOLTAGE LOSS.

A handy rule to remember, and one that is applicable to most wireless receivers, is that each thousand ohms of resistance absorbs one volt at one milliampere. For example, a 1,000-ohm resistor, passing 5 milliamperes, will absorb 5 volts. Take another case that is likely to arise in practice: that of the anode circuit of a power-grid detector, estimated to pass 8 milliamps., and where it is desired to fit a 20,000-ohm decoupling resistance. Applying the simplified formula, we see that the voltage loss will amount to $20 \times 8 = 160$ volts.

When dealing with bias resistances, it is, perhaps, more convenient to remember that 0.1 volt is developed across each 100 ohms for each milliamp. flowing in the circuit.

NEWS OF THE WEEK.

Earlier Olympia Show.

THIS year's National Radio Exhibition at Olympia is to be held nearly a month earlier than usual, from August 19th to 26th.

It is fully expected that last year's record attendance of 193,070 will be beaten.

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Listening Centres for Unemployed.

THE Hull Rotary Club is considering a scheme for the provision of wireless listening centres for the use of unemployed men. The idea seems an excellent one, but we imagine that some special arrangement would have to be arrived at with the Post Office on the licence question before the scheme could be put into practice.

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Dealers Must Not Tell.

THE Post Office has decided for the present not to proceed with the "anti-pirate" scheme whereby wireless dealers would supply the officials with the names and addresses of their customers. It is understood, however, that further discussions are to take place.

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Hear Russia's Radio Film.

RUSSIAN wireless history is to be portrayed in a special film entitled "Five Years of Soviet Radio," now in preparation. The story opens with the voice of Lenin reproduced from a gramophone record preserved in the Moscow archives, and then gives a pictorial and sound review of radio's progress from political, artistic, and economic standpoints.

We understand that the sound version of the film will be broadcast in Russian, German, and English.

Baird Television.

BY the purchase of 800,000 Baird deferred shares Mr. Isidore Ostrer, President of the Gaumont-British Picture Corporation, has, we understand, secured control of Baird Television. Voting control will be registered in the name of L.B.T., Ltd., the directors of which are to be Mr. Maurice Ostrer, assistant vice-chairman of Gaumont-British, and Mr. Sydney Moseley, vice-chairman of Baird Television.

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Sponsored Programmes in the Balance.

THE American Senate has passed a resolution directing the Federal Radio Commission to enquire into the broadcasting situation, with particular emphasis on the feasibility of Government ownership and operation.

Far from being perturbed over this resolution, the National Association of Broadcasters, according to our Washington correspondent, welcomes "any fair and impartial investigation as an opportunity to demonstrate that the American plan of competitive broadcasting, in the hands of private industry, is immeasurably superior to the system prevalent in Europe."

Senator Couzens, who introduced the resolution, said:—

"I am convinced that the whole radio industry is being irreparably damaged by the amount of time given to advertising on the radio, and if the industry is to continue to meet popular opinion either advertising must be discontinued entirely or limited to a single statement concerning sponsorship of the programme." Senator Couzens added that he was not committed to any particular scheme, but desired a guide when the matter comes up in Congress, which is highly improbable in this session because of the approaching presidential campaign and the press of other major problems.

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N.P.L. Test Signals.

SPECIALLY modulated test transmissions will shortly be made from 5HW, the station of the National Physical Laboratory, for the benefit of experimenters and others requiring calibration signals. The twice-monthly tests on Tuesday afternoons have been discontinued.

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Radio-Gramophone at Science Museum.

A "His Master's Voice" Model 531 nine-valve superheterodyne automatic record-changing radio-gramophone is the latest acquisition of the Science Museum, South Kensington. The new exhibit is housed in a specially built glass case and mounted at an angle with the back removed to enable the interior of the instrument to be clearly examined.

Six other H.M.V. instruments which the museum has acquired from time to time show the march of progress in gramophone design from the commencement in 1896.

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The Faraday Medal.

THE Council of the Institution of Electrical Engineers have made the eleventh award of the Faraday Medal to Sir Oliver Lodge, D.Sc., F.R.S. The medal is awarded not more than once a year for notable achievements in electrical science.

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A Happy Quest.

IN days of depression, or alleged depression, it is good to hear such a pæon of joy as the one which reaches us from Radiocabinets, Ltd., Stafford Street, Walsall, who report that the works are growing, that new and modern machinery is being laid down, and that a site for more extensive premises is now being sought.

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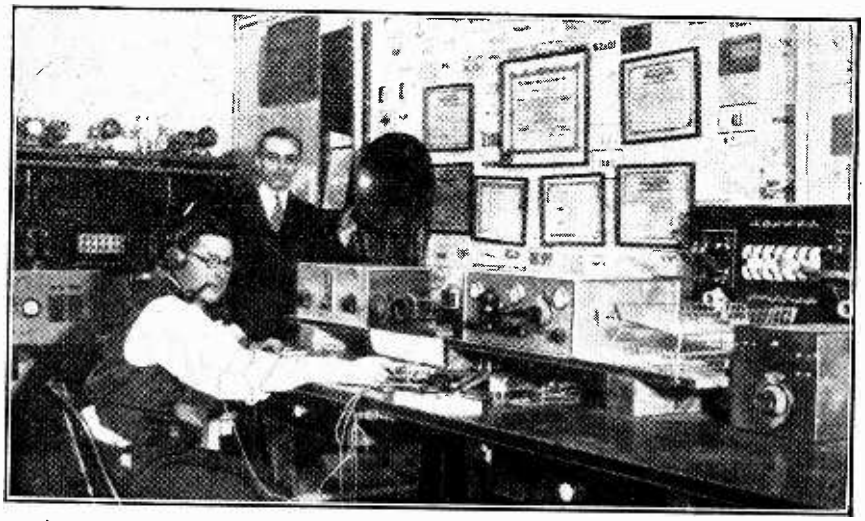
"The Wireless World" Information Bureau.

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

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



A 'VARSITY STATION. This is WIYU, the short-wave experimental station owned by the Yale University Radio Club. The station's record in international contacts is a formidable one, as the "wallpaper" shows.

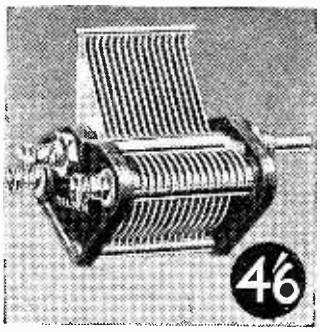
Next Week's Set Review:
H.M.V. AUTOMATIC RADIO-GRAMOPHONE.

TELSEN

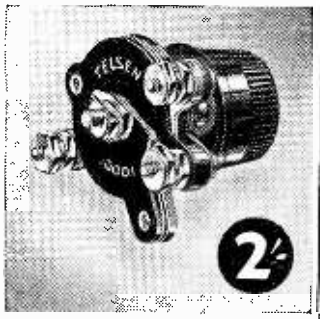
100% BRITISH RADIO COMPONENTS

L.F. TRANSFORMERS.

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



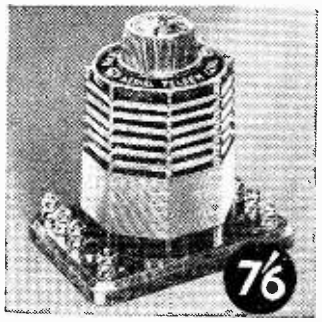
VARIABLE CONDENSER.



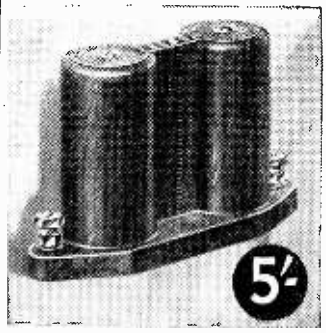
BAKELITE DIELECTRIC CONDENSERS

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

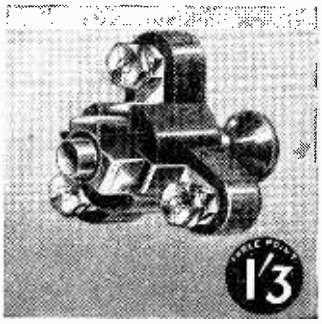
Output Transformers - 12/6
H.F. Chokes - - from 2/-
Output Chokes - „ 8/-
Power Grid Chokes - 8/-
L.F. Coupling Chokes - 5/-
Slow Motion Dial - - 2/6
Fixed Condensers from 6d.
Pre-set Condenser - - 1/6
Spaghetti Resistances from 6d.
Loud Speaker Chassis from 5/6
Fuse Holder - - - 6d.
Grid Leak Holder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



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

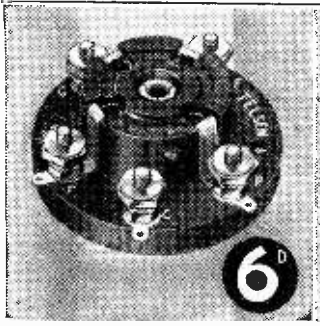


BINOCULAR H.F. CHOKE



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

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



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

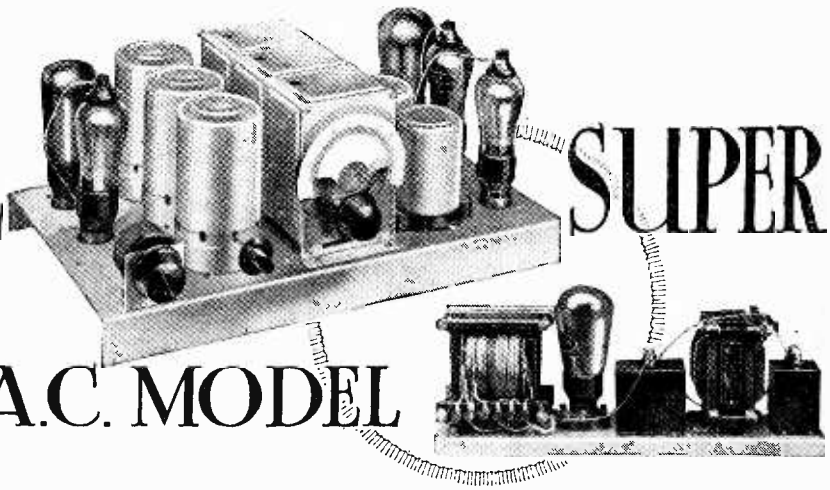
Telsen 4-pin Valve Holder .. Price 6d.
Telsen 5-pin Valve Holder .. Price 8d.

GRID-LEAKS. Telsen Grid-leaks are absolutely silent and non-microphonic, and practically unbreakable. They cannot be burnt out and are unaffected by atmospheric changes. Telsen Grid-leaks are not wire wound and therefore there are no capacity effects. Their value is not affected by variation in the applied voltage. Made in values from ½-5 megohms.

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

CVS—126

SINGLE-DIAL SUPER



HAYNES RADIO

A.C. MODEL

Five-Valve Superheterodyne Kit Set.

WHEN the single-dial control of a superheterodyne on both wave ranges was first described in this journal, the principle was applied to a battery-operated type. The demand for a mains model was as swift as it was inevitable, and special interest, therefore, attaches to the first effort to meet popular requirements by means of a constructors' kit set. Haynes Radio have now produced such a set for all mains working from A.C. supply embodying several novel features, and have submitted to us a kit for review.

A study of the circuit diagram shows many refinements consonant with the need for simplicity and efficiency. A band-pass filter precedes the first detector, its purpose being all-important in a single-dial superheterodyne as a means of eliminating heterodyne whistle. At whatever frequency an oscillator may be set it can render audible signals on two wavelengths, and the purpose of the band-pass circuit is primarily that of excluding the unwanted station. It must likewise reject signals that may usurp the function of the valve oscillator and thus not only give reception at false positions on the dial but produce a series of mixings and repetitions in the form of heterodyne whistles.

THE WIRELESS WORLD Single-Dial Super for battery operation, described recently, has proved a very popular set and many enquiries have been received for an A.C. version.

Haynes Radio have designed such a set and at our invitation have submitted an advance model for review. As this set is based upon one already described in our pages, it is of special interest to readers and we are, consequently, dealing with it at greater length than usual in the case of commercial kit sets, and giving a report on its performance.

The receiver under review was found to produce no such whistle beyond a few fixed-note heterodynes, due to the close proximity of certain station frequencies. By the use of the input band-pass filter the superheterodyne is able to dispense with the frame aerial familiar in old type sets, and, to the great improvement in performance, an elevated aerial can be employed. The volume control precedes the band-pass filter—an arrangement which excludes powerful signals from the wiring of the band-pass circuits, thus eliminating the dangers of unwanted heterodyne. A single variable resistance serves a dual purpose, for as the input is weakened the bias on the intermediate amplifier—a variable-mu valve—is suitably increased. The sliding contact is noiseless in action, and the distortionless method of volume control employed operates smoothly without change of tone.

New Oscillator Coupling.

There are certain circuit details which merit special attention. The biasing resistance and associated condenser in the cathode of the first detector are also common to the cathode of the oscillator. The object of this is not primarily that of saving components but of producing a critical degree of coupling between oscillator and first detector, which is suitably self-compensating over the wavelength range to correct for the change in output of the oscillator. It is a simple and effective method, and, above all, avoids the need for tapped coils or special windings coupled to the oscillator-tuned circuit. Reference has already been made to the use of a variable-mu valve in the intermediate stage. Its primary object is to give a wide range of control of amplification without rectification and distortion, and to cut down background noise to the very minimum. Beyond the band-pass intermediate couplings there is a high-efficiency screen-grid valve acting as the second detector, the associated circuit of which gives a measure of automatic volume control.

This valve is biased to the most sensitive position, but the increase in cathode current which tends to flow when a strong signal is received gives rise to a rapid increase in grid bias. The effect is partly offset by a

Single-Dial Super A.C. Model.—

fall in anode volts. Normal resistance-coupling feeds the output pentode, the resistance and condenser values being suitable for following a high-impedance detector. There is an H.F. stopping resistance in the grid of the pentode and tone compensation is applied by means of a by-pass condenser connected to the anode.

In the eliminator the field winding of the moving-coil loud speaker serves as the smoothing choke of high inductance, but, being only in the feed of the early valves, it serves equally as decoupling. Thus, the output transformer to the loud speaker may be safely interposed directly in the anode lead to the pentode without the necessity for filter feed. It is interesting to find that no form of switching is used in connection with the gramophone pick-up circuit. It is only necessary to take a lead to a point in the wiring and another to the frame. The resistance and condenser

FEATURES.

GENERAL: Single-dial 5-valve Superheterodyne for A.C. mains. Wave-range 200 to 600 and 850 to 2,000 metres. Totally screened coils with ganged waveband switching and pre-set couplers. Oscillator scale corrected by tracking condensers; oscillator coupling by common cathode bias resistance. Intermediate frequency of 110 kc. "Free" field excitation. Output 2,000 milliwatts.

CIRCUIT: Band-pass input circuit coupled to screen-grid first detector. Variable-mu I.F. valve linked to screen-grid anode bend second detector. L.F. resistance coupling. Compensated pentode output. Full-wave valve rectification. Provision for gramophone pick-up.

CONTROLS: One-dial tuning, volume, waveband switch.

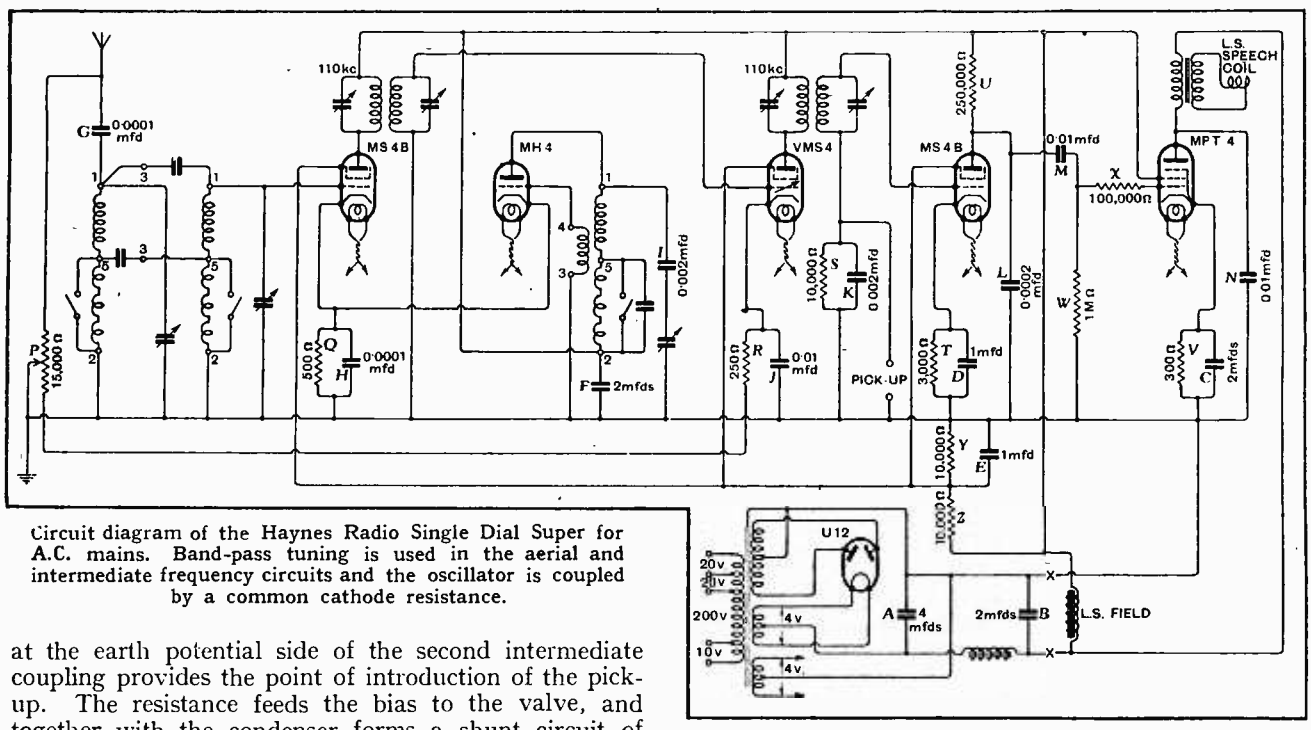
VALVES: Osram MS4B; MH4; VMS4; MS4B; MPT4; U12.

PRICE OF KIT: Including valves and moving-coil loud speaker, £21.

MAKERS: Haynes Radio, 57, Hatton Garden, London, E.C.1.

assembly, and certainly bestows an attractive finish. With the type of set under consideration, however, a metal chassis is advantageous also as it provides screening for the wiring, safeguarding it against local station pick-up, so that the effectiveness of the input band-pass filter is not defeated, and heterodyne whistles are, in consequence, avoided. The eliminator assembly is arranged as a separate unit, for which a second stiffened aluminium plate is supplied. The mains transformer is undoubtedly of ample proportions and contains a fully screened primary which goes a long way towards avoiding residual hum. A high-inductance smoothing choke is carried on the plate, and, being of large dimensions, its resistance is low, an important consideration, as it is passing the total H.T. supply, and in consequence, the watts loss is small.

In regard to assembling this receiver, there are but few points on which comment is



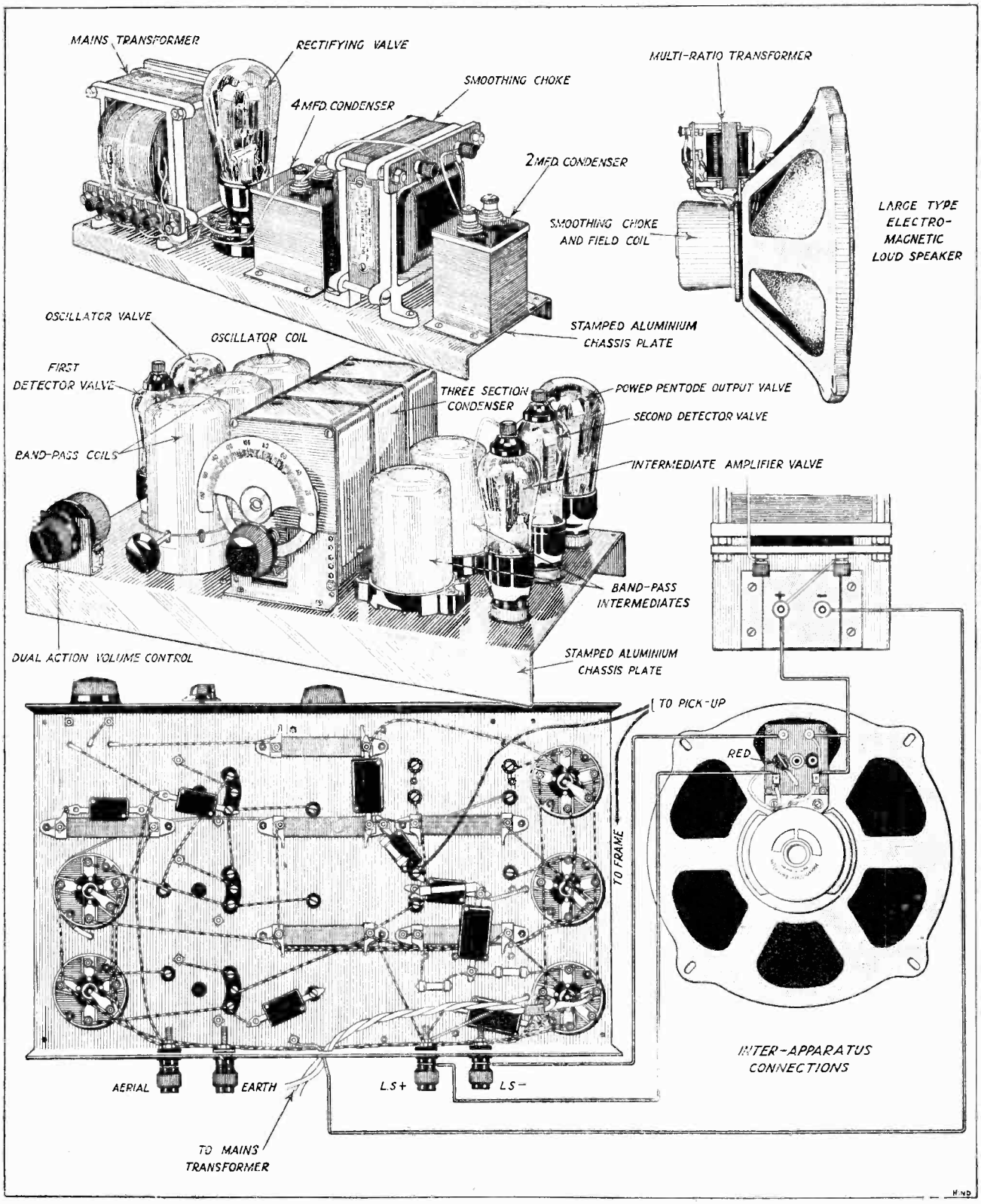
Circuit diagram of the Haynes Radio Single Dial Super for A.C. mains. Band-pass tuning is used in the aerial and intermediate frequency circuits and the oscillator is coupled by a common cathode resistance.

at the earth potential side of the second intermediate coupling provides the point of introduction of the pick-up. The resistance feeds the bias to the valve, and together with the condenser forms a shunt circuit of suitable value across the pick-up.

The metal baseplate used avoids all setting-out problems and removes the need for drilling, gives easy

necessary. All screws, nuts, wire, and sleeving required are included in the kit. It is best to attach the valve holders first, taking care that chips of metal

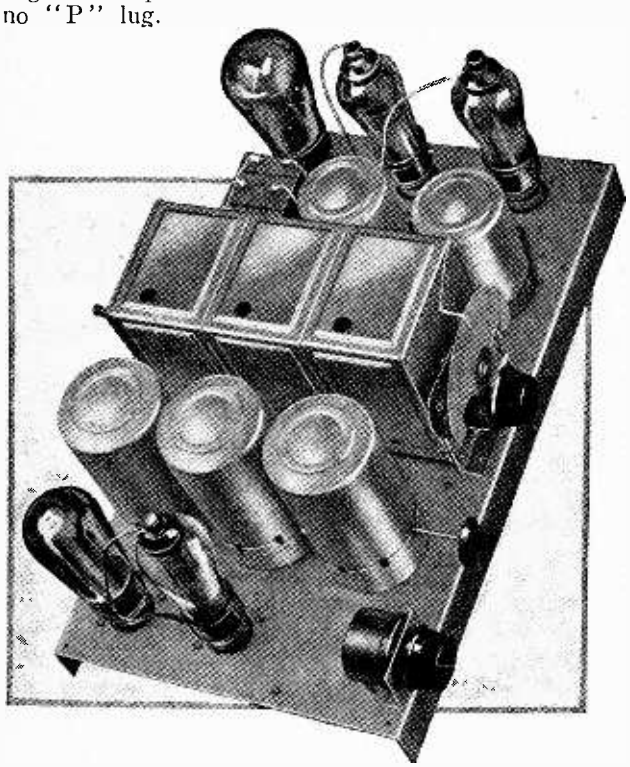
CONSTRUCTOR'S KIT ON METAL CHASSIS.



Showing details of receiver and eliminator units.

Single-Dial Super A.C. Model.—

protruding from the screw heads under the valve holders cannot accidentally contact with the aluminium plate. The valve heater circuits should then be wired. A slightly heavier gauge of wire and sleeving is supplied than issued for the remainder of the leads. While the top of the plate is still clear the six resistances should be fixed, care being taken to arrange each valve in the right place. All the other components go together quite easily, but one must see that all underlugs are well clear of the metal. In order to ensure correct alignment and free working, do not tighten up the coils until the switch rod has been pushed through. The terminal extensions on the intermediates should be screwed in tightly, and when fitting one should note that the "P" and "G" connections are nearest the edge of the plate and that the centre intermediate has no "P" lug.



The advantages of the metal baseplate are apparent from this view.

All terminals are insulated from the plate except the earth, which carries a metal spacing washer. The fitting of the volume control is best left until the wiring is proceeded with. With all stems and terminals projecting through the underside, the small tag condensers may be attached. It is scarcely necessary, perhaps, to remind the constructor not to confuse the values, an observation which equally applies to the four metallised resistances, all of which should be fitted up before going on with the wiring, which can be carried through without soldering. In order to elevate one of the 0.01 mfd. condensers where it crosses the 300-ohm resistance, a pair of 6BA nuts is carried on the screw to which it is clamped.

A detailed blue print showing the underside of the set accompanies the kit of parts, and while showing clearly the identity of every condenser, resistance and terminal, their location and method of fixing, also serves as a complete practical wiring guide. The fine gauge silk sleeving undoubtedly helps to make even a roughly wired job look neat. In all cases where a lead passes through the plate it is advisable to use an inch of medium size sleeving to provide extra protection.

LIST OF PARTS.

1 Set of dual range coils with ganged waveband switching, and designed for single-dial superheterodyne control (Colvern, Types K21, K22, K23)
1 Three-section tuning condenser (Jackson)
2 Intermediates, 110 kc. (Colvern Colverdynes)
1 Volume control resistance, 15,000 ohms. (Colvern Colverstat)
1 Baseplate for set
1 Baseplate for eliminator unit
1 Bracket for volume control
2 Condensers, 2 mfds. } 250 volts D.C. working, with soldered
2 ,, 1 mfd. } wire extensions (T.C.C.)
5 Five-pin valve-holders with underside connections and recessed screw heads ("W.B." Whiteley Electrical Radio Co., Ltd.)
1 Valve-holder with terminals above base ("W.B." Whiteley Electrical Radio Co., Ltd.)
Strip type resistances. 250 ohms, 300 ohms, 500 ohms. 3,000 ohms, 2 10,000 ohms. (Colvern)
Small fixed condensers, 2 0.0001 mfd.; 1 0.0002 mfd.; 2 0.002 mfd.; 3 0.01 mfd. (T.C.C. "M." type)
Small fixed resistances, 10,000 ohms, 100,000 ohms, 250,000 ohms, 1 megohm (Metallised type Dubilier)
1 Condenser. 4 mfds. 800 volts D.C. test (Dubilier)
1 ,, 2 mfds. ,, ,, (Dubilier)
1 Mains transformer (Rich & Bundy)
1 Smoothing choke (Rich & Bundy)
4 Terminals with insulating pieces (Belling Lee)
1 Moving-coil loud speaker, large type (Magnavox)
Valves: 2 Osram MS4B, 1 Osram VMS4, 1 Osram MH4, 1 Osram MPT4, 1 Osram U.12
Wire, sleeving, flex, and screws.

In a further instalment a wiring plan will be given, together with a calibration chart indicating the performance which may be expected under average conditions.

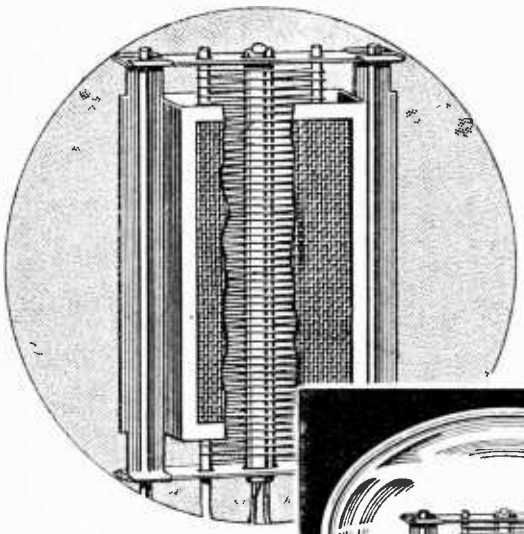
BOOKS RECEIVED.

Broadcast Advertising: The Fourth Dimension, by Frank A. Arnold, with foreword by H. P. Davis. The progress and practice of Broadcast Advertising as conducted in U.S.A., the author being Lecturer on this special subject at the College of the City of New York. Pp. 275+xix. Published by John Wiley and Sons, Inc., New York, and Chapman and Hall, Ltd., London, price 18s.

Thermionic Vacuum Tubes and Their Applications, by E. V. Appleton, M.A., D.Sc., F.R.S. The construction, action, and application of two-, three-, four-, and five-electrode valves. Pp. 117, with 68 diagrams. Published by Methuen and Co., Ltd., London, price 3s. net.

Finding Foreign Stations: Long-distance Wireless Secrets, by R. W. Hallows, M.A. Instruction in the method of finding and identifying foreign stations, with notes on short-wave reception, improving sensitivity, fading, atmospherics, and other sources of interference, measuring, and testing. Pp. 184+vii, with eight plates and 86 illustrations and diagrams. Published by George Newnes, Ltd., London, price 3s. 6d.

The Outline of Wireless for the Man in the Street, by Ralph Stranger. A popular treatise on electricity and magnetism, as applied to wireless matters, and the general principles of wireless reception and receivers. Pp. 816+xvi, with about 600 illustrations and diagrams. Published by George Newnes, Ltd., London, price 8s. 6d.



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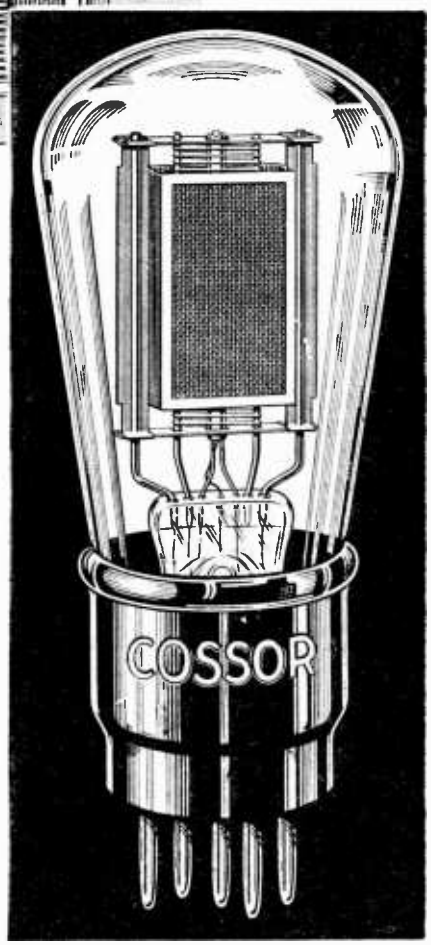

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Broadcast Brevities

By Our Special Correspondent.

The Empire Station Contract.

THE contract for the short-wave broadcasting station at Daventry has been placed with Standard Telephones and Cables, Ltd., and work has already started. It is hoped to radiate initial programmes by the end of this year.

I understand that the cost of the station will be in the neighbourhood of £50,000. This is £10,000 in excess of the figure estimated at the Colonial Conference in 1930.

The Zone System.

Considerable use is to be made of directional aerials, or rather reflectors, and it is interesting to note that the "Empire" is to be divided into five zones, each of which will be given special transmissions to ensure good reception between 6 p.m. and midnight, local times.

5XX as Empire Transmitter ?

Strangely enough, 5XX came into the limelight during the discussion on Mr. Noel Ashbridge's lecture on Empire broadcasting at the Royal Empire Society last week. Someone asked how Gibraltar would be served by the short waves, and the Chief Engineer at once replied that "Gib" would have no need of them. Already listeners in Gibraltar can enjoy the Daventry long-wave transmissions after dark, and it is confidently predicted that good signals should be coming in during the daytime when 5XX has been reconstructed. Even Malta should then get the service after dark.

Losing Prestige.

A plea that this rebuilding of 5XX should go ahead as soon as possible was put forward by Major Cowie. He contended that the station was losing prestige on the Continent on account of its poor quality and was rapidly being swamped by more powerful neighbours.

Most listeners will support this demand. There is irony in the fact that 5XX was once the pride of the long waves; indeed, it was the first long-wave broadcasting station in Europe. Now it is practically obsolescent.

Two Years' Delay.

It is unlikely, however, that anything will be done with 5XX for some time. The B.B.C. engineers are determined to complete the Regional scheme before shouldering other responsibilities. In other words, Western Regional and the new transmitter at Belfast must both be working satisfactorily before constructional work is begun at 5XX, and the probable delay will be for at least two years.

Catastrophe.

THERE are no half measures in "Catastrophe," the new play by Dallas Bower which will be broadcast on February 11th and 12th. Mr. Bower, who, incidentally, is a contributor to *The Wireless World*, tells me that the play involves a planetary collision in which not even the B.B.C. escapes.

A Suggestion.

It has been suggested to Lance Sieveking, who is producing "Catastrophe," that the play might be highly suitable for that last broadcast from Savoy Hill, upon which he is known to be working.

VOLCANO OBLIGES.

Hawaii's active volcano, Halemauman, was the subject of a recent outside broadcast by station KGU, Honolulu.

But it so happens that the staff may not leave for Portland Place for another three months yet, and "Catastrophe" is too good to be kept waiting. Mid-April is considered as the earliest possible date for the complete evacuation of the old building.

Disillusion.

By the way, people walking into the new entrance hall at Broadcasting House are struck by the extraordinary resemblance which the reception desk has to an hotel cocktail bar, and I am told that more than one of the younger set from Savoy Hill have been desperately disappointed on approaching nearer to what appeared to be a real haven of welcome.

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A Great Comb Out.

THERE is more than meets the eye in the B.B.C. announcement that musical auditions are suspended for a period of six months. I learn that this step is only a prelude to the more drastic move of combing out four or five hundred names from the existing registers, which include the names of all "approved" artistes.

A Hint to Artistes.

Simultaneously some of the leading artistes whose names are household words have been given to understand that only a limited number of engagements can be expected from the B.B.C. owing to the congested state of the artistes' roll.

This is a hint which is not relished by certain individuals.

Peeved.

One famous artiste has already stated that, although he flatters himself that he is in some demand at Savoy Hill, he would not hesitate now if faced with a choice between broadcasting and an outside engagement. He would accept the latter.

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A Critical Moratorium.

HERE is a timely warning for all who may be tempted to use precious stamps and paper on a fruitless task. The B.B.C. have decided to ignore all criticism of Henry Hall's broadcast dance band during the first three months of its service.

Feeling Their Feet.

It is thought that the new band should be given a chance to "feel its feet," but although I sympathise with this kindly sentiment, I fail to understand how the band's success can be correctly gauged without reference to the public response.

As things stand at present, the band will serve, not a probationary period, but its opposite.

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Irish Night.

GORDON McCONNEL'S production, "Irish Bulbuls," is to be revived on February 8th (National) and 9th (Regional).

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Murder Theme Again.

AN original playlet by Arthur Eckersley entitled "A Tabloid," will be produced by Charles Brewer on February 15, with T. B. Glynne-Williams, Gordon Bailey, and James Prodger in the cast. The plot tells of a young playwright who, for purposes of his work, would like to know the feelings of a murderer. How his wish is fulfilled, and without any disastrous consequences, is the subject of a very original comedy. Midland Regional will give this programme.

National Relay from Llanllechid.

A service in Welsh, relayed from Llanllechid Parish Church, will be given in the Daventry National programme on February 14th.

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Consolation.

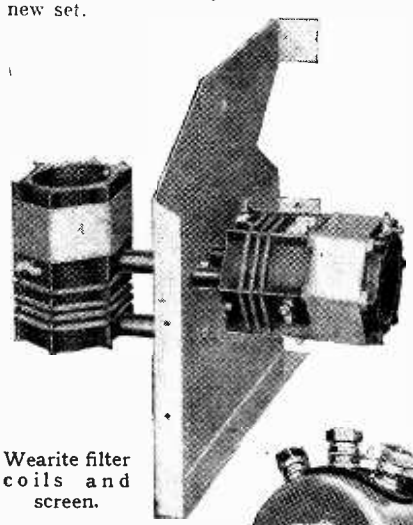
FROM the *Oldham Evening Chronicle*: "'Most of the ills to which a radio receiver is heir,' writes M. G. Scroggie, B.Sc., in *The Wireless World*, 'may be grouped under these four headings: (1) Complete absence of reception; (2) weak reception, including loss of selectivity; (3) distortion; (4) noises.'

"To the unwilling listener No. 1 can be a very great consolation, and he classes all other accomplishments of the wireless under heading No. 4."

FOR THE POWER RADIO-GRAM.

Some Alternative Components Reviewed.

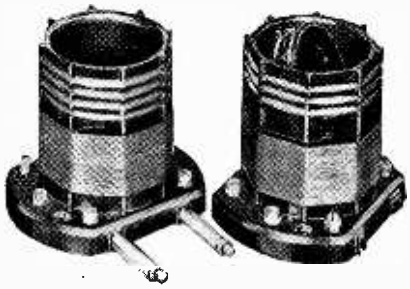
A NUMBER of components for the "Power Radio-Gram" have been submitted for test by various manufacturers, in order that we may judge their suitability for inclusion in the new set.



Wearite filter coils and screen.

Wearite volume-control potentiometer.

A specimen coil assembly, complete with the necessary screen, has been sent in by Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N.17, and was found to be accurately wound; its construction was fully up to the usual high standard maintained by this firm. Electrically, the published specification has been followed implicitly, but extra mechanical strength has been given by a more rigid method of mounting. These coils, ready mounted on an aluminium screen, cost 15s. complete. The same firm also produces 30-ohm and ½-megohm potentiometers that can also be recommended for use in the positions where these resistance values are specified.

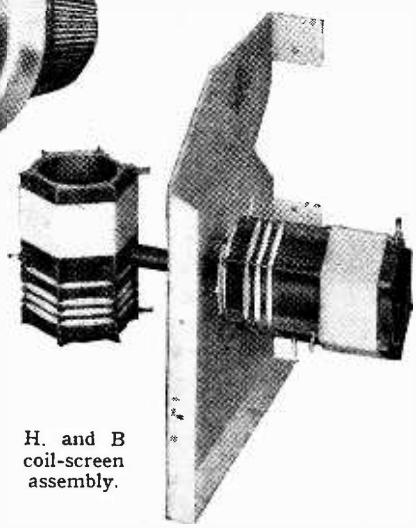


Colvern tuning coils with adjustable aerial coupling.

Another coil-screen assembly which is entirely satisfactory in every respect has been submitted by H. & B. Radio Co., 34-38, Beak Street, London, W.1. It may here be pointed out that these coils, although intended especially for the set with which we are now concerned, have a wide range of usefulness, particularly for short-range "quality" sets designed for operation close to a twin transmitter. The H. & B. coils cost 15s., ready mounted on a screen.

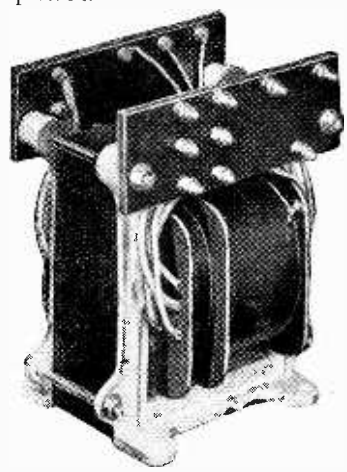
Standard Colvern coils, types RM.1 and RM.3, are wound in a similar manner to those used in the original receiver, and, moreover, by using distance pieces that are available from the makers (Colvern, Ltd., Mawneys Road, Romford, Essex), the two sets of windings may be mounted in the correct axial relationship on either side of the screen. The input coil (RM.1) is fitted with interchangeable and adjustable primaries; for general use the 30-turn coil is best. This extra adjustment takes the place of a series aerial condenser. Colvern coils of this type cost 8s. 6d. each.

Suitable power equipment is available from a number of firms; a special transformer made by Chester Bros., 495, Cambridge Road, Cambridge Heath, London, E.2, was carefully tested and found, on the full load imposed by the radio-gramophone, to deliver the various rated voltages within extremely close limits. The windings and core are planned on liberal lines, and the transformer runs quite cool.



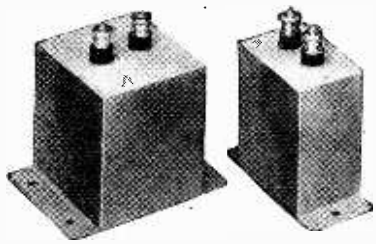
H. and B coil-screen assembly.

Paper condensers, as used for smoothing and decoupling, must be chosen with extreme care in a high-voltage receiver, even though a delay action switch be fitted, as in the present case, to prevent the application of high voltages on light loads. Special interest attaches to the "Peak" paper condensers submitted by Wilburn and Co., of 23, Bride Lane, London, E.C.4. All these are tested at 1,500 volts D.C., and cost, for the 4-mfd. size, only 6s. 9d. each. The same condensers, but with a capacity of 2 mfds., are sold for 3s. 9d. In view of their high test voltage, they should be able to stand up indefinitely to the pressures existing under working conditions in all those positions where paper condensers are specified.



Power transformer made by Chester Bros.

Three items of mains equipment have been sent for test by Sound Sales, Ltd., Tremlett Grove, Junction Road, London, N.19. These include a mains transformer specially designed for the receiver, and sold at 50s. All the outputs were found to be of the correct voltage on normal load, and, moreover, as the transformer is well regulated, it is possible to draw from it more current than that required for the set without producing any serious drop. Insulation—an important point when dealing with high voltages—would appear to be entirely adequate. The same firm have also sent in a well-designed constant-inductance choke, priced at 15s., which, though of suitably low D.C. resistance for the main smoothing circuit, has a sufficiently high inductance value when passing between 70 and 80 milliamps, which is the normal H.T. current consumption of the "Power Radio-Gram." Condensers to withstand high to medium working voltages are also produced. Prices are: 4 mfds., 1,500-volt test, 11s.; 2 mfds., 1,500-volt test, 6s. 6d.; 2 mfds., 500-volt test, 2s. 4d.



Wilburn "Peak" high-voltage condensers.

CORRESPONDENCE

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

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

THE "RECEIVER OF THE FUTURE."

Sir,—You are to be congratulated on the Editorial in your issue of January 20th, which shows that we are very near the end of the fiercest and most prolonged controversy which has ever taken place in the history of wireless. Your Leader does not come as a complete surprise, for *The Wireless World*, although well known for its conservative policy, has never withheld information from its readers when once it has been satisfied as to the facts. The excellent work of Mr. F. M. Colebrook has no doubt helped to pave the way to the action you have now taken.

This controversy was started when I announced the "Stenode" over two years ago, and showed that it was possible to receive modulated waves on the most selective devices known, and in addition, pointed out that with such devices we could obtain entirely new and unexpected results in the way of elimination of interference, and, therefore, on the spacing of transmitting stations in the ether. Your Editorial shows that the claims I made at that time had a solid scientific basis.

There can be no doubt in the minds of your readers that what you called "the receiver of the future" is the "Stenode," and there seems to me no reason why this name, which is well known throughout the world, should not continue to be used in connection with my inventions. One of the greatest experts of the world, Professor E. V. Appleton, has always used the word "Stenode" in his writings on this subject, and I think at the present juncture it would be inexcusable on my part were I to forget to point out that he was the first well-known authority to appreciate my theory and practical results.

In discussing with authorities I invariably gave my views freely, and the theory of demodulation in particular was discussed with them.

I really believe that the change in attitude of scientists towards the "Stenode" took place when Prof. Appleton appreciated how this phenomenon of demodulation was operating in the "Stenode."*

Again, I may be pardoned in drawing attention to the fact that another well-known authority, Mr. E. B. Moullin, understood the advantages that were to be gained from the "Stenode" at a very early date.

BRITISH RADIOSTAT CORPORATION LIMITED.
J. ROBINSON, Technical Adviser.

* This reference is to an important letter published under "Correspondence" in *The Wireless World* of June 17th, 1931. —EDITOR.

Sir,—I should like to be permitted to give the history of some work done in my department while I was Chief of Research of the Marconi Company.

In 1923 I initiated a series of experiments in circuits of extremely low resistance for tuning purposes. The work was carried out on long waves from 10,000 to 20,000 metres. Together with my assistants, Mr. T. L. Eckersley and Mr. G. M. Wright, I investigated the effects of using the circuits for telegraph purposes, and we very clearly differentiated between "copper" circuits—the name we gave to the type of circuit where the resistance is not a function of the amplitude—and "reaction" circuits, which at that time we were unable to free from non-linear trouble.

During the experiments either Mr. Eckersley or Mr. Wright (I rather fancy from a letter I possess that it was Mr. Eckersley) suggested that after the super tuning curves were obtained, by passing the signals through the low resistance circuit and rectifying, if we then "differentiated" the rectified result we should obtain the signal back in its original shape. This differentiation was done by passing the rectified current through a small inductance and tapping off the voltage across the inductance. These results were embodied in patent No. 225,595 of 1923.

A little later Mr. Wright generalised the whole idea of correcting in the L.F. circuit any resonance distortion in the receiver by adding the low pass filter which is necessary to complete the scheme, and he embodied this in patent No. 233,024 (1924).

Mr. P. W. Willans also patented a similar circuit using reaction. Patent No. 233,417 (1924).

We recognised at the time that waves had to be extremely constant to enable the method to be used, at least to the full extent.

The advent of super short waves necessitated laying the whole scheme aside, as these short waves were a long way off the required steadiness.

When Dr. Robinson first announced his Stenode he mentioned the use of a crystal, and I at once made a correct guess that he was using the same method as Wright with a mechanically resonant circuit.

Some little time ago it occurred to me to investigate the position of reaction circuits under the now new conditions of very much better valves. We had in the old experiments tried to get circuits of low resistance with reaction, but they were only linear to a certain degree, if a large number of valves were used in parallel. One modern valve is at least equal to ten of the old valves in parallel.

Mr. P. K. Turner assisted me in these experiments, and added various ideas regarding phasing, etc., in the reaction circuit. This work was embodied in patents Nos. 358,932 and 360,463.

We proved to our satisfaction that over quite large ranges of amplitude reaction could now be depended upon to be linear, and that all the Stenode effects could be produced on wavelengths as low as 300 metres by reaction, provided the special circuits were used and the wavelengths being received were steady enough.

As Mr. Turner suggests, however, these circuits are not yet for the broadcaster. The adjustments are too critical and complicated.

Also I am not at all sure that these super tuning ideas in any form can be put into real broadcast practice yet awhile—at least in their full form—because only a few stations are steady enough, and therefore one would be left with a receiver capable of handling only a few stations. These stations would be the stronger modern ones, such as London and Rome, which do not need such accurate filtering anyhow.

At the same time there is no doubt that these new circuits give results which the finest filter circuit of ordinary type is unable to reproduce; in some form or other they will undoubtedly be extensively used in the future.

Marconi House, H. J. ROUND.
London, W.C.2.

Sir,—The loss of higher frequencies in electrical communication is a problem with which electrical engineers have been faced since the early days of submarine telegraphy. In a long, unloaded cable the input e.m.f. in Morse code consists of a series of dots and dashes having a rectangular profile. At the receiving end of the cable the *current* is represented by a line having gentle modulations. The signals are unintelligible, and would not be recognised as the original rectangular formation. To obtain readable signals it is necessary to insert a correction network between the receiving end of the cable and earth. This consists of a resistance and inductance in series, the combination being in parallel with a shunted condenser in series with the recording apparatus. The purpose of the resistance and inductance is to shunt the low frequencies. The condenser being of high impedance to low frequencies makes doubly certain that they shall be kept out of the recorder. The complete action of the circuit is more complicated than this, but there is no need to go into detail here. The point to be observed

is that the correction is obtained by obstructing the passage of L.F. through the recorder and also by-passing it by the magnetic shunt. In other words, the unwanted portion of the signal not being allowed to enter by the front door, is led round the house and then run off the premises. It will be observed that the current is the thing of the moment—not the voltage.

Coming now to radio telegraphy: In 1923 I was conducting research on the recording of wireless telegraph signals, which culminated in my discovery of the magneto-cohesion effect. This effect was embodied in recording apparatus and a paper read before the I.E.E. (*J.I.E.E.*, August, 1923). To record signals from the long-wave American stations, WII, WSO, etc., it was necessary to use very selective apparatus to reduce the atmospherics to a minimum. The general scheme was H.F. tuning, H.F. amplification, heterodyne to note frequency rectification, note filtering, and amplification, then rectification and recording. For this purpose I used the circuit described in *World Power*, June, 1923.

By reducing the damping of the circuits a point was reached when the record was merely a continuous line, the signal profile having disappeared owing to the oscillation of the circuits during spacing. Low damping was used in an attempt to record through atmospherics. A survey of the problem was given in *Experimental Wireless*, February, April, and August, 1924. Two artifices were used to make the signals readable: (1) a transformer with low primary inductance was inserted between the second rectifier and the power valve for the recorder; (2) the rectifying valve was given an abnormally large bias. The effect of the transformer was to square the signal profile by differentiation. This it certainly did with marked success, and the recorder, which assisted mechanically in this direction, gave square signals.

Everything worked well until heavy atmospherics arrived, and the improvement due to the transformer was not sufficient to warrant its use. In fact, it is now well known that the atmospheric spectrum penetrates the signal band, and therefore the two are mutually inclusive.

It is to be observed that the correction in this case was effected by operating on the current curve to obtain a sharp rise in voltage. The latter was applied to the grid of the power valve which actuated the recorder.

About this time Mr. G. M. Wright was working on receiving circuits with—I believe—the object of reducing atmospherics. To square up signals he used a large air-core coil of low resistance in series with a non-inductive resistance, his object being to square up accurately a current growing exponentially. He said that for his purpose linear rectification by aid of a diode was very important. This circuit was ultimately patented—about 1924, I think.

Meanwhile, Mr. P. W. Willans was busy designing receivers for broadcast purposes. He incorporated reaction in these receivers, and, naturally, came across side-band cutting. He worked out the analysis of H.F. reaction combined with rectification, where the rectifier had an inductance and series resistance in its anode circuit. This analysis gave the necessary conditions for accurate correction.

Personally, I have always advocated the use of tone-correction circuits for broadcasting, even when the H.F. selectivity is quite normal (see "Speech Amplifier Design," *The Wireless World*, January 13th, 20th, and 27th, 1926 (see Patent Specification 307,544). In fact, it is usually desirable to incorporate some form of tone control in an amplifier for local station work.

Obviously, with the highly selective circuits used for distant stations, in the present wave-length congestion, it is imperative to correct in order to obtain pleasing reproduction. Unfortunately, few receivers are designed with this end in view. Reception is much more enjoyable when reduced interference is combined with good quality. Whether the wavelength constancy of broadcasting stations is adequate for an ultra-selective regime remains to be seen. It is to be hoped, however, that the problem of high quality involving a frequency response of $\pm 10{,}000$ cycles will not be sacrificed to the desire to get $2n$ stations when these are only n.

N. W. McLACHLAN

London.

[The above letter, although dealing mainly with the application of tone correction to cable telegraphy, also serves to endorse the importance of the principle to broadcast receivers —EDITOR.]

BATTERY-OPERATED GRAMOPHONE REPRODUCTION.

Sir,—I am a regular reader of your excellent publication, *The Wireless World*, and, although I have taken it ever since the War, it is very rarely that one can find cause for criticism.

I do, however, venture to disagree with your rather sweeping statement contained in the last two sentences of the last paragraph of the article, "Feeding the Single Dial Super."

Three years ago I carried out an interesting experiment in providing the music for a local dance. Having at that time a very good receiver, I used the L.F. portion of it as amplifier, and a small portable gramophone was used with a Lissen pick-up.

The reproduction, although not up to the standard obtainable with present-day apparatus, was truly remarkable, and the volume ample for the purpose in the small hall in which it was used, which holds about twenty-five dancing couples. The dancers themselves were highly pleased with the music.

What may surprise you most was that on the first occasion I used an Amplion *open cone* speaker hung up from the ceiling in the centre of the room. This was the standard open cone, selling at that time at 39s. 6d.

Afterwards I used a Lion chassis, choke fed, as was the open cone, from two super power valves in parallel, and using 150 volts H.T.

In case you should reply that such an output is beyond the ordinary battery user, I consider that any set with a properly designed L.F. amplifier, consisting of a standard pentode valve, or its equivalent in watts output, is capable of giving much better reproduction of gramophone records than acoustic reproduction.

My own district is as yet not supplied with any electric mains, and there must be many thousands of listeners who have to rely on batteries as their only source of H.T. supply, who, on reading your article, may feel that the benefit of electrical reproduction of records is to be denied them. So long as they are prepared to provide large-capacity batteries, or, preferably, 5,000 mA. H.T. accumulators, there is nothing whatever to prevent their pleasure.

In conclusion, may I compliment you on your publication; the whole of it, as it is all so regularly excellent that it is too difficult to pick out any parts specially.

"TRADER."

Yorkshire.

ELECTRIC SUPPLY.

Sir,—Until reading Mr. Pirie's letter in *The Wireless World* issue of January 6th I was under the impression that my town was the only one with a fluctuating power supply; however, we are evidently not alone in our misery!

Due to this uncontrollable variation, my experiments with a D.C. radiogram have proved extremely costly, to the tune of six P650 output valves, as it was assumed that the valves were faulty and not the mains. On investigation, however, with a Weston voltmeter results very similar to those of Mr. Pirie were obtained, and on two or three occasions I have known the voltage to change from 217-248 between 11 a.m. and 3 p.m. A graph plotted over a period of twelve hours showed a curve with as many peaks as would rival the "Rocky Mountains," in addition to the rise and fall.

Fortunately enough, a remedy is available in the shape of a regulator lamp, but even this does not control anode voltage, and the quality of reception must still suffer at times. The problem of matching stages and allocating suitable valves to feed resistances under such circumstances is just as much fun as Mr. Pirie states it provides, with the unfortunate addition that my week-end conditions are no different from those during the week.

I also have written to the supply authorities, but their cry is that there will shortly be a "change over" to A.C., and things cannot be altered at present. "Shortly," as far as I can gather, may mean anything from twelve months to five years in my district.

Evidently the B.O.T. regulations do not apply to municipal authorities! But it would be interesting to learn whether the electric supply authorities are liable in this respect. To sum up, it is very annoying, after studying the excellent articles which appear in *The Wireless World*, and attempting to experiment at home, to find one cannot get the required results owing to other people's poor voltage regulation.

C. H. VERITY.

Birkenhead, Chesire.

Laboratory Tests

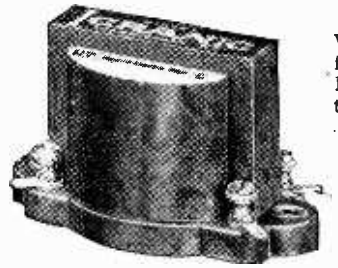
ON NEW RADIO PRODUCTS.

IGRANIC MIDGET TRANSFORMER.

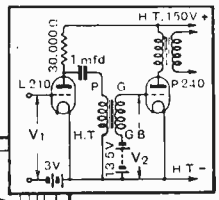
The specimen midget L.F. transformer sent in for test is a new model having a step-up ratio of 1 : 5, being intended for use where one L.F. amplifier only is employed, as in the case of a set fitted with a pentode output valve.

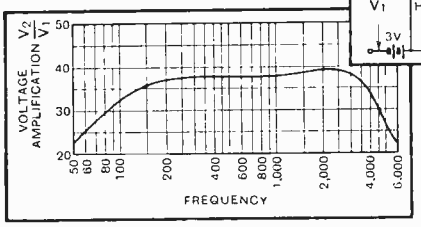
The primary shows the satisfactory inductance value of 56 henrys without D.C. flowing. It will carry up to 5 mA. of D.C. before signs of magnetic saturation appear, but a considerable reduction in the inductance follows. For example, with 2 mA. the inductance falls to 26 henrys, and with 4 mA. it is down to 16 henrys.

The transformer was tested for voltage amplification with parallel-feed using a 30,000 anode resistance and a 1 mfd. condenser. The preceding valve had an A.C. resistance of 12,500 ohms and an amplification factor of 10.6, while the output stage was fitted with a two-volt super-power valve.



Voltage amplification-frequency curve of Igranic Midget L.F. transformer: Ratio 1 : 5.





As can be seen from the curve, the voltage amplification is reasonably constant from about 200 cycles up to 3,000 cycles, and it then begins to fall off until at 6,000 cycles the level is about the same as that at 50 cycles. Music and speech will be reproduced faithfully, since the amplification is good at both ends of the audible scale. A loud speaker with a response well above the average might enable the lower amplification of frequencies above 4,000 cycles to be noticed.

The performance of this transformer is most satisfactory in every respect, and at the reasonable price of 10s. 6d. it is excellent value for money.

The makers are the Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.

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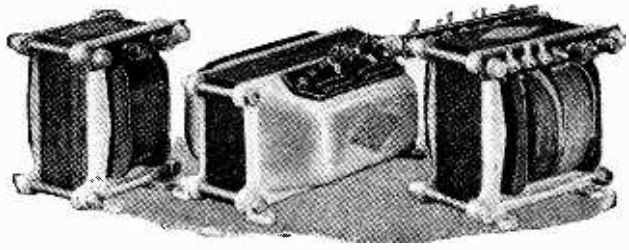
VORTEXION MAINS EQUIPMENT.

These components are made by Vortexion, Ltd., 105, The Broadway, Wimbledon, S.W.19, the material used being the best procurable and British-made throughout. The mains transformer tested has been designed especially for the Variable-Mu three-valve receiver described in *The Wireless World* dated November 18th last. The primary is tapped for supply voltages of 200, 220, and 240 at 50 cycles, and there are three secondary windings rated to give 250+250 volts, 4 volts at 2.5 amps. for the rectifying valve, and 4 volts at 3 amps. for the valves in the set.



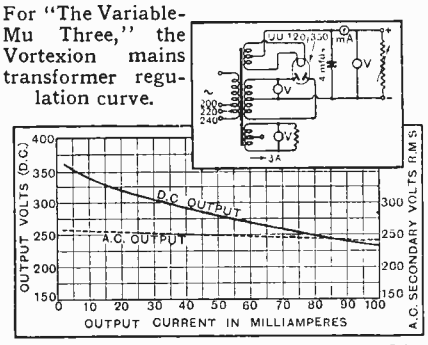
Selection of Vortexion mains transformers and L.F. chokes.

Tested under equivalent load conditions to those obtaining in the receiver, the various output voltages were sensibly correct. The filament of the rectifying valve received exactly 4 volts, while the other L.T. winding gave 4.1 volts at 3 amps.

The regulation of the H.T. secondary winding is quite good, the difference between no load and the full load of 80 mA. was 6.5 per cent. only. The workmanship is of an exceptionally high order, and we can confidently recommend this transformer as a satisfactory alternative to the one specified. The price of the model as illustrated is £1 8s. A shrouded model is available at the price of £1 14s.

There is a wide range of enclosed and open-type smoothing chokes rated to carry from 50 mA. to 150 mA. and maintaining a satisfactory inductance value.

For "The Variable-Mu Three," the Vortexion mains transformer regulation curve.



Measurements were made with a 30-henry model designed to carry 120 mA. of D.C. This is one of the shrouded type, designated the model C1/A2, and the price is £1 7s. With no D.C. flowing the measured inductance was 42 henrys, which fell to 34 henrys with 20 mA. and to 30 henrys with 80 mA. of D.C. passing. At 120 mA. the inductance was 22 henrys. These measurements were made at 50 cycles and with 6 volts A.C. across the winding.

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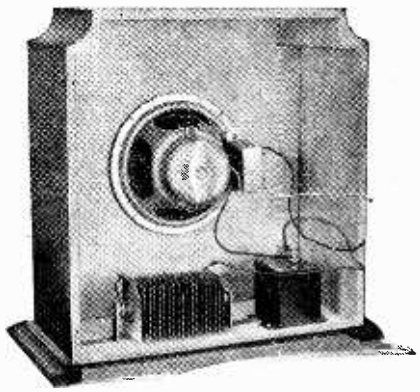
"CORDO" LOUD SPEAKERS.

For those in search of a cabinet moving-coil loud speaker at a reasonable price, the "Cordo" series should make a special appeal. They are housed in compact oak cabinets of neat design. The D.C. model, which is suitable for 110/280 volt mains, costs 3 guineas, and the A.C. model (190/250 volts) £4 7s. 6d. The latter is fitted with the same field winding as the D.C. model and is energised through a high-voltage metal oxide rectifier, which is found to give negligible background hum.

The moving-coil unit, which we understand is of Canadian origin, has a 5-inch diaphragm. In spite of its small size the overall sensitivity of the unit is well up to standard, and the reproduction in the base, even down to 50 cycles, is surprisingly good. The principal resonance is at 175 cycles, and does not affect speech or increase mains hum. In the middle register the output is aurally uniform, and in the upper register shows an increase between 3,000 and 5,000 cycles, after which the cut-off is rapid.



Cordo moving-coil loud speaker (A.C. model), employing a high-voltage Westinghouse rectifier for the field.

Under normal working conditions in conjunction with a broadcast receiver the performance was in every way equal to that of the average 7-inch diameter type of moving-coil unit. We understand that a permanent-magnet model will be announced shortly, and that a special field winding suitable for the Haynes Radio Single Dial Superheterodyne (A.C. model) is already available.

The makers are Cordo Electrical Products, Ltd., 68, Victoria Street, Westminster, London, S.W.1.

Readers' Problems.

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

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

Measuring Plate Voltage.

A CORRESPONDENT has been trying to measure accurately the actual voltage on the plate of his detector by connecting up a good-class voltmeter in the position shown in the dotted lines in Fig. 1. He is surprised at the low voltage reading obtained, and, in asking how to arrive at this voltage more or less accurately, he quite rightly surmises that the voltmeter is giving a fictitious reading.

The problem is quite a simple one, as all that it is necessary to do is to find out the voltage absorbed by all devices in the plate circuit of the valve and subtract them from the terminal voltage of the H.T. accumulator which is in use. The only instrument required is an inexpensive milliammeter, which should be connected to the plate circuit of the detector in the position shown. Its reading should be divided by 1,000 and multiplied by the resistance of the other components in the plate circuit, which, in this particular case, are the transformer primary and the anode resistance. The resistance of the latter component will obviously be known, and all reputable transformer manufacturers will furnish the former nowadays. The resistance of the milliammeter itself can be neglected, since even if it is of an inexpensive type it will not be sufficiently great to cause a potential drop greater than a fraction of a volt. Similarly the internal resistance of an H.T. accumulator is sufficiently small to be negligible for our purpose, and so the voltage on load can be taken as being equal to its normal voltage.

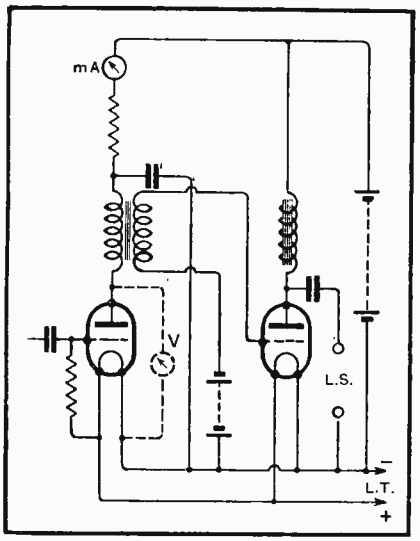


Fig. 1.—To ascertain plate voltage, calculations based on the reading of a plate circuit milliammeter should be made; the use of a voltmeter in the position shown in dotted lines will give misleading results.

If a source of H.T. supply having a high internal resistance, such, for instance, as an eliminator, were being employed, then a milliammeter alone would not suffice, and the actual voltage at the terminals of the H.T. supply unit *under normal conditions of load* would have to be measured by a high-resistance voltmeter. It should be emphasised that a voltmeter of sufficiently high resistance to read the voltage output of an eliminator with reasonable accuracy could in no circumstances be used to measure the plate voltage direct in the manner indicated by our correspondent.

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Lamps as Resistances.

THE question of using lamps as voltage-dropping resistances in all-mains D.C. receivers has again cropped up, and a query has been received from a reader who states that he has been warned against using them for this purpose by his local dealer, and he asks us to explain the reason for this warning.

There is no disadvantage in using lamps for the purpose mentioned, and we can only think that the dealer had in mind the fact that it is only possible to calculate the resistance of lamps from the customary data of voltage and wattage when they are burning at normal brilliancy. Consequently, there is a risk of a wrong value of resistance being included in the circuit. A comprehensive article on this subject, in which tabulated data was given for the purpose of arriving at the resistance of a lamp at various values of current flow, appeared in the issue of this journal dated October 21st, 1931.

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Varying the Transformer Ratio.

IN the "Readers' Problems" section of this journal for May 27th, 1931, various methods of artificially increasing or decreasing the normal step-up ratio of a transformer were given, and it was shown that by the employment of the parallel-feed system it was possible to interconnect the transformer terminals so that a 1 : 1 ratio and three step-up ratios could be obtained.

A reader asks whether it is possible to arrange matters so that a step-down ratio is obtained as he has the idea of constructing a volume control consisting of a switch arranged to change over the transformer connections as desired.

There is, of course, no difficulty in arranging matters so that a step-down is obtained, and in Fig. 2 the necessary connections are given. Fig. 2 (a) gives a small step-down, and Fig. 2 (b) a very large step-down. The actual ratio of the transformer is easily calculable. Thus, supposing the normal ratio of the transformer were 1 : 7, then the arrangement of Fig. 2 (a) would give a step-down of 1 : 0.875 and the other arrangement would give a step-down of 1 : 0.125.

We cannot, of course, recommend this arrangement for volume control because,

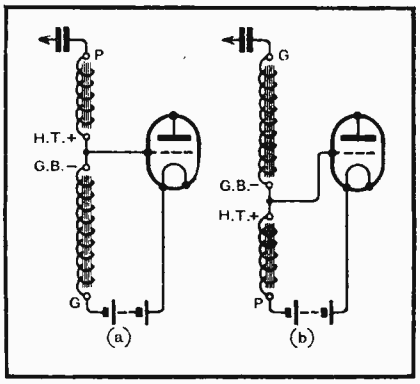

Fig. 2.—Arranging the connections of an intervalve transformer so that a step-down in signal volts is obtained, a method which a reader suggests for volume control purposes.

apart from the fact that it would vary volume in very irregular steps, the complications of the connections to the switch would be very detrimental to the performance of the amplifiers. For experimental purposes, however, the latter difficulty could be got over by a simple plug-and-socket system.

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Matched Coil on Transformer.

WE are asked by a reader who is constructing his own moving-coil loud speaker whether it would be better to wind the coil with a suitable number of turns to "match" the power pentode valve which he intends employing in his output stage, or whether it would be better to put on a low impedance winding and couple it to the loud speaker *via* a transformer of suitable ratio.

Little or no difference will be noticed in the results whichever course is adopted. If possible, however, we like to advise the use of a low impedance winding, and the purchase of a good output transformer, owing to the fact that a few turns of a comparatively stout gauge of wire is much easier to wind and is less liable to a breakdown than a winding consisting of a very large number of turns of fine-gauge wire. At the same time, however, we would point out that, provided care is taken in winding, quite a successful job can be made of a high impedance coil and the extra expense of a transformer dispensed with.

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The "Receiver of the Future."

THE publication of statements by *The Wireless World* suggesting that the principle of highly selective circuits followed by tone control will provide the basis for the design of the selective receiver of the future has aroused wide interest, and it is not unnatural that, the subject being so intimately connected with the claims made by Dr. James Robinson for the Stenode receiver, the Stenode and selective circuits followed by tone control generally should be discussed together. Our Correspondence pages have provided a repository for some interesting statements, including the question of patent claims.

We do not regard the subject of patent claims, however, as a matter on which *The Wireless World* can enter into discussion. We have carefully avoided this topic and endeavoured to discuss the question from an entirely independent standpoint. In this issue Dr. Robinson replies to the letter from Captain Round, published last week, and he interprets Captain Round's letter as providing further evidence that the Stenode is the "receiver of the future."

It seems to us that what would be welcomed in this discussion is a definition of the Stenode. Some day, not very far distant, a writer compiling a technical dictionary will have to devise a definition of the Stenode, which reminds us that we are at present conducting, through *The Wireless World*, a section described as an "Encyclopedia of Wireless Terms," and we offer to place at the disposal of Dr. Robinson a page in this series for him to give us this definition.

The design for a constructional receiver to demonstrate the remarkable possibilities of the use of ultra-selective circuits followed by correction, which we have already referred to in our columns, is now ready to put before our readers, and the first details will be given in our issue of next week. Experimenters will find in these ideas entirely new scope for investigation.

Informative Advertising.

A VERY interesting letter on this subject is included in our Correspondence columns this week; the writer is Mr. Watkins-Pitchford, who has had a very large experience in advertising of all kinds. We are in sympathy with his views that there are times when it is difficult to give much technical data, since so much depends upon questions outside the manufacturer's control, and he therefore rather favours the "How-it-is-made" type of advertisement.

We would, however, suggest that what is far more useful to the reader is an advertisement indicating "How it is to be used." In the case of performance of complete sets, we are still a long way behind America in the matter of indicating performance; we know that here again there are difficulties owing to lack of standardisation of tests, but there is, nevertheless, much scope, without it being necessary to get involved in matters controversial.

Designing Detector Circuits.

IT would probably not be an exaggeration to say that a broadcast receiver is as good as the detector stage, and, unless proper attention is paid to detection, quality, at least, is certain to suffer.

The importance of designing detector circuits cannot, therefore, be over-estimated, and we are very glad to be able to publish in this issue an article on the subject of detector circuit design, which describes what we believe to be a new method of determining the ideal conditions under which a given detector valve should be operated.

Designing Detector Circuits

By P. K. TURNER, M.I.E.E.

New Method which Simplifies Calculation.

IT is now a commonplace that by using the anode volts-anode current curves of a power valve, as given by the makers, one can easily find out its maximum undistorted output, the load impedance required to match it, and the input swing and grid bias needed. Many articles on this subject have appeared in *The Wireless World*.

But up to now there has been no corresponding facility for valves used as detectors. Not many could work out for (say) a Mullard 354 V valve, working as a grid detector at 3 to 4 mA. into a 20,000-ohm resistance coupling, just what is the best value of input to give least distortion; what is the resulting output voltage for 100 per cent. modulation, and so forth.

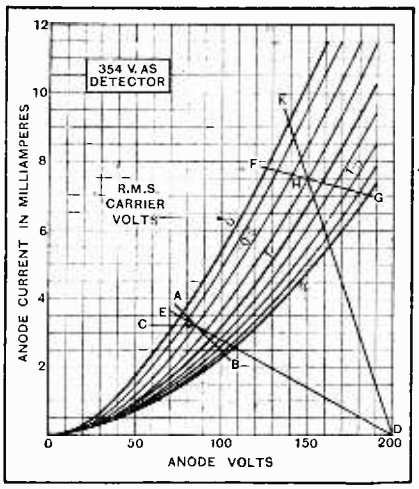

Fig. 1.—The new kind of Anode volts-anode current curves of a Mullard 354 V valve. Each curve corresponds to a fixed value of H.F. input.

I have, however, found a means of showing all these things by a special set of curves which can easily be supplied by the manufacturers—unfortunately they are not really easy for the ordinary user to make himself.

Fig. 1 shows such a set for the valve already mentioned. They are anode volts-anode current curves; but they are taken with the valve connected as a grid rectifier (see Fig. 2), and each curve corresponds, not to a fixed grid bias as in the usual published curve, but to a fixed value of H.F. input.

WHILE copious information concerning the behaviour of valves in amplifying stages has long been available, detector valves until lately have been strangely neglected. Readers will welcome this article by an acknowledged authority on valve technique setting forth detector design data in a new light.

The shape of the curves is technically very interesting, and throws valuable light on certain problems of rectification, but we are more concerned with their practical use.

Suppose we resistance-couple this valve to the next by a 20,000-ohm load, and use 150 volts of anode supply. We draw the load-line AB just as we should for an amplifier, i.e., through 150 V. on the anode volts scale and 7.5 mA. (=150 V./20,000 ohms) on the current scale. The points where each curve cuts AB show the D.C. anode current and voltage for any H.F. input, and as the H.F., being modulated, varies at audio frequency the resulting change of voltage along the line AB shows the audio-frequency output. For example, suppose the carrier is 0.5 volt, modulated 50 per cent. The D.C. anode current, which in

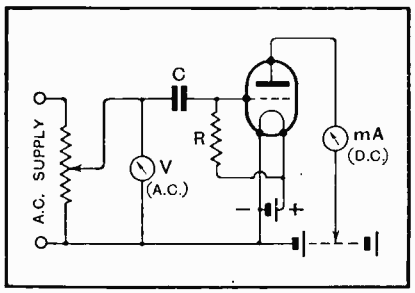

Fig. 2.—The circuit used for obtaining the dynamic detector curves.

the absence of the carrier is 3.65 mA., drops to 3.25 mA. when the carrier comes on. At 50 per cent. modulation the carrier varies between 0.25 and 0.75 volt at audio frequency, so the current swings between 3.5 and 3 mA. and the volts on the anode from 80 to 90; the difference between these last two, or 10 volts, is the actual output volts swing on the load, and hence on the grid of the next valve.

Now as to distortion. Since the various curves are for equal increase of 0.25 volt carrier, there will only be absence of distortion if they cut AB at points equally spaced. Looking at AB, we see that the first two curves are too close together, as are all the curves after the one for 0.75 volt carrier; so there will almost always be some distortion, at any rate for deep modulation. It is clear that the least distortion will be got by having a mean carrier of 0.5

Designing Detector Circuits.—

volt (point C), and *we know quite well when we have this;* it is not necessary to measure it; all we have to do is to adjust the H.F. volume control till the detector anode current drops by 3.65—3.25 or 0.4 mA. when the carrier is tuned in. I know of no other method by which one can quite easily be sure of getting the right H.F. on the detector.

The decoupling resistance.

Up to now we have not considered any decoupling resistance. Suppose we decide to use one, the working point to be at C as before, but the total anode supply being 200 volts. We join C to D, and find that CD (produced) cuts the current scale at 5.6 mA., so that the total resistance in the anode circuit must be 1,000 times 200V/5.6 mA. = 36,000 ohms. As the load resistance is 20,000 ohms, the "stopper" must be 16,000. Then, since both load and stopper affect the D.C., the current with no carrier will be point E, or 3.5 mA., with a fall of 0.25 mA. to C when the carrier comes on; but since only the load resistance is effective for audio-frequency changes, the A.F. output will still follow the line AB.

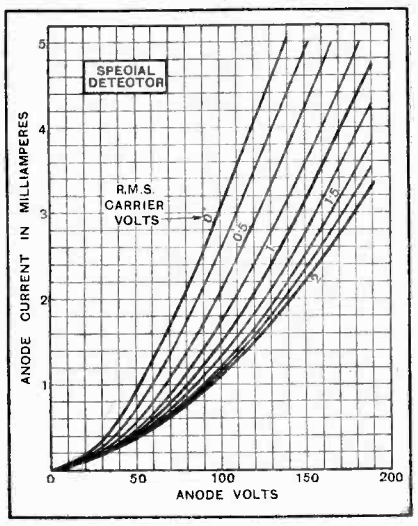

Fig. 3.—Detector curves of an experimental valve taken under similar conditions to those of Fig. 1.

Take the same valve and supply voltage, and consider what happens if we use transformer coupling. A good transformer will usually correspond to an anode load (for audio frequencies) of 50,000 to 100,000 ohms; take it as 75,000 Its D.C. effect should be negligible—only 1,000 ohms or so. If we draw a line FG at a slope corresponding to 75,000 ohms, we see that we get least distortion by using a mean carrier of about 0.75 volt (point H), which for 100 per cent. modulation gives no less than 173 − 126 = 47 volts output swing on the primary of the transformer; or at 3:1 ratio about 150 volts swing on the grid of the power valve. Joining HD, we find that its slope corresponds to a stopper of about 7,000 ohms, and the D.C. drop will be from K to H, or 9.2 − 7.5 = 1.7 mA.

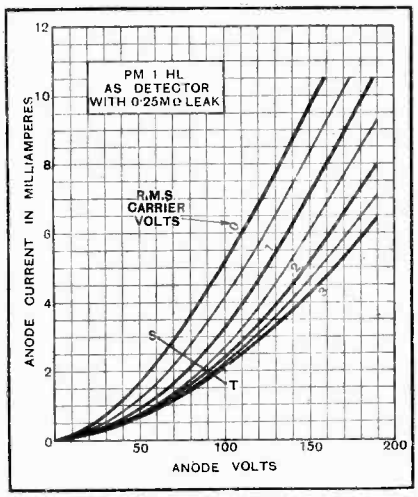

Fig. 4.—Curves of a Mullard PM1HL valve which gives almost distortionless detection with as small an input as 0.25 volt.

Now that the method of using the curves has been explained, it is interesting to compare them for various valves and conditions of use. One point common to the curves for all valves is the way in which at low current values the curves for the larger inputs crowd together. The lower the anode current the smaller is the permissible carrier input if distortion is to be avoided. In the case already taken the line AB at about 3 mA. offers much less choice of input than the line FG, and at the best the distortion will be greater. In fact, this valve, from the curves (and this is confirmed in practice), is essentially one to be worked well up on its curves, at 6 to 10 mA.

Compare it with the next example—an experimental detector valve. Its curves are shown in Fig. 3. This works much better at low voltages, as may be confirmed by drawing load-lines centred on

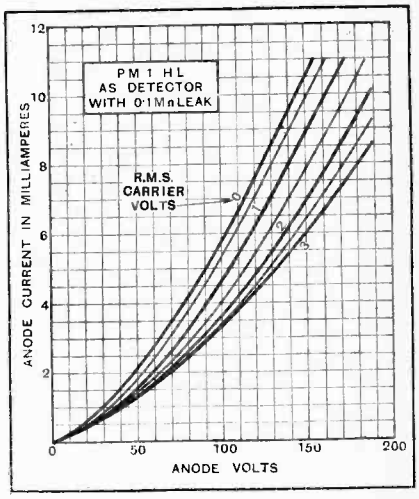

Fig. 5.—Using a grid leak of 0.1 megohm with the PM1HL the curves are closer together showing less efficient rectification and greater distortion.

about 2 mA.; the distortion is negligible for a carrier of about 0.5 volt. On the other hand, the 354 V is better at high current and for large output.

A somewhat similar comparison may be made for battery valves between the PM2DX and the PM1HL. The former is at its best when worked at about 6 mA., with a carrier of 1 to 1.5 volts. The PM1HL, on the other hand (see Fig. 4), though it can be used quite successfully at 6 mA. with a 1-volt carrier, is exceptional in the way it works with quite small current and input. For example, the line ST is for resistance coupling by 30,000 ohms on 150 volts H.T.; on a more detailed curve-sheet, with more lines for intermediate H.F. inputs, it is found that the distortion is still quite small for a carrier as low as 0.25 volt with a D.C. drop of 0.1 mA., though the best condition on ST is obviously a drop of 0.25 mA., which means 0.5 volt carrier.

All the curve-sheets up to now have been drawn for leaks of 0.25 megohm. It is interesting to compare the results with other values, and Figs. 5 and 6 show the same valve as Fig. 4 (PM1HL) with leaks of 0.1 and 2 megohms. We see that with 0.1 megohm the curves

Designing Detector Circuits.—

are much closer together, i.e., the same change of carrier gives less output, showing less efficient rectification; also, there is considerably more distortion, for the distance between the curves for 0 and 0.5 volt is too small compared with that between other pairs of curves. But there is very little difference between the results for leaks of 0.25 and 2 megohms. If we take in both cases lines for 30,000 ohms load on 150 volts H.T., we find that for 0.5 volt carrier, 100 per cent. modulated, the output swing with 0.25 megohm is 83–67 or 16 volts, and for 2 megohm leak 88–71 or 17 volts. This proves that with 0.25 megohm the leak or grid loading resistance is already so high compared with that of the grid path inside the valve that there is little to be gained by increasing the leak, and, as we naturally desire as low a leak as possible to avoid loss of high notes, 0.25 megohm is (for this valve at any rate) a reasonable value.

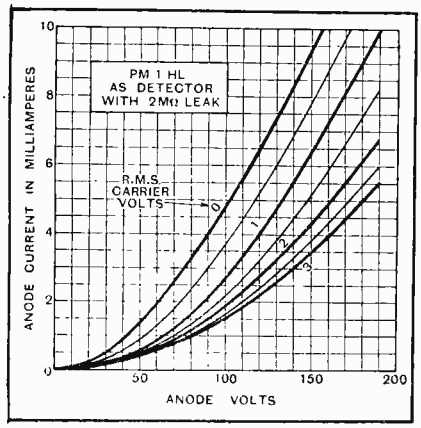

Fig. 6.—The performance of the PM1HL with a 2-megohm leak. There is little difference in the curves as compared with those taken with a 0.25 megohm leak.

One last point. Although not really difficult, the measurements necessary to draw these curves are more tricky than those for ordinary curves; so the task is essentially one for the valve manufacturer, who can measure many samples and publish average curves as he already does in the case of ordinary characteristics. In order to induce valve makers to publish such curves it is necessary to convince them that they are desired, by persistently asking for them.

PRACTICAL HINTS AND TIPS.

AIDS TO BETTER RECEPTION.

TROUBLE is sometimes found in radio-gramophones, or installations where the receiver and speaker are mounted in the same cabinet, from howling or resonance effects on certain frequencies. At first one nearly always suspects the detector valve, following the experience gained in the very early days of radio when microphonic valves were common, but nowadays this is not usually the source of the trouble.

HOWLING IN RADIO-GRAMOPHONES.

In many cases the trouble is due to the vibration of the plates of the variable condensers, and this is particularly likely to be the case with superheterodynes. Condensers whose vanes are made of brass are more likely to prove troublesome than the usual type with aluminium vanes, but complete safety cannot be ensured with the usual methods of receiver mounting.

Where the receiver and speaker must be in the same cabinet, therefore, it is sometimes worth while to mount the chassis upon blocks of sponge rubber so that vibrations cannot be transmitted from the speaker to the set *via* the woodwork. The dial and tuning knobs, of course, must not be rigidly fixed to the panel, which will usually be a part of the cabinet, but must be fixed to the receiver chassis so that they are free to move slightly with it. This often introduces difficulties, which are overcome in some commercial receivers by adopting the usual receiver mounting with a rigid chassis, but mounting the variable condenser only upon blocks of rubber. Only the condenser shaft and dial then requires to be kept free from mechanical connection with the panel, and this may be achieved by the use of a "behind the panel" type of dial with a large clearance hole for the tuning shaft. The dial escutcheon, of course, is fixed to the panel, and so the peculiar result is obtained of being able to move the condenser dial relative to the escutcheon by pressing the tuning knob.

It might be thought that this would make tuning difficult and calibration impossible; this is not the case, however, if the arrangement be properly set up, for the dial always comes to rest in the same position, and the suspension is stiff enough to prevent any movement during the normal rotatory motions of tuning.

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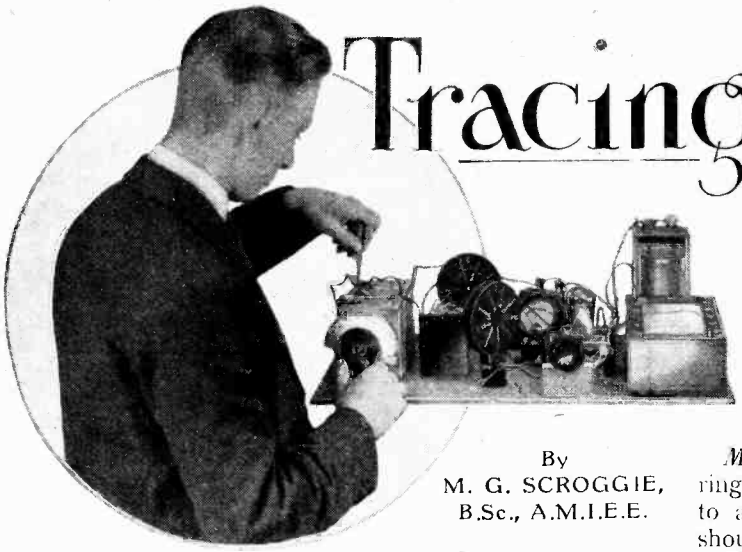
FOR reasons that have been explained many times in these columns, it is often a matter of great difficulty to make accurate measurements of the voltages applied in the various anode circuits of a mains-operated receiver. As often as not, a reading of the current passing, rather than of the voltage applied, is equally, if not more, informative, but one often hesitates to apply this test, even if a milliammeter is available, because of the necessity for disconnecting leads.

ANODE CIRCUIT TESTING.

To avoid this, it is an excellent plan to fit, at the low-potential end of each anode and screening grid circuit, a pair of terminals in a reasonably accessible position; these terminals are normally bridged by a short-circuiting strip, which, of course, is removed when it is desired to take a reading of the current flowing. If this is found to be in fairly close agreement with the figures given in the manufacturers' literature, or on *The Wireless World* Valve Data Sheet, it is unlikely that anything will be wrong with the valve concerned.

Those who adopt this scheme would be well advised to keep some record of the normal anode currents, in order that they may know when valve emission begins to fall off with increasing age.



Tracing Troubles

No. 4.
Eliminating Distortion and Background Noise.

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

THE previous articles have provided an outline of the procedure of tracing a fault in any battery-driven receiver of typical design, first a general examination by means of anode-current readings, and then a process of elimination in the particular case of reduced or interrupted reception. We now come to Trouble No. 4 on our list: Distortion, which has to some extent been covered already, as it is commonly associated with weak reception. Such things as grids cut adrift from their bias, partially short-circuited output chokes, and valves past their prime are among the common causes of distortion, as well as, probably, loss of strength. The appearance of distortion alone, in a previously well-behaved receiver, is somewhat rare, and even so its cause should be apparent during the course of the tests already described in earlier articles of the series. There is therefore very little that can be said in general under this heading.

High-amplification receivers are very sensitive to battery resistance unless thoroughly decoupled, and a case has been known of a corroded H.T.-accumulator terminal causing distortion by introducing enough resistance to back-couple the stages of amplification. In fact, it eventually set up a L.F. howl, which brought it within the scope of the next section, No. 5, dealing with noises.

There are many ways of tackling the numerous varieties of undesirable noise which may be superimposed on the more intentional part of the programme, and experience makes testing unnecessary in a large number of cases, for most noises betray their origin audibly, by their characteristic sound. Perhaps the most useful treatment of the subject will be to refer to the common types of noise, with the places to look for them, and then outline the systematic method to be adopted when the character of the sound does not give it away. There may be microphonic and hissing noises, motor-boating, or man-made static.

IN the fourth article of this series on the location of faults, using only impromptu apparatus, the possible causes of distortion and noise are discussed. The troubles sometimes encountered in mains receivers will form the subject of the concluding instalment.

Microphonic Noise.—Usually a clear high-pitched ringing note which builds up more or less gradually to a loud sound. This is a well-known effect which should not be difficult to identify, but is sometimes rather difficult to stop. If the loud speaker is separate the obvious thing is to shift it to a spot where its outbursts do not impinge so violently on the valves, but if it is built into the receiver one must try the usual dodges of wrapping the valves in swaddling clothes of cotton wool, or applying to the makers for a better valve. The offending valve may be identified by tapping and noting which one's "pong" corresponds to the prevailing howl. The detector valve is generally the offender, but microphonic H.F. valves are not uncommon, and the effect is then slightly obscured by the fact that it takes place only when a carrier wave is tuned in. The audio-frequency variations in the anode current of an H.F. valve caused by vibration are not likely to be passed through at sufficient strength to give rise to a microphonic howl, but may modulate an amplified carrier wave sufficiently for the purpose. Those receivers in which the volume is controlled by dimming the filament may display microphonic effects at a particular filament temperature. It is undesirable to be only just saved from microphonic noise, because there will be undue emphasis in the reproduction of one particular note.

Motor-boating.—This term applies more particularly to the sound it resembles and which is most common in receivers fed from power units, in which the oscillation caused by back-coupling is at a very low frequency by reason of the large time-constant of the smoothing circuits, but may here be taken to include all noises caused by back-coupling, whether resembling a motor boat or a motor horn. It is possible for the cause of the L.F. amplifier becoming unstable and emitting a continuous noise to be an internal fault, such as the disconnection of a decoupling or by-pass condenser, perhaps inside the condenser or perhaps a dry joint in the wiring, but it is more likely to be battery trouble, as emphasised at the end of the paragraph on distortion. If so, not only should the battery be

Tracing Troubles.—

renewed or recharged or its connections made good, as the case may be, but more decoupling should be introduced into the receiver to make it less sensitive to resistance in the supply. It should be noted that the effect of back-coupling is not always to *increase* the amplification; with some arrangements there may be a reduction and with it an element of distortion.

Continuous hissing or rushing.—If unaffected by removing the aerial is almost certain to be valve noise; the question of which valve is soon settled by pulling them all out in turn, beginning at the aerial end. Even if reduced or stopped by removing the aerial it may still be valve noise, as it may be present only when the carrier wave of a station is being received, and thus be a little difficult to distinguish from microphone hiss, but if all stations are noticeably affected an H.F. valve may reasonably be suspected. This effect is particularly likely to occur when the grid circuit is completed by a grid leak of high resistance, and is more common with mains valves than with battery valves. If heard only when the aerial is connected, and present without a received carrier wave (though perhaps much more strongly with it) the cause is some form of external interference. A particular type of atmospheric, usually accompanying thundery showers, is of this character.

Other noises.—If the origin of these noises is not sufficiently obvious from the character of the sound it must be traced by elimination, first removing the aerial to distinguish between external interference and internal fault, bearing in mind that certain internal faults do not give rise to noise until something is being received for them to work on, as explained earlier. Apart from atmospherics there are scores of sources of interference in these days of multitudinous electrical appliances. Battery-chargers, fans, cleaners, refrigerators, signs, tramcars, violet-ray machines, automatic telephones, cinema projectors, and many other things add a background, or perhaps even a foreground, of roars, rustles, bangs, pops, crackles, and other effects. The B.B.C. interval signal has been criticised, but the same thing many times louder, throughout programmes as well as intervals, is the fate of those who live close to crossings on arterial roads which are furnished with flashing beacons. The silencing of these varied disturbances is a separate subject, which, incidentally, might with advantage be tackled in this country as energetically as in Germany.

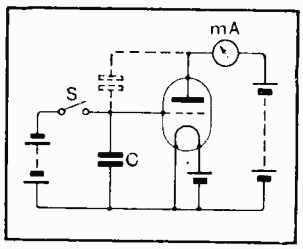


Fig. 2.—Method of testing leakage of large condensers. The insulation of the grid circuit must be beyond suspicion. The condenser under test is shown at C.

Supposing, however, that the noise originates within the receiver, it is usually a simple enough matter to locate it, gradually cutting things out from the aerial end until the noise stops, and then concentrating on that last thing. Failure to do what the set is supposed to do is tackled, as already described, by gradually adding to some part which does work, until the addition of some component or group of components introduces the element of trouble. In the present case, when the receiver is doing something which it is not wanted to do, the opposite procedure is adopted, and things are gradually cut out until the part is removed which causes the noise. Removing the valves one by one is the laziest method of gradually rendering the receiver inoperative, but perhaps not the best. If access is reasonably possible it is better to short out the coupling components at various stages. Thus, take the case of the four-valve receiver indicated in skeleton circuit by Fig. 1. Short-circuiting AB cuts off all noise emanating from the H.F. valve or preceding circuit. If the noise still remains, shorting CD cuts out anything picked up by the detector grid. It may be a loose detector-valve filament or a noisy anode resistor, however, in which case shorting EF puts an end to it. The next test may be a short across GH, which does not take into account the possibility of a loose connection in the bias battery circuit, or it may be across GJ which does. As the grid leak is of high resistance in relation to the grid-bias voltage no harm will come through doing this, but it would not be a good plan to short K to J, because the relatively low resistance of the transformer primary is all that would stand between the H.T. battery and disaster, and it would not stand very long. Neither would it be advisable to short MO, because the removal

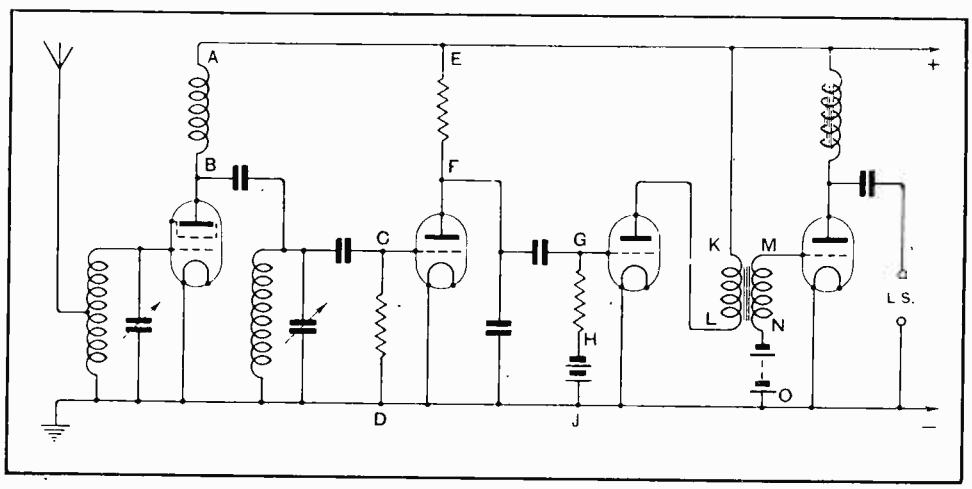


Fig. 1.—Skeleton circuit of a typical four-valve receiver showing how faults may be traced by the systematic short-circuiting of various components.

Tracing Troubles.—

of its bias might have unfortunate effects on the power valve. Shorting MN is equivalent to putting all the preceding equipment out of action and confining the possibility of remaining noise to some fault in the power valve or output circuit. The system seems too obvious to need explanation were it not for a regrettably prevalent tendency to start by trying components indiscriminately without narrowing the field of inquiry.

Supposing now that the trouble, in whatever type of apparatus, has been traced to a particular component; to conclude the proof satisfactorily it is necessary to extract the offender and fasten the guilt definitely on it. A few methods of doing this without invoking the aid of laboratory equipment, other than that already mentioned, may be appropriate at this stage.

Resistance paths, legitimate and illegitimate, can generally be explored with a battery and voltmeter, as explained in the first article. When it is a fixed condenser of, say, 0.1 mfd. upwards which is called into question this may not be a practicable method, first, because the meter may not be sensitive enough to indicate with any reasonable voltage, and secondly because the charging current of the condenser tends to obscure the result. A rough and ready but useful tip is to charge the condenser from a convenient source of about one or two hundred volts and then let it stand. A good condenser gives a spark when it is short-circuited hours afterwards, but a leaky condenser gives little or no spark after a few seconds.

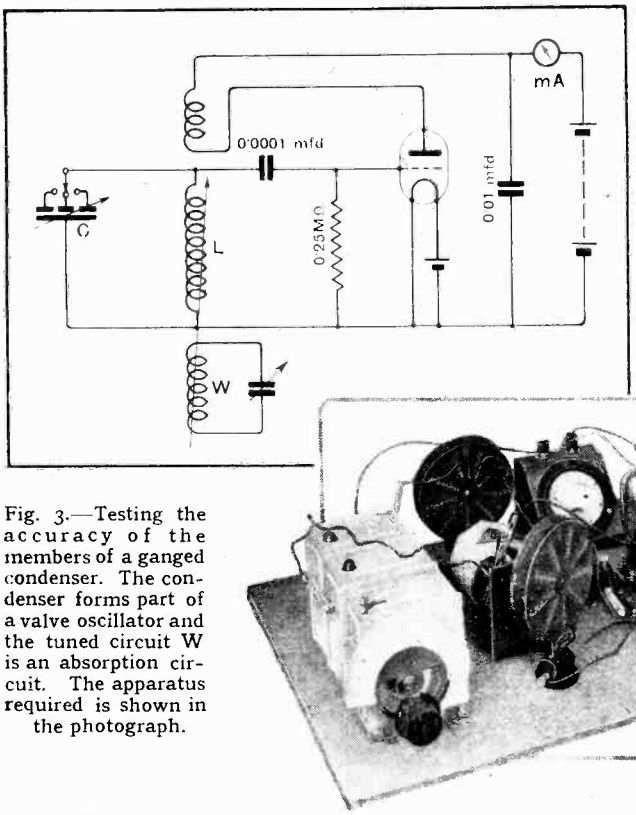


Fig. 3.—Testing the accuracy of the members of a ganged condenser. The condenser forms part of a valve oscillator and the tuned circuit W is an absorption circuit. The apparatus required is shown in the photograph.

A prettier method, but one involving rather more equipment, is shown in Fig. 2, and consists in connecting the condenser across a valve which is negatively biased, so that a milliammeter in the anode circuit reads almost zero. The bias battery is then removed, and as the condenser discharges through its own leakage the meter reading will very gradually rise if it is a good condenser, or suddenly if it is a bad one. It is obviously very necessary to make sure that there is very little leakage external to the condenser, by avoiding a "soft" valve or a doubtful valve-holder. The other principal fault of a fixed condenser, an open-circuit or disconnection, is also characterised by failure to hold a charge, for the simple reason that it is incapable of getting one to hold, and to distinguish it from a leak or short-circuit it may be connected in parallel with some other condenser such as one tuning a H.F. circuit; some idea of the actual capacity is obtained by noting how much the tuning condenser must be altered to restore the original tuning. In the case of large-capacity condensers an alternative method is to connect it in series with a battery and voltmeter, to prove by momentary charging current that it really is a condenser.

Matching Ganged Condensers.

To test the satisfactory behaviour of a potentiometer, the total resistance having been already measured, the end terminals may be connected to a suitable battery, that is to say, one which does not cook it, and the slider or brush and one end terminal to the voltmeter. Moving the slider round or along its travel will then reveal breaks (in the form of a sudden transition from full to zero reading), bad contacts, or shorted portions, as well as giving some idea of the "law"—whether the resistance element is uniform or is tapered to give more rapid control at one end.

It is difficult to test the matching of gang condensers without some form of set-up, and a bridge of sufficient accuracy is rather an expensive item. There are a variety of other ways of doing it, depending on the components which happen to be handy. In most cases a valve oscillator is fairly easy to rig up, if it is not available already. The gang condenser is placed so that the rotor is connected to the low-potential end of the oscillator coil and the high-potential end to each of the stators in turn. Some sort of frequency or wavelength measuring device is required, though it need not be calibrated. If a heterodyne wavemeter is present, it is simple enough to set the trimmers of the gang so that with the vanes set to zero (all out) the oscillator generates at the same wavelength for each stator connected. The rotor is then moved round to

Tracing Troubles.—
various other positions, and the differences in wavelength with the various stators connected indicate the imperfections in matching. If a wavemeter is not available a good substitute is a coil and variable condenser, the coil being of approximately the same inductance as that of the oscillator and preferably low-loss; it is coupled loosely to the oscillator coil, just enough to cause a slight kick of the pointer of a milliammeter in the anode circuit of the oscillator, when it is tuned through resonance. This is in effect a simple absorption wavemeter, and the procedure is the same as before. The same circuit may be utilised for matching coils, by connecting them in turn to form part of one circuit which can be compared with another.

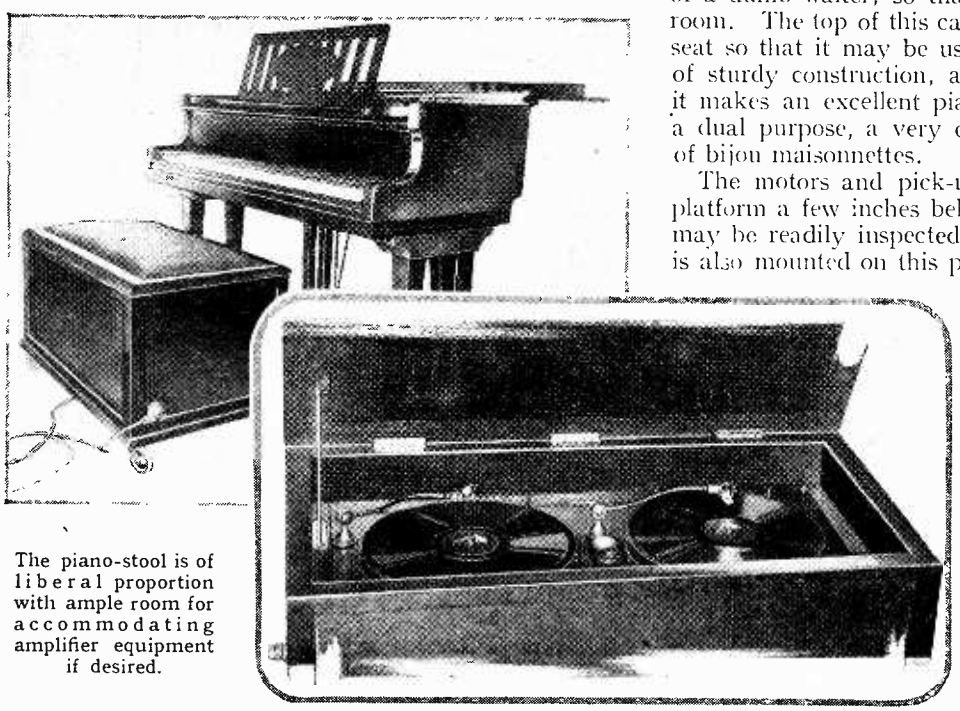
All the matter hitherto refers primarily to battery-driven receivers, but with a few obvious exceptions it applies to those which derive their power wholly or in part from the mains. The special troubles of the latter, both A.C. and D.C., will form the subject of the concluding article of this series, together with a few notes on the superheterodyne.

PIANO-STOOL GRAMOPHONE.

New Idea for Housing the Turntable Equipment.

MODERN methods of electrical recording in the production of gramophone records together with the excellent electrical reproduction which may now be obtained has led to a great popularity of the gramophone as an alternative to broadcasting as a means of entertainment at home. There is the obvious advantage that one can choose one's own programme.

One point, however, is too often neglected by modern gramophone designers, and that is that even a twelve-inch record lasts only about four and a half minutes, and that there is therefore the nuisance of having to keep changing it. With radio, if one can find a programme to one's satisfaction, it is only necessary to tune-in and then sit back in comfort in an easy chair to enjoy it to the full. Most people enjoy good music all the more if they are comfortable.



The piano-stool is of liberal proportion with ample room for accommodating amplifier equipment if desired.

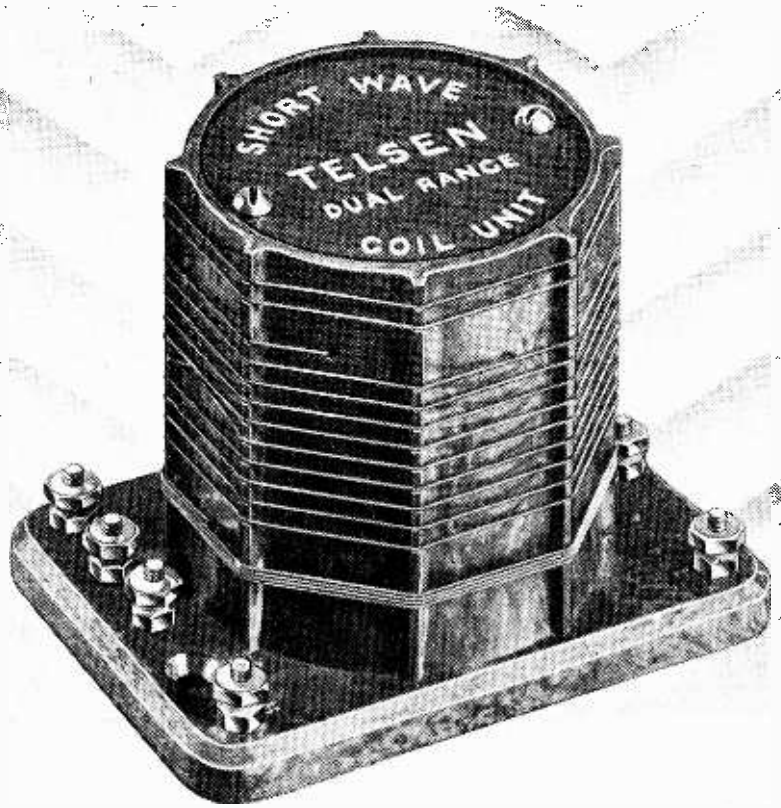
One solution of this problem obviously lies in the automatic record changers which are now appearing on the market. These wonderful pieces of human ingenuity are, however, outside the scope of this article, and will therefore not be discussed here. The author's solution is shown in the illustration. Two electric turntables and pick-ups are mounted in a low cabinet about the size of the chests which are often used for storing logs. The cabinet is mounted on wheels, in the manner of a dumb waiter, so that it may be moved about the room. The top of this cabinet is covered with a leather seat so that it may be used as a stool. It is naturally of sturdy construction, and the author has found that it makes an excellent piano stool and therefore serves a dual purpose, a very desirable feature in these days of bijou maisonnettes.

The motors and pick-ups are mounted on a hinged platform a few inches below the lid, so that the former may be readily inspected. A special pick-up "fader" is also mounted on this platform, with the usual needle cups. This arrangement has the great advantage that, by the skilful use of the fader, it is possible to get about nine minutes of uninterrupted music. It is also possible to get a continuous performance if the music is recorded on the discs in the order 1-3, 2-4, etc. This last method of recording has already been adopted for certain issues of light operas.

The dual-turntable arrangement is also of great assistance to those who use their gramophones for dance music, as the turntables may then be used alternately, thus avoiding those gaps which usually occur when the needle is being changed or a new record put on. There is plenty of room in the lower part of the cabinet for a complete two- or three-stage amplifier and the necessary power supply unit.

H. ANDREWES.

TELSEN SHORT WAVE COIL



TELSEN COMBINED DUAL RANGE SHORT-WAVE COIL UNIT

This Unit for the first time brings the construction of short-wave receivers into line with the simplicity of modern practice. When tuned by a ·00025 condenser, a wave range of 20 to 75 metres can be covered by the operation of a switch as in ordinary broadcast practice. No coil changing is necessary and no other coils are required, as the unit incorporates windings for aerial, tuning and reaction circuits. The coil is also suitable for use with sets covering all wavebands with a .0005 tuning condenser. In this case the dual range feature is not employed.

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Advt. of The Telsen Electric Co. Ltd., Aston, Birmingham. CVS—143

A19 *Handbook of Technical Instruction for Wireless Telegraphists. (Fourth Edition.)* By post, 25/9

UNBIASED

BY FREE GRID

And So to Bed.

ONE encounters wireless receivers in all sorts of unexpected places. I remember in the early days of broadcasting strolling up to the stage door of a London theatre shortly before the conclusion of the evening performance to keep an appointment with an actor friend, and finding the keeper of the gate so engrossed in manipulating his catwhisker that I could have successfully slipped by into forbidden territory without his noticing had I not tripped over his "counterpoise."

Handed over the 'phones.

The most recent instance in which I have unexpectedly run into a brother radio enthusiast occurred the other "night" at 3 a.m., when I chanced to be returning from a dinner at which I had been the guest of honour. I happened to run across one of the many coffee stalls which drive up from nowhere in the watches of the night and plug in to a special point which a kind-hearted municipality supplies on certain lamp-posts in order to supply them with light. The stall was deserted, and, to my surprise, the proprietor was busily engaged with a pair of headphones attached to a wireless set. After my demand for hot dogs had been satisfied and I was in better condition to take an intelligent interest in wireless it occurred to me to wonder what on earth he found to listen to at that hour. In reply to my enquiry he handed over the 'phones, and I was delighted to recognise a Yankee short-wave station. At his invitation I went behind the counter, and found he had a very workmanlike "superhet.," complete with short-wave attachment; nor was it battery-driven, for the whole apparatus derived its power from the mains. Though mine host had a loud speaker, he found very little use for it, as, he explained, the police objected to his entertaining his customers with music during the early hours; apparently it had caused crowds to collect, and selfish people, "steeped in swinish sleep," as Shakespeare says, had objected to its use after midnight. I was so interested that it was well after six o'clock before I finally bade him good-night and betook myself to bed.

°°°°

An Unimpeachable Source.

I HAVE been busy investigating the source of the rumour that the Post Office is about to supply programmes to all telephone subscribers, and find that it is not quite so unfounded as I at first thought. It comes, I find, from the same unimpeachable source as the rumour which gained ground some time ago that the B.B.C. intended to supply programmes via landline to all licence holders who live in the "wipe-out" area of the Regional transmitters.

°°°°

A Human Touch.

I WAS coming across from the Continent with a friend the other day, and as we strolled on deck in the vicinity of the wireless cabin the high-pitched screams of the spark transmitter came to our ears. Both of us being able to read morse, we paused awhile to listen to other people's business and, incidentally, I suppose, to break all sorts of regulations. Our talk naturally turned to wireless, and my friend wondered what was the actual voltage between aerial and earth. He was surprised when I estimated it at several thousand volts, and was quite indignant that a wire carrying what he described as a dangerously high voltage should be permitted to sway in the wind just above our heads. I pointed out to him, of course, that, as the energy in the aerial was of the high-frequency variety, not the slightest sensation would be felt even if the down lead were grasped firmly in the hand. I noticed a vertical steel ladder attached to the side of the wireless cabin, and, to prove my words, I climbed it and, holding on precariously with one hand, touched the terminal of the lead-in insulator with the tip of my all-metal brolley, which I then moved an inch or so away, thus drawing after it a merrily crackling spark. Unfortunately my demonstration was interrupted by a coarse voice demanding, in stentorian tones, what the h—— I thought I was playing at, and I felt myself firmly grasped by the seat of the trousers. When the resultant tumult had subsided, my friend and I managed to get into conversation with the wireless operator, who told us of a remarkable incident on a steamer on which he had once served. It appeared that the men were accustomed to string their washing on a clothes line stretched between two of the funnel stays; one day the bo'sun was unfortunate enough to stretch out his hand to touch his newly washed shirt at the moment that the transmitter was in operation, and he was more astonished than hurt to find a fat spark leap from it to his hand. Forthwith he complained to the skipper that the devil was in the ship.

More astonished than hurt.

H.M.V. AUTOMATIC RADIO-GRAMOPHONE

Model 531.

A Selective A.C. Superheterodyne.

An outstanding example of modern receiver design.

IT is only within the last two years that the need for selectivity has become of any great importance, and until recently quality of reproduction and high sensitivity were considered the chief characteristics of a good receiver. At the present time, however, selectivity is of such paramount importance that very considerable sacrifices of sensitivity, and even of quality, are willingly made in order to obtain it. Since the superheterodyne is unquestionably the most selective type of receiver known, it is not surprising that it should have once more become popular, particularly when a well-designed instrument can give as good quality and as great a sensitivity as the best of straight sets.

The design of a first-class superheterodyne, however, is not work to be undertaken lightly, necessitating as it does a considerable amount of experience with this class of receiver, and it is probably due to this that the number of sets commercially available is small. It is gratifying to note, therefore, that one of the foremost of the sound-reproducing companies has adopted the superheterodyne in their latest and most luxurious radio-gramophone. That the receiver is indeed in the luxury class is evidenced by the fact that no fewer than ten valves are employed, and that an automatic record-changer is fitted.

The apparatus is housed in a well-designed walnut cabinet of pleasing proportions, and the only controls visible are the volume control and the push-button record rejector. The tuning controls and illuminated dial, which is calibrated in wavelengths, are placed on the horizontal motor-board, and are accessible by lifting the sound-proof lid. The controls are few in number, and comprise the single-tuning control, the "local-distance" switch, and a four-position switch which serves to turn on the apparatus, to change from one waveband to the other, and to change from radio to gramophone.

The automatic record-changer is of standard type, and will accommodate eight 12in. or 10in. records, and so give a continuous programme of about half an hour's duration. There is a record rejector, so that if one tires of a selection one has only to push the button on the front of the cabinet and an immediate change is made to the next record on the pile. A numbered dial is fitted and turned to the number of records one wishes to hear, and after this number has been played the apparatus is automatically switched off.

The radio and amplifier chassis are probably the most interesting portions of the apparatus, however, and these are unit built in order to economise space and facilitate repair and adjustment, although this should prove unnecessary, since everything is very solidly built. In the upper compartment the receiver chassis is housed just below the induction type gramophone motor. A steel chassis is used, and it is supported on blocks of sponge rubber in order to minimise the effect of acoustic reaction. On this chassis is built a six-valve superheterodyne, the valves being arranged as preliminary H.F., first detector, oscillator, two stages of I.F. amplification, and second detector. An inductively coupled band-pass filter is employed for the input circuit, so that with the tuned grid H.F. intervalve coupling there is a total of three tuned circuits preceding the first detector. Second channel interference, therefore, should be negligible, and actual test showed that this annoying form of interference has been satisfactorily overcome.

These circuits are tuned by three sections of the four-gang condenser, the fourth section of which is used for the oscillator. The arrangements for securing single-dial control in a superheterodyne are always interesting, and an examination of the circuit diagram shows that the padding condenser circuit is em-

FEATURES.

General.

Completely self-contained A.C. mains radio-gramophone with single dial control and automatic record changer. Mains energised moving-coil speaker.

Circuit.

A six-valve superheterodyne with a three-valve L.F. amplifier. With mains rectifier there is a total of ten valves. There are ten tuned circuits, nine of which are effective on the signal. Anode bend detection is used, together with push-pull output of 4½ watts.

Controls.

1. *Single-knob tuning control.*
2. *Local-distance switch.*
3. *Combined on-off, waverange and radio-gram switch.*
4. *Combined radio and gramophone volume control.*
5. *Gramophone record rejector button.*

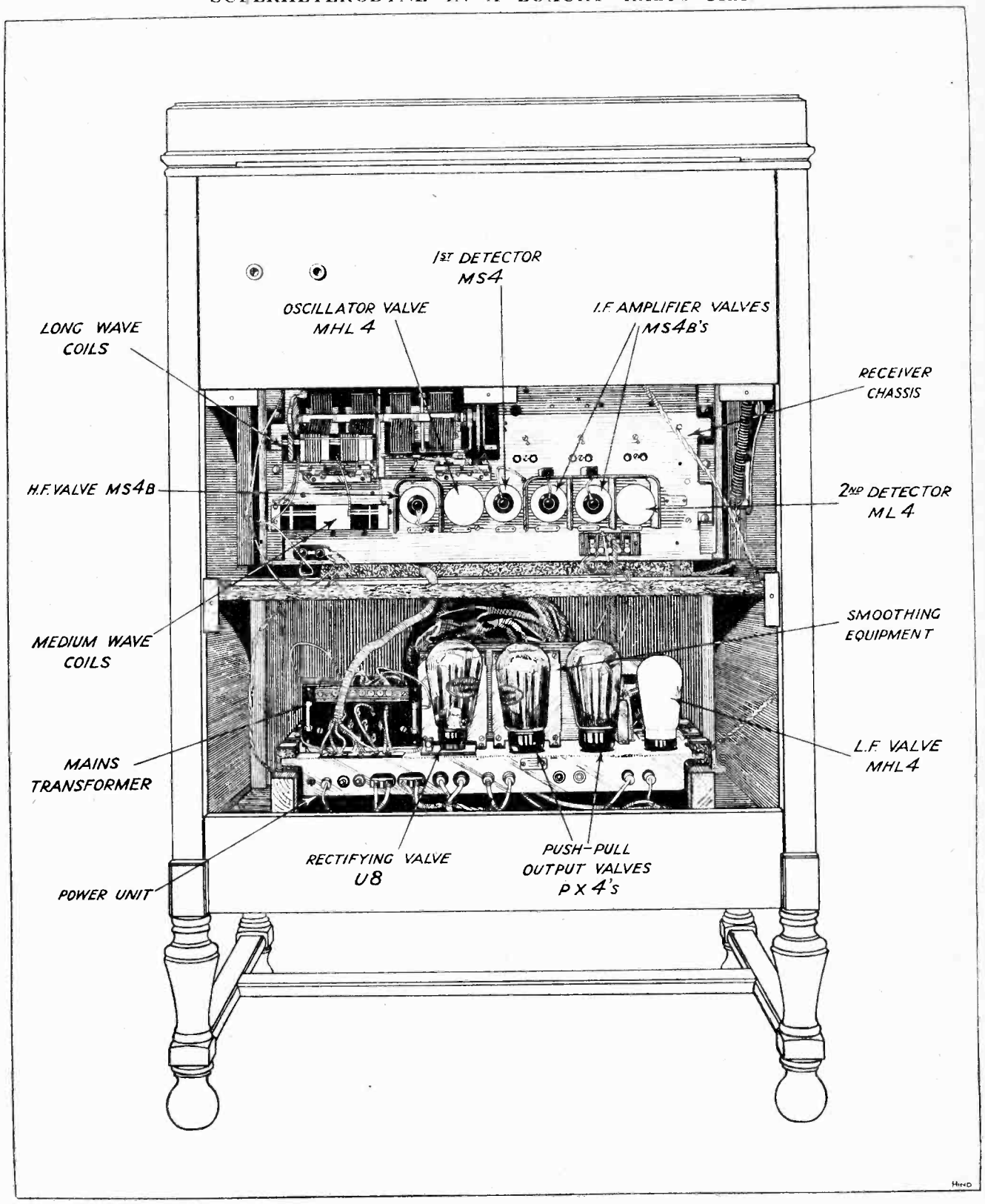
Price.

70 guineas complete.

Makers.

The Gramophone Co., Ltd., Hayes, Middlesex.

SUPERHETERODYNE IN A LUXURY RADIO-GRAM



The superheterodyne chassis is mounted above the L.F. amplifier.

H.M.V. Automatic Radio-Gramophone.—ployed. An adjustable trimming condenser is inserted in series with the oscillator condenser, and by the correct choice of its value and the relative values of the tuning inductances the oscillator is maintained with its correct frequency difference from the signal frequency circuits.

The I.F. Amplifier.

Band-pass filter intervalve couplings are employed in the I.F. amplifier, and in all there are six circuits tuned to the intermediate frequency. Together with the input circuits, therefore, the signal has to pass through nine tuned circuits before reaching the second detector, and so it is not surprising to find that the adjacent channel selectivity is extraordinarily high. It is so high, in fact, that a certain amount of sideband cutting does take place, with the result that the quality of reproduction is rather low pitched. In order to remedy this state of affairs in cases where the maximum selectivity is unnecessary, a "Local-Distance" switch is fitted. This switch operates upon the first I.F. transformer, and in the "Local" position connects a damping resistance across its primary while introducing also a series resistance in the secondary, and acts very effectively to reduce the amount of sideband cutting and the sensitivity. The quality is very noticeably improved with the switch in the "Local" position, and both the sensitivity and selectivity are still adequate for good long-distance reception under normal conditions.

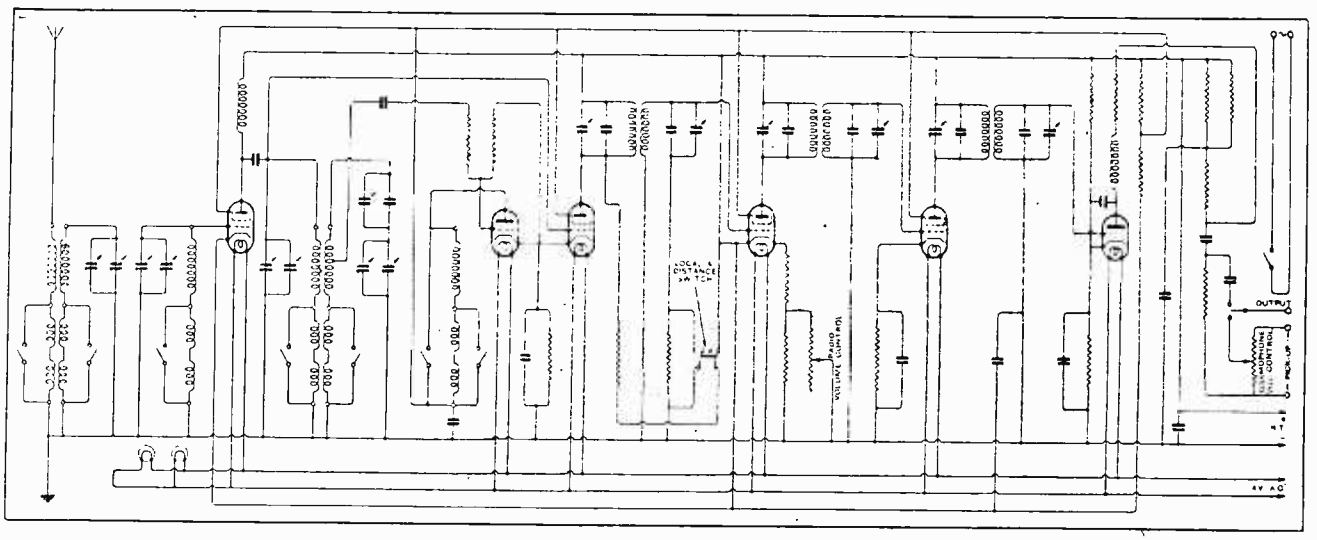
The second detector is of a type rarely seen in this country, although it is common in America; it is an anode bend detector using a low-resistance valve, actually an M.L.4, automatically biased. The advantage of this type of rectification, of course, is that it will handle a large input, since the bias voltage is dependent upon signal strength and increases with an increase in input. This valve is resistance capacity coupled to the output circuit, to which is fitted the "Radio-Gram" switch and gramophone volume control. This control is mounted on the same spindle as the radio volume control, and consists of the usual potentiometer across the pick-up. A good point about the gramophone switch is that the oscillator reaction coil is short-circuited in the "Gram" position, and as a result there is no chance of interference from radio when reproducing records.

The automatic record-changer, pick-up and radio controls are situated on the motor board.

Absence of Hum.

The output of the superheterodyne, or of the pick-up, is taken to the amplifier chassis, in which a single L.F. valve feeds an output stage consisting of two P.X.4 valves in push-pull. The mains equipment is also mounted on this chassis, and consists of the usual full-wave rectifier with a U.8 valve and exceptionally ample smoothing equipment. Two chokes are employed, one of which is semi-tuned, in addition to the speaker field winding, and it is no doubt this which is responsible for the complete absence of hum.

The quality of reproduction of gramophone records is excellent and is characterised by ample bass and a marked absence of needle scratch, while the volume available is sufficient for the largest rooms. On radio the sensitivity, as might be expected, is ample for consistent long-distance reception with the smallest aerials, while the selectivity proves equally satisfactory. At a distance of 13 miles from Brookman's Park it is possible to receive Mühlacker with only a trace of interference from the London Regional, and this with switch set for "Local" reception.



Circuit diagram showing the six-valve superheterodyne portion of the H.M.V. Model 531 radio-gramophone.

Next Week's Set Review:
TANNOY SENIOR RADIOGRAM.

CURRENT TOPICS

Events of the Week — In Brief Review

Shorter Programmes in Germany ?

RUTHLESS retrenchment is the order of the day with the German broadcasting authorities, and the latest move is the decision to put into service the new auditorium at the Berlin Radio House without adopting the elaborate acoustic devices which had been planned by the engineers.

Other proposed economy measures are the suppression of "local" programmes in favour of national relays and the shortening of the transmission periods.

Watch Luxembourg.

EUROPE'S first "publicity broadcasting station" is nearing completion at Luxembourg. We understand that the initial tests may be expected on or about April 15th next. Considering that the power will be in the neighbourhood of 200 kilowatts, the "publicity" should be fairly extensive. The wavelength will be 217.4 metres.

"Reception" on the Stage.

A REALISTIC imitation of a broadcast relay occurs in "The Last Coupon," the comedy now running at the Garrick Theatre, London. In the biggest scene, which takes place in a Park Lane drawing-room, the action turns on the dramatic effect of a running commentary on an Albert Hall boxing match. The "relay" is, of course, conducted "off stage," and fed through amplifiers to a modern radio set and loud speaker on the stage. The technical side of this interesting stunt is in the hands of the Mullard Wireless Service Company.

Ekco Fire.

SERIOUS damage has been caused at the works of Messrs. E. K. Cole, Ltd., Southend, by a fire which broke out in the early hours of Friday morning last. It is understood that the fire began in the experimental laboratory. The administrative offices were soon involved, and before the fire brigades arrived some damage was done to the factory, and many sets were destroyed.

Seven Thousand at Southend.

ALMOST every type of radio receiver was on view at the eighth annual exhibition of the Southend and District Radio Society, held at the Boys' High School on Saturday, January 30th, which was attended by over seven thousand visitors. A special feature was made of technical demonstrations by members of the society and by *The Wireless World*. The amateur section was judged by Messrs. H. B. Dent and F. L. Devereux, B.Sc., of *The Wireless World*. The Pocock Silver Championship Cup, for the exhibit of most outstanding merit, was awarded to Mr. E. J. Tunnicliffe for his A.C. all-mains five-valve "superhet" based on *The Wireless World* "Super Selective Six."

The amateur exhibits included short-wave receivers, television gear, gramophone amplifying equipment, and a mains-driven electric clock.

Oh Silly Graph.

"THE tones of a saxophone appear in photographs like a picture of a three-jawed crocodile.

"This is revealed in a display of sound-photographs which are being shown in Philadelphia by Dr. Dayton C. Miller. . . . One photograph of the notes of a piano appears like a bouquet."—Press message in the *Evening Standard*.

Another Radio Inquisition.

MANY hitherto undisclosed secrets of the American radio industry are expected to come to light in the replies to the new questionaire addressed to broadcasting stations by the U.S. Federal Radio Commission in preparation for the Commission's forthcoming report to Congress on the feasibility of Government ownership of broadcasting and the abolition of radio advertising.

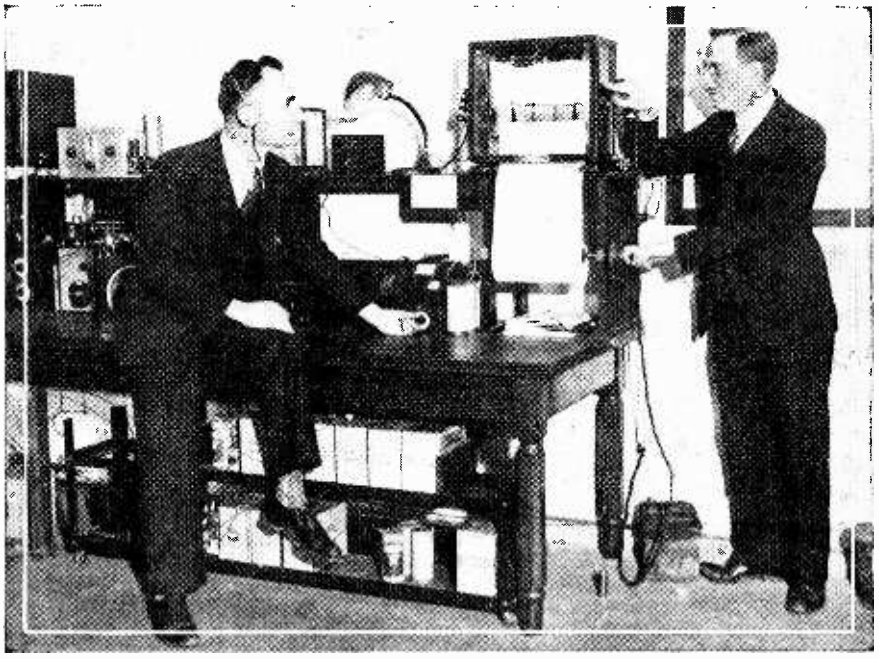
The Commission (writes our Washington correspondent) first selected a "typical broadcast week" to be covered in the questionaire. Naming the week of November 8th to 14th, it asks stations to designate the number of hours devoted to commercial and sustaining programmes during the day and night.

The Commission, cautioning broadcasters to be "very accurate," asks how many hours were devoted to sales talks or descriptions of commodities advertised, the terms of contest, and the like. It asks, too, how many hours were used to advertise the business of the station owner, or that of any principal officer or stockholder.

Prof. Appleton on the Amateur.

MR. WEBER, a Bristol amateur, was publicly complimented by Prof. E. V. Appleton, F.R.S., in a lecture entitled "The Sun's Influence on Wireless," delivered at Bradford a few days ago. Prof. Appleton, referring to his request through *The Wireless World* for reports from amateurs concerning the incidence of "echo images" in television reception, dealt with Mr. Weber's reply. "Using figures made available by this communication," said the lecturer, "I was able to make a calculation as to the height of the reflecting region, and it came out at 61 miles.

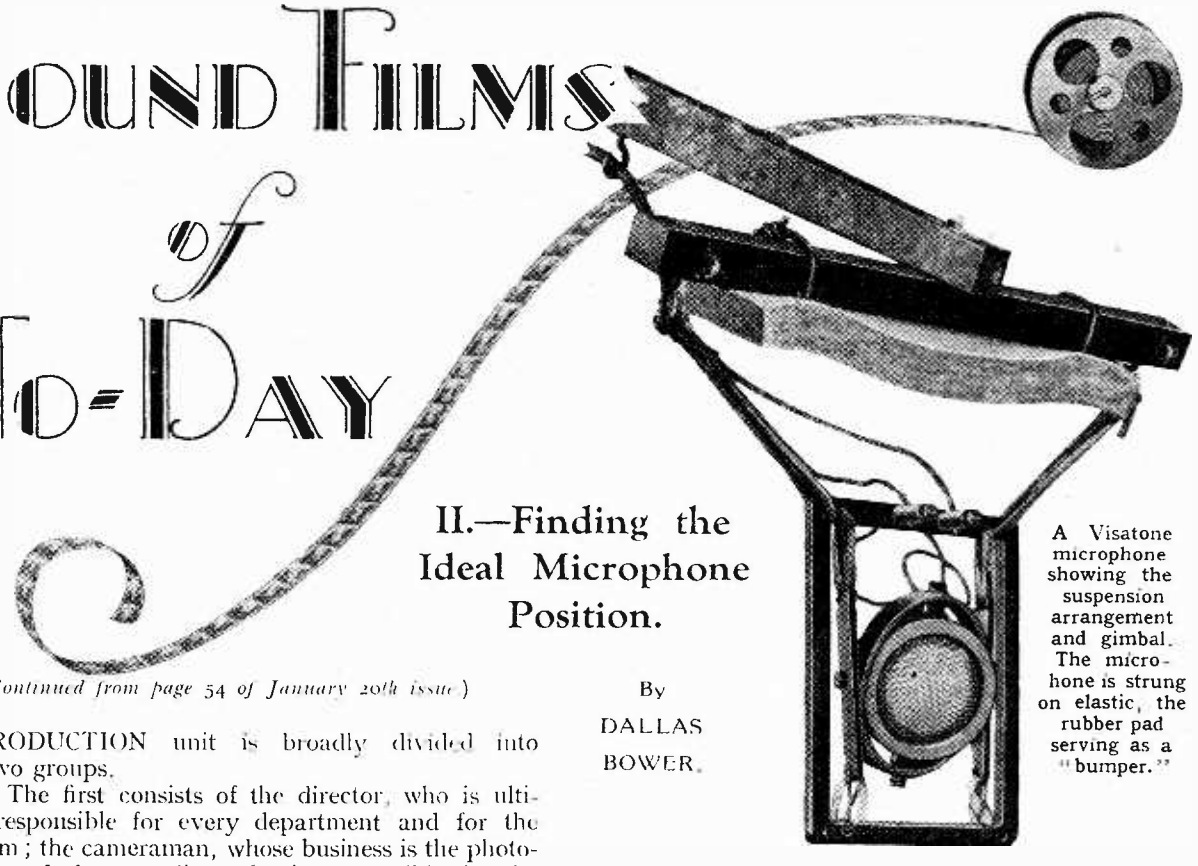
"It is agreed by those qualified to judge that the extraordinary properties of short waves were discovered by amateur experiments, and now you have it that Mr Weber was the first to discover these television echoes."



SOLAR STORMS AND RECEPTION. Dr. H. T. Stetson, of Delaware, Ohio, who is becoming well known for his pronouncements on the subject of sun-spots and their effect on radio reception, is here seen (right) with his apparatus for measuring signal intensity.

Sound Films of To-Day

II.—Finding the Ideal Microphone Position.



A Visatone microphone showing the suspension arrangement and gimbal. The microphone is strung on elastic, the rubber pad serving as a "bumper."

(Continued from page 54 of January 20th issue)

By DALLAS BOWER.

A PRODUCTION unit is broadly divided into two groups.

The first consists of the director, who is ultimately responsible for every department and for the entire film; the cameraman, whose business is the photography; and the recordist, who is responsible for the sound. The director has an assistant, sometimes two; the cameraman a second cameraman and a number of juniors for loading magazines, moving the cameras, etc. The recordist has a floor staff directly under his control consisting of an assistant for shifting cables, microphone booms, and general manual work. A second assistant is available for the same purpose if the work is complicated.

Except in self-contained units, the sound-camera operator is not under the recordist's charge, although he has necessarily to work in very close co-operation with him. Sound-camera operators and maintenance engineers are under the direct supervision of the chief sound engineer or sound department manager.

The second group of a production unit includes the architect, electricians for the lighting, property men, and stage hands.

It is the recordist's business to obtain the best possible sound conditions for every shot. This entails the placing of the microphone or microphones, control of modulation, adjustment of local damping if required, manipulation of "effects" and supervision of the effects-man, and a careful check on dialogue enunciation and the volume at which the players speak. Mutual understanding between director, cameraman, and recordist is essential for efficient shooting. Without it working conditions will not only be difficult but unpleasant, with bad work as the inevitable result.

STRATEGY and tactical skill are both required when handling the microphone in modern film plays. Each shot demands special treatment by the recordist, who, in the most unobtrusive way possible, must aim at securing a mean volume level from the source of sound.

Apart from microphone technique, which we will discuss later in detail, the recordist has to consider sound perspective. This means, even with the limited range, that the sound on a long shot (distant view) must not be quite so loud as it would be on a medium or close shot; on a big, close shot it must be as loud as possible.

Considerable difference in volume is, however, unsatisfactory, for, unless a film is substantially level in volume, it will need alteration in amplifier gain at points where unevenness appears when projected in the cinema. But it is very necessary to guard against negative perspective; i.e., weakness of the sound on a big, close shot, as compared with the sound on more distant views.

Correct enunciation of words and the volume at which they are spoken is very important in dialogue recording. The limited volume range requires care in obtaining correct volume. A word too loud will "overshoot," suggesting in reproduction fierce grid blasting, and a word too soft will be lost in the hiss level.

To prevent overshooting on a very loud word, a con-

Sound Films of To-day.—

siderable reduction in amplifier gain has to be made, and the result of this is to bring a certain lifelessness into the reproduced speech, caused by incorrect ratio of the particular utterance, as a record, to other speech and sounds. Even with modern so-called noiseless recording, a certain hiss level will always be evident, due to valve hiss in the recording and reproducing amplifiers and the quantities of dust a film so easily accumulates after it has been run a few times.

Players and the Microphone.

Consequently, the condition at which to aim is a mean volume level from the sound origin itself (an actor or actress, in the case of dialogue), thereby reducing the necessity for wide electrical volume control during the actual speech. Four transmission units should be the maximum over which amplification may be controlled during utterance. This is not to say that groups of lines from particular players may not be at higher or lower level than groups of lines from other players. The recordist may "come up" or "go down" as much as eight transmission units on a pause which is a cue for a new group of lines from a character or number of characters.

It will be appreciated, therefore, that successful results are also largely dependent on the players. If they refuse to follow the recordist's instructions, bad quality will result, bringing harm to their reputation into the bargain. Fewer players have acquired a proper technique for sound-film acting than is popularly supposed.

Acting for the stage and for broadcasting differs from acting for sound-film. From the point of view of the sound department the player's most important attribute is microphone consciousness, which involves a careful noting of microphone position and speaking only over prescribed limits as far as the action of the shot will allow.

Few players seem capable of accomplishing this really successfully, partly because they are too occupied with the histrionics of the particular situation, and sometimes because of other causes such as under-rehearsal, incompetency, and a rather stupid belief that their own way of doing a thing is infallible. The most successful stage players are usually the best in sound-films, because they are ready to learn, at the same time bringing to bear their knowledge of stage technique on each problem as it arises and affects them.

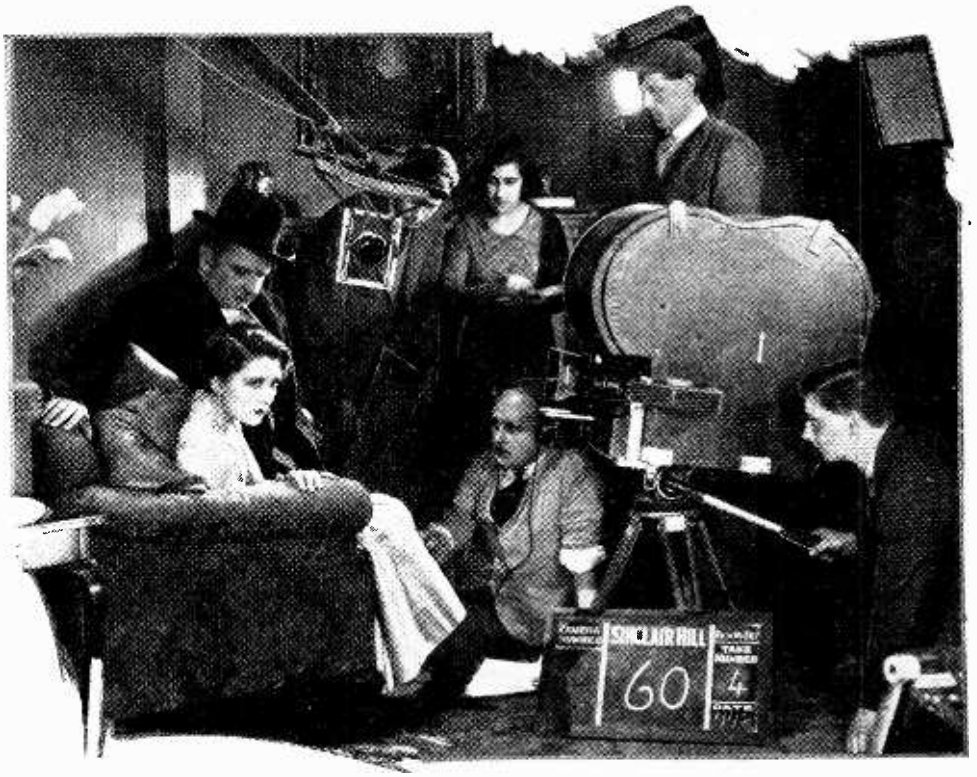
Accentuation of sibilants must never be allowed, in order to guard against excess-sibilancy which will ruin illusion and destroy the value of a scene. A player whose s's are prominent is dangerous on this account, and attention has to be given to this factor when a film is cast. Very strong s's nearly always have to be given special treatment, either by adjustment of relative microphone position or alteration in the frequency response curve of the amplifying system.

Another fault of many players which needs the recordist's attention is a falling-off in the volume of speech at the end of words and sentences. Even with the generally satisfactory condition of recording and reproduction at the present time, lack of intelligibility is easily possible. A good recording voice is an absolutely essential qualification for a sound-film player to be successful. Such a voice being a gift of Nature and not to be acquired, it follows that some voices are naturally unsatisfactory.

The Ideal Voice.

High-toned voices are particularly bad; thus women's voices are less easy to handle than men's.

For best results in replica a voice must be strong, fairly low-toned, and lacking in undue sibilancy. Bass voices, although easy to handle in recording, are not too good in reproduction, being liable to boom.



A "close shot" from the film "Other People's Sins" (P.D.C.). The picture camera is in the case marked "I," while the microphone is slung just out of range of the camera lens. The film director is seen wearing headphones.

Sound Films of To-day.—

Microphone position is one of the most important factors in successful recording. The subject, although simple in the main, can become quite complex in certain situations. It is certainly the most interesting part of production recording. A few general rules must be adhered to, but every "set-up," i.e., every single shot, has had its own little problem, resulting almost invariably in compromise.

It is very rarely possible to obtain an ideal microphone position; camera distance, the construction of the set, the number of players, and local acoustics, all have to be considered. Microphones of different recording systems have slightly different polar diagrams, but we may take it as a general rule that "the forty-five degree limit" should always be sought after, no matter what microphone or system.

This means that a player's position relative to the microphone should not be outside an imaginary line extending at an angle forty-five degrees either side of the centre of the microphone face. The amount of variation in quality due to position is, of course, in the main governed by the polar curve.

In most recording microphones quality differs largely, depending upon whether a speaker is side-on or face-on; in other words, variation over a right angle is considerable.

Microphone Distance.

The distance between the microphone and the player is determined, first, by the efficiency of the microphone, which sets the outer limit for safe working to obtain clear speech (approximately fifteen feet in most cases) and the camera position. A microphone hidden on the set in some property, such as a vase or clock, should never be used if it can possibly be dispensed with on account of the entirely empirical knowledge of the acoustic conditions obtaining with such an arrangement. It is impossible to know off-hand for any particular set of circumstances what will be the effect of objects in very close proximity.

Consequently, a microphone suspended on a boom must be used wherever possible, and its position will be determined by the "top cutting line" of the camera. That is to say, for each shot so much of the set will be in view; on long views a large part or all of it; on close views only limited parts. In each case the furthermost point the camera is photographing in an upward direction determines the height of the microphone, which, of course, must not be seen in the picture.

Echo and its Treatment.

A second general rule implies, except in very special circumstances, that the microphone should always be placed as near the players as possible for all conditions. This is important in big, close shots, because it is impossible to obtain in any other way that intimacy and roundness of speech noticeable in many broadcast transmissions. As fullness makes for greater intelligibility, the rule holds good for every kind of camera view. On extreme long shots where, for correct sound perspective, a suspicion of echo or lack of intimacy is desirable, the microphone position is often so high that a little echo is introduced naturally.

Local Damping.

Sometimes this echo is of the wrong kind, in that it is too low-toned or "boomy," owing to the acoustics of the set. Local damping then has to be introduced by means of boards, covered with layers of felt, measuring approximately six by three feet. To act as compensators, they are put in appropriate places just outside the limits the camera is photographing, usually behind the lights. Such damping, however, is rarely necessary in a properly designed set on a correctly damped stage.

When the microphone has been lowered to a point where it is just out of the picture, this may be called the rough position. It has then to be accurately adjusted for angle. The mechanism which holds it on the end of the boom varies with different systems, but it is usually a gimbal device allowing of universal movement. Absolute freedom to put the microphone in the best position is necessary, for an alteration of fifteen degrees or so can make a difference on sibilants.

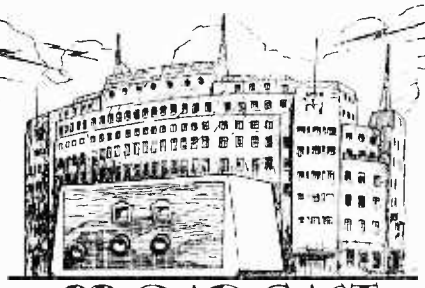
For complicated action over large areas, the microphone must move with the camera or players; alternatively, a number of microphones may be employed. Here we come to the third general rule, that, whenever possible, one microphone only should be used. Two microphones on small sets give a slight increase in echo. Speech passing out of the permissible limits of one microphone into another is usually noticeable by a change of quality on the actual transition, and in such cases the microphone should "track" or "pan" with the players. Only two years ago it was thought that tracking and panning microphones were impractical, owing to the inadequacy of microphone booms and the very complicated business of moving a heavy camera booth.

Sound-proof Cameras.

With the development of more elaborate booms and camera "blimps" (sound-proof covers) enabling the camera to be mounted on the tracking trolleys previously used in silent film making, a panning or tracking microphone nowadays presents no difficulty. Two microphones have to be used when a voice is to be heard and not seen, but this causes no difficulty, as the second microphone can be set-up on a stand in any suitable place off the set. There are occasions, of course, when two microphones on the set are essential. Such an occasion would occur in the case of dialogue spoken by players on both sides of a dinner table.

A scene like this, in which several players are engaged, suggests that some may be in more favourable position than others relative to the microphone. In such a case a mean position has to be found for all players, preference being given to the player with the weakest voice by slight adjustment of angle. Supposing one of the players to be possessed of bad sibilants, it is necessary to have him as much "off mic." as possible.

(To be concluded.)



BROADCAST BREVITIES

By Our Special Correspondent.

Going West.

MIDLAND Regional is to find a new site. Since the decision to erect the Empire short-wave station at Daventry, it has become evident that there is insufficient accommodation there for three broadcast transmitters.

The search for a site has already begun, and I understand that the opportunity will be taken to bring the Midland transmitter very much nearer to its studio in Birmingham, which is at present nearly sixty miles away.

Secrets of Savoy Hill.

WILL Broadcasting House, one wonders, ever be so "interesting" as Savoy Hill? The old building holds so many secrets and is the scene of so many human happenings (despite talk of the Government Department atmosphere) that it really seems unlikely that Portland Place will be able to build up such traditions for a long time to come.

A New Crusade.

Up till now, however, there have been surprisingly few "scandals" connected with British broadcasting; certainly there has been no suggestion of the necessity for a "purity crusade"—to use the term which is now on everybody's lips at Savoy Hill, nor am I persuaded that there is any real need for such a movement to-day.

Resignations.

Enquiries have been made concerning the private lives of some of the officials, and it is likely that one or two may resign.

The marvel, in my eyes, is that an inquisition of this sort, affecting a mixed staff of more than eight hundred, should have revealed so little cause for complaint.

Old Spanish Custom?

Inquisitions are fashionable. The London School of Economics is asking us, through the medium of the B.B.C., where we first met our wives. And the B.B.C. is asking its staff where they last met their wives.

Untouchables.

There is one aspect of life under the B.B.C. banner which might be investigated with advantage. I refer to the inflexible and inexorable staff grading system which seems to beget snobbery in the most unexpected quarters.

The untouchables and depressed classes are not confined to India.

Boom.

HAVE you noticed it? I hadn't, nor had several of the B.B.C. engineers, who actually work in the Control Room, where the deed was done.

They arrived one morning to find that the interval signal was still secure in its box, that the master clock was still ticking out the seconds, that the amplifier was still functioning; they found all this, but . . . the interval signal had lost its boom.

At least, they say it has. To me the signal sounds just as ghoulish as ever, boom or no boom, and I expect the general opinion is the same.

Jack Payne Explains.

JACK PAYNE wishes me to make it clear that the microphone is *not* moved about the studio during the dance programmes. The question had been raised in a letter from a *Wireless World* reader who protested that the intervals during the tea-time dance music were punctuated by low thunder "caused, presumably, by the microphone being trundled about the floor."

Moving the Microphone.

"I never touch the microphone during an actual broadcast," Jack Payne told me. "On the rare occasions when a new microphone position is necessary I invariably buzz through and wait till the mike is dead before touching it.

"It is just possible that the trouble is due to the fact that we are using an experimental Edison microphone, which is unusually sensitive."

Too Sensitive ?

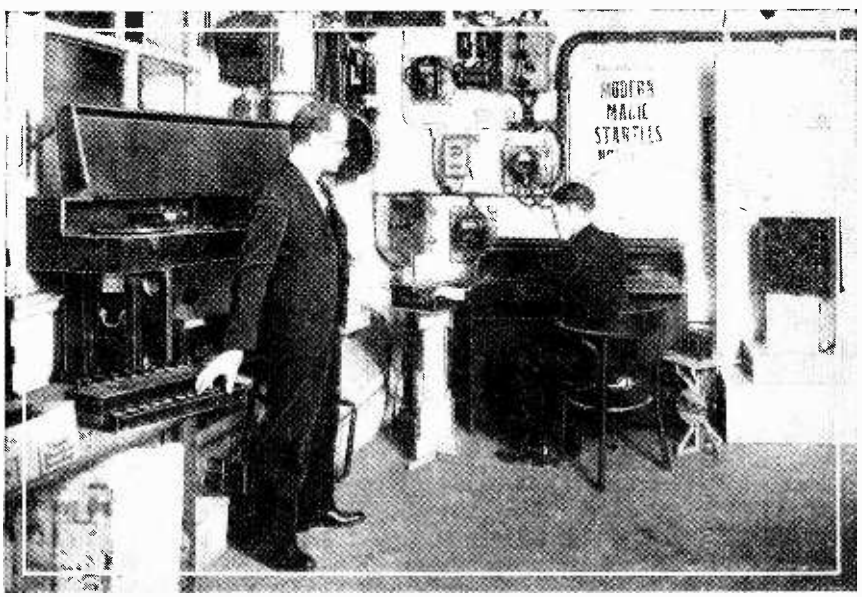
The microphone in question is, of course, the Edison condenser instrument which is non-directional and will pick up the slightest sound in any part of the studio. The B.B.C. have been testing several of these for six weeks past for vaudeville and dance programmes, but it has not yet been decided whether they shall be used permanently.

Another American Relay.

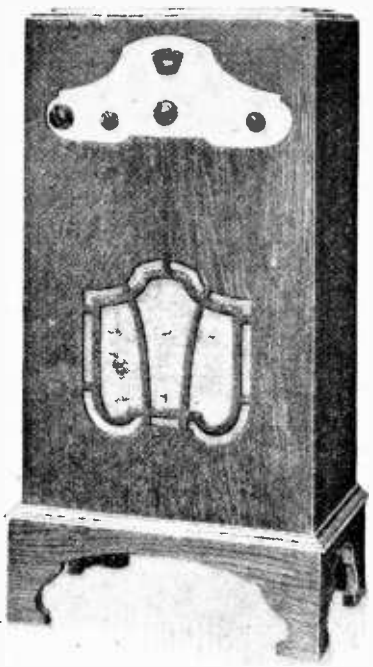
"HELLO, Europe!" is the title of the programme which is to be relayed by the Columbia Broadcasting System from the United States to Regional listeners on Monday next, February 15th. The programme consists entirely of Negro spirituals. The Fisk University Chorus, directed by Edward Matthews will be heard in the following:—"Rise, Shine, for the Light is Coming," "Balm in Gilead," and "Go Down, Moses." Ray Francis Brown will direct the Chorus in "Listen to the Lamb."

In Case You Did Not Know . . .

THE much-talked-of "dispensing station" at Savoy Hill consists of a little cardboard box, bought (I think) from a Strand chemist, containing a few lint bandages and a bottle of iodine. Oh, and aspirins.



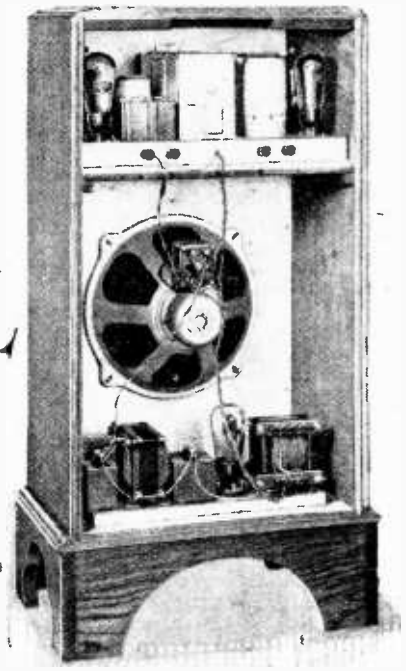
THE WITCHES' CAULDRON. Engineers in the Marconiphone Company's stagecraft department at Radio House devising new "magic" for the next season's publicity displays.



SINGLE-DIAL SUPER

HAYNES RADIO

A.C. MODEL



Constructional Hints and Details of Performance.

HAVING explained the circuit principles in last week's issue, it now remains to consider points in construction and to indicate the performance under average conditions.

Certain of the small fixed condensers are carried on the 4BA terminals of the coils, and we found that the holes in the tag ends had to be very slightly enlarged before assembling. When wiring to the terminals, do not make use of the slotted ends, but clamp the leads down under the second small nut so as to avoid the possibility of shearing. It should be specially noted that thicker wire and sleeving is supplied for the heater circuits; a coil of flexible wire is also supplied for interconnecting the eliminator, loud speaker, and receiver chassis, and it is important to avoid a drop in voltage on the connections from the 4-volt terminals. Every resistance and condenser has a reference letter on a blue print supplied with the kit, and we have reproduced these in the diagrams in order to facilitate cross-reference. In the course of wiring, therefore, it becomes a simple matter to identify and see the purpose of a component by reference to the theoretical circuit. Only two wires are connected to the eliminator unit, and one of these, the H.T. negative, is merely an earthing connection between the two aluminium baseplates. The positive from the eliminator runs to one of the loud speaker terminals, which is joined across to a tag of the field winding; the remaining terminal connects to the loud speaker minus, and the tag to loud speaker positive. It is an interesting detail that so few leads should be needed between the three units.

In the absence of testing equipment it is advisable to look over and check all leads and connections carefully before bringing the set into operation. It is wise also when first switching on to watch the U.12 rectifier to see whether its plates overheat, which would suggest a short-circuited H.T. supply. Having proved the H.T. supply, there is no risk involved in proceeding to test the set with all valves in position.

Adjusting the Trimmers

When the set is first put into commission, stations will at once be received all round the dial, and it is merely a matter of trimming to bring the set into its most sensitive condition. Trimming is best effected by screwing home the control on the rear condenser and then slacking off by some three or four half turns. Tune to a distant station between 20 and 30 degrees on the dial, and adjust the remaining two trimmers for maximum effect. To check that the oscillator is not set for reception on the incorrect channel, swing the dial over to Budapest and note that the adjustments hold good. Tuning curves are reproduced here, and there is no reason why the constructor using identical components should not set the oscillator trimmer so as to obtain a station of known wavelength on the dial reading indicated, adjusting the other two trimmers for maximum results.

The levers on the intermediates are adjusted preferably by a stick of wood after the coupling coils themselves have been set to the desired degree of selectivity. The top intermediate coil in each case is released by an

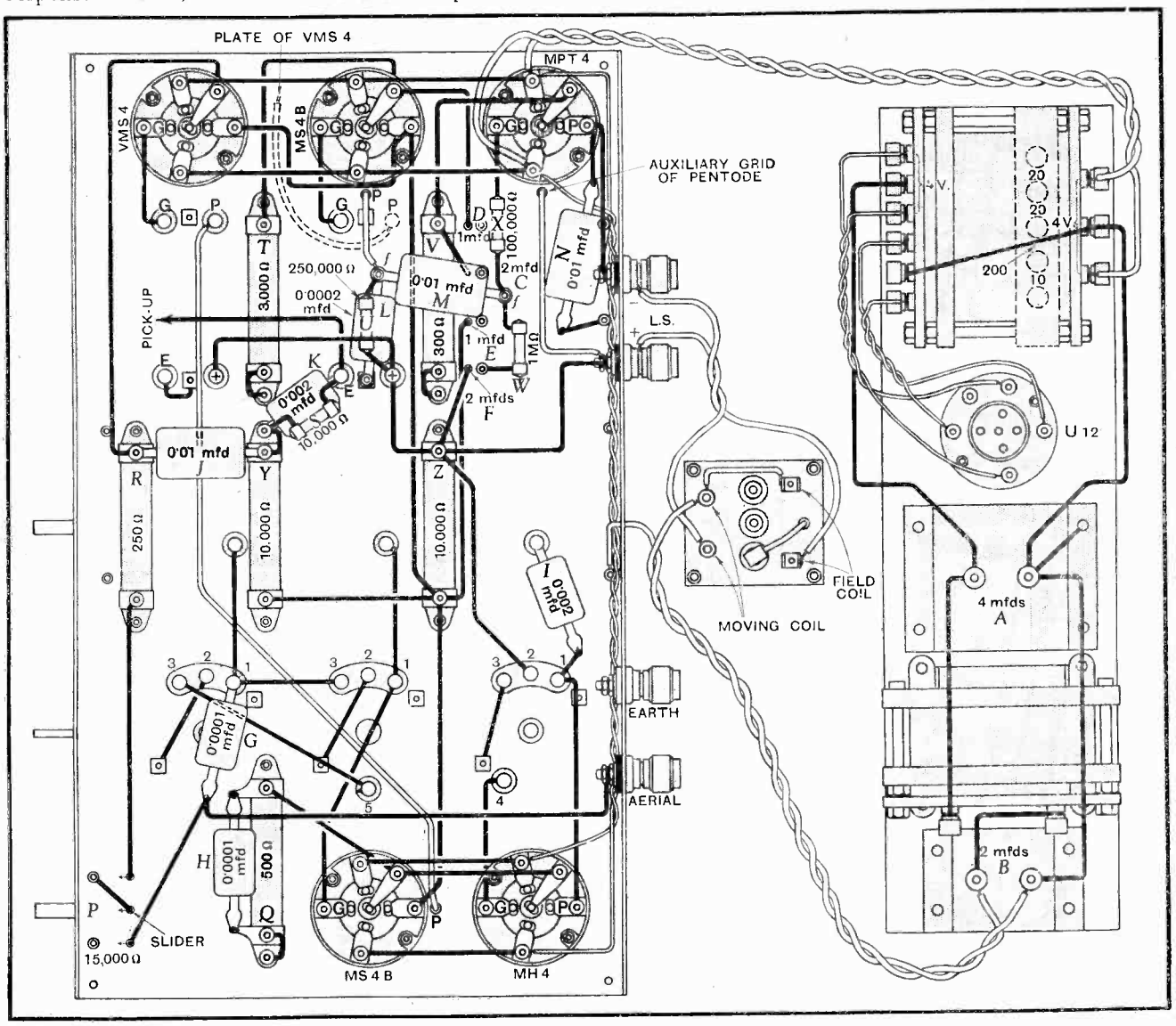
Single-Dial Super A.C. Model.—

anti-clockwise rotation, and by bringing them within half an inch of the top of the pillar a degree of selectivity results such that the Mühlacker and the London Regional, for example, can be separated in the London area. This result is, no doubt, dependent to some extent upon the fact that the second detector is biased back for anode-bend rectification being self-adjusting to give a fairly constant output from stations of various strengths.

Turning now to the tuning circuits, the graphs indicate a greater tuning range than was the case with the battery-operated Single-dial Super, the broadcast range embracing 200 to 620 metres. This is made possible by the modified form of oscillator coupling used with mains valves.

Although a loud speaker known to have a good bass response is used, the set was found to operate with distinct freedom from hum. On the score of quality, this receiver should dispel those doubts which many of us have held with regard to long-range reception. On distant stations the quality is remarkably good, and the increasing interest in the programmes from abroad, many items from which are intended only for the British listener, makes this type of receiver especially attractive.

There is no need to mention individually the stations receivable, but it is interesting to note that the low-power transmitter of Ljubljana, in Yugo-Slavia, comes in well near the top of the scale and where the sensitivity is at a minimum. There are more than two dozen European transmissions which can be tuned in at will, and, with the absence of background noise, reception can indeed be said to yield entertainment as distinct from mere signals. It might be mentioned that when listening in the London area one of the London transmitters is encountered in the long-wave range right alongside,



View of the underside of the metal chassis showing layout of components and general wiring plan. On the right is the eliminator unit.

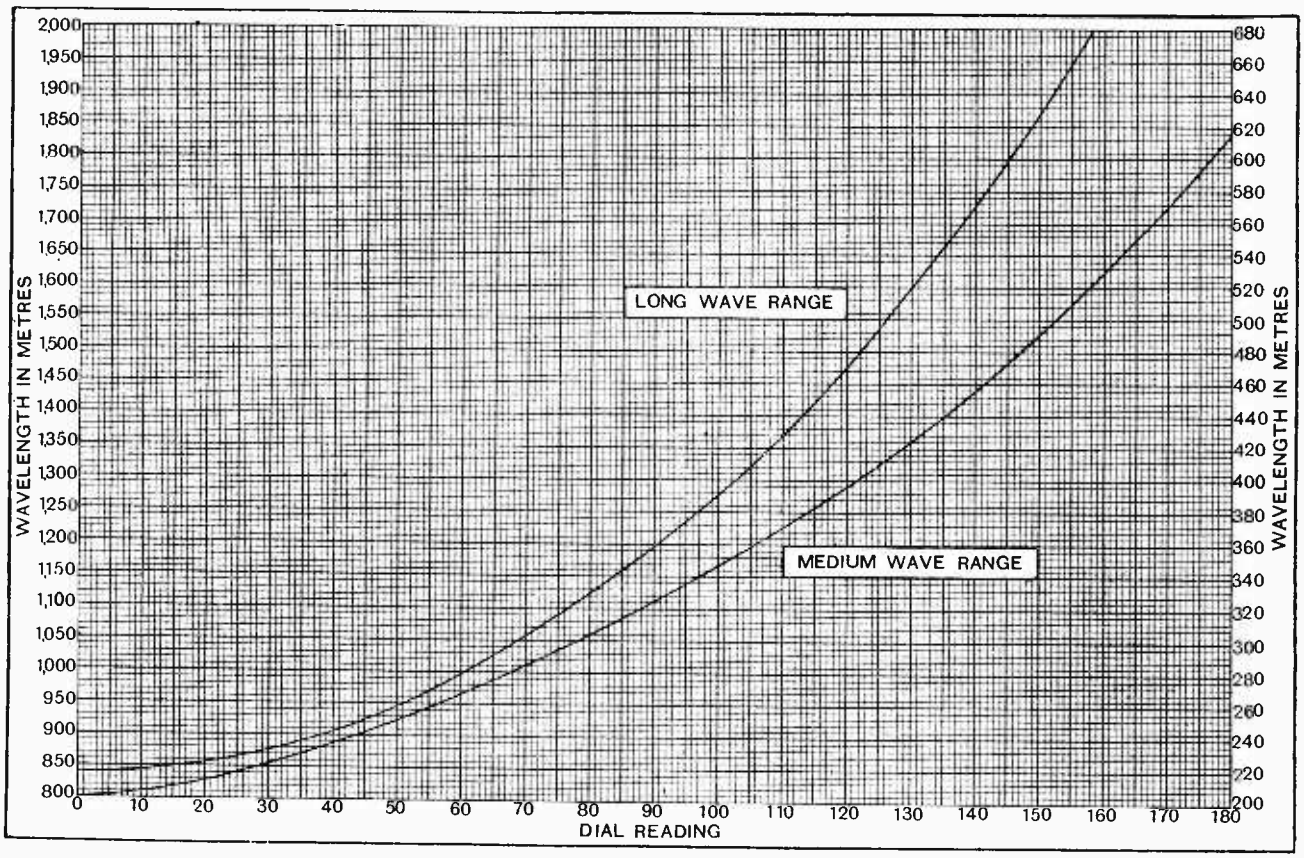
Single-Dial Super A.C. Model.—

and only just separated from, Moscow. This may be unfortunate for Moscow, but the effect is unavoidable and is due to the 306 kc. difference between the two London transmitters.

In using the set for gramophone reproduction, a single lead is taken from the earthed side of the grid circuit of the second detector. This arrangement has no doubt been adopted to remove the objection to a wandering high-potential lead running to a switch or to the gramophone pick-up, and no H.F. can circulate into the connections of the gramophone equipment. The pick-up is introduced between this point and the chassis, and if a switch is desired it may either be arranged to break this lead, or, alternatively, to short-circuit the pick-up. A load resistance is provided for the pick-up, which is generally considered an advantage, while a small shunt condenser takes into account the need for a scratch filter when using a pentode output valve with its high-note response. The speech output of 2 watts is generous and can be obtained from either pick-up or radio. The Marconiphone pick-up is normally used in conjunction with the kit.

To summarise the merits of the set, we may confidently say that in combining range with selectivity and quality it represents an advanced standard of design.

A range of cabinets has been designed to meet various requirements.



Calibration curves giving condenser dial readings for the medium and long wave ranges.

Records for the Power Radiogram.

THE publication of the details for *The Wireless World* "Power Radiogram" has resulted in a request for suggestions as to a selection of examples of modern recording chosen to show up the high quality of reproduction of which this instrument is capable. Amongst recent record issues the following have been selected as typical of the best modern recording and giving excellent results with the "Power Radiogram."

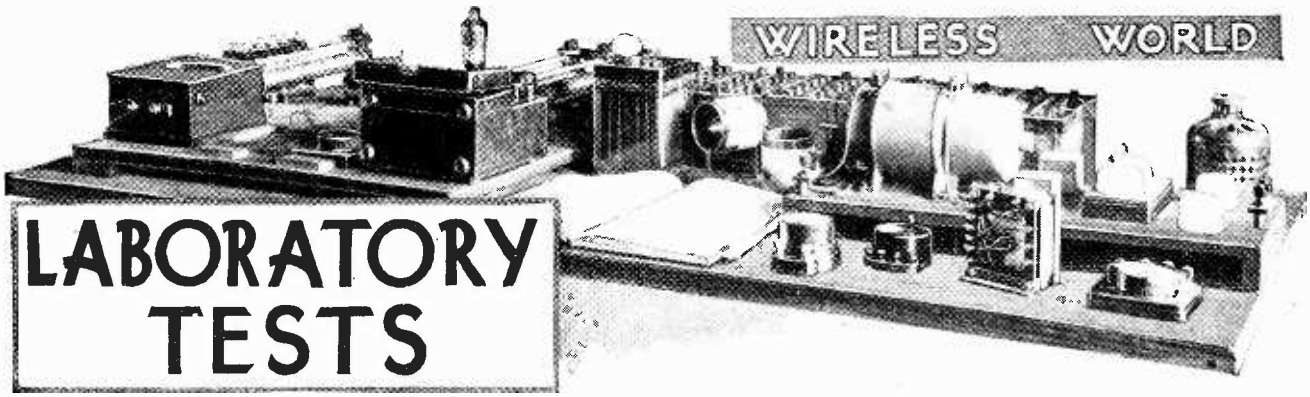
H.M.V. "Cavalcade" descriptive record is an outstanding example with great depths of contrast. It is a record, too, which is achieving immense popularity just now (Cat. No., C.2330).

Another recording of outstanding merit is "Your Tiny Hand is Frozen," from Act I of *La Bohéme*, sung by Beniamino Gigli (tenor) in Italian, the reverse side of which is "Salve, Dimora, Casta e Pura," from Act III, *Faust* (Cat. No., DB.1538).

Tone-poem "Finlandia," Op. 26, No. 7, Leopold Stokowski and the Philadelphia Orchestra, is another example of H.M.V. recording to which only the best in reproducing instruments can do anything like justice, and may therefore be regarded as an excellent test piece. The catalogue reference to this record is DB.15845.

In selecting from Columbia recording our choice has fallen upon an organ performance (Col. DX.320). Mendelssohn's "Wedding March" and the "Allegro molto" from the last Sonata (Mendelssohn). Both are rendered by Edouard Commette. Those who enjoy organ music will find ample enjoyment in this record: it is a wonderful example of modern recording.

Another record which is excellent for demonstrating the possibilities of the Radiogram in the matter of bass is "Overture to Euryanthe" (Weber), by the Concertgebouw Orchestra, conducted by Mengelberg. The range and varying intensity of this recording makes it an excellent subject for demonstrating, and beats of the drum are especially well reproduced.

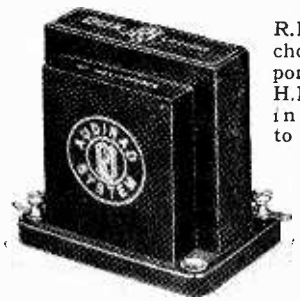


LABORATORY TESTS

A Review of Manufacturers' Recent Products.

R.I. AUDIRAD CHOKE.

This new R.I. L.F. choke embodies a novel scheme for which is claimed far more effective smoothing for the H.T. supply than can be achieved with the orthodox smoothing choke. The ordinary iron-cored choke offers an exceedingly high impedance to small impulses at audible frequencies, but is a comparatively easy path for radio frequency currents. In the Audirad system an air-cored high-frequency choke is incorporated in the same unit as the low-frequency choke, and this results in a very effective filter for both high- and low-frequency impulses. Of course, the usual smoothing condensers must be used with this system as with any other.



R.I. Audirad choke incorporates an H.F. stopper in addition to an L.F. choke.

In the new R.I. model the low-frequency filtration is taken care of by a "Dux" L.F. choke, while a small H.F. choke housed in the bakelite case serves to filter out the high-frequency component. The "Dux" choke has a nominal inductance of 25 henrys, while the H.F. stopper is stated to possess an H.F. inductance of 10,000 microhenrys. Since it is not practicable to separate the two component parts of this combined filter for individual measurements, the L.F. inductance only was checked with various amounts of D.C. flowing through the choke. Incidentally, the maximum current is given as 50 mA.

The following inductance values were obtained with an A.C. potential of six volts across the unit.

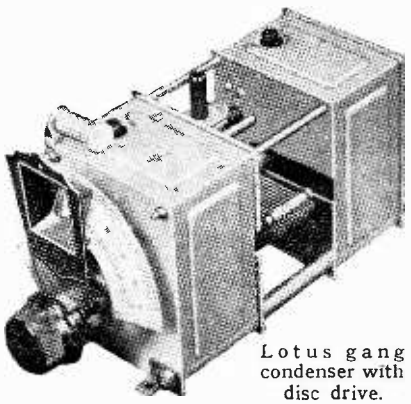
D.C. in mA.	Inductance in henrys.
0	27.2
10	26.8
20	26
30	24.8
40	23.2
50	20.4

During the course of a practical test the H.F. stopping qualities of the component were found to be perfectly satisfactory.

The makers are Radio Instruments, Ltd., Purley Way, Croydon, and the price of the Audirad choke is 8s. 6d.

LOTUS COMPONENTS.

Of the many Lotus components submitted for test, only a few selected specimens can be dealt with here. The gang condensers will be of special interest, in view of the fact that this style is now widely used in modern sets. The Lotus range includes 2-, 3- and 4-gang models, each unit of which has a capacity of 0.0005 mfd. They are made in two styles, viz., for mounting at right angles to the panel and operated by a disc drive, and for mounting parallel with the panel. In the last-mentioned style a drum drive is incorporated in the unit.



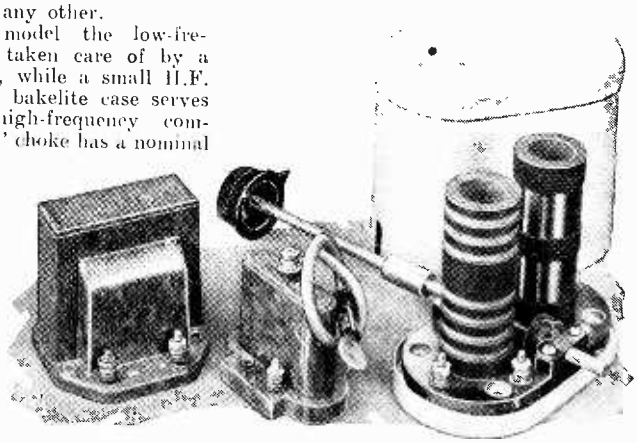
Lotus gang condenser with disc drive.

A sample 3-gang unit was tested, and the capacity of each condenser measured at various parts of the scale, the values obtained being tabulated below. The minimum capacity was adjusted in each case to 30.5 mmfds.

Scale.	Front Condenser.	Middle Condenser.	Back Condenser.
	mmfds.	mmfds.	mmfds.
0	30.5	30.5	30.5
20	59	57	58
40	103	102	101
60	173	176	172
80	296	295	296
100	503	502	512

Each condenser is fitted with a small trimmer, the maximum capacity of which is about 90 mmfds. They afford a variation in capacity of some 64 mmfds., which is ample for all purposes. The 3-gang model, as illustrated, with disc drive, costs 35s.; with drum drive the price is 37s. 6d.

The L.F. transformer tested is one of the least expensive of the Lotus range, being priced at 5s. 6d. It has a step-up ratio of 1 : 3, and showed the satisfactory primary inductance of 35 henrys with no D.C. flowing; this fell to a shade under



Lotus L.F. transformer, screened binocular coil and H.F. choke.

26 henrys with 2 mA. of D.C. passing through the winding. To obtain the best results the valve preceding the transformer should have an A.C. resistance of the order of 8,000 ohms., and the steady anode current should not be allowed to exceed 2 mA. There is a 1 : 5 ratio model, also, in this style, available at the same price.

Another interesting component examined is a screened binocular dual-wave coil with built-in wave-change switch. The coils are wound on ebonite formers 1in. in diameter and 2½in. high; a reaction winding is included. The price is 10s. 6d. complete.

Enclosed in a neat bakelite case is a small H.F. choke which has a flexible lead attached to one terminal. This terminates in a spade-end connector with an insulated body, and is intended as the anode connector when the choke is used in the anode circuit of an S.G. valve. The price is 2s. 6d. only.

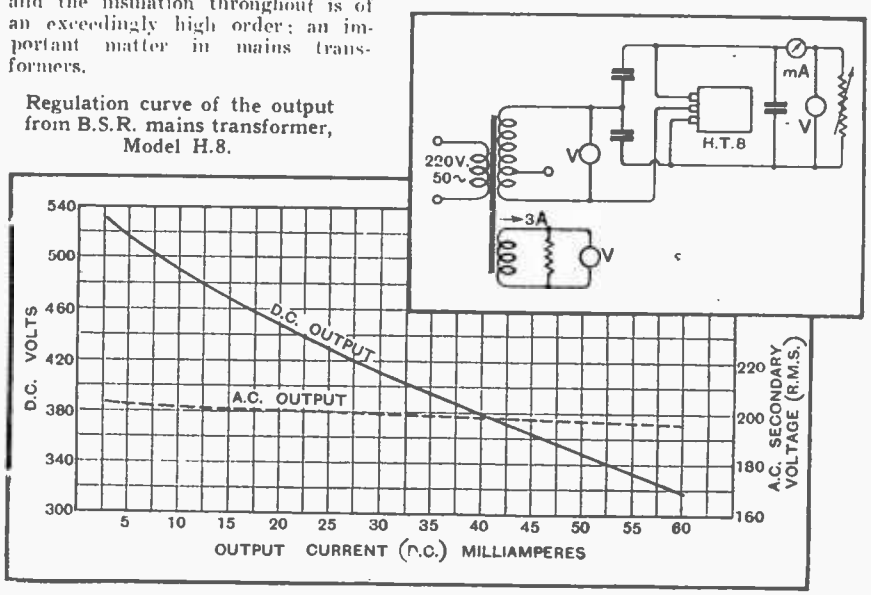
The makers are Lotus Radio, Ltd., Mill Lane, Liverpool.

B.S.R. TRANSFORMERS.

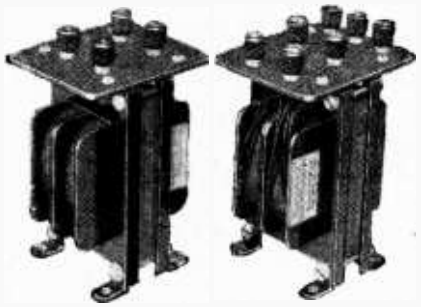
These transformers are made by the Birmingham Sound Reproducers, 40-41, Perry Street, Blackheath, Birmingham, who specialise in the manufacture of power amplifiers and associated apparatus for public address equipment. The samples sent in for test comprise a mains transformer designed for use with the Westinghouse H.T.8 rectifier and a heavy-duty output transformer for low-resistance moving-coil loud speakers.

Despite the fact that the best materials are employed and that the design and workmanship are of the highest standard, the prices of these components compare favourably with anything of a similar nature on the market. The coils are wound on moulded bakelite formers, and the insulation throughout is of an exceedingly high order; an important matter in mains transformers.

Regulation curve of the output from B.S.R. mains transformer, Model H.8.



On test the model H.8 was found to give exceptionally good regulation, the A.C. output from the secondary winding varying by the small amount of 3.5 per cent. between a load of a few milliamps. and the maximum of 60 mA. The D.C. regulation curve on the graph is thus virtually the regulation of the rectifier alone.



Birmingham Sound Reproducers' mains transformer, Model No. H.8, and heavy-duty output transformer, Type S.2/0.

All measurements were made with the single 4-volt winding loaded by a resistance passing 3 amps. Its maximum output is given as 4 amps. This winding gave exactly 4 volts with no load on the H.T. circuit, and 3.93 volts with the rectifier fully loaded; a very satisfactory performance indeed.

The output transformer tested appears in their catalogue as the model S.2/0, and has a step-down ratio of 15 : 1. This model is available in various other ratios, extending from 40 : 1 to 1 : 1, and special models can be made to order.

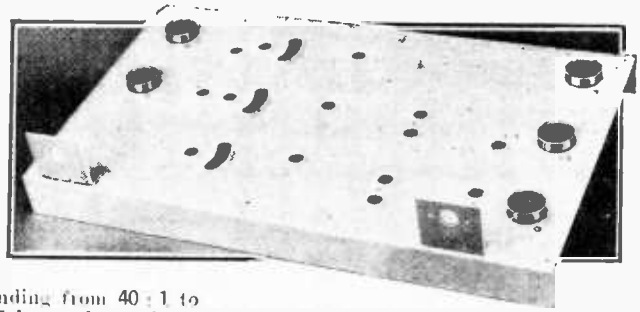
Owing to the generous size of the core and the provision of a small air gap in the magnetic circuit, anode currents up to 120 mA. (D.C.) can be passed through the primary winding. Thus there is no need to employ choke coupling, and the transformer may be connected direct in the anode circuit of the output valve.

The measured inductance of the primary winding is 10.7 henrys without D.C. flowing, and 8 henrys with 120 mA. passing, the change in inductance being sensibly linear between these two limits. Since this model will be used generally with super-power output valves whose A.C. resistance is less than, or of the order of, 1,500 ohms, the inductance of the primary is more than sufficient to assure that perfectly satisfactory results will be obtained.

The price of the mains transformer described above is 27s. 6d. with one 4-volt L.T. winding, or 25s. without this addition, and that of the output transformer 25s.

ALUMINIUM CHASSIS FOR SINGLE-DIAL SUPERHET.

Two specimen aluminium chassis made for the Single-dial Superhet have been sent in for examination by W.H.F. Radio Service, 23, Whilton Dene, Isleworth, Middlesex. They are exceptionally well



Aluminium chassis for Single-dial Superhet made by W.H.F. Radio Service.

made, all holes are clearly formed without the slightest trace of burr, and they are correct to size and accurately positioned. The holes for the valve holders are perhaps a shade smaller than specified, but this is an advantage in some respects, as they enable the valve holders to be very accurately centred.

One of the two chassis submitted is fitted with five of the specified type of valve holders, and complete with brackets and screws costs 10s. 6d. The other specimen is not fitted with valve holders, but is complete in every other respect, and the price is 7s. 6d.

CATALOGUES RECEIVED.

Houghtons, 88-89, High Holborn, London, W.C.1.—Well-illustrated catalogue, containing over 300 pages, dealing with the range of proprietary receivers, accessories, and components handled by this well-known firm of wholesalers. It is compiled in sections, and a thumb index is provided.

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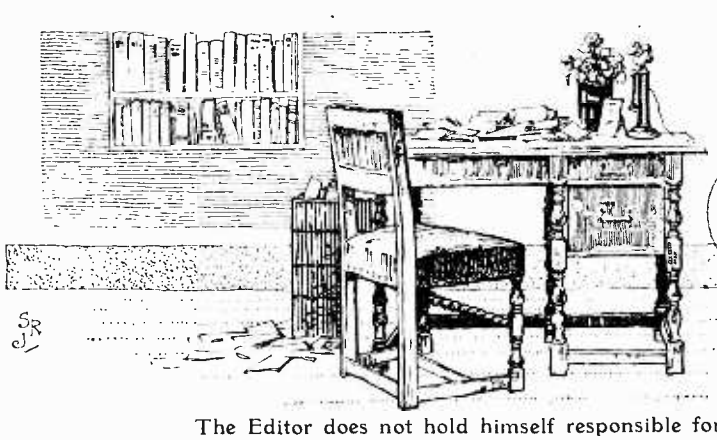
Ferranti, Ltd., Hollinwood, Lancs.—Broadsheet giving full constructional details of Ferranti. Constructor's A.C. mains Band-Pass S.G. Three receiver.



The Week's Postbag

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

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

The Receiver of the Future.

Sir,—In your issue of February 3rd Captain Round's letter gives still further evidence that the "Stenode" is "the Receiver of the Future"; whether the selectivity is obtained by piezo crystals, tuned circuits, or reaction, is all the same to me. It is very interesting to have such confirmation from one who has been chief of research of the Marconi Company.

Your Editorial comment is, as one would expect, a completely unbiased statement, which brings into perspective the work of Captain Round and others, and its bearings on the "Stenode" principles.

You suggest that in the "Stenode" we "push selectivity to an extreme case" and use low-frequency correction, and, even if it is no more than this, I am satisfied with your other statement that the troubles due to congestion of the ether "will be removed by one revolutionary stroke."

Now that the scientific storm has passed, and having borne the brunt of the criticisms, I am amused to see so many people claiming that they really invented the "Stenode" and not myself.

It is perhaps sufficient comment on Captain Round's claims that even at this late stage he has apparently not realised the present stage of development of the "Stenode" patents.

Possibly his experiments are restricted to the use of reaction circuits, which would explain his incorrect statement. It is well known that there are many disadvantages in using reaction, one of these being the fact that it is not easy to obtain high selectivity in this way without the danger of the receiver bursting into oscillation. Another disadvantage of reaction is the Zieben effect, which shows that the frequency of a reaction circuit can be changed by transmissions on neighbouring channels.

My work on the commercialisation of the "Stenode" has, in the main, been directed to the use of circuits where the frequency is stable, and the Quartzless "Stenode" Radiogram now under commercial production will receive practically any station in Europe without interference, and can be easily handled by anyone, whether technical or not.

In conclusion, I would add there are very few stations in existence to-day whose frequency varies to a sufficient extent to make them difficult to receive even when the selectivity is as high as that obtained with a piezo quartz crystal. These results I have invariably been ready and willing to demonstrate to technicians and the public alike. J. ROBINSON.

London, W.1.

Post Office Wireless Licences.

Sir,—The licence fee payable in this country for the privilege of receiving the B.B.C. or any other progammes is one of the most remunerative ways of spending ten shillings.

It is not paid for the very doubtful privilege of possessing a receiver, but for receiving the programmes.

An attempt to dodge this perfectly reasonable charge on the part of the poor or unemployed could be understood and sympathised with. The most persistent efforts, however, are being made by those whose residences show them to be well able to afford the cash. Does their self-respect not prevent their wishing to obtain something at the expense of their less well-to-do fellow countrymen? WILLIAM B. WEST.

Deal, Kent.

Sir,—Mr. T. L. Stanton evidently misunderstands the P.M.G.'s regulations in the matter of broadcast reception in flats. These are, I think, fairly summarised in the "Wireless World Diary," thus:—

> "A single receiving licence will cover the installation of more than one set, provided that the sets are all in the same house, flat, etc.; that is to say, tenants of separate flats or sub-let premises in the same building are not entitled to share the benefits of one licence, nor may extensions be made from a licensed set whereby occupiers of other houses, flats, etc., may listen without taking out separate licences."

This seems a clear answer to the first point raised by Mr. Stanton. As regards the second point, it is clearly stated on the receiving licence that the "secrecy" clause is not intended to apply to broadcast information, though, of course, the B.B.C. prohibits the republication of copyright news or other specified matter.

With regard to "radio-servicing," it is unlikely that either the B.B.C. or the Government will organise a service as suggested, but I imagine that the objects which various dealers and companies have in view when starting "wireless exchanges" are much the same as those visualised by Mr. Stanton. The Post Office Relay Service Regulations were summarised in *The Wireless World* of July 1st, 1931, and I presume that the promoters of wireless exchanges will arrange to give their subscribers a free choice of programmes, as their service will offer little attraction if every subscriber is compelled to hear only the programme selected by the central receiving station.

London, S.W. W. HEATH.

Informative Advertising.

Sir,—As one who has been entrusted with the writing of advertisements on radio products for the last ten years, I should welcome the opportunity of replying to your correspondent, Norman P. Slade.

May I say at the outset that the sales value of "informative" advertising is governed by the type of journal in which it appears? And may I add that out of the scores of journals for which I write technical advertisements there is not one which shows so spontaneous a reaction to informative advertisements as *The Wireless World*.

There are, however, serious limitations imposed upon the writer of such advertisements. It is not always expedient, from a commercial point of view, for him to divulge too freely details of manufacture. And at the same time it is difficult for him

to make definite claims as to the performance of some wireless components and accessories even when the support of authentic curves and graphs is available—so much depends upon variants outside the manufacturers' control.

The most that can generally be done is to draw up informative advertisements of the "How it is made" type, leaving the instructed reader to draw his own conclusions as to the effect of manufacturing skill upon performance in practice.

In the case of loud speakers—a point raised by Mr. Slade—a series of informative advertisements is at present appearing in the valued pages of your journal, and is proving distinctly successful. But it is thought wiser to restrict these announcements to incontrovertible facts rather than to attempt performance claims which must necessarily either be too vague to be of practical value or else be hedged round by a close set of limiting factors before they can be considered valid.

London, W.C.1. R. WATKINS-PITCHFORD.

Sir,—We were particularly interested to read the letter and leading article that appeared in your issue of January 27th under the heading of "Informative Advertising." We are only sorry that your correspondent did not outline the type of advertisement he advocates when featuring a complete instrument.

In advertising the new "His Master's Voice" instruments we appear to have borne in mind many of the points suggested by Mr. Slade. In fact, it is a remarkable coincidence that the page facing your editorial this week should be occupied by an advertisement for our nine-valve radio-gramophone, which would seem to satisfy his requirements as far as particulars of performance are concerned.

As each laboratory has a different standard at the present time for plotting curves and obtaining calibrations, we think it would be misleading to the general public if manufacturers gave some of the information in their advertisements mentioned by your correspondent.

It is a fairly simple matter to give complete information regarding single components, but this is not the case with complete receivers, although we indicate as much as possible in advertising the capabilities of our various models.

When advertising our pick-up and loud speakers in the technical Press we have always given details of the impedance, output, etc., in the case of the former, and particulars of the power handled by the latter.

THE GRAMOPHONE CO., LTD.
F. L. HEATHORN,
Advertising Manager, English Branch.

"An Ominous Sign?"

Sir,—There appear to be signs of a movement afoot to restrict the frequency range of sound reproduction, in the case of broadcasting, by lessening the station separation in order that more transmitters may occupy the limited space available, and in the case of gramophone pick-ups, in order to diminish the range of scratch frequencies reproduced.

Everyone who is interested in obtaining the finest response from their apparatus will realise what this movement, if it progresses, must mean to them. In the case of broadcasting one feels some sense of security and hopefulness in the determined efforts of the B.B.C. to avoid any further contraction of the kilocycle separation at present agreed upon, but one was rather unpleasantly surprised the other day to learn that one of our leading manufacturers of gramophone pick-ups, and one whose name carries a great deal of authority, had produced their latest model with, if one's information is correct, a cut-off at about 3,000 cycles—on the grounds that it was better to miss out some of the higher harmonics than to include a corresponding amount of needle-scratch.

This is all very well for those who prefer matters so, but for those who have gone to no little trouble and expense to ensure that their apparatus is capable of dealing with harmonics up to 6,000 cycles or more the situation may become tragic; for if manufacturers decide that their pick-ups shall cut off at a low figure, is it not logical to expect that the record manufacturers may also decide that it is merely wasteful to record anything above this figure?

Where shall we be if the tendency gains ground? At present those of us who prefer to try to bring out the higher frequencies, and thereby attain to something resembling the true and full quality of the sound concerned, at least have the choice of other pick-ups; but if we are to have the records themselves reduced in frequency range, then we are defeated from the source. So long as the practice goes no farther than the instruments referred to all is well, but one would most sincerely beg of the record companies that they will not carry the idea to the conclusion mentioned.

Those who cannot tolerate *any* scratch have other means at their disposal, quite simple, of reducing it, but most experienced people will agree that if scratch is reduced to such a degree, by any method known at present, the quality of reproduction suffers, audibly, and unquestionably, owing to the loss of the higher harmonics.

The more one considers the matter the more it becomes apparent that we cannot afford to lose *any* of the frequencies that can be transmitted or recorded, and the problem of scratch is better approached from the mechanical rather than from the electrical angle.

But, whatever the recording companies may do about that side of the matter, it would be a deplorable state of affairs if they should decide to rob us of any of the already restricted band of frequencies they offer us.

Perhaps one may take consolation from the fact that the Bell Telephone Laboratories in America have recently produced a loud speaker "good from 3,000 to 10,000 cycles." They are evidently in the hope that there may still be such frequencies to reproduce.

N. P. S.

Frequency Range of Records.

Sir,—It has been stated, from time to time, in the technical Press, that musical frequencies recorded on gramophone discs undergo a progressive attenuation below 250 cycles owing to unavoidable restriction of the width of the sound-track. This follows from the employment of the constant velocity system of recording, in which the amplitude varies inversely as the frequency, for if the maximum permissible amplitude is reached at a given (fairly low) frequency, the voltage output obtained *via* a pick-up must, in accordance with this principle, fall off at frequencies below this prescribed value.

The writer suggests, however, that some unjustifiable conclusions have been drawn. An inspection of commercial records gives the impression that the recording level is kept at such a value that the safe maximum amplitude, i.e., the cut-off point, is reached only at a frequency *considerably below* 250 *cycles*.

The bearing of the above upon the design of reproducing apparatus is obvious, particularly in view of the absurdly exaggerated bass response of certain makes of pick-up.

Incidentally, how is this bass cut-off accomplished in the recording process?

Possibly *Wireless World* readers can offer comments?

London, N.W.11. GILBERT PACKMAN.

The Cheapest Transmitter.

Sir,—In Current Topics of January 27, 1932, you ask if anyone can beat W8APM, who has worked 43 countries in 6 continents, using a transmitter consisting of only two valves of the receiving type, the total transmitter costing only 25 dollars. The answer to this question is definitely "yes!"

Many stations in this country, and abroad, are using transmitters which cost little over 50/-, and have been in touch with some 60 countries in 6 continents.

Using a transmitter employing an ordinary power valve of the 6-volt type, with 200 volts anode supply from dry batteries, I have been in touch myself with 46 countries in 5 continents, the missing continent, so far, being South America. The input here never exceeds 5 watts. This self-excited transmitter cost under £3, including valve.

I know that many low-power stations can beat my results, so surely W8APM is a long way from being the champion QRP station either in cost of apparatus or results obtained!

Farnham, Surrey. James N. Roe, R.S.G.B.
QRP Manager,
Amateur Radio G2VV.

Readers' Problems.

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

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

Simplified Waveband Switching.

SEVERAL requests have been received for a method of waveband switching for an ordinary two-valve set in which only a simple three-point switch is used for short circuiting the long-wave coil and simultaneously transferring the aerial from its normal tapping on the short-wave coil to a suitable tapping on the long-wave coil.

There is, so far as we are aware, only one way in which this can be done, and that is by following out the scheme of connections illustrated in Fig. 1. In this diagram the coils AB and CD represent the short-wave winding. The number of turns naturally depends upon the diameter of the former, but they should be so arranged that the number of turns between AB is about three times the number of turns on CD. Thus, if the total winding consisted of 60 turns, CD would consist of 15 turns, and AB of 45 turns.

In cases where greater selectivity is desired, it is obvious that the ratio between CD and AB should be increased. There need be no space left on the former between the coil AB and the coil CD because the long-wave coil EFG could, if desired, be wound on a separate former, using a finer gauge wire. Here, again, the selectivity on long waves would depend on the ratio between FG and EF.

The degree of selectivity required on the long waves could be made smaller or greater than that on the short waves as circumstances might dictate, since there is not the slightest need for the ratio between FG and EF to be similar to that between CD and AB.

With regard to reaction, of course, a winding could be placed over FG and another one over CD, the two being connected in series; in this manner reaction would be carried out at the low-potential end of the circuit on both long and short waves. The coil EFG is effectively short circuited by the three-point switch when on long waves, there being no need to perform a similar function for the long-wave reaction winding.

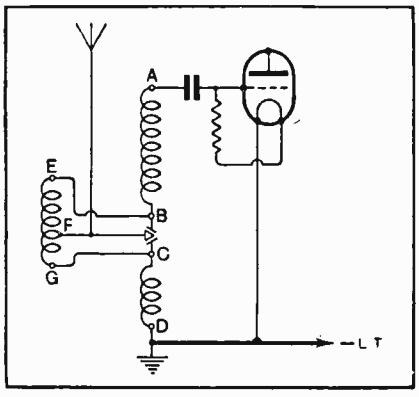


Fig. 1.—Using a simple three-point switch for waveband switching.

A Question of Smoothing.

A LETTER has been received from the would-be constructor of an H.T. eliminator, in which he asks whether inductance or capacity plays the greatest part in smoothing. The answer is, of course, that the degree of smoothing produced by the ordinary choke and condenser arrangement is proportional to the product of the inductance and capacity where the inductance is rated in henrys and the capacity in microfarads, as is usually the case. It will be seen, therefore, that both these properties of the circuit play an equal part, and, furthermore, it is only necessary to double the value of one of them when it is required to double the value of smoothing in any particular circuit.

Grid Bias from D.C. Mains.

IT is obvious from correspondence received that the all-mains D.C. receiver has not yet fully come into its own, and a large number of people are still using battery sets in conjunction with H.T. eliminators and trickle chargers.

Most of the enquiries received recently concerning this matter have dealt with the question of obtaining grid bias from the mains. There is, of course, no difficulty in doing this, it being only necessary to insert a resistance between the negative terminal of the eliminator and the H.T. negative terminal of the receiver. The value of this resistance should be calculated by dividing the total plate current of the set into the grid voltage required by the output valve; the low-potential end of the grid circuit of the valve must be connected to the H.T. negative, and other valves in the set which require negative grid bias must be tapped into this resistance in positions proportionate to the ratio between the grid bias requirements of the output valve and their own requirements. Needless to say, the grid circuits must be carefully decoupled before connecting to the biasing resistance. It must not be forgotten that the potential drop across this resistance means so much voltage loss in the H.T. supply.

Hum Elimination.

IN spite of much that has been written on the subject, many people are still troubled with hum, and at the request of several correspondents we publish in Fig. 2 a diagram showing a useful method of ascertaining whether trouble is being caused by interaction between the output choke and the power transformer of an all-mains receiver.

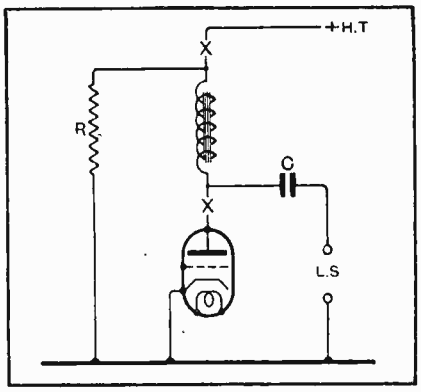


Fig. 2.—Connecting a resistance in the output circuit of the last valve to locate the source of hum.

All that need be done is to break the connections between the H.T. supply and the output valve, and to connect a resistance R in the position shown in the diagram. The value of this resistence should be approximately equal to the A.C. resistance of the output valve.

If no hum is heard under these conditions it can be safely said that the interaction mentioned above does not exist to any appreciable extent. If hum is heard, however, it is advisable to alter the position of the choke relative to the mains transformer, as this will very often completely get rid of the trouble. In the case of an output transformer, the resistance R should be shunted across the transformer primary.

This arrangement can also be used to determine whether there is any interaction between an inter-valve transformer and the mains transformer. It should be pointed out, however, that if the parallel feed system is used in connection with the inter-valve transformer, then the value of R should be equal to the A.C. resistance of the preceding valve and the resistance of the coupling resistance *in parallel*.

Useful to Valve Makers.

A CORRESPONDENT who employs an H.T. eliminator and a trickle charger in order to derive power for his receiver from A.C. mains, proposes to build a separate grid bias eliminator, using an ordinary triode as the rectifier, and asks whether any objections can be raised to the scheme. While the apparatus would, of course, function well, it must not be forgotten that, when the triode burns out through old age or any other cause, the effect will be the same as though the grids of the valves were completely disconnected. It would be more advisable, therefore, to employ a small metal rectifier for this purpose.

Overcoming Matching Difficulties.

TWO interesting queries have been received relating to the output stage. In the first of these an experimenter has a loud speaker which gives undue prominence to the upper musical register, and, although his output valve is a triode, he found by experiment that pleasing results were obtained by coupling up the loud speaker either with a centre-tapped choke or with an output transformer normally intended for a pentode valve.

The arrangement worked well during his experiments, but motor boating occurs now that he has incorporated it into a new receiver, and this can only be stopped by ignoring the centre tapping of the choke and connecting it up in the normal manner. Doing this, however, has naturally caused a return of the shrillness which he set out to cure in the first place. He is anxious to find the cause and cure of the motor boating.

It is quite evident that the new receiver is sufficiently near to the L.F. oscillation point to require the stabilising influence of the normal choke filter output

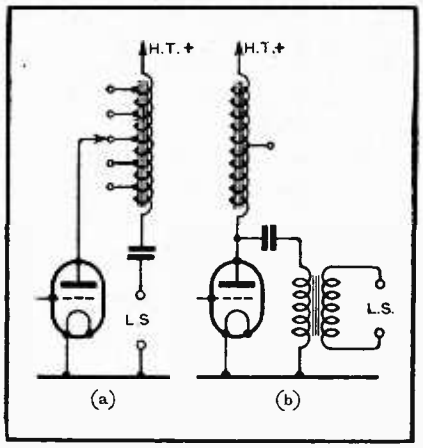


Fig. 3.—Two methods of matching output valve and loud speaker in order to overcome special difficulties.

arrangement, a property which it unfortunately loses when a tapped choke is used. While the motor boating could doubtless be cured by improving the decoupling arrangements in other parts of the receiver, it is probable that the easiest way out of the difficulty would be to use the components already in hand by adopting the arrangement shown in Fig. 3 (b), which would enable stability to be achieved, and at the same time permit of the retention of the matching arrangement which has been found to be so successful.

In the second case a reader asks how to match a triode output valve to a moving-coil loud speaker specially wound for following a pentode valve. In such a case it becomes necessary to use a step-up transformer, but it is not possible to use an ordinary output transformer with its connections reversed since the secondary of such a device is not intended to carry the heavy plate current of an output valve. It is perfectly easy, however, to press into service a tapped choke in order to obtain a step-up ratio, and the necessary connections are shown in Fig. 3 (a). It will be realised from the problem just discussed that low-frequency oscillation might occur due to this particular output arrangement if proper care is not exercised in the matter of decoupling thoroughly elsewhere in the receiver.

Layout.

ALTHOUGH questions are often received from set constructors regarding the layout of components, it is almost impossible to give answers that are brief but at the same time helpful, or even to discuss the matter in general terms. But there is one general rule which, if observed, will generally confer immunity from the more serious forms of trouble that are likely to arise from inter-action due to incorrect mounting of components. Every modern multi-valve set may be looked upon as a chain of cascade amplifiers, in which the strength of a signal is progressively increased from the input to the output end; if the components associated with each end of the chain are kept as far apart as possible the constructor will be working on the right lines.

Another rule, which, if it does not make for prettiness, at least ensures short leads at vital points, and freedom from undesirable inter-stage reactions, is, in arranging a layout, to follow the theoretical circuit diagram as closely as may be possible.

FOREIGN BROADCAST GUIDE.

BOLZANO
(Italy).

Geographical position: 46° 30′ N.; 11° 30′ E.
Approximate airline from London: 623 miles.

Wavelength: 368.1 m. Frequency: 815 kcs. Power: 1.5 kW.

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

Standard Daily Transmissions.

11.30 G.M.T., weather, news bulletin, gramophone records, time signal and carillon from Gries Monastery; 16.00, concert; 17.00, news; 19.00, concert; 21.00, relay of outside broadcast or play; 21.30, news.

Announcer: Woman.

Call: *Ente Italiano Audizioni Radiofoniche, Stazione di Bolzano*, curtailed between items to E.I.A.R. (phon.: *Eh-Yah*) *Radio Bolzano.*

Opening signal: Gramophone record (bells, organ, choir, orchestra).

Closes down with the words: *Fine della trasmissione. Signore e Signori, Buona Notte*, followed by the Italian National Anthem and Fascist hymn.

"The Wireless World" INFORMATION BUREAU.

Conditions of the New Service.

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

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

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

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

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

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

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

The Wireless World AND RADIO REVIEW

(19th Year of Publication)

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EDITORIAL COMMENT.

Launching the "Autotone."

IN this issue we announce the new receiver which, since we first referred to it as a design incorporating features which we believe will be widely adopted in receivers of the future, has become a topic of conversation in wireless circles everywhere.

This receiver constitutes quite definitely a new departure in design, and, although the principles involved are applicable to receivers of almost every type, we have set about to produce the first practical example adopting the simplest circuit to demonstrate its possibilities. The receiver should really be regarded as comprising three valves for detection and amplification, the fourth valve being, to all practical purposes, a passenger as far as amplification is concerned, but it is employed for the purpose of enabling adequate tone correction to be obtained after the extremely selective input arrangement. Those who make up this receiver carefully to our specification should have no difficulty in repeating the results which have been attained in our laboratory, which results will be found equal in selectivity and sensitivity to some of the most expensive receivers at present available, and, when once the set has been adjusted, tuning is simple.

It is always well to give a name to a new receiver, and we have been at some pains to evolve a suitable title. The bottle of champagne had stood on the shelf of our laboratory for some time before finally its neck was broken and the receiver launched as the "Autotone." This name appeared to us well suited to convey the principle involved, which is, as readers will have realised, automatic tone correction for the effect produced with an input circuit of extreme selectivity. Quality is restored by correcting for the attenuation of sidebands in the tuned circuits, so that they are reinstated in their proper proportion.

One point of special interest which we would like to stress is that the new principles which we are expounding in our columns provide probably more opportunity for experiment and development than anything new in wireless which has come along for a good many years, and we predict that just as our lead was followed when we reintroduced the superheterodyne to this country and popularised it, and later produced the first single-dial super for amateur construction, so in this case also history will repeat itself, and both the manufacturers and contemporary wireless journals will make haste to adopt these ideas.

Supply Voltages.

A CONSIDERABLE amount of correspondence has been received on the subject of fluctuations in voltage at consumer's mains, and an interesting letter in the correspondence columns of this issue indicates that the Electricity Commissioner is responsible for undertaking to test a consumer's supply on request, in return for a fee, and that the supply authorities who permit their voltages to fluctuate beyond a certain percentage are liable to a penalty.

Our correspondent suggests that, in a district where the voltage is fluctuating beyond this percentage to the annoyance of the consumer, a group of consumers might join in a request to the Electricity Commissioner for the services of an inspector to carry out a test. It would therefore appear that the machinery for redress of this grievance exists, and, should any consumers decide to follow the suggestions put out by our correspondent, we should be interested to know the result of their action.

The Reflection of Waves from the Ocean Bed.

SCIENCE has done much for trade and commerce during the first thirty years of the twentieth century; and the art of navigation, ancient and long practised though it is, has benefited in many ways from recent applications of scientific knowledge, particularly in the use of wireless and wireless principles.

Wireless telegraph communication and direction-finding has been used for some years not only in big ships, but also in small ships for such purposes as directing the operations of whaling fleets. Indeed, so highly has it enabled this particular work to be organised that the fear has been expressed that unless the activities of whaling fleets are curtailed there may, before long, be no more whales to catch.

Trawlers, fishing in home and northern waters for smaller prey, have adopted—though somewhat tardily—wireless telegraphy and telephony to help them in their fishing. They have also, more readily, adopted the latest manifestation of wave transmission—reflection sounding—because it has been demonstrated that it definitely helps to increase the catch, and therefore the earning power, of the trawler. Until the middle of last year few trawlers were equipped with this apparatus, but over 130 ships have been fitted during the last few months and orders given for a total of over 300 installations.

SOUNDING the depth of the ocean by means of reflected waves is one of the latest aspects of wave transmission to assume commercial importance. During the last few months of 1931 about 130 sounding device installations were fitted on British trawlers. Readers will be interested to learn that apparatus of this nature was used recently by the Navy in its endeavour to locate the ill-fated submarine M2.

Science Applied to Outwit Fish.

The value of this apparatus to fishing fleets is due to the fact that the majority of fish are bottom feeders, and observation has enabled fairly reliable information to be compiled in regard to the depths at which various types of fish are likely to be feeding at particular seasons. Any apparatus, therefore, that gives the skipper quickly and accurately the depth of water and some idea as to the nature of the bottom is of the greatest value. Heaving the lead would give this information, of course, but that method is too slow and cumbersome for use on fast-moving modern trawlers. The development of apparatus which will measure the time taken for a sound wave to travel to the bottom of the sea and return, and indicate automatically the depth of the sea, has enabled the same information to be obtained almost instantaneously and without the need for any check in the progress of the ship. The deep-sea fisherman has therefore at his command a piece of apparatus which has a demonstrable earning power, in addition to its value as a navigational aid.

Out of the Turmoil of War.

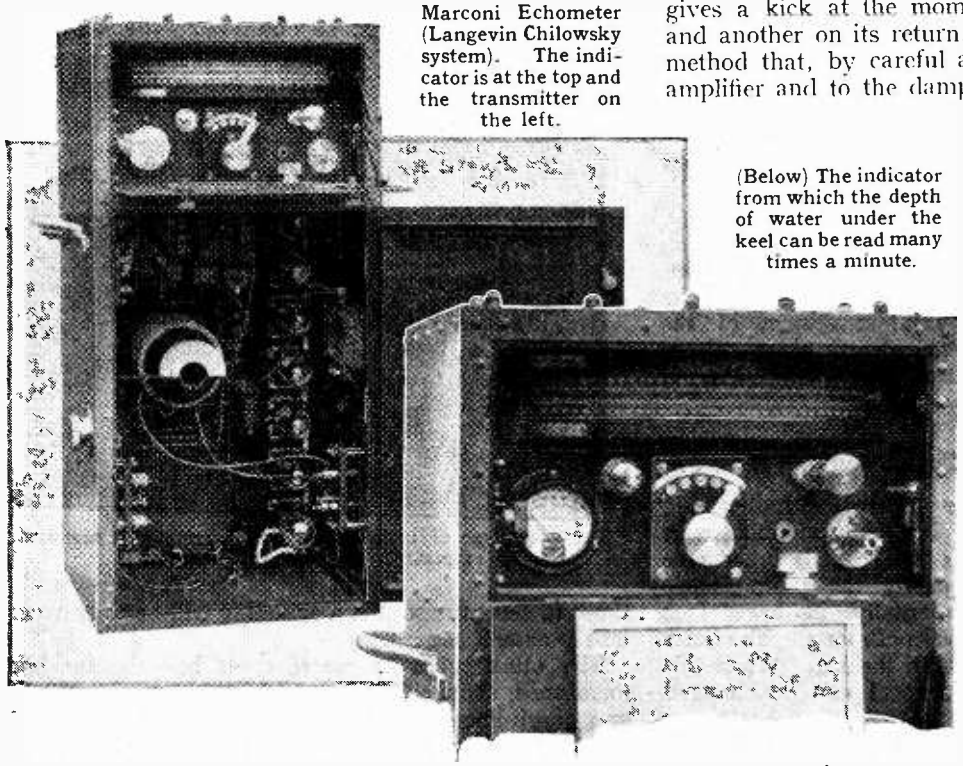
The idea of echo sounding is, of course, not new. It was known as long ago as 1887, but, like many other

Sounding the Ocean Depths.—

branches of scientific knowledge, it was not turned to practical account until the War encouraged many theories which had lain undeveloped to be tested in practical use. Many deep-water surveys have now been taken by reflection sounding, and up to 4,000 fathoms have been measured, though, for ordinary commercial requirements, merchant ships are more interested in depths from two to twenty fathoms, and at most 100 fathoms, than in anything greater, while trawlers need to record up to 350 fathoms. Greater depths than these would only interest scientific expeditions.

The object of reflection sounding is, of course, to make a disturbance in water and to time the return of the echo from the bottom of the sea to the point of departure. Although the rate of propagation of electric waves in sea water depends on the temperature and salinity of the water, it may be taken at an average value of 4,900 feet per second, or 408 fathoms for each second that elapses between the time of the emission of a signal and the time of its return.

Several types of apparatus are now available to meet this requirement, the principle upon which they are operated being the creation of the transmitted signal by either a hammer blow on the bottom of the ship or resonance at supersonic frequency. In either case the period during which transmission lasts must be very short in order that the greater part of the energy of transmission shall have died away before the echo returns.



Interior view of the Marconi Echometer (Langevin Chilowsky system). The indicator is at the top and the transmitter on the left.

(Below) The indicator from which the depth of water under the keel can be read many times a minute.

Receivers are either hydrophones—that is to say, a special type of microphone adapted for use in water—or piezo-electric receivers. Again there are those which leave a permanent or semi-permanent record of the depth, and those which do not leave a record. Those that leave a record use a stylus moving at right-angles to the direction of the motion of the paper at a speed selected with reference to the depth to which the instrument is designed to work. Paper movement, stylus movement, and the transmission of the signal are all controlled by the same mechanism, with the result that a line is drawn across the paper at the moment of emission. This line is adjusted so as to allow for the depth of the transmitter below the surface of the water, as charts are marked from the surface. The return of the signal will again actuate the stylus, and a second line is drawn which marks the depth. A constant repetition of these signals will, of course, represent a contour of the sea bottom.

Ingenious Indicating Devices.

Those instruments which do not leave a record are of two main types. The one has a light at the end of a revolving arm which moves over a circular scale and shows a quick flash as the arm passes the emitting point, and another when the signal returns; while, in the other, a light spot traverses a straight scale and gives a kick at the moment the signal is transmitted and another on its return. It is claimed for the latter method that, by careful attention to the design of the amplifier and to the damping of the mirror movement, the return indication can be made to take a definite form which will vary according to the nature of the sea bottom, a smooth, hard bottom causing a sharp and clear-cut tooth to appear, a soft, slimy bottom making the base of the tooth much longer, and rocks and boulders giving the top of the tooth a serrated edge.

The problems involved in reflection sounding are not confined to methods of creating and recording signals; but include the disentangling of the echo from unwanted noises. One method of doing this is the use of so much transmitted power that the return echo shall be considerably over the noise level, and another and more delicate method is that of taking advantage of the effects of resonance and of directional reception to select the required signal.

The single-impact transmitters now in use are electric- or spring-driven hammers, or, in some cases, pneumatic hammers, which strike directly on to the frame of the ship or on to a watertight tank fitted inside the bottom of the ship with the skin of the ship as one of its walls. This tank, filled with water, is kept under a pressure

Sounding the Ocean Depths.—

approximately equal to the hydrostatic pressure and the blows are struck on the tank or by means of a hammer face in contact with the water in the tank.

The high-frequency piezo-electric transmitter, on the other hand, working with supersonic frequencies, makes no noise and causes no vibration. Its frequency is approximately 37.5 kilocycles per second, representing an elastic wave (in salt water) of about 4 centimetres. A comparatively small disc oscillating axially at this

The projector of the Marconi sounding device consisting of a mosaic of crystals compressed between two thick steel plates. The outer plate is made to vibrate at high frequency.

frequency gives a highly directional transmission and, as used commercially, confines the majority of the energy radiated within a cone or beam having an angle from wall to axis of about six degrees.

The construction of the active part of this "projector" is most ingenious. It consists of a thin layer of piezo-electrically active pieces of quartz fitted together in a perfect mosaic, all the parts being fastened together and to the surfaces of two steel discs, between which it is placed, with a special form of cement. Provided that the adhesion due to the cement is perfect between the parts of quartz and between them and the steel, the whole mass acts piezo-electrically as one, and at a frequency which has no apparent connection with that of the quartz alone. The whole is so constructed that its thickness is half-wavelength at its resonant frequency, and the axial movement of the outer faces when electrically excited at a given voltage at its own frequency is about seventeen times that of the quartz pieces alone.

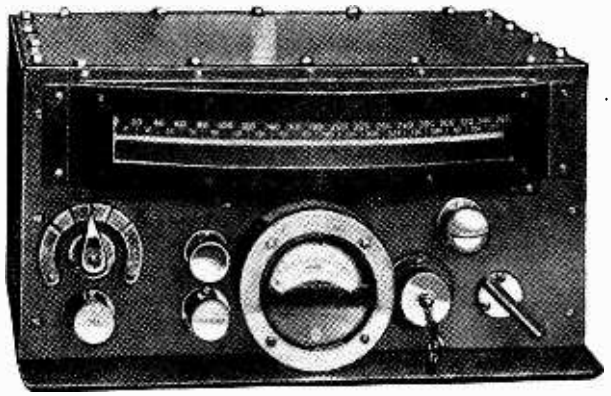
Piezo-electric Equipment.

This projector is housed in a special steel hull-casting in the bottom of the ship. It is usually mounted with its outer face in contact with the sea, its inner face being highly insulated. Recently the piezo-electric element has been mounted internally, its lower face resting on a steel plug half-wavelength long. The outer face of this plug is in contact with the sea. When this mounting is used the active element can be changed when the ship is afloat, but the mounting has to be built into the ship when she is out of the water. Such a projector is obviously also a directional piezo-electric receiver, and in practice the same apparatus performs the duties both of transmission and of reception, a separate receiver as is used in other systems not being necessary.

When transmission takes place an oscillatory voltage is applied across the plates for an instant. This causes the outer plate to vibrate at high frequency, and thus imparts a wave motion to the water. This signal travels to the bottom of the sea, and is reflected back again. When the return signal strikes the projector the reverse process takes place, and a small voltage is produced in the circuit connected to the projector. The measurement of the depth of the water is thus a question of measuring the time interval between the transmission and reception of the echo.

The receiving dial has an opaque sector graduated from 0 to 360 fathoms. A spot of light from an electric lamp is reflected on to this scale by way of a revolving mirror and an oscillograph mirror. The revolving mirror is moved by an accurate motor so that the spot of light runs across the scale in exactly the time taken for a transmission to go to the depth of 360 fathoms and be reflected back. The spot of light is also reflected by the oscillograph mirror, and when the electric current is received in the coil of the oscillograph an armature moves the mirror attached to it and projects the spot of light in the vertical plane.

The starting of the revolving mirror actuates a contact which causes the transmission of waves through the water and also causes the oscillograph to work so that the spot of light will jump, and a peak, rather like a tooth, appear on the scale. When the echo returns, the amplifier will again work the oscillograph and another peak or tooth in the path of the spot of light will appear on the scale. This will be opposite to the graduation corresponding to the depth of the water from the surface; and as the spot of light moves across the scale sixty



The latest type of indicator for the Echometer is mounted separately from the transmitter.

times in seventy seconds a sounding will be shown very nearly once a second.

The other types of recorder, as has already been mentioned, show either a spot of light on a circular disc or a graph line on a roll of paper. In either case, when a sounding is required, the ship's officer has merely to pull a small switch handle mounted in the face of the indicator, and the depth of the water vertically is at once shown. Thus the modern navigator has at his disposal in an instant information which navigators for the last 2,000 years could only obtain by heaving the lead, a process which, in the most favourable circumstances, takes many minutes and in time of stress is a much longer and a somewhat arduous proceeding, and science ameliorates the rigours of seamanship.

Set Testing in the Factory

Modern Methods of Ensuring Perfection.

By W. J. BROWN, B.Sc., A.M.I.E.E.

Front view of the apparatus for testing the audio-frequency response of a completed receiver.

THE ever-increasing stringency of the manufacturing conditions appertaining to the modern wireless set or electrical reproducer has imposed on the manufacturer the definite need of an entire revision of systems of production testing which in more leisurely times were found satisfactory.

The Gramophone Company early saw the need for really efficient testing apparatus, both with regard to components and complete instruments, and a special department of the Research Building at Hayes was set aside to study the theoretical and practical aspects of high-speed testing and the design and calibration of semi-automatic apparatus, some of which has to work between remarkably fine limits, and all of which has to be operated by comparatively unskilled labour.

The testing of a product divides itself into two principal stages. The first stage is the testing of materials and components, while the second is the testing of the finished product at various points in its erection prior to its actual performance test under operating conditions.

It is perhaps best to give an example of both types, and a brief description of the method employed for the testing of, say, enamelled wire used in the winding of transformer primaries and secondaries will give an indication of the methods used in the first stage.

TESTING a receiver is not the least important task of the home constructor. On a far larger scale the mass producer, anxious to safeguard his reputation and retain the good will of his customers, must organise a system of rigorous tests in which, as this article shows, nothing is left to chance.

Samples are taken from each batch of wire and are first passed through a mercury bath, connected to which is a recording apparatus which indicates the number of points of contact, if any, established by the mercury through the faulty insulation. Samples of wire are also tried for voltage breakdown, according to the standards recommended by the British Engineering Standards Association, and the insulation material is tested for its reaction to certain solvents with which it is likely to come in contact in course of manufacture, and to various atmospheric conditions which may prevail during subsequent use.

Stretching tests are also applied, in order to see that the requisite amount of flexibility is present in the enamel insulated covering and the necessary ductility in the copper. The wire is finally tested under temperatures considerably in excess of those it is likely to encounter in use.

As an example of the procedure in the testing of components, the mains transformer of an all-mains four-valve instrument will be considered. The two most common breakdowns in this type of transformer are (1) insulation breakdown, and (2) heating. It is also extremely important to know that the transformer under operating conditions is giving the correct voltage for the valves in order to ensure the maximum valve life. Although it is obviously of vital importance to the customer, this safeguard is not generally appreciated by him.

The first test applied is to the coil windings before they are assembled in the transformers. The coils are placed on a magnetic core electrically excited at a frequency of about 500 cycles. The induced voltage

Set Testing in the Factory.—

is then accurately measured across the end of the coil, as a check on the possibility of shorted turns and the correct number of turns.

The coil is next subjected to a more sensitive test for short-circuited turns. It is placed on a laminated iron core, on which are also situated the grid and anode coils of a low-frequency oscillator valve, the coupling between the grid and anode coil of this oscillator valve being so adjusted that the valve is just in a state of oscillation. In the event of the coil under test having a short-circuited turn, this is immediately indicated by cessation of the oscillations.

The coil is then tested for D.C. resistance by a method which makes it possible to employ entirely unskilled labour and, at the same time, to attain a very high speed of operation.

From a manufacturing point of view all that it is required to know is whether or not the resistance of the coil to be measured is, within certain limits, above or below the standard. A semi-automatic Wheatstone Limit Bridge has been developed for this purpose, the four arms of the bridge being specially arranged so that all that is necessary to test a resistance is to press each of two buttons in turn and note that the galvanometer deflects opposite ways for the two buttons—thus indicating that the resistance is *above* the lower limit and *below* the upper limit.

Testing Mains Transformers.

The Gramophone Company base their radio mains transformer tests on the standard practice for large power transformers, elaborating this where necessary in order to secure rapid and economical as well as thorough testing.

The first step is a flash test for insulation breakdown on all windings at a predetermined voltage of approximately three times the normal operating voltage (R.M.S.), and, by the use of special testing fixtures, the electrical stress required for this test is applied in every possible combination of winding conditions. Any breakdown between any winding in any position is indicated at once by the illumination of a warning lamp.

An insulation-resistance test is also applied to guard against the possibility of weakness of insulation developing during use by the consumer. The transformer is placed in a similar fixture, but is now subjected to a test of high-voltage direct current with an indicator to detect the presence of any leakage current.

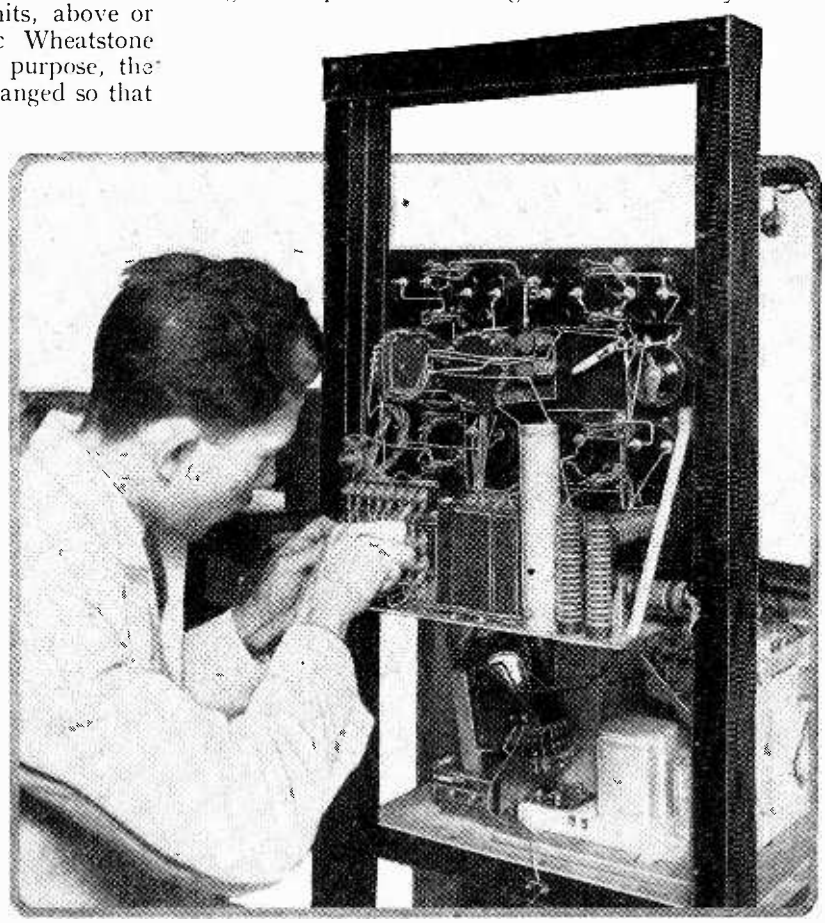
The transformer is then tested on a fixture which indicates, in under five seconds, the possibility of any overheating which might take place in a normal period of operation of anything up to one hour.

A point which is not frequently realised is the exceedingly fine limits to which it is necessary to test ganged variable condensers when high-speed mass production is being employed.

Where comparatively small numbers of instruments are being made it is possible to gang up three or four gang-condenser banks by hand in a more or less satisfactory manner, but, as with other components, when mass production is being employed special care is essential; condensers should be ganged as accurately as possible so that the final adjustments may be reduced to a minimum.

An alternating-current bridge has been developed for the purpose of accurately ganging three condensers, such as those used in the well-known 521 Radio Gramophone.

It has been found that when continuous use is made of head telephones for testing purposes of this kind fatigue is apt to militate against the accuracy of the work, and it is interesting to note that His Master's Voice Works' Test Department have developed, and have in use, instead of the usual head telephones, a visual indicator, which will actually indicate limits of 1/10 of a micro-microfarad, or, roughly speaking, the capacity of a diminutive sphere of only 1 millimetre radius in free space.



A meter panel for wiring tests. Dummy valves take the form of specially wound resistances.

Set Testing in the Factory.—

This apparatus, highly sensitive and super accurate as it is, can now be operated by a factory girl, who is able to test condensers on this instrument at the rate of one every three minutes.

The most interesting part of the testing procedure is that relating to the complete chassis. In the case of a modern receiver employing all-mains operation and fully ganged tuning it is necessary to check all the following points if the entire and continued satisfaction of the customer is to be assured:—

(1) That the insulation throughout the instrument is satisfactory.

(2) That the actual wiring has been done correctly.

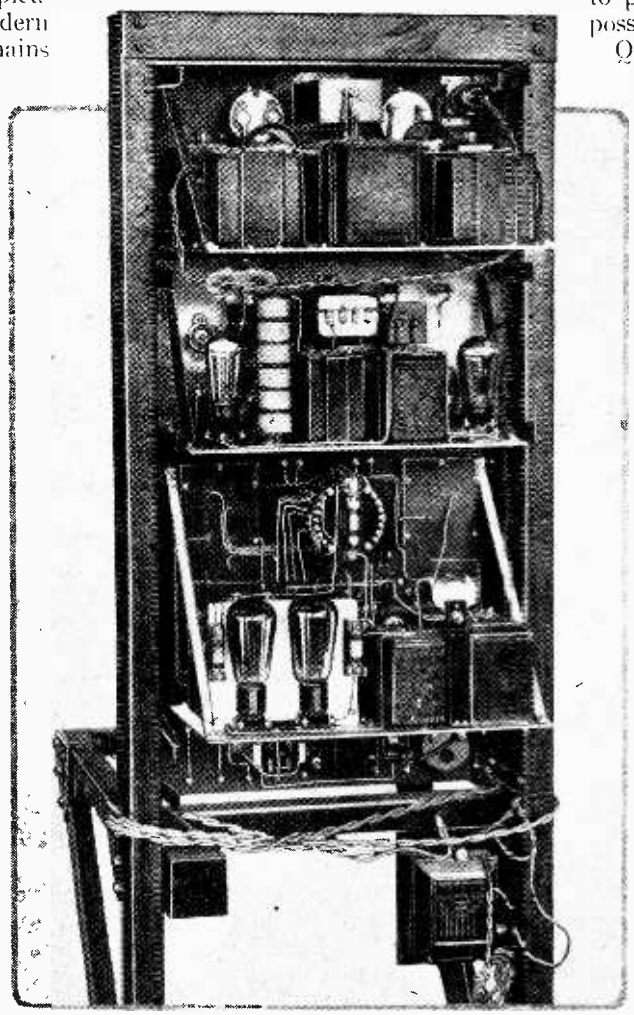
(3) That no components (such as resistances) of incorrect value have been employed.

(4) That with any given arrangement of components the response curve from the audio-frequency point of view is up to standard, so as to ensure good quality of reproduction.

(5) That any hum which may be present is within the limits allowable, and is below audibility under ordinary listening conditions.

(6) That a final adjustment be made for aligning all the tuned circuits to compensate for any slight differences in manufacture, wiring capacities, etc.

(7) That the radio-frequency performance of the instrument throughout the whole tuning range, both long and medium wave, be carefully checked.



Rear view of the meter panel shown in the title illustration. Of the three panels, the lowest is the oscillator ; above it is the valve voltmeter and at the top is the power supply unit for the entire apparatus.

Testing for insulation.—This test has, of course, to be made at a point during manufacture before certain earthing wires have been connected. Under mass-production conditions the chassis is assembled on a conveyor. Operators stationed along the conveyor add the various components and execute the wiring to a predetermined schedule; thus it is gradually built up from a bare metallic frame to a completely wired chassis. For the purpose of insulation testing the instrument is attached to a special fixture, and taken, when it reaches a certain point in its progress, down the conveyor. A number of special test clips are then applied, the process taking less than ten seconds. A lid is then shut down, entirely covering the whole instrument and automatically connecting a supply of 1,000 volts D.C. to every circuit and between every circuit and earth. Any leakage in any particular circuit arrangement is at once shown by a visual indicator, the lid serving to protect the operator from any possibility of shock.

Quite apart from safeguarding the ordinary insulation of wires, this test is extremely valuable in disclosing any weaknesses in insulation in material used, such as valve sockets and terminal strips.

Wiring Tests.

Continuity test for correct wiring.—This test takes place when the chassis has been completely wired up, and is carried out as follows: The instrument is slid off the conveyor belt straight on to a fixture which automatically makes connection to all sockets and terminals in one action. The movement of a lever inserts a series of dummy valves into the valve holders. The dummy valves take the form of resistances which are wound to correspond to the anode and filament resistances of the actual valves. Connections are taken out from these dummy valves to a meter panel on which the voltages or currents on the filament, grid, anode, and screen-grid of every valve can be checked. The back of this meter panel is illustrated on the previous page.

Testing for audio response curves.—The instrument is again withdrawn from the belt and placed in the standard fixture which automatically makes all the necessary connections—a set of standard valves being automatically inserted. It is interesting to note that while these valves are not in use the filament heaters are kept warm so that they are ready for operation immediately they are inserted in the chassis under test.

When in position in the testing fixture the chassis has its pick-up input terminals connected to an audio oscillator and its speaker output terminals connected to an appropriate load. A special form of valve voltmeter, calibrated in decibels, is employed to read the

Set Testing in the Factory.—

input and output voltages. On pages 161 and 163 are shown front and rear views of this apparatus. (The valve insertion gear was not in place at the time when the photos were taken.) It will be seen that it comprises three separate panels, of which the lowest is the oscillator, the middle one the valve voltmeter, and the top panel the power-supply unit for the whole apparatus.

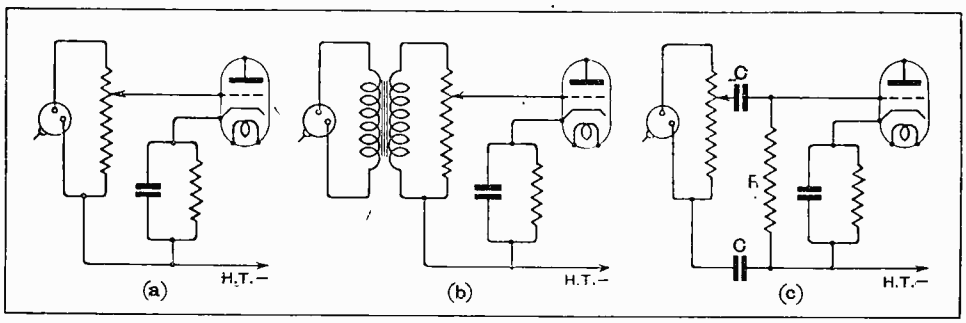
In the usual method of taking response curves or gain runs it is necessary to readjust the frequency and amplitude of the oscillator rather carefully between each point on the curve and also to make sundry attenuator adjustments, so that it takes ten or fifteen minutes to take a complete run. (*To be concluded.*)

THE PICK-UP ON D.C. MAINS.

Isolating the Pick-up leads from High Voltages.

THE use of a gramophone pick-up has now become so commonplace that its method of connection to the receiver is almost standardised. A method often used is that shown at (*a*) in the illustration, and it will be seen that one of the pick-up leads is connected directly to the negative of the receiver H.T. supply. This is of no importance whatever with battery-operated receivers, nor need it be considered with A.C. mains sets, for these always have a transformer which isolates the receiver circuits entirely from the supply mains.

The case is quite different, however, when D.C. mains are used for the H.T. supply; no isolation of the receiver circuits from the mains is then possible, and there is a grave danger of a shock if metal parts of the set are touched. It is for this reason that the I.E.E. regulations specify that where the H.T. supply is taken from D.C. mains fixed condensers must be connected in series with the aerial and earth leads, and the loud speaker must be connected to the set either by means of a transformer or with a fixed condenser in each lead.



Three methods of connecting a pick-up. For A.C. mains (a) is satisfactory, while with D.C. mains (b) or (c) must be used.

The gramophone pick-up, however, is even more important than the loud speaker, for it is frequently handled, and it will be seen that if complete safety is desired it should be connected to the receiver through an isolating circuit. The simplest of such isolating circuits, of course, is a transformer, and the connections for this are shown at (*b*). If the transformer is not designed to suit the pick-up, however, there is a certain risk of distortion, although an ordinary high-quality intervalve transformer will often give excellent results. It will be noted, however, that by using an instrument with a step-up ratio, the amplification may be considerably increased.

Where it is considered undesirable to use a transformer, however, a resistance-condenser filter circuit should be employed, and such a circuit is shown at (*c*). The values of the components are by no means critical, and it is generally possible to use any which are at hand; the two condensers C should each have a capacity of about 1 mfd. in order to avoid cutting off the low notes. The purpose of the resistance R is to allow of the bias voltage being applied to the valve; as it is effectively in shunt with the pick-up, too low a value will lead to a high note loss, and in general it is inadvisable to go below 0.5 meg.

A filter of this type costs little and is easily fitted, and it removes any risk of shock while handling the pick-up. In this connection it is well to remember that in cases where the pick-up is fitted with a third terminal for earthing the frame, this terminal must never be connected to the negative H.T. with a D.C. mains set, although this may be quite permissible, and, in fact, usual, with battery and A.C. mains sets. With D.C. mains the pick-up frame must only be connected directly to the earth itself.

W. T. C.

BOOKS RECEIVED.

Submarine Telegraphy.—A practical manual, by I. De Giuli. Translated from the Italian by J. J. MacKichan, O.B.E., A.M.I.E.E., with a foreword by T. E. Herbert, M.I.E.E., comprising instruction on cable-laying, testing, and other matters of interest to cable engineers. Pp. 225+X. with 173 diagrams and illustrations. Published by Sir Isaac Pitman and Sons, Ltd., London, price 13s. net.

The Cinema Organ, by Reginald Foort, F.R.C.O. The construction and mechanism of the cinema organ, including special noise effects, with remarks upon broadcasting, recording, accompanying silent pictures, interludes, etc., from the organist's point of view. Pp. 126, with frontispiece and 58 illustrations. Published by Sir Isaac Pitman and Sons, Ltd., London, price 2s. 6d.

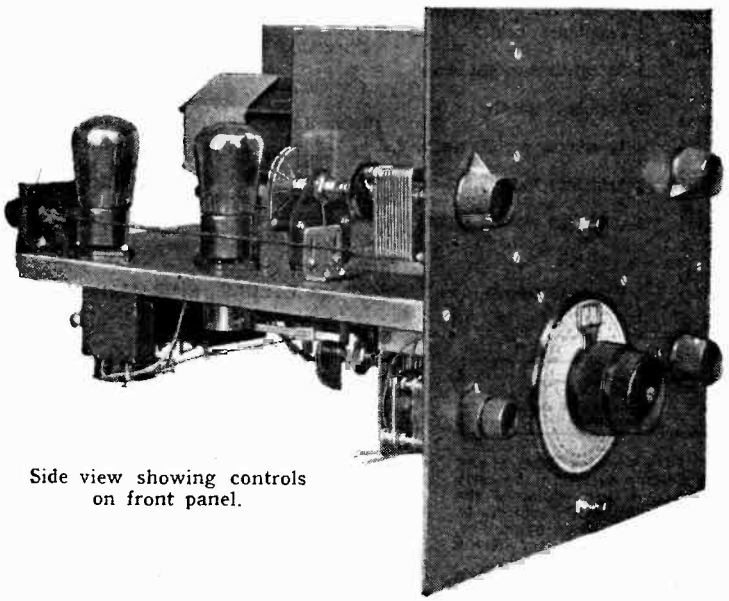
Les Effets Electriques de la Lumière et Leurs Applications Moderne, by P. Hémardinquer. Including photo-electric cells, talking films, use of invisible rays, television, etc. Pp. 104, with 44 illustrations and diagrams. Published by J.-B. Baillière and Fils, Paris, price Fcs. 15.

The Wireless World AUTOTONE

First Pictures of the New Tone-corrected Set.

LIST OF PARTS REQUIRED.

DESIGNED originally with the object of obtaining practical proof of the principles of tone correction in conjunction with ultra-selective tuning, this simple detector-L.F. circuit has given such remarkable results in the matter of range, as well as selectivity and high quality, that it was decided to introduce refinements which would make the set an ideal broadcast receiver for home use as well as a practical demonstration of the fundamental principle involved. The circuit employs critical reaction, yet it can be quite safely placed in the hands of a novice, since the circuit is so balanced that the whole of the wave-band can be searched under critical reaction conditions without touching any of the controls other than the main tuning dial and without spilling over into oscillation at any point.



Side view showing controls on front panel.

Constant reaction over three-quarters of the wave-band can be readily obtained by careful attention to detail in the design of the reaction coupling, but it is all but impossible to carry these conditions to the extreme ends of the tuning scale by coil design alone. In the final design this difficulty has been successfully overcome by means of a special reaction compensating condenser coupled to the spindle of the main tuning dial, with the result that there is no possible excuse for oscillation. The same type of compensating condenser has solved the problem of the input volume control, which would normally upset the ganging of the tuned circuits. Here again the volume control can be operated throughout the whole of its range without the least fear of provoking self-oscillation.

Outstanding Features of the Circuit.

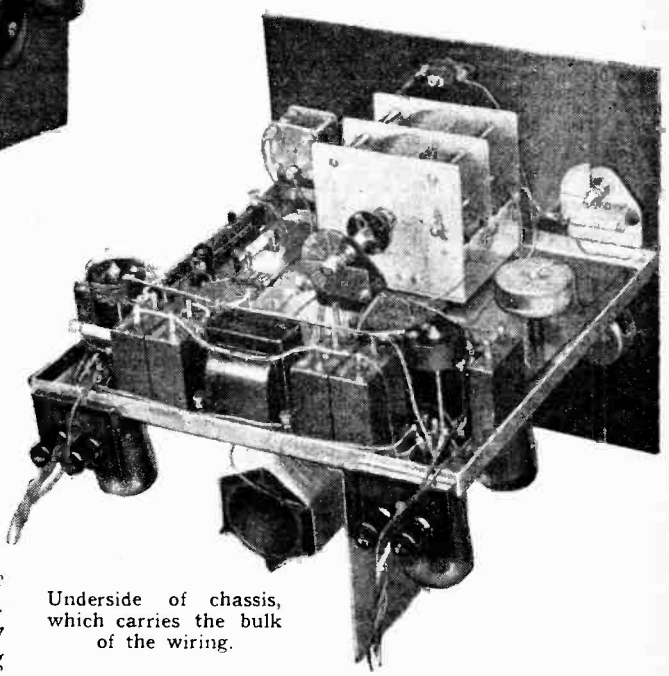
(1) *Two-circuit tuner (single-knob control), giving in conjunction with reaction an unusually high degree of selectivity.*

(2) *Attenuation of high audio-frequencies compensated by tone correction stage.*

(3) *Ease of control assured by the inclusion of special reaction compensation.*

(4) *Four valves arranged as follows : Detector —Tone compensator—1st L.F.—Output.*

(5) *Low H.T. current consumption (with PM2A output valve, less than 10 mA.). Approximate cost : under £10.*



Underside of chassis, which carries the bulk of the wiring.

No special instruments are required for making original adjustments, as a special indicator is included in the circuit. This takes the form of a trimming condenser, the setting of which gives a visual indication of the slightest misalignment of the tuned circuits.

Next week's issue will contain a full description of the circuit and constructional details of the chassis,

The Wireless World Autotone.

tuning coils, tone-correction choke, etc. These will be followed immediately by instructions for wiring the set and adjusting the compensating condensers. In the meantime we append a list of parts in order that readers who wish to do so may get together the necessary components in readiness for next week's issue.

LIST OF PARTS.

Components actually used in the receiver to be described next week, together with a list of parts of other makes that are electrically suitable, but in some cases of different dimensions. The use of some of these alternative components will therefore necessitate minor changes in layout and general construction.

Aluminium chassis and coil screen (White Bros. & Jacobs)
Paxolin panel, 12 in.×12 in.×¼ in. (Wearite)
1 Primary tuning coil (Wearite)
1 Secondary ,, ,, (Wearite)
1 Four-point push-pull switch (Telsen)
1 Two-point ,, ,, ,, (Telsen)
(Benjamin, Bulgin, Claude Lyons, Colvern, Igranic, Junit, Lotus, Ormond, Red Diamond, Sovereign, W.B., Wearite.)

1 Dual screened gang condenser, 0.0005 mfd. (Special "Experimenter's Model"; Utility)
1 Condenser dial, high ratio (Utility, Type W.181)
(Ormond).

2 Flexible couplings (insulated) (Utility)
(Ormond, Cyldon).

2 Universal compensating condensers, with brackets (Utility)
1 Special indicator condenser, 50 mmfds. (Utility)
1 Special variable condenser, 0.0003 mfd., with spindle extension and knob (Utility, "Mite")
1 Slow-motion differential reaction condenser, 0.0003 mfd. (Polar)
1 Variable resistance, 5,000 ohms (Wearite)
(Claude Lyons, Colvern, Watmel).

1 Special choke coil, 0.3 henry.
4 Valve-holders, skeleton type (W.B.)
(Burton, Graham Farish, Junit, Lotus, Telsen).

2 Inter-valve transformers (R.I. "Parafeed")
(Climax, Ferranti, Igranic, Varley).

1 L.F. choke (Ferranti, B.8)
(B. & J., Bulgin, Challis, Clarke Atlas, Climax, Formo, Igranic, R.I., Savage, Sound Sales, Telsen, Trix, Varley).

1 H.F. choke ("Kinva")
(British General, Bulgin, Burton, Climax, Igranic, Lissen, McMichael, Telsen, Varley).

4 Fixed condensers, 2 mfd. (T.C.C., Type 65)
2 ,, ,, 1 ,, ,, ,,
1 ,, ,, 4 ,, ,, ,,
(Dubilier, Formo, Hydra, Peak, Sound Sales, Savage, Telsen).

1 Fixed condenser, 0.0001 mfd mica (Graham Farish)
(Dubilier, T.C.C., Telsen).

4 Fixed resistances, 30,000 ohms (Berco)
1 Fixed resistance, 50,000 ohms ,,
1 Fixed resistance, 30 ohms ,,
(Bulgin, Lewcos, Magnum, Varley, Watmel).

1 Grid leak, 0.25 megohm. (Ediswan)
(Dubilier, Graham Farish, Loewe).

1 Metallised resistance, 50,000 ohms (Dubilier, 1 watt)
(Ferranti, Graham Farish, Loewe).

1 Resistance holder (Bulgin)
(Dubilier).

1 Potentiometer, 400 ohms (Ready Radio)
(Igranic).

2 Terminal panels (Junit)
(Belling-Lee).

4 Terminals, aerial, earth, L.S.+, L.S.− (Belling-Lee)
(Clix, Eelex).

1 Grid bias battery, 16-volt (Ever-Ready)
(Grosvenor, Pertrix, Siemens).

4 Grid bias wander plugs, 3−, 1+ (Clix, Vice-grip)
(Belling-Lee, Eelex).

ACCESSORIES.

4 Valves (Mullard), two P.M.2D.X., one P.M.1H.F., one P.M.202 or P.M.2A
1 Cabinet (Apollo)

Champion of the Superhet.

MR. F. H. HAYNES dealt with the history, development, and modern construction of the superheterodyne receiver in his recent lecture before the Tottenham Wireless Society. It was claimed that the superheterodyne gave ease of control with great selectivity and, in modern types, good quality. Mr. Haynes followed a detailed description of an "All Mains Superhet" with a demonstration of such a receiver. Many stations came in at good strength, and a noticeable feature was the complete absence of valve hiss and mains hum.

Hon. Secretary: Mr. W. B. Bodemeaid, 10, Bruce Grove, Tottenham, N.17.

Set Designing by Vote.

A NOVEL experiment—the design of a receiver by members' votes—was put into effect at a recent meeting of Slade Radio, Birmingham. First it was decided that the receiver should contain three valves (S.G., detector, and pentode), and the members thereupon proceeded to discuss the design, all knotty points being settled by vote. "In a multitude of counsellors there is wisdom," and the experts present considered that the finished circuit was perfectly practical, and might at a later date be put to the test.

Visitors are welcomed at the weekly meetings, held on Thursday at 8.15 p.m., and full details of the Society may be obtained from the Hon. Secretary at 110, Hillaries Road, Gravelly Hill, Birmingham.

Rectification on the Film.

THE theory of the "Westinghouse Metal Rectifier" was entertainingly presented in a lantern and film lecture by Mr. D. Ashby, B.Sc. (of the Westinghouse Company) before the Battersea and District Radio Society at a recent meeting. The film showed the actual flow of current through the transformers and rectifiers.

Hon. Secretary: Mr. S. F. Harris, 13a, Winstead Street, Battersea, S.W.11.

Talk on Television.

A BOMBARDMENT of questions followed the interesting talk on Television given by Mr. B. Clapp, of the Baird Television Company,

CLUB NEWS

at a recent meeting of the Croydon Wireless and Physical Society. Mr. Clapp described the early television experiments, and then explained the various methods of illuminating the subjects to be televised, the operation of the scanning disc, synchronising devices, and other phases of the art.

Visitors are heartily welcomed at the Society's meetings, and full particulars can be obtained from the Hon. Secretary: Mr. H. T. P. Gee, 51-52, Chancery Lane, London, W.C.2.

Radio History.

MR. OSWALD B. KELLETT, A.M.I.W.T. (G-5KL), recently gave a successful lecture-demonstration entitled "Some Interesting Features in Radio" at the fourth winter meeting of the Southport Society of Natural Science.

Interesting demonstrations were given of crystal control oscillators and also of the "Fultograph" picture receiver. The lecture was concluded with a series of lantern slides entitled "The Radio Valve," kindly loaned by The Mullard Wireless Service Co., Ltd., illustrating the early stages and development of the valve, and followed by the modern methods of manufacture. A very fine variety of apparatus was also exhibited, including a 100-watt transmitter.

Hon. Secretary: Mr. John Clegg, 1, Westmoreland Road, Southport.

Are Band Pass Filters Worth While?

JUDGING took place on Friday last, February 12th, in the competition held by the Golders Green and Hendon Radio Society for the best piece of testing apparatus costing not more than 7s. 6d. At the same meeting the question "Are band pass filters worth while?" was discussed by Messrs. Percy W. Harris, Maurice Child, A. J. Bremner, B.Sc., Corfield, Emerson, and Black.

"The Stenode" will be the subject of the lecture by Mr. E. Gardiner, B.Sc., to be given on February 25th, at 345, Finchley Road, N.W.3.

The Society's annual dinner takes place on Monday, February 15th, at Moon's Restaurant, 11, Brewer Street, Piccadilly Circus, W.1.

Hon. Secretary: Mr. W. A. Hudson, 22, The Parade, Golders Green.

A Foreign Visitor.

A VISIT by the Italian transmitting amateur 1HI was enjoyed by members of the Kentish Town and District Radio Society at a recent meeting, at which experiences were exchanged. The club meetings are now held every Tuesday at 8 p.m. at the L.C.C. School, Holmes Road, Kentish Town, N.W.5, where a larger room has been taken in order to carry out practical experiments.

Enthusiasts are welcomed, and all communications concerning membership should be addressed to the Hon. Secretary: Mr. Eric A. C. Jones, 46, Lady Margaret Road, Kentish Town, N.W.5.

Detectors Past and Present.

DETECTION from the earliest days of wireless up to these days of power grid detection was discussed by Mr. Gowing at the last fortnightly meeting of the Gloucester and District Radio Society. Mr. Gowing began with the Hertzian Ring, and then described coherers, crystal detectors, the first thermionic examples, and the galaxy of valves which have followed from the discovery of the "Edison Effect."

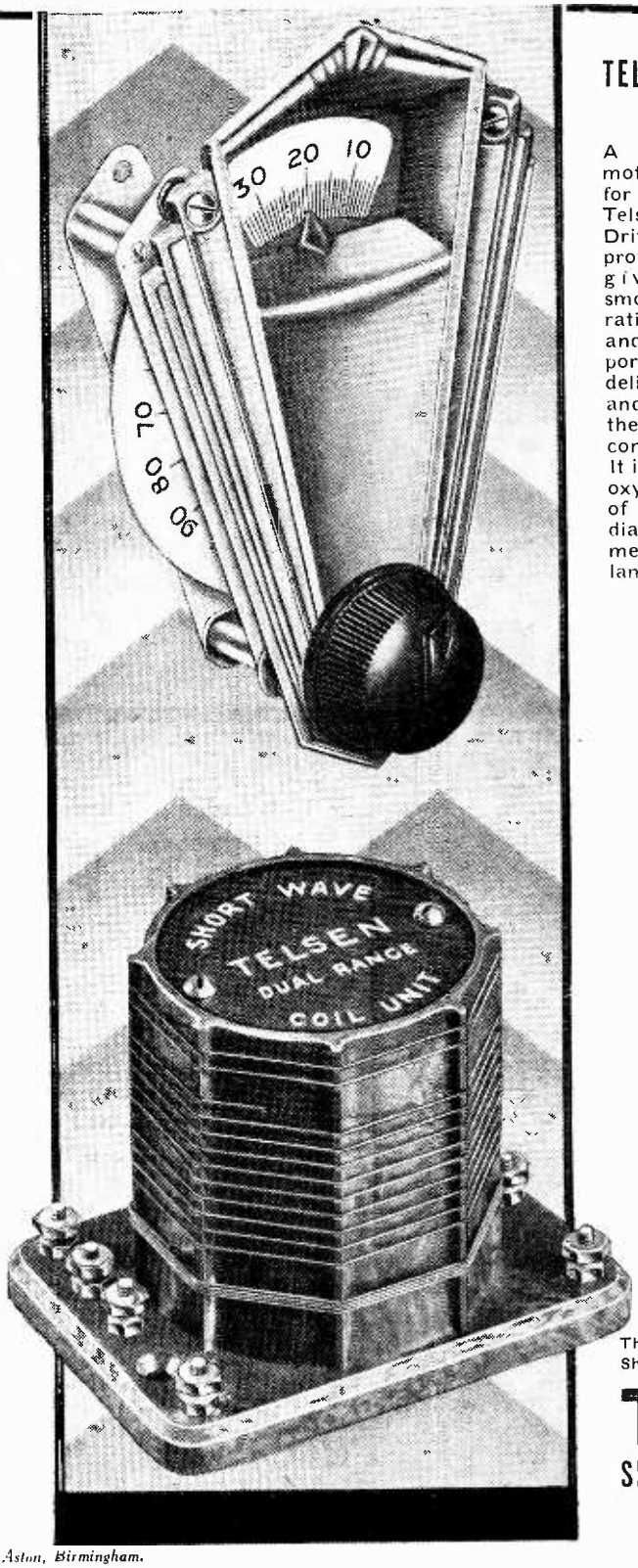
Hon. Secretary: Mr. J. W. Hamilton, Upper Parting, Sandhurst, Gloucester.

Top Notes in Trouble.

DISTINCTION came to one member of the South Croydon and District Radio Society at its last meeting, when he imagined that a heterodyne whistle was actually a continuation of a jazz number which had just been received. The evening was devoted to quality reproduction, particularly in regard to the high notes, and experiments with various types of loud speaker showed how certain notes in the musical scale suffer when reproduced on different instruments. The test was carried out by means of a very high heterodyne note which, in the case of some loud speakers, was not reproduced at all!

Hon. Secretary: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

TELSEN SHORT WAVE COMPONENTS



TELSEN ILLUMINATED DISC DRIVE

A good smooth "slow motion" drive is essential for short wave work. The Telsen Illuminated Disc Drive incorporates an improved movement which gives an exceptionally smooth action and a gear ratio of approximately 5-1, and the bold and well proportioned figures make for delightfully easy tuning, and as the dial rotates over the full circle, all types of condensers are catered for. It is fitted with a handsome oxydised silver escutcheon of modern design and the dial may be illuminated by means of an ordinary flash-lamp bulb.

4/6

COMBINED DUAL RANGE SHORT WAVE COIL UNIT

This Unit for the first time brings the construction of short-wave receivers into line with the simplicity of modern practice. When tuned by a .00025 condenser, a wave range of 20 to 80 metres can be covered by the operation of a switch as in ordinary broadcast practice. No coil changing is necessary and no other coils are required, as the unit incorporates windings for aerial, tuning and reaction circuits. The coil is also suitable for use with sets covering all wave bands with a .0005 tuning condenser. In this case the Dual Range feature is not employed.

4/6

The Telsen Short-wave Coil adds the Short Waves without coil changing.

TELSEN
SHORT-WAVE COMPONENTS

CVS-166

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

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

UNBIASED

BY FREE GRID

Private Thoughts on Television.

IN spite of the thoroughly praiseworthy efforts of the televisionists to find a place in the sun, I fear that this particular application of science will never make much headway while the present system of moving mechanical parts is adhered to in any shape or form. Having said this, I sit back and await with calm confidence the arrival of the tumbril to carry me off to the guillotine amid the execrations of the mob and the avalanche of defunct cats and decaying vegetable matter, to say nothing of the disused and rusted scanning discs which will be shied at me by all and sundry.

The tumult having subsided, I can now proceed to say that I do not in the least mean to belittle the efforts of those who have been so hard at work with mechanical systems; indeed, the really marvellous things they have achieved commands the admiration of everybody, and no doubt they could in time get a lot farther along the road they are at present travelling. I think, however, that eventually the trouble will be satisfactorily solved by electrical means, and, indeed, the use of the cathode-ray tube already points in that direction. Not, of course, that I mean to suggest that the application of this method of tackling television is something new; on the contrary, I myself well recollect the idea being both mooted and hooted nearly a quarter of a century ago.

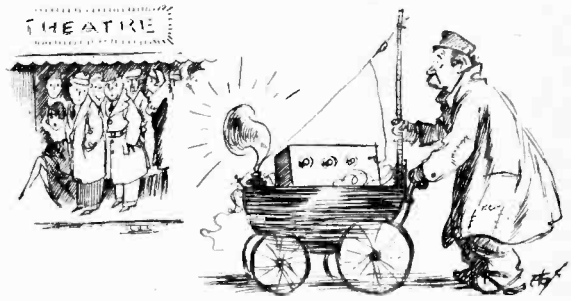
With calm confidence.

The present situation with regard to television is rather similar to that of wireless telephony in pre-War days, when valiant efforts were being made with various forms of arc systems, and, although it cannot be doubted that further progress would have been achieved against fearful odds, yet modern broadcasting would never have been possible had it not been for the development of the valve.

The ordinary public does not take a terrifically great interest in television at the present, but I think that this is partly the result of the disappointment almost akin to disillusionment which awaited it several years ago when it was led to believe that television had really "arrived"; radio dealers all over America and Europe tantalising credulous crowds with mysterious boxes containing ground glass screens and recessed loud speaker horns. I am afraid that the television people have cried "Eureka" so often since then that, when a presentable instrument does eventually arrive, they will have the greatest difficulty in persuading the public that they are telling the truth at last, and they have only themselves to thank for it.

Pity the Pit Patron.

THE other evening as I was striding briskly along the Strand, swinging my umbrella in a moment of elation, I had the misfortune to strike a fellow-citizen, whose subsequent remarks on the subject were far from conciliatory. As I made my apologies I observed with interest that he was stage-managing the efforts of a very ancient five-valve set standing in an exceedingly disreputable-looking perambulator which, expectantly, he was wheeling along the queue of patient-looking people who were waiting to get into the Lyceum. As



Fat-stock prices for all.

the loud speaker was at the moment bellowing forth the fat-stock prices, the pecuniary response from the crowd was not very great.

Now, I have seen a great variety of theatre-queue entertainers, including the type who merely wheel an ancient gramophone in a barrow, but *radio* entertainment for a theatre queue was an entire novelty to me, and it has set me wondering why theatre managers do not make an effort to while away the weary waiting hours of their pit patrons in this manner. They could easily install a sensitive and selective set in the box-office and arrange for someone to keep the programme alive by changing from station to station as occasion demanded. They could even, if necessary, stimulate interest in the plays running at their associated theatres by putting across Blattnerphone or gramophone excerpts. It would be quite easy, of course, for one or two loud speakers to be carefully placed in position over the heads of the queue.

Since all theatres have queues at about the same time, they might even unite in giving a pukka entertainment from a central studio of their own and distribute it to the various queues by land-line.

Current Topics.

BRITISH-BUILT STATIONS IN SWITZERLAND.—Two views of the Beromünster regional broadcasting station, which was built by the British Marconi Company. The power is 75 kilowatts. Wavelength : 459 metres.

New Radio Centre.

WITH the removal of the B.B.C. to Portland Place, the entire neighbourhood seems to have come under the spell of wireless. A number of prominent radio firms are opening showrooms in the district, and it would seem that Upper Regent Street will soon conjure up associations as unmistakable as those of Wardour Street, Harley Street, and Carey Street.

Wireless and Disarmament.

WE understand that the League of Nations has issued special requests to a number of broadcasting stations to transmit photographs of the sittings of the Disarmament Conference in Geneva, together with portraits of the leading national representatives. Since the B.B.C. has abandoned photo transmissions it will, of course, be impossible for the request to be complied with in this country.

Radio Toulouse, we learn, is transmitting a series of Belinograph pictures of the Conference.

300 kW. from Moscow?

THE new Moscow-Stalin broadcasting station has made a modest start with a power of 103 kW., but it is announced that next year 300 kW. will be used. The wavelength is 424 metres.

1,423 Broadcasting Stations.

ACCORDING to the U.S. Department of Commerce, there are 1,423 broadcasting stations in the world. Of the seventy countries which now have broadcasting facilities, twenty-nine allow broadcasting to be conducted by private enterprise, as in the United States, twenty make broadcasting a State monopoly, and two have combined private and public systems. Of the total number of stations, 617, or nearly half, are in the United States or its possessions.

The Radio City.

ASSUMING that three people listen to every wireless set in Manchester, the latest figures show that the programmes are enjoyed by half the population of the city. Approximately 130,000 licences are now in force, as compared with 98,000 last year and 75,000 in 1930.

Sharp Tuning.

THE world's greatest problem, i.e., what to do with old razor blades, seems to have been solved by Mr. H. Steanson, a Newcastle wireless experimenter, who, according to Press reports, has constructed a one-valve set which incorporates sixty-three blades and receives five stations. The blades are used as condenser vanes.

Prize for Radio Cabinet Design.

A PRIZE of £10 is offered for the best design for a radio-gramophone cabinet in connection with the Ninth Annual Open Competition of Industrial Designs organised by the Royal Society of Arts. Intending competitors should apply for particulars to the Secretary, John Street, Adelphi, London, W.C.2.

Ether "Cops" to Guard Listeners.

WE raise the editorial hat to Maître Antoine Vincent, of Dieppe, who, in an address before the local radio society, has suggested the establishment of an international wireless "code" similar to the rules which govern all civilised road traffic. Maître Vincent has his eye on electrical interference with broadcast reception.

Excelsior?

THE Radio Suisse Romande station is claiming that its microphone has scaled heights greater than any other. Recently a running commentary was given from a height of 10,000ft. on Mount Gornergrat.

Cause and Effect.

SWISS licence figures have risen by close upon fifty per cent. during 1931, due to the opening of the high-power station at Söttens and Beromünster. On January 1st, 1931, the figure stood at 103,808; the high-power stations were inaugurated during the year, and on December 31st there were 150,021 licence holders.

Still a President.

"THE most enlightened amateur in France" is the epithet won by ex-President Doumergue, who delighted radio enthusiasts during his term of office by the interest he invariably displayed in wireless matters. Now, in retirement at his home at Tournefeuilles, M. Doumergue operates an ambitious receiver, and he has now accepted the honorary presidency of the Toulouse-Pyrénées Radio Society.

Wireless Discussion Groups for the Blind.

AN urgent appeal for a thousand sighted persons to act as leaders of wireless discussion groups of blind listeners has been issued by the National Institute for the Blind.

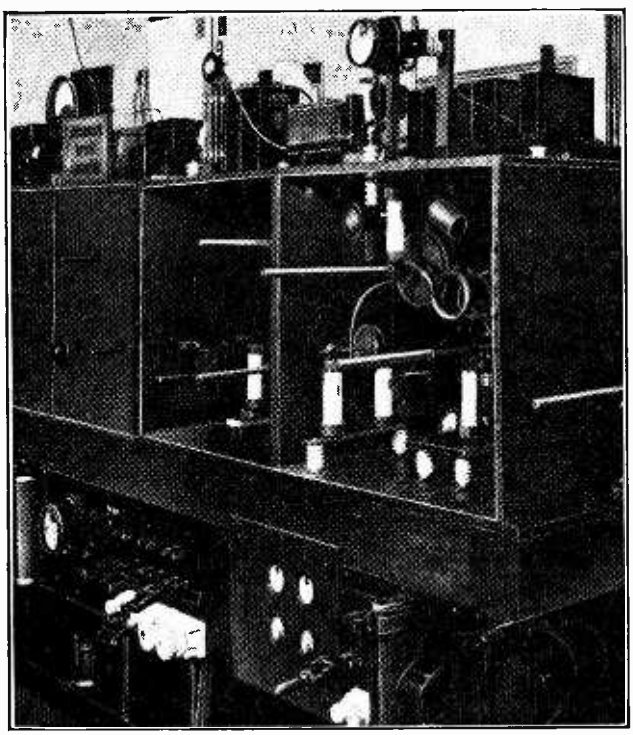
Co-operation in the running of these groups has been offered by the B.B.C.,

Seven-metre Broadcasting.—

Very few experimenters are in a position to be able to tackle the problems concerned with the transmission side of these waves. There is ample scope, however, on the reception side, and the development of a consistently sensitive set offers an enormous field which is as yet comparatively undeveloped. The efficiency of the receiver must ultimately decide the utility of ultra-short waves for public services. It must be a simple and foolproof instrument capable of producing results with the quality and reliability of the modern "broadcast receiver."

UPON the efficiency of the receiver ultimately depends the success of broadcasting on the ultra-short waves. Many problems still await solution and this article suggests several tempting lines of research which offer a large scope to the enterprising amateur experimenter.

The problem centres around the design of the ultra-short-wave valve oscillator and its associated tuning circuits. Sensitivity, selectivity, quality, and flexibility of control are points which must receive very careful consideration. The circuits shown on the previous page are simple oscillators which have been used with great success on these waves and around which experimental receivers have been built for five-metre work. To guide us in our experiments we must keep in mind the following possibilities: We may use (1) a "straight" receiver, or (2) a "superhet," or (3) a super-regenerative receiver. In each case we need an oscillator working on a seven-metre wavelength. In the case of the "straight" receiver it must be remembered that a valve rectifier employing reaction is very much more sensitive when oscillating than when just off the oscillating point, and this effect becomes more apparent as the wavelength of the received signal is decreased. To maintain high detector efficiency on a seven-metre wavelength we shall need plenty of reaction, which will be detrimental from the point of view of reception of high-quality telephony and music.



The Telefunken Company have been associated with ultra-short-wave broadcasting since 1929. This experimental transmitter has been used in Berlin by the German Post Office for more than a year.

Again, the normal detector will respond to signals of all intensities. On the very short waves a detector will only respond to signal voltages above a certain critical value, the particular value depending on the type of valve and the wavelength. This has been called the "Threshold Effect," and must not be confused with the well-known "Threshold Howl" effect.

Hence it is doubly essential to use a receiver employing a highly sensitive detector stage, and, as we have seen, this limits our choice to the superheterodyne and the super-regenerative types for the reception of telephony and music. The experimenter will find great scope for his own initiative in working on these problems. Such questions as the optimum size for coils, the optimum gauge of wire to use, the most sensitive type of valve, the size of the aerial, and optimum intermediate frequency, are but a few which come to mind immediately.

The writer has observed another effect which has been found to occur with disturbing regularity with every receiver he has used on the wavelengths shorter than ten metres. The receivers have been sensitive to interference from the ignition systems of petrol engines, and an oscillating receiver frequently responded to interferance from an engine a hundred yards away; in certain instances even the passive (i.e., non-oscillating) receiver was found to be very sensitive. The remedy for this is probably in screening the petrol engine.

Nothing has been said yet about electronic oscillators of the Barkhausen-Kurz (or Gill-Morrell) type. These were developed for the very short wavelengths shorter than two metres. There is no reason, however, why these oscillators should not be adapted for the longer waves of seven and eight metres.

A STUDY IN PROFITS.

IN America, where radio is considered as little more than another advertising medium, the world depression has brought prosperity to the broadcasting concerns. The gross profits of the two major chains, the National Broadcasting Company and the Columbia Broadcasting System, totalled $35,791,999 during the past year, the receipts of the former being $25,607,041, and those of the latter $10,184,958.

It will be understood with what eagerness these two great concerns are watching the Federal Radio Commission's enquiry into the merits of the existing system of sponsored programmes.

TANNOY SENIOR RADIOGRAM

A Six-valve A.C. Superheterodyne.

Single-dial tuning is a feature of the Tannoy superheterodyne.

UNTIL recently the radio side of even expensive radio-gramophones has been rather neglected, and many models have incorporated simple receivers of a type suited for no more than local reception. The demand for better radio equipment has coincided with the growth in popularity of the superheterodyne, and so it is not surprising to find that many of the latest and most up-to-date radio-gramophones are now fitted with this type of receiver.

Six valves are employed in the Tannoy 1932 Superhet. Radiogram, as preliminary H.F., first detector, oscillator, I.F. amplifier, second detector, and output stage, and it will be seen from the circuit that several departures are made from normal practice. The pre-selector circuits are of the band-pass type, but the mutual inductance between the two filter coils is provided by means of a link circuit, instead of the more usual coupling coil.

The H.F. stage, which employs a Cossor variable-mu valve (type M.V.S.G.), is coupled to the M.S.G./L.A. first detector by means of an aperiodic H.F. transformer.

Following the first detector is the single I.F. stage with another M.V.S.G. variable-mu valve and band-pass filter couplings. The intermediate frequency is about 105 kc., and a high degree of adjacent channel selectivity is obtained with a small amount of sideband cutting. The M.H.4 second detector works as a power grid detector, and is auto-transformer-coupled to the P.X.4 output valve.

The Gramophone Equipment.

The moving-coil loud speaker is transformer coupled to the output valve; but sockets are provided for fitting an external speaker. The speaker field is used as the main smoothing choke in conjunction with high-capacity electrolytic condensers, and a metal rectifier is employed for the H.T. supply.

An induction type gramophone motor is fitted, and the pick-up is housed in a compartment with a sound-proof lid, which effectively prevents pick-up chatter from being audible. The whole apparatus is housed in a polished walnut cabinet of pleasing proportions, and of a size which is not too large for the average room, while the controls and illuminated dial are conveniently located beneath the loud speaker fret.

The Tuning Circuits.

Single-dial tuning is fitted as a matter of course, and it is interesting to note that a departure has been made from the usual method of employing padding condensers in the oscillator circuit. A special three-gang condenser is used with vanes so shaped that the correct frequency difference between the different circuits is automatically obtained.

A single switch is used to change from medium to long waves, and from radio to gramophone, and a departure is made from usual practice in regard to the pick-up connections, for the pick-up is connected to the lower end of the detector grid leak, and all switching of the intermediate frequency circuits is avoided. On gramophone, the detector grid leak, in conjunction with the volume control potentiometer, forms a fixed potentiometer which limits the input to the amplifier, and thus makes it impossible to overload the output valve.

A similar effect is obtained on the radio side by the careful adjustment of the second detector anode voltage, and conditions are such that the detector and output valve just overload together. As a result, the volume falls off when the volume control is advanced too far, and really bad quality cannot be obtained, no matter how carelessly the controls are handled.

The same potentiometer is used for volume control on both radio and gramophone; on gramophone it is connected as the usual potentiometer across the pick-up, but on radio it is used as a variable resistance in the cathode leads of the H.F.

FEATURES.

Six-valve A.C. mains superheterodyne radio-gramophone, with induction type gramophone motor. Variable-mu valves.

Single dial tuning with illuminated scale and special gang condenser with shaped plates. Combined wavechange and radio-gramophone switch. Volume control operative on both radio and gramophone by the same knob.

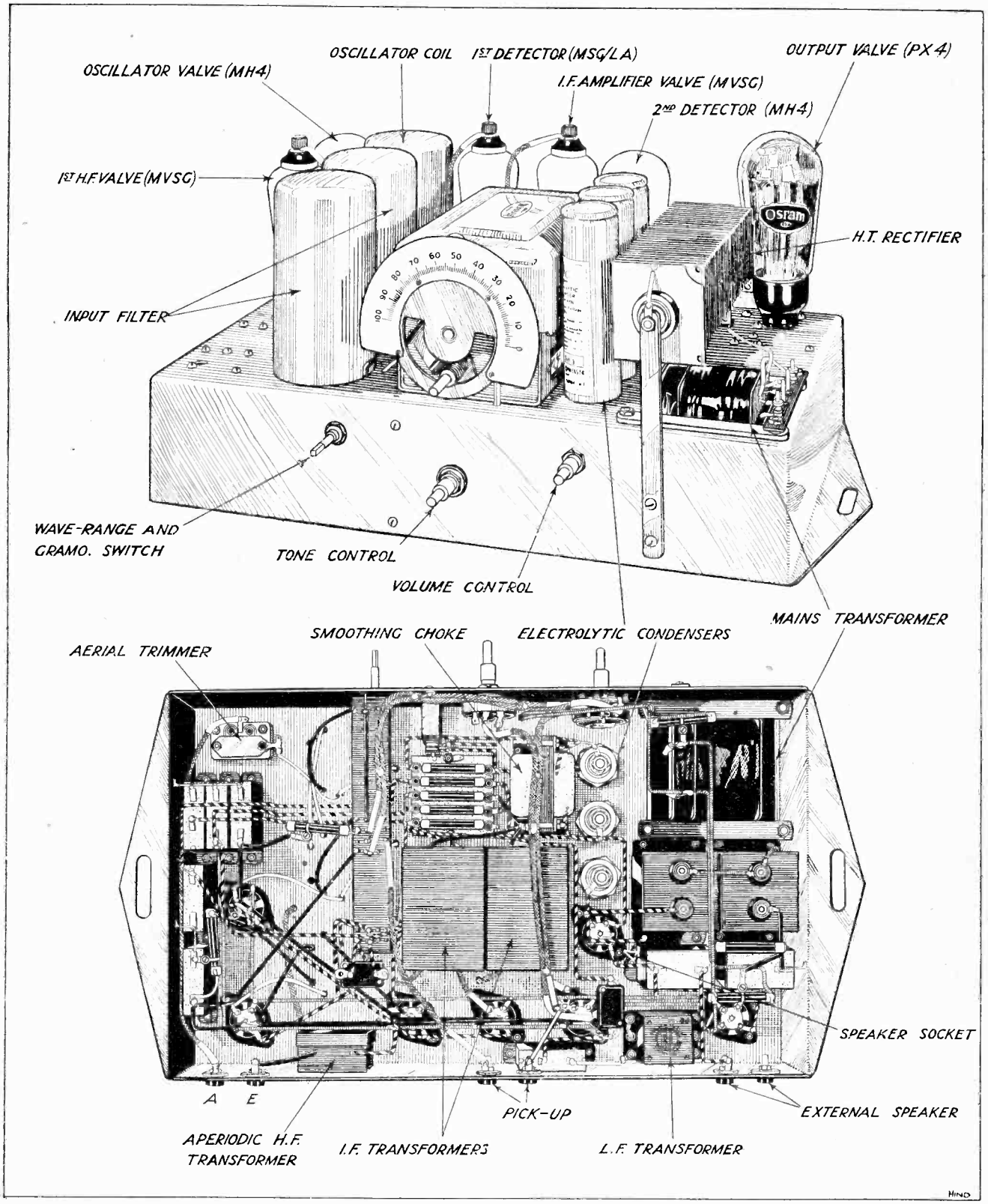
Moving-coil loud speaker, with provision for external speaker. Speaker field is energised from the smoothing circuit.

Tone control, to reduce the upper audible frequencies and background noise.

Price 55 Gns.

Makers:—Tannoy Radio, 1-7 Dalton Street, West Norwood, London. S.E.27.

SENSITIVE SUPERHETERODYNE ON METAL CHASSIS.



Two views of the Tannoy Senior Radio-gramophone which embodies variable-mu stages.

Tannoy Senior Radiogram.—

and I.F. valves. Volume is thus controlled by varying the grid bias of these valves.

Practical Results.

The receiver has been tested at about nine miles south of Brookmans Park, and it gave a very satisfactory performance. In an instrument of this nature, which is intended more for entertainment purposes than for ultra long-distance reception, quality of reproduction is perhaps the most important point, and it may be said that in this respect the receiver proved exceptionally good. The power output is ample for all domestic purposes, and the balance between high and low notes is just right. Complete freedom from cabinet resonance has been obtained, and the lowest notes are reproduced naturally and without a distressing boom. The high notes, too, are unusually prominent for a superheterodyne, and, indeed, those accustomed to less perfect apparatus may at first find them too strong. For this reason, therefore, a tone control is fitted, with which it is possible to obtain any desired type of reproduction from the full brilliance to a complete absence of the high frequencies. The general tone on both radio and gramophone appears to be about the same, and it is evident that the pick-up employed gives ample correction for the weak bass rendering in records.

The adjacent channel selectivity is a little lower than usual for a receiver of this type, and it is doubtless due to this that the quality shows the presence of the high audible frequencies. In a test, it proved impossible to receive Koenigswusterhausen free from Daventry 5XX, while on the medium waveband Mulhacker could not be received without a strong background of the London Regional. These tests are, of course, very severe, and tax the capabilities of the most selective sets to the utmost. Algiers, which is spaced from the London Regional by 18 kc., could be received without a trace of the latter station, and all the stronger Continental stations are available free from interference and at a strength and quality of good programme value.

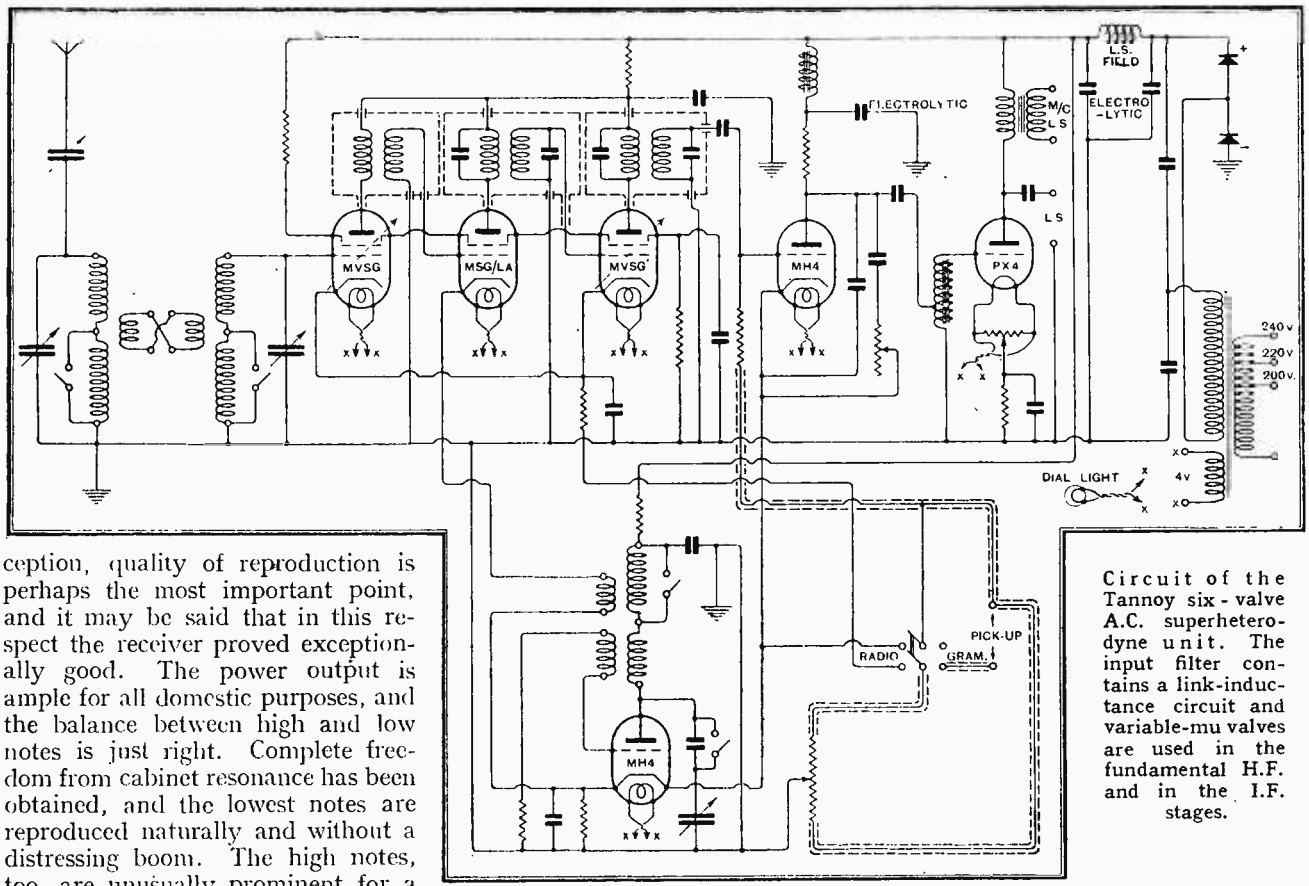
No Beat Interference.

The set is remarkably free from whistles due to beat interference and I.F. second harmonic interference, and this is no doubt largely due to the fact that lavish use is made of screened wire in the internal connections, and to the efficiency of the input band-pass filter. Second channel interference is, of course, found at two points on the dial, and is almost inevitable with any superheterodyne at such a short distance from the high-power Brookmans Park transmitters.

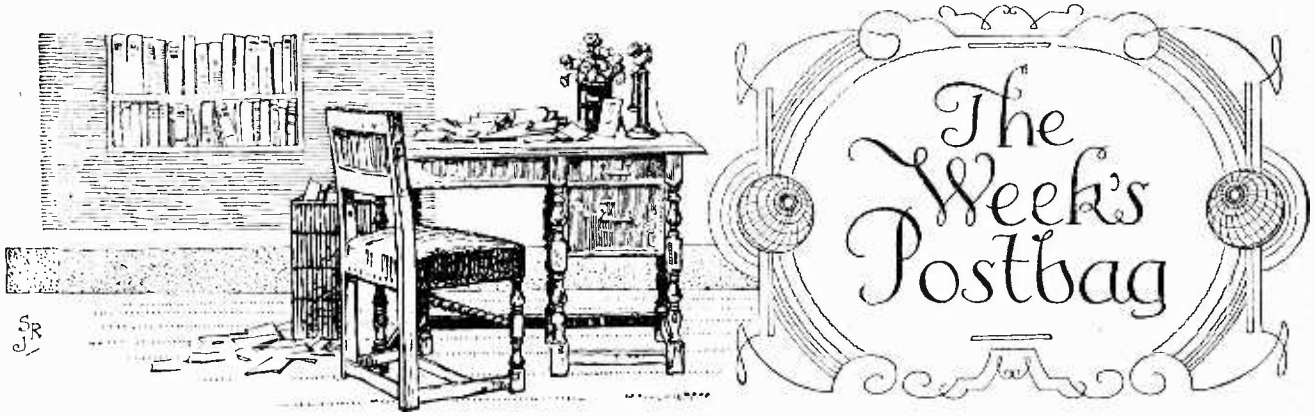
The sensitivity is ample for the reception of the weakest stations, and the receiver will provide good volume from the stronger Continental stations with but 10ft. of wire as an aerial. When the set is being worked all out, however, background noise is rather in evidence, and, where possible, it is desirable to use a reasonably efficient aerial; under these conditions the set is very quiet in operation, and dozens of stations can be received without a trace of background noise.

Mains hum is entirely negligible, due to the use of large-capacity smoothing condensers, and to the fact that the pick-up connections are run with screened wire.

The makers are Tannoy Products, 1-7, Dalton Street, W. Norwood, S.E.27, and the price is 55 gns.



Circuit of the Tannoy six-valve A.C. superheterodyne unit. The input filter contains a link-inductance circuit and variable-mu valves are used in the fundamental H.F. and in the I.F. stages.



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

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

Tone Correction and Interference.

AT the beginning of what is likely to prove an interesting and fruitful series of developments in receiver design it is very desirable that there should be a clear understanding of what may and what may not be expected in the way of freedom from interference in high-selectivity, tone-corrected sets. I had hoped that my article published in *The Wireless World* on December 30th, 1931, and January 6th, 1932, would be found quite explicit on the point, but certain phrases that have since appeared in the Correspondence columns of this periodical seem to indicate a need for a more precise statement.

In the light of existing experimental and theoretical knowledge, it may be expected that reception on symmetrically resonant tuned circuits of high selectivity, followed by appropriate tone correction, will give a correspondingly high degree of freedom from all interference except that which arises from the interaction of the carrier wave of the wanted transmission with the carrier waves or side waves of transmissions on neighbouring frequencies.

This statement obviously does not imply the possibility of receiving fully, and free from *all* interference, either of two modulated transmissions of which the side bands actually overlap, but it does indicate the possibility of receiving either of these transmissions free from appreciable reproduction of the intelligible modulation of the other.

Further, it appears necessary to point out that in the article referred to above it was deliberately emphasised that nothing was either stated or implied about the behaviour of circuits in which abnormally high selectivity was obtained by means other than the use of ordinary tuned circuits, retroactive or otherwise.

Finally, I would like to take this opportunity of amending a statement made in the article on the demodulation effect associated with the linear rectification of interfering transmissions. It was stated that the demodulation effect on the weaker signal would only be fully effective if the carrier beat frequency was supersonic. A further examination of the matter has shown that this condition is not essential, and that the demodulation effect will also occur when the carrier beat frequency is audible. It will actually be more pronounced the higher the carrier beat frequency, but this will be due to the increased disparity between the detector voltages in consequence of the increased frequency separation. With square law rectification there is no demodulation effect, but, as this type of rectification has an inherent discrimination against the weaker signal, the resulting interference will be of the same order with either type of rectification. In both cases the high selectivity of the tuned circuit has the additional advantage of producing rectification conditions which enhance the overall selectivity. F. M. COLEBROOK.

Teddington.

Selectivity and Tone Correction.

IN Mr. Turner's interesting letter on this subject, in the issue of January 20th, he states that he obtains a remarkable freedom from "modulation interference," by which he presumably means the heterodyne notes between the carrier of the station he is receiving and the nearer sidebands of the unwanted station; moreover, he states that this experience confirms the theory set out by Mr. Colebrook in his two articles in this journal on December 31st and January 6th last.

To take this second point first: Mr. Colebrook shows that the direct interference from hearing the unwanted transmission may be cut down by using a selective circuit with audio tone correction, but he specifically states in the second part of his article that this will have no effect upon the heterodyne interference from the unwanted sidebands. Thus Mr. Turner is obtaining a result which is not at all to be expected from Mr. Colebrook's article; his experience agrees, however, with some of the rather vague reports of the capabilities of the Stenode Radiostat.

Secondly, with regard to Mr. Colebrook's theory: when considering the matter some nine months ago, I came to the same conclusions, which seemed quite inescapable, but nevertheless, it appeared worth while to test them as far as possible by experiment; for this purpose, local transmitters were used, which could be modulated at known percentage with any desired audio notes; quantitative measurements were taken, and it was found that, however much the direct interference was cut out by sharp tuning, the heterodyne note from the nearer sideband was not affected at all, and the latter behaved exactly as if it had been a sideband of the desired transmission.

Hence, one can only suggest that in Mr. Turner's experiments (which were, as far as one can gather, of a qualitative nature on ordinary music and speech transmissions) either the receiver imposed a considerable high-note-cut off or else that the transmitter modulation percentage for the high notes was very small; this latter is, of course, to a certain degree a property of all practical transmissions. M. V. CALLENDAR, B.A.

Lissen Research Laboratory.

Interference.

MAY I defend my honour by first stating that I have experimented with most of the band-pass filters that *The Wireless World* has published. My present 1-v.-1 set uses the coils from the "D.C. Band-pass Five"—these together with an H.F. transformer of "1930 Everyman Four" vintage; power-grid detection (275 volts), and matched power pentode output "*can give me a large selection of foreign stations at good strength and with real quality.*" It is here that Mr. Nugent C. A. Gilders must leave his key-hole and take a broader view.

The three classes of interference which most upset me are Morse (possibly more a seaboard trouble), electrical disturbances, caused by obsolete or badly designed machines, and, the biggest curse of all, the misuse of the reacting detector coupled direct to the aerial.

A few experiments with an o.v.1. : a "Wireless World Four," and a long and a short aerial will remove many ambiguities from our minds.

Couple the two-valver to the long aerial and note interference/signal ratio—reconnect to short aerial, using reaction to ensure the same loud speaker volume; you will find the interference is, if anything, more prominent than before.

Connection of the "Wireless World Four" to *either* aerial gives approximately similar aural results on stations receivable on the two valver owing to the large overall magnification "of the set." Full-out, the volume of sound is too great to be "felt" for long in the usual size of room. On reducing the volume, the interference, in the case of local stations, is reduced to inaudibility. Well and good! but don't forget when we "turn the wick up" to receive a foreign programme, which with such a powerful set is well within our service area, we shall receive the interference many times louder than with the two valver.

Let us summarise as follows: a band-pass filter will not cut out untuned, or flatly tuned, interference; H.F. stages ensure a background, free from extraneous noises, when receiving a station that permits the volume control to be near the off position; To enjoy a foreign-station programme no creation of interference can be tolerated; H.F. stages are an essential in securing first-class quality from any except a local station, they are a great help towards securing selectivity, and prevent our interfering with the reception of others; lastly, the size of the aerial does not affect the interference/signal ratio of the output, which is governed entirely by the overall magnification of the installation as a whole. Q.E.D.—You can't have interference and enjoy programmes from foreign stations. I think this also answers other points raised in Mr. Nugent C. A. Gilder's letter.

Cheshire. FRANKLIN JUDGE.

Electricity Supply.

REFERRING to the failure of various electric supply authorities to maintain their declared pressure, possibly your correspondents are not aware of the regulations of the Electricity Commissioners for "ensuring a proper and sufficient supply of electrical energy" made under the provisions of the Electricity (Supply) Acts, 1882-1919. Regulation B3 states: "Before commencing to give a supply to any consumer the undertakers shall declare to that consumer the constant pressure at which they propose to supply energy at his terminals. The pressure so declared shall be constantly maintained subject to a variation not exceeding 4 per cent. above or below the declared pressure under any conditions of supply which the consumer is entitled to receive. . . ." Regulation B5 states: "If the undertakers make default in complying with any of these regulations as to supply, they shall, subject to the provisions of the Order, be liable on conviction to a penalty not exceeding £5 for every such default and to a daily penalty not exceeding £5." In Section 40 of the Schedule to the Electric Lighting Clauses Act (which is incorporated for the purposes of Section 12 of the Electricity Supply Act, 1919), "An electric inspector . . . . shall, on payment by the consumer of the prescribed fee, test the variation of the electric pressure at the consumers' terminals . . . for the purpose of determining whether the undertakers have complied with . . . the Board of Trade regulations." It seems that if the authorities in question will not take notice, several consumers should jointly apply to the Electricity Commissioner and ask for the services of an electric inspector, unless, of course, there happens to be such an inspector available in the district concerned. "ADSUM."

THE many subscribers to *The Wireless World* in Grimsby thank you for your article, which we know had a very beneficial effect on our local Electrical Mandarins.

The idea of this imposition has now been dropped. If possible our admiration for *The Wireless World* has increased.

Grimsby. JOHN EASTE.

Informative Advertising.

I WISH to take this opportunity of expressing my thanks to Mr. N. P. Slade for his letter on "Informative Advertising" and also to you for drawing attention to it in your Leader. It is very difficult, when perusing the advertisements of the radio industry, to realise that one is dealing with a branch of applied *science*, and Mr. Slade has expressed the case very well.

Before making and advertising apparatus it must be *designed*, and to many the word design means nothing other than a list of parts made to fit together and look like something. True there are firms who have excellent technical departments, and their work on the whole is good and reliable provided it is not tampered with in the other departments, whose interests lie more in sales and production; but there are many more firms who do not possess such a brain centre (technical department I mean), and I think it is high time they called in the services of a competent consultant who not only knows how to design the apparatus scientifically, but can arrange matters for a cheap and efficient production to follow.

So much for design, but what about testing? What standards do the industry attempt to work to? The answer is, *none*. It is high time, therefore, that a set of definitions was compiled for the testing and specifying of apparatus, and only when that is done can we say that the industry realises that it is a science with which it is dealing. The Americans have done much in this respect, and their deliberations are to be found in the 1931 Report of the Standardisation Committee of the Institute of Radio Engineers. I invite firms to read this and then see how their products fit, or, rather I should say, misfit.

I quite appreciate the fact that many possible standard tests would prove too costly for many of the firms, but why not install the gear at some central proving station to which all apparatus can be sent? This station will, in the first instance, submit a confidential report to the firm concerned, and, if satisfactory to them, can then be published. Future production can then be checked by comparison with a standard tested component. WM. D. OLIPHANT.

Edgware, Middlesex.

I QUITE agree with Mr. Slade in his appeal to advertisers in the wireless Press to give more data in regard to their products, instead of astounding claims, etc.

I wonder how many people have been disappointed on buying one of these astounding articles, when, in all probability its performance is no better than that which it replaced. In the same issue as Mr. Slade's letter the author of the Power Radio-Gram points out the false economy of using condensers of a lower voltage rating than those specified.

Now at least four advertisers in the same issue quote prices ranging from 5s. 6d. to the seemingly stupendous sum of 19s. 4d. for a fixed condenser of 4 mfd. *tested* at 1,500 volts D.C.

Now, Sir, surely more data is required to explain this wide difference in price, or must we look to your editorial heading of August 19th, 1931, for enlightenment? T. LEBBON.

Harrogate.

Empire Broadcasting.

THE news that the B.B.C. is to proceed at once with the erection of a short-wave station has been received with joy by all wireless enthusiasts in this country. It is now up to the British manufacturers to evolve some really good short-wave receivers, which will be able to stand up to the hard climatic conditions which exist in many of Britain's colonies. In this country humidity of the atmosphere is our chief drawback so far as components are concerned, and I assume that similar conditions appertain to Ceylon, The West Indies, Nigeria, Kenya, Hongkong and parts of India.

The Deputy Agent, Malayan Information Bureau, Charing Cross, London, writes that he is frequently receiving enquiries from persons about to proceed to this country, as to what receivers are most suitable for this country. Manufacturers who are interested in developing their business in Malaya could probably benefit themselves by supplying the above-mentioned gentleman with particulars of their products.

There are three amateur short-wave stations operating at the present time in Singapore, and this Society is, at the moment, endeavouring to obtain the Government's permission to erect a small medium-wave transmitter for serving Singapore.

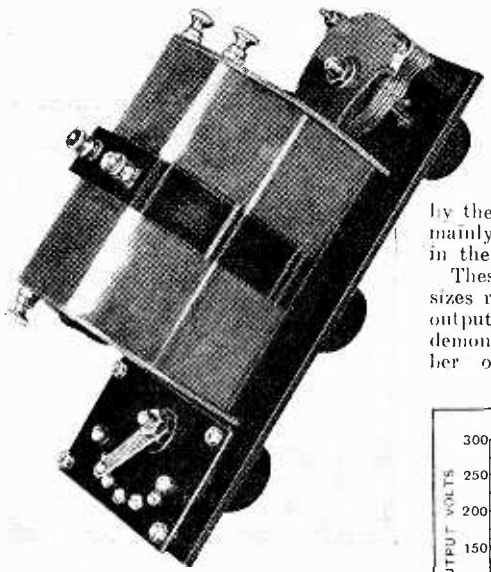
Other stations which we get regularly are: Saigon, French Indo-China; Bandoeng, Java; Bangkok, Siam; Kuala Lumpur, F.M.S.; Pontoise, France; a few American short-waves and when conditions are good, Chelmsford.

D. W. MORTLOCK.
Hon. Treasurer.
Amateur Wireless Society of Malaya (Singapore.)

Laboratory Tests on New Apparatus

HAMBLING "AUTOKOIL."

The "Autokoil" is an all-wave tuner consisting of a four-section coil having five tappings which are brought out to a selector switch, a rotary reaction coil, and a small variable condenser connected in series with the aerial lead. Although primarily intended for use as an aerial coil, it can be employed either in a tuned grid H.F. circuit or as a tuned anode coil, in which case the small aerial condenser could be utilised as the coupling condenser to the following valve.



"Autokoil" all-wave tuner with variable reaction coil and five-way selector switch.

The wave range covered is from 190 metres to 2,100 metres, approximately, with a 0.0005 mfd. tuning condenser, and there is a generous overlap between the respective ranges covered by the various sections.

Regeneration is effective over the whole wave range covered, but it was found necessary to adjust the series aerial condenser so as to reduce the effect of the aerial load when in the region of 200 metres to obtain satisfactory operation.

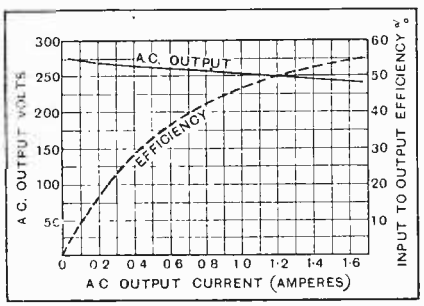
The makers are A. W. Hambling, 104, High Holborn, London, W.C.2, and the price is 12s. 6d.

CRYPTO RADIO CONVERTOR EQUIPMENT.

The Crypto Electrical Co., Ltd., Willesden, London, N.W.10, have for long studied the problem of converting D.C. to A.C. for the purpose of operating the A.C. type of receivers from direct current supply mains. The earlier difficulties of adequately filtering the output to remove the D.C. commutator ripple, and also to prevent direct induction between the machine and the wireless apparatus, have been satisfactorily overcome, and tests carried out with one of their latest models proved quite satisfactory even with the most sensitive type of receiver.

Mechanical noises are almost entirely absent, as the machine is mounted on sponge rubber and enclosed in a sound-proof cabinet. Large holes are cut in the base to allow adequate ventilation and circulation of air, this being assisted by a small fan mounted on one end of the armature. The electrical interference problem has been satisfactorily solved, partly by the general design of the machine, but mainly by the special filter unit embodied in the equipment.

These machines are made in various sizes ranging from 50 watts to 600 watts output, the larger sizes being ideal for demonstration show-rooms where a number of receivers are operated simultaneously. Special starters fitted with "over-load" and "no volt" release gear should be used with the machines giving 400 watts output and over. An output voltage regulating rheostat is available for use where necessary.

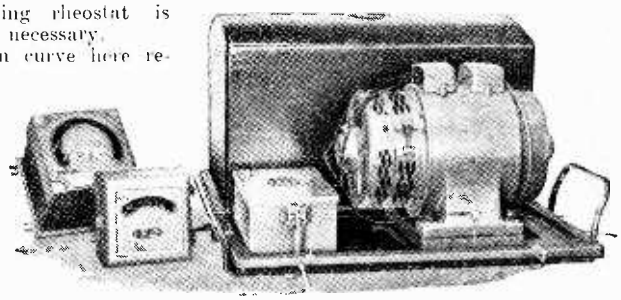


Voltage regulation and efficiency curves taken with a 400-watt Crypto D.C. to A.C. convertor.

The voltage regulation curve here reproduced was obtained with a 400-watt machine. The broken-line curve shows the efficiency under various load conditions, the output watts being recorded as a percentage of the input watts.

The prices of these convertor equipments range from £13 10s. for a 50-watt size to £32 for a 600-watt outfit.

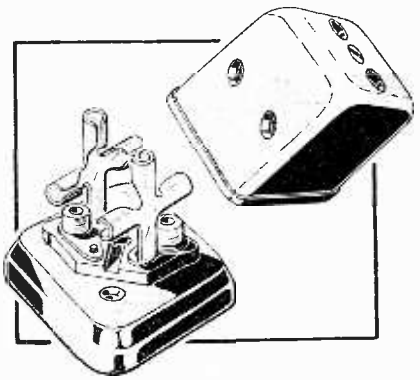
The makers are the Crypto Electrical Co., Ltd., Willesden, London, N.10.



Crypto radio convertor equipment, 400-watt rating, with cover removed.

NEW THREE-WAY EXTENSION POWER SOCKET.

This special socket is intended for use in ordinary domestic electrical supply circuits, and provides a three-way connection using the standard 5-amp. two-pin plugs. Fitted to an existing power point, it will enable three separate pieces of apparatus to be connected individually or collectively, and should prove useful where a wireless receiver and possibly an electric clock, together with other domestic electrical apparatus, have to draw their supplies from a single power-point.



Crabtree three-way socket for power-point extensions.

An alternative use would be for loud speaker extensions, as it could be utilised as a three-way junction box. The base is made of brown glazed china, while the removable cover is a brown "Jacelite" moulding. This is fixed by a single screw.

The makers are J. A. Crabtree and Co., Ltd., Lincoln Works, Walsall, and the price is 1s. 8d.

R.I. AUDIRAD CHOKE.

In a test report relating to the new R.I. Audirad L.F. choke published in our issue of February 10th last the price was given as 8s. 6d., but we now learn that the correct price is 8s 9d.

Nuts to Crack

Instructive Problems and their Solution.

THE present series has been started by *The Wireless World* for the benefit of readers who like to work out little problems for themselves and be sure that the results they obtain are correct. At frequent intervals wireless problems are set, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Last week problems 16 to 18 were given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

Problem No. 16.—**A condenser of 0.0002 mfd. is placed in series with one of 0.002 mfd. What is the value of the resulting capacity, and what would the capacity have been had they been placed in parallel?**

Answer—0.00018 *mfd. and* 0.0022 *mfd.*

Capacities when expressed in microfarads provide excellent scope for gymnastics with the decimal point. If C denote the resultant capacity of the two capacities in series, then, by the well-known formula,

$$\frac{1}{C} = \frac{1}{0.0002} + \frac{1}{0.002}$$

$$= 5{,}000 + 500 = 5{,}500$$

$$\therefore \quad C = \frac{1}{5{,}500} \text{ or } 0.00018 \text{ mfd. (approx.)}$$

If placed in parallel, the total capacity is simply the sum of the two component capacities, i.e., 0.002 + 0.0002, or 0.0022 mfd.

o o o o

Problem No. 17.—**It is desired to use a milliammeter whose maximum reading is 5 mA. to measure currents up to 100 mA. If the meter resistance is 50 ohms, what value of external resistance will it be necessary to use, and how should it be connected?**

Answer—2.63 *ohms, in parallel with the instrument.*

At full-scale deflection the meter passes 5 mA. or 0.005 amperes. Therefore, the voltage drop across it at maximum deflection will be IR or 0.005×50 volts, i.e., 0.25 volt. Since the meter can take no more current without danger, it follows that if greater currents are to be measured the extra current must be shunted away from the instrument through a resistance placed in parallel with it. In our case, we wish to pass 100 mA. through the combination of meter and resistance in parallel so that at the same time the meter will show its full-scale reading. Since it does this at 5 mA., we must obviously pass the balance of 95 mA., or 0.095 amperes, through the shunting resistance. Now, the potential drop across the meter was found above to be 0.25 volt, and this must also be the drop across the resistance, since the two are in parallel. We have, then, a means of finding the value of the resistance, since, from Ohm's Law, $R = \frac{E}{I}$. Its value is thus $\frac{0.25}{0.095}$, or 2.63 ohms.

o o o o

Problem No. 18.—**With 100 volts on the plate, a certain valve passes a steady current of 17.5 mA. when the grid has a negative bias of 10 volts. If the magnification factor of the valve under these conditions is 15, and the mutual conductance 2.5 mA. per volt, what will be the approximate current taken by the valve if the grid bias is increased to 12 volts negative?**

Answer—12.5 *mA.*

This question will test your knowledge of what is meant by "mutual conductance." This simply means the rate at which the anode current changes with the grid voltage when the plate voltage is maintained at a constant value. The mutual conductance of the present valve is 2.5 mA. per volt, which means that, under the working conditions specified, a change of 1 volt in the grid potential will result in a change of 2.5 mA. of anode current. Since the negative grid potential is here increased from 10 to 12 volts, we shall thus expect the anode current to fall by twice 2.5 or 5 mA., so that its new value will be 12.5 mA. approximately. Note that the magnification factor has nothing at all to do with this question. Note, too, that owing to the nature of the grid-volts anode-current characteristic, an increase of negative grid potential results in a *fall* of steady anode current. The result as we have obtained it is, of course, only true so long as the grid potentials in question lie on the "straight" part of the characteristic, for which the mutual conductance has a constant value.

NEXT WEEK'S PROBLEMS.

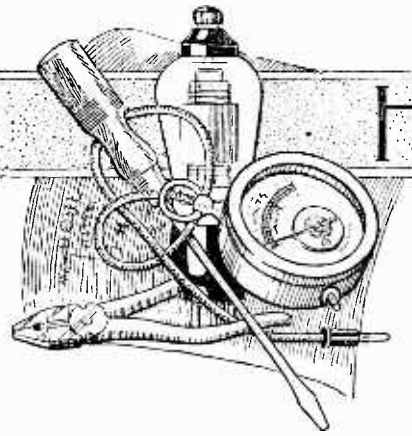
Problem No. 19.—**Under working conditions a certain triode has an anode A.C. resistance of 20,000 ohms and a mutual conductance of 1.8 milliamperes per volt. What is its magnification factor?**

Problem No. 20.—**A 50-turn coil has an inductance of 200 μH. What is its approximate reactance at a wavelength of 314 metres? If its resistance is 500 ohms, what is the impedance of the coil at this wavelength?**

Problem No. 21.—**The filaments of two valves are connected in parallel, and current is supplied from a 4-volt accumulator. If the resistances of the two filaments are 10 ohms and 12 ohms, what is the total filament current taken?**

NUTCRACKER.

Practical Hints & Tips



AS a supplement to meteorological information broadcast by the B.B.C., the aviation weather reports and forecasts which are transmitted at frequent intervals from Heston are distinctly useful. But there is the difficulty of wavelength; the aerodrome station works on 833 metres, which is just outside the wave range of the average broadcast receiver, and so a slight modification will generally be necessary if these transmissions are to be received.

THE A.A. WEATHER REPORTS.

The usual way of extending the long waveband in a downward direction is to remove turns from the long-wave sections of the tuning coils. So far so good; but in doing so it will almost always be found, especially if stray capacities across the circuits are considerable, that the upper limit of wavelength will be no greater than, perhaps, 1,800 metres.

To avoid this sacrifice, however, each tuned circuit may be rearranged as in Fig. 1, a single-pole change-over switch, with a definite "off" position, being used in conjunction with a semi-variable condenser (C_x) to give three tuning ranges. When the switch is in the "up" position it will be seen that this extra capacity is placed in parallel with the main tuning condenser.

The procedure in setting up an arrangement of this sort is, first, to remove turns progressively (and equally) from the long-wave section of each coil until the 833-metre transmission can be received, and then to fit and wire the switches and condensers as indicated. The operation of the receiver on the "long" and "medium" bands will not be greatly affected, but reception of transmissions around the 1,800-2,000-metre mark is ensured by making a suitable adjustment of the extra condenser—or condensers—which may have a maximum capacity of 0.0002 or 0.0003 mfd.

Simplified Aids to Better Reception.

APPARENTLY unimportant details often exercise a marked effect upon the results obtainable from a receiver, and a case in point is the silk backing to the loud speaker fret. This silk is often secured by being glued around the edge of the hole only, and is not fixed to the cross-strips of the fret.

Now the cone of a moving-coil loud speaker develops a considerable amplitude of movement at low frequencies, and, in fact, it will often move visibly when a low note is applied suddenly, as when a drum is beaten. Such a large movement of the cone means that a large volume of air is displaced, and this movement of the air carries with it the silk backing to the fret.

RATTLING IN M.C. SPEAKERS.

In itself a movement of the silk causes little harm, but it will often be found that in its forward movement it is brought up with a jerk against the fretwork, and causes an audible rattle.

The remedy, of course, is to glue the silk firmly to every portion of the woodwork with which it can come into contact, so that this trouble cannot occur.

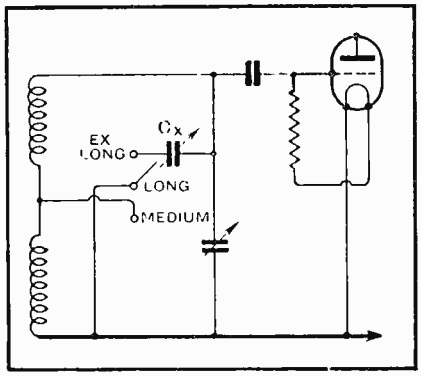


Fig. 1.—Triple wave-range switching, with extra tuning capacity to compensate for removal of turns.

ONE of the advantages of tone-corrected L.F. amplification in conjunction with ultra-selective tuned circuits is that the amateur can give this system of reception a trial without the need for hardly any more apparatus than is likely to be in his possession.

As was shown in the preliminary announcement of the new *Wireless World* tone correction receiver which appeared in the issue for January 27th, the circuits are basically simple, and, as far as the skilled amateur is concerned, enough information was given to allow of a start being made. It should be made quite clear, however, that an experimental receiver of this sort, without special provision for constant reaction, is only suitable for those whose ability to handle tricky circuits is rather above the average. Those who mistrust their capabilities in this direction would do better to wait for the simplified version of the set, in which all manipulative difficulties have been overcome, and which is to be described next week. For the benefit of the others, it may be pointed out that the throttle-controlled Hartley detector circuit, preferably with the addition of a separately tuned and loosely coupled aerial circuit, is in some ways an ideal arrangement for this purpose, although it would be a matter of very real difficulty to provide ganged tuning of the two circuits.

THE "AUTOTONE."

Broadcast Brevities.

By Our Special Correspondent.

B.B.C. and the "Autotone."

WHETHER the B.B.C. are preparing for the new reception as exemplified in the "Autotone" I know not, but it is a fact that each new Regional station appears with one mast fewer than its predecessor. The inference is obvious! Or isn't it?

Brookmans Park has four masts, Moorside Edge manages with three, and now, I hear, it has been decided to give the Scottish transmitter only two.

Fewer and Fewer.

It would be going too far, perhaps, to hint that Western Regional will have only one, like Eiffel Tower, nor would I dream of suggesting that the rebuilt Belfast transmitter will content itself with an artificial aerial, though I have no doubt that the "Autotone" could cope even with that without loss of quality.

Silly Story.

Excavations have started at Watchet for the construction of Western Regional. During the digging operations, so the story goes, it has been revealed that the Ancient Britons, who thickly populated the spot, knew something about wireless. At all events, no wires have been found.

March 15th.

WHAT a fateful moment it will be at 8 p.m. on Tuesday, March 15th, when the new B.B.C. Dance Orchestra, under Henry Hall, gives its first broadcast! The inaugural programme will last half an hour—just long enough to give us some inkling of what is in store in the shape of "sweet music."

All Dressed Up.

Here is a case where television would be useful, for the members of the band are to wear bright new uniforms consisting of white tunics, soft shirts, black bows, and black trousers. And Henry Hall himself will sport swallow tails. Oh, boy!

And the Reason.

There is a sound reason for making the orchestra feel smart. Mr. Hall believes —and most of us will probably agree with him—that a well-dressed orchestra is likely to do better work than one in which the members are variously clad in plus fours, Fair Isle jumpers, and even more provocative types of masculine apparel.

Jack Payne and—

By the way, there is no truth in the rumour of an "agreement" that Jack Payne and his boys shall continue to broadcast from Savoy Hill at least once a month. The official pronouncement is that he will broadcast "from time to time," and I understand that this may be interpreted as not less frequently than once a month.

SETTING A SPEECH TRAP. An American "O.B." engineer with the parabolic microphone recently tested in the Washington Senate House with a view to the inauguration of political broadcasts.

—Jack Hylton.

After an interval of four years, Jack Hylton and his band will make a reappearance in the B.B.C. programmes on March 1st and 2nd.

It looks as if competition in the dance band world is on the increase.

A New Appointment.

THE position vacated by Mr. Gambier-Parry as Information Executive at Savoy Hill will not be filled but will be regarded as a "part-time job" for Mr. B. E. Nicolls.

Mr. Nicolls was originally station director at Manchester. Later he succeeded Mr. Walter Fuller as the London station director, and is now general editor of all the B.B.C. publications.

Edgar Wallace.

EDGAR WALLACE was a good broadcaster. The microphone had no terrors for him; indeed, when giving us that series of crime stories a little while ago he might, for all the emotion he showed, have been speaking them into his dictaphone in his Portland Place flat. If he had lived, the B.B.C. would undoubtedly have arranged other broadcasts by the world's most prolific writer.

Listening to "Section E."

THE custom of labelling the various portions of the B.B.C. Symphony Orchestra as "Section B," "Section C," etc., is neither beautiful nor informative, and last week, having enjoyed the performance of Section E, under Joe Lewis, I took the trouble to enquire just what "Section E" amounted to.

Section E consists of forty-seven players. There are three other sections, viz., B, C, and D.

The Other Sections.

Sections B and D are small symphony orchestras and either may include any number of players up to sixty-eight. Section C is a light orchestra of thirty-six players.

None of these sections must be confused with the Theatre Orchestra, which is an independent combination.

Edison Bell Microphones.

IN my reference last week to the condenser microphone now being experimented with at Savoy Hill, I ought to have made it clear that these are Edison Bell instruments, and thus have given full credit to a British firm.

Crowded Week for "O.B." Men.

FOR the "O.B." engineers the week ending March 19th will surely be one of the busiest in their experience.

On the 18th there will be the running commentary on the Grand National at Aintree. On the following day there will be, first, the description of the Boat Race and then the Scotland *v.* England Rugger Match. The boat race finishes at lunch time, but very little margin of time will be left for the engineers to pack up their gear and speed off to Twickenham, where they are due at two o'clock.

The three broadcasts will involve a week of hectic preparation, yet I believe that many readers of *The Wireless World* would covet the engineers' job.

Background and Underground Noises.

DESPITE the talk about the extraneous noises which are said to be causing misgivings at Broadcasting House, Mr. Ashbridge insists that no unwanted sounds will ever reach the microphone.

It is true that the new building is almost on top of the Bakerloo tube railway, but, from my experience in listening to the rumble of traffic just above the warehouse studio at Waterloo Bridge, I should be ready to agree that any faint noise coming from the underground trains in Portland Place would be quite lost in transmission.

The Dear Old Days.

In any case, it has yet to be proved that listeners really object to outside noises. In the early days at Savoy Hill it was a commonplace to hear the sirens of the Thames tugs superimposed on the studio performances. Indeed, I was told of an elderly listener who, in the days before the Greenwich time signal, used to set his watch by the whistle of the 8 p.m. express from Charing Cross.

READERS' PROBLEMS.

Explaining the Wheatstone Bridge.

A CORRESPONDENT who wishes to test the values of several resistances by means of a Wheatstone Bridge asks to be enlightened concerning the basic principles of this device concerning which he is somewhat hazy. Probably the simplest way of explaining it is by means of the diagram which is given in Fig 1, which shows the principles of the Bridge. R_x is the unknown resistance whose value it is desired to ascertain, the remaining resistances being of known value.

Now, in this arrangement, if the ratio between R_2 and R_3 is equal to the ratio between R_1 and R_x, the points CD will be at the same potential, and therefore no current will flow through the galvanometer G. To express this more simply, we can indicate it as a simple equation, namely $\frac{R_2}{R_3}=\frac{R_1}{R_x}$. Since, as already intimated, the values of R_1, R_2 and R_3 are known, it will be obvious that R_x can be simply found, its value being equal to $\frac{R_3 \times R_1}{R_2}$. It will be seen, therefore, that to find the value of any resistance it is only necessary to connect it in the position R_x and to vary the values of the other resistances until a zero reading is obtained

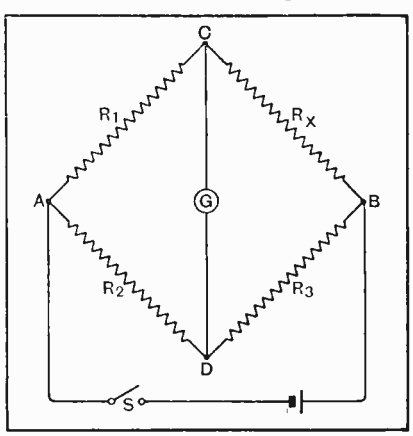


Fig. 1.—The above arrangement shows the basic principles of the Wheatstone Bridge.

on the galvanometer. This, therefore, is the underlying principle of this device which in various forms is used for measuring unknown resistances, capacities, etc., by balancing them against known values in a bridge arrangement.

Those who are observant, will quickly spot many possible variations of the foregoing simple arrangement. For instance, it will be seen that it is not absolutely necessary to know the actual values of R_2 and R_3, but merely the ratio between them, and if this is fixed the value of R_1 need only be varied until a zero reading is obtained; the resistance of R_1 must, of course, be known.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found elsewhere in this issue.

Special Headphones for the Deaf.

A NUMBER of letters have been received from readers having the misfortune to be partially deaf, in which they seek a solution to their difficulties. In nearly every case we find that they have resorted to headphones for various reasons, the chief of which is that to hear in comfort they have to advance the volume control of the receiver to such an extent that the degree of sound emanating from the loud speaker is troublesome, not only to others in the house, but to neighbours.

Unfortunately, when headphones are used considerable distortion is experienced, due to the chattering of the diaphragm on the pole pieces. Headphones are designed, of course, for handling very limited power, and the amplitude of the diaphragm is confined to very narrow limits so that with normal adjustment it is quite close to the pole pieces in order to achieve maximum sensitivity.

The solution of the problem is the construction of a special type of headphone, the design of which is based upon the principles of the loud speaker, and readers who are interested in this matter will be pleased to learn that such an arrangement has actually been devised, and was briefly described by its inventor in the issue of *The Wireless World* dated May 8, 1929.

The Voltage Regulation Curve.

THE question of correctly calculating the value of the voltage dropping resistances used in a mains unit has once more cropped up in many recent queries. It is, of course, only necessary to apply the formula $R=\frac{E-e}{I}$. In this equation, R equals the value of the resistance required, E being the voltage of the mains in the case of D.C. or in the case of A.C. mains the output voltage of the rectifying unit. I and e are respectively the normal plate current and the normal plate voltage requirements of the particular valve in the receiver whose needs are being dealt with. The two latter quantities are, of course, obtainable from the figures supplied by manufacturers or, alternatively, from *The Wireless World* "Valve Data Sheet," I being expressed as a fraction of an ampere. The principal thing which troubles most of our correspondents is the method of ascertaining the value of E when the mains are of the A.C. type.

This value can be measured by a high resistance voltmeter if an artificial load equal to the normal load imposed by the receiver is connected to it, but probably the most straightforward method is to solve the problem by calculation only, using as a basis for this the voltage regulation curves which are obtainable nowadays from all reputable valve makers. It may be pointed out that many of these curves have been published from time to time in the pages of this journal. It is possible for them to take various forms, but the most usual, and probably the most useful also, is the type shown in Fig. 2, where the relationship between the output voltage (unsmoothed D.C.) and load is shown by means of a family of curves plotted for different values of applied R.M.S. volt-

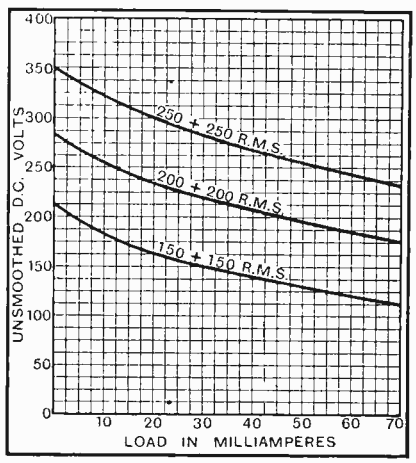


Fig. 2.—Voltage regulation curves of a thermionic rectifier.

age. From the curves published, it will be seen, for instance, that if the calculated load from the set is 35mA, then the unsmoothed voltage will be 275 volts when the R.M.S. voltage delivered to the two anodes by the secondary of the transformer is 250. It will be noticed that the D.C. output voltage is roughly proportional to the R.M.S. volts applied and normally one will use a transformer delivering the maximum voltage specified by the valve maker, but if a transformer giving a lower secondary voltage is available, an examination of the curves will reveal whether it suffices for the purpose in view or must be discarded in favour of a new one.

A Band-pass Difficulty Overcome.

APPARENTLY a very large number of people are still using receivers employing a simple capacity filter in spite of the many advantages of the "mixed" filter, which have been pointed out from time to time in this journal. Trouble is being experienced in several cases in the use of a multi-gang variable condenser of the modern type in which all the rotors are electrically united. The diagram in Fig 3 is typical of one form in which this difficulty has arisen.

Our correspondent is building an all-mains set containing two H.F. stages, and the filter he is using is of the simple type shown at (a) in Fig 3. The four-gang tuning condenser, which he has in his possession is of the type already mentioned, and his difficulty is to know how to avoid short-circuiting the band-pass coupling condenser C_3 when the rotors of C_1 and C_2 are connected. It is obvious that if he joins the common connection of all four rotors to the point A, then C_3 will act as a coupling condenser for all circuits, whereas if he connects to B, C_3 will be *non est*.

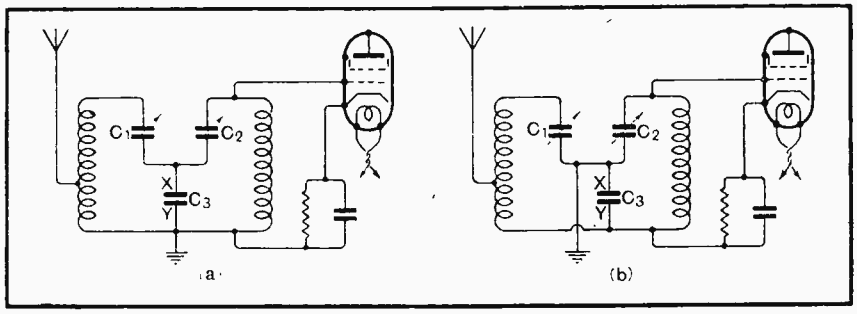


Fig. 3.—Alternative connections of a capacity filter.

A difficulty of this type, which at first seems perplexing, is actually very easily overcome, it being only necessary to adopt the connections shown in Fig 3 (b). The action of the band-pass filter will, of course, be in no way affected. It will be noticed that this method of overcoming the difficulty does not upset the grid bias arrangements in any manner.

FOREIGN BROADCAST GUIDE.

BRUSSELS (I.N.R.)

(Belgium).

Geographical position: 50° 50′ 16″ N.; 4° 21′ 12″ E.

Approximate airline from London: 218 miles.

Wavelength: 338.2 m. Frequency: 887 kcs. Power: 15 kW. (Copenhagen rating).

Time: Greenwich Mean Time. (Belgium adopts B.S.T.)

Standard Daily Transmissions.

12.15 G.M.T., gramophone records; 17.00, concert; 18.00, gramophone records; 19.15, talks and news bulletin, gramophone records; 21.00, main evening entertainment (concert, play or relay); 22.00, news.

Announcer: Man. All announcements are made in the Flemish language.

Call: *Hier Bruessel*, followed by the initials of the Association responsible for the broadcast.

Opening signal (temporary): Tuning note.

Note: The entertainments are provided by various political and religious associations, including S.A.R.O.V. (*Socialistische Arbeiders Radio Omroep voor Vlaanderen*), K.V.R.O. (*Katholieke Vlaamsche Radio Omroep*), V.L.A.N.A.R.A. (*Vlaamsche Nationale Radiovereeniging*), etc.

Usually closes down with good night greetings (*goede nacht*) followed by the Belgian National Anthem, but on evenings when the S.A.R.O.V. sponsors the broadcast, the *Internationale* is played.

A Perennial Enquiry.

WE are repeatedly asked for the correct number of turns to use in constructing a frame aerial. By the use of a very simple rule of thumb any reader should be able to make his own calculations.

In the case of a frame aerial intended for use on the normal broadcasting band it is correct to put on the frame about 75ft. of wire, this figure applying irrespective of the size of the frame aerial. This will obviously mean that the larger the frame the smaller the number of turns, and vice versa. In the case of the long waveband about 240ft. should be used. The length of wire is critical in neither case.

A Forgotten Factor.

WE have received several letters concerning a method of converting a milliammeter to give a higher reading than its scale reading. Many readers working from Ohm's law have been making up external shunt resistances equal in value to the internal resistance of their milliammeter with the object of doubling the scale reading, and they are puzzled by the fact that when testing by putting a borrowed precision milliammeter in series, they find that the shunted meter is inaccurate.

Assuming that calculations have been made correctly, the trouble is most probably traceable to the fact that the temperature co-efficient of the shunt resistance (which is wound with a proprietary brand of resistance wire) is considerably lower than that of the copper wire winding of the coil inside the meter. In the case of many proprietary instruments sold with external shunts, it is usual to build into the meter a large "swamp" resistance which is placed in series with the copper wire winding so that the whole internal resistance of the meter has more or less the same temperature co-efficient as the external shunt.

"The Wireless World"

INFORMATION BUREAU.

Conditions of the New Service.

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

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

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

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

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

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

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

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EDITORIAL COMMENT.

What Is Perfect Reproduction?

YEAR by year the aim of technicians in the field of broadcasting is to improve the quality of reproduction. Ever since broadcasting began steady progress has been made in this direction; but physical limitations have been imposed which seem to indicate that perfection can never be reached and that a compromise will always have to be accepted between quality and quantity, the term quantity in this sense being used in reference to the number of transmitters which it is required to accommodate in the wavelength bands within which necessity decides that broadcasting must be confined.

If there were no restrictions imposed it would probably be possible to design transmitters, and all that is associated with the transmission end, so as to put out a broad enough band of frequencies to embrace the whole of the audible spectrum. But if we started to attempt this with transmitters of to-day, we should find that only a very few stations out of the total number transmitting could be accommodated. It is here, then, that our first compromise has to be resorted to. We have to be content to transmit only a wide enough band to give "reasonable" quality so as to leave room for others claiming an equal right in the ether. The definition of "reasonable" quality is therefore of the utmost concern to technicians.

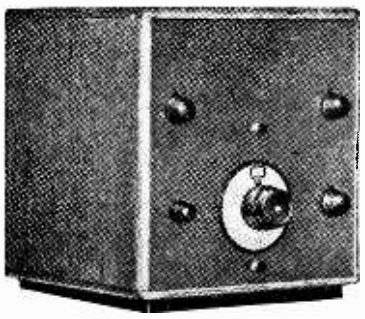
In broadcasting we accept to-day as good quality a range of frequencies where very little is likely to be faithfully reproduced above 4,000 cycles, and probably the vast majority of listeners, because they have had nothing better, are content at present with reproduction much below this value. Yet in sound reproduction for the cinema the inclusion of frequencies up to 10,000 is aimed at, and, according to recent investigations, frequencies far higher than this are required to be reproduced before we can begin to state that we are approaching a faithful representation of the original

But common sense must take some share in deciding this question for us. In broadcasting speech it might reasonably be claimed that intelligibility should be our chief concern. In music, however, we must consider the listeners for whom we are catering. Only a minute percentage of the audience is capable of appreciating the difference between perfection and a pleasing result; and it is, therefore, well to consider whether it is worth while to broadcast ideal quality. But here those responsible for making any decision must walk very warily, because whatever standard is adopted for broadcasting will rapidly become the world's standard of music, and once accustomed to a constant supply of music to any standard, the listening public all over the world will *know* no better, and probably will *want* no better reproduction. Only those musically trained will be in a position to appreciate the difference.

The New Receiver—The Autotone.

NO wireless development of recent years has been so much a subject of conversation in technical circles as the "Autotone," the new receiver which we begin to describe constructionally in this issue. The principles involved in the design are new, and have been discussed theoretically in recent issues of *The Wireless World*.

The basis of the arrangement consists in extremely high selectivity regardless of loss of quality due to sideband cutting, followed by correction to reinstate sidebands in their proper proportion. The fact that formerly such an arrangement was regarded as impracticable makes this receiver all the more intriguing now that technicians generally have come round to a recognition of the potentialities of the system.



The AUTOTO

A "Wireless World" Set Involving New Principles.—Th Most Talked Of Receiver of To-day.

By F. L. DEVEREUX, B.Sc., and H. F. SMITH.

BEFORE undertaking the construction of this intriguing receiver it will help the reader first to acquaint himself with the electrical characteristics of the circuit. While it would be quite possible to construct and wire the set in a mechanical sort of way from the instructions and diagrams which will follow, much more enjoyment will be derived, and the possibilities of minor errors in wiring will be reduced, if the function of each component is properly appreciated.

Since a high degree of selectivity is probably the most important object of the design, the tuning coils and their arrangement in the layout should be the first matters to receive attention. It will be seen from the circuit in Fig. 1 that a two-circuit tuner is employed, with condensers C_1 and C_2 at the high-potential ends of the medium- and long-wave coils forming the coupling between the two tuned circuits. A similar arrangement has been used previously in the design of band-pass filters, but it is important to note that in the present design the coupling must at all costs be kept sufficiently small to prevent the slightest trace of "double hump" tuning. In practice it was found possible to arrive at fixed values of C_1 and C_2 which gave adequate (though slightly sub-optimum) coupling at the top end of each wave-range without deviating from the single-peak form of tuning at the bottom end of the scale. The fact that C_1 and C_2 are of approximately the same value may at first seem puzzling, but it should be remembered that on long waves the combined capacity of C_1 and C_2 is augmented by the self-capacity of the wave-range switch contacts. C_2, which was found experimentally, therefore represents the difference between the optimum capacity required and the capacity of the switch. The construction and adjustment of the coupling condensers C_1 and C_2 will be fully described when we come to deal with the operation of the set.

Obviously, with such small couplings involved, effective screening between the primary and secondary

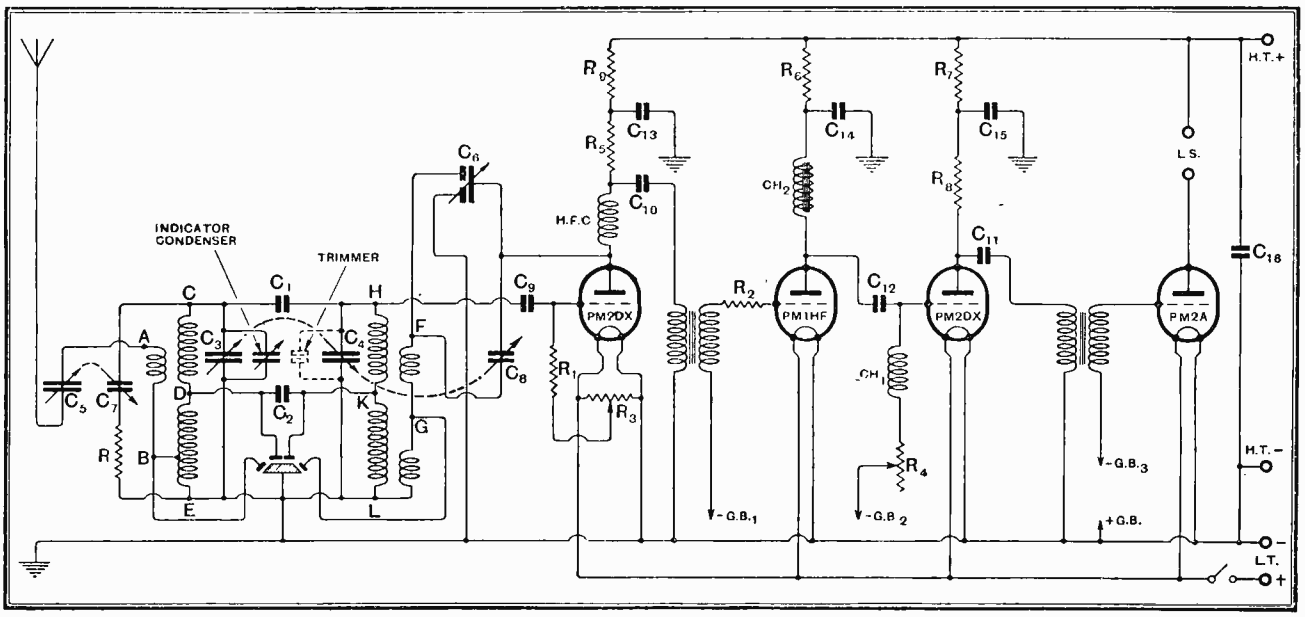
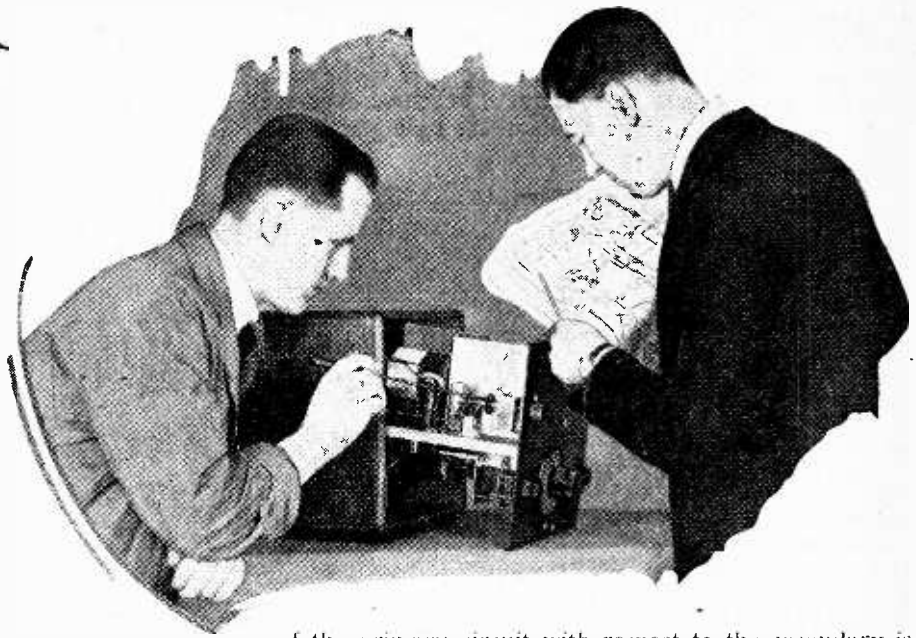


Fig. 1.—Complete circuit diagram. C_1, 2.5 micro-mfd.; C_2, 2.0 micro-mfd.; C_3, C_4, 0.0005 mfd. (ganged); C_5, 0.0003 mfd.; C_6, 0.0003 mfd. (differential variable); C_7, C_8, variable compensating condensers (30 micro-mfd. approx.); C_9, 0.0001 mfd.; C_{10}, C_{11}, 1 mfd.; C_{12}, 4 mfd.; C_{13}, C_{14}, C_{15}, C_{16}, 2 mfd. R, 30 ohms; R_1, 0.25 megohm; R_2, 50,000 ohms; R_3, 400-ohm potentiometer; R_4, 5,000 ohms max.; R_5, R_6, R_7, R_8, 30,000 ohms; R_9, 50,000 ohms; CH_1, 0.3 henry; CH_2, 30 henrys (approx.).

HERE we begin the description of how to build the "Autotone"—the most talked of receiver of to-day.

The new principles incorporated in this receiver are expected to herald a new departure in selective receivers of the future. This "Wireless World" design is the first practical set to embody the new system which provides an extraordinary degree of selectivity obtained by entirely new means.



tuning coils is of paramount importance. Complete enclosure of the coils is the ideal method, but if the good electrical properties of the tuned circuits are to be preserved the screening boxes must be of unwieldy size. The screening system finally adopted is illustrated diagrammatically in Fig. 2. It will be seen that three sides of each coil (including the high-potential end) are open and that the arrangement is perfectly symmetrical provided a non-conducting front panel (indicated by the dotted line) is used. Any alteration of inductance due to the screening will therefore be the same in both coils. The electrical separation of the two circuits with this system of screening is such that with C_1 disconnected, and the wave-range switch in the medium-wave position, no trace of coupling can be detected between the two coils. Capacity between the wiring in the two circuits would, of course, annul the effect of the screening, and it is essential to keep wires associated with one circuit out of the screening compartment of the other. In particular the leads to the two sections of the gang condenser should be well separated. Readers who wish to modify the layout to incorporate components other than those specified in the original design should therefore bear in mind the importance of preserving the essential layout and spacing of the tuning coils and their associated wiring.

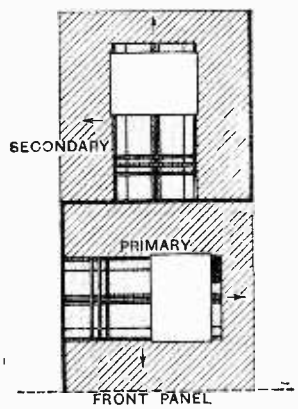
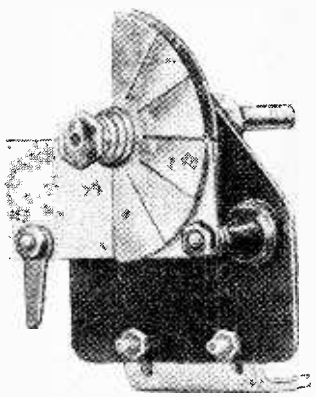


Fig. 2.—Diagrammatic layout of coil screening.

With such a minute coupling between the two circuits accurate ganging is essential, since a slight mistuning of the primary circuit with respect to the secondary is sufficient to upset the reaction conditions. However, the special "Utility" gang condenser ("Experimenter's Model") makes the ganging of the two circuits easy. It is fitted with soft end vanes slotted more deeply than usual and is provided with eight sections. Using the indicator condenser in parallel with C_3 as a means of tracing misalignment, the main tuning condensers can be ganged in about ten minutes.

Simplifying Tuning.

Having made provision for accurate ganging, care must be taken that it is not disturbed by the other controls in the set. As will be explained later, the process of ganging will be carried out with reaction adjusted for normal reception conditions, so that no difficulty need be anticipated from this source. The volume control, on the other hand, might easily upset the tuning of the primary circuit due to variations in the transferred aerial capacity. This difficulty is surmounted by a compensating condenser ganged to the spindle of the volume control condenser C_2. As the effective capacity, and incidentally the resistive load, of the aerial is reduced, an equivalent capacity is added to the primary circuit by the compensating condenser C_7. It will be obvious that the damping effect of the resistance R will increase with the capacity of C_7 so that a progressive replacement of the capacitative and resistive

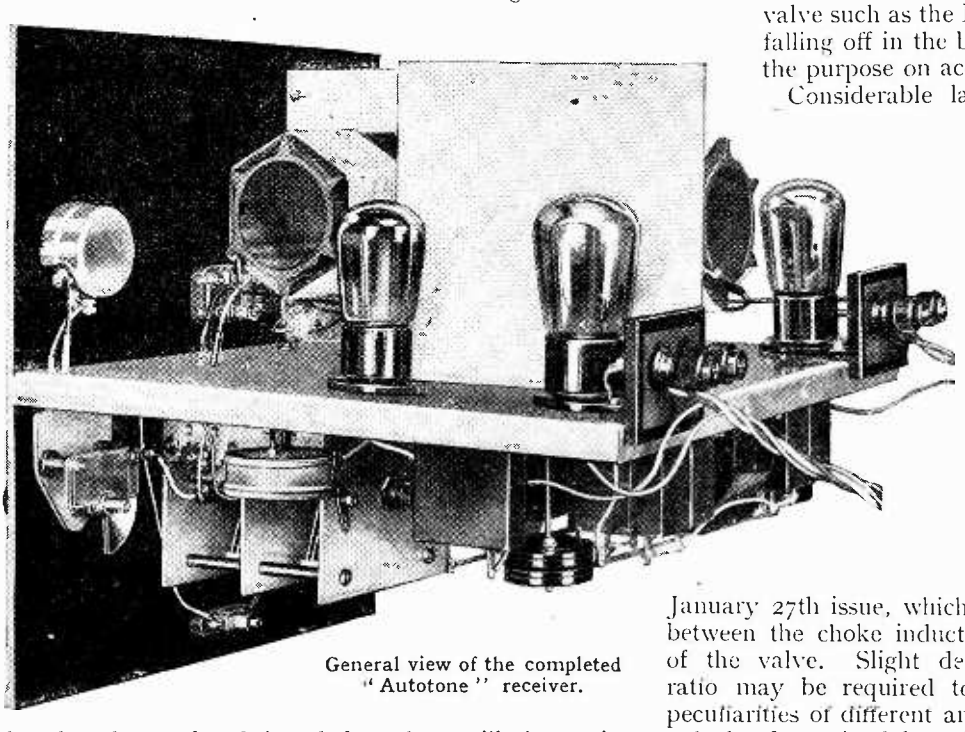


"Utility" trimming condenser for reaction and volume control compensation.

The "Autotone."—

load of the aerial takes place as the volume control is reduced.

A second compensating condenser ganged to the main tuning spindle gives uniformity of reaction over the medium waveband. The whole of the tuning scale can



General view of the completed "Autotone" receiver.

therefore be explored just below the oscillation point without touching any of the subsidiary controls, and it will be found that all available stations can be picked up under these conditions. When a choice of any particular station has been made it is then but the work of a moment to make a final adjustment of the reaction and tone controls to give the best possible selectivity and quality. The whole of the tuning process can be carried out without once causing the set to oscillate.

Freedom from backlash in the reaction control is important in a set of this type, and as this is largely controlled by the detector bias a potentiometer R_3 has been included for this purpose.

In designing the L.F. amplifier it is essential that all stages, with the exception of the tone corrector, should give as close an approximation to straight-line amplification as possible. The tone compensator is designed to correct solely for the distortion in the selective tuned circuits, and if there is loss of amplification in the bass in the other L.F. stages over-emphasis of the middle register will be evident in the final result. The amplification curve of the R.I. "Parafeed" in conjunction with a 10,000-ohm valve such as the PM2DX shows no appreciable falling off in the bass, and is therefore ideal for the purpose on account of its small dimensions.

Considerable latitude is permissible in the design of the tone corrector stage, and several alternative combinations of valve and choke inductance will give the same correction curve. Experiments have shown, however, that the PM1HF valve with a 0.3-henry correction choke gives a satisfactory compromise between amplification and power-handling capacity, and this combination has therefore been standardised. Experimenters who may wish to try out other combinations are referred to the curve on page 91 of the January 27th issue, which shows the basic relationship between the choke inductance and the A.C. resistance of the valve. Slight deviations from the theoretical ratio may be required to account for the individual peculiarities of different amplifier designs, but these can only be determined by trial and error. In general, if relatively greater high-note response is required, a lower value of inductance than that given by the curve should be employed and vice versa.

The choke CH_2 is not critical, and the only stipula-

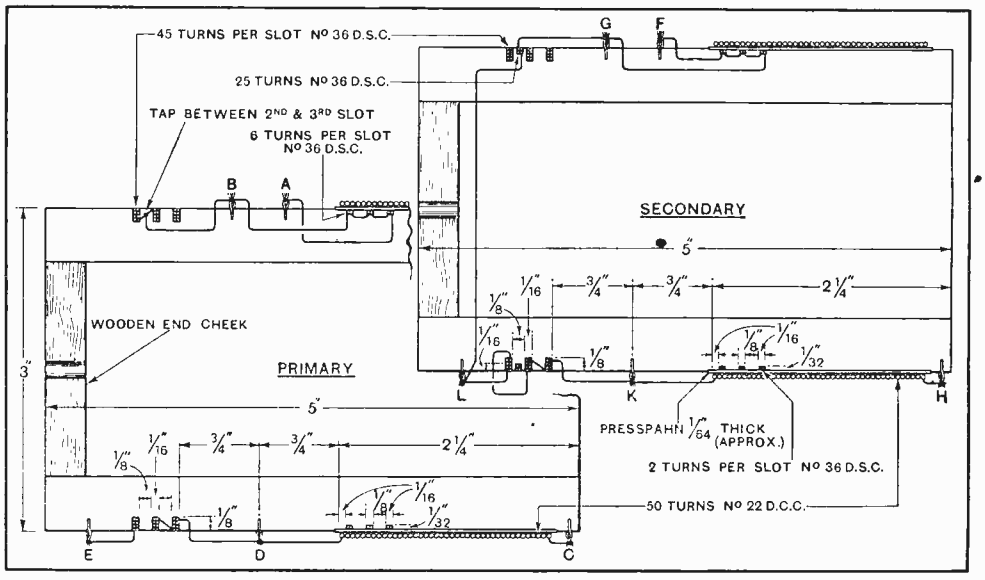
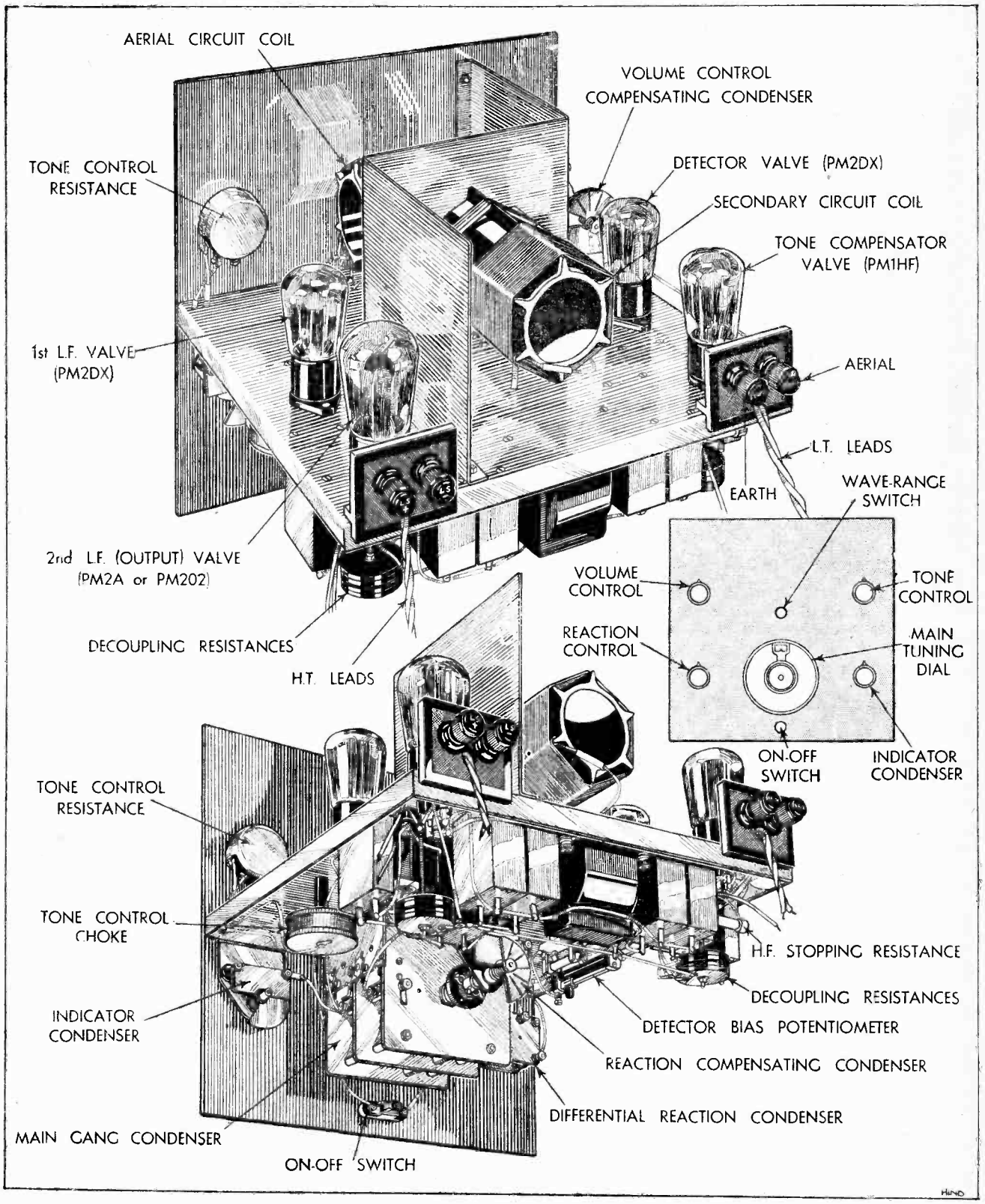


Fig. 3.—Dimensions of coil formers and details of windings. Complete coils are available from manufacturers.

CHASSIS DETAILS OF THE "AUTOTONE."



Three views showing layout of components and disposition of controls in the "Autotone" receiver.

B 15

The "Autotone."—

tion is that it should be large in inductance compared with the tone-correction choke. The special form of construction for the latter shown in Fig. 4 is designed to give a high ratio of inductance to D.C. resistance. This is important, as excessive D.C. resistance will limit the maximum correction available at the lower end of the frequency scale.

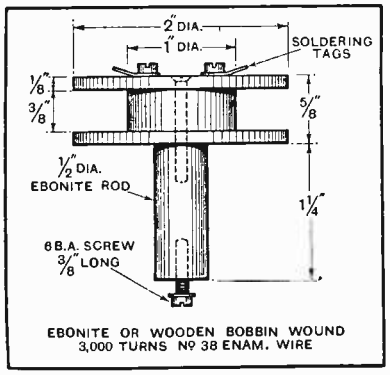


Fig. 4.—Constructional details of the 0.3 henry tone correction choke. This component is obtainable ready made from a number of sources.

The output valve recommended for operation from H.T. batteries of standard capacity is the PM2A, when the total current taken by the set will be about 10 mA. at 150 volts. The circuit is thoroughly decoupled, and will work well from a battery eliminator. Under these conditions it will be practicable to use a larger output valve such as the PM202. With this valve the current consumption will be approximately 15 mA. at 150 volts, and the undistorted output of 350 milliwatts will be ample for the average living room.

(To be continued.)

[Next week's issue will contain a complete wiring plan and the following instalment will be devoted to hints on adjustment and operation.]

LIST OF PARTS.

Components actually used in the receiver, together with a list of parts of other makes that are electrically suitable, but in some cases of different dimensions. The use of some of these alternative components will therefore necessitate minor changes in layout and general construction.

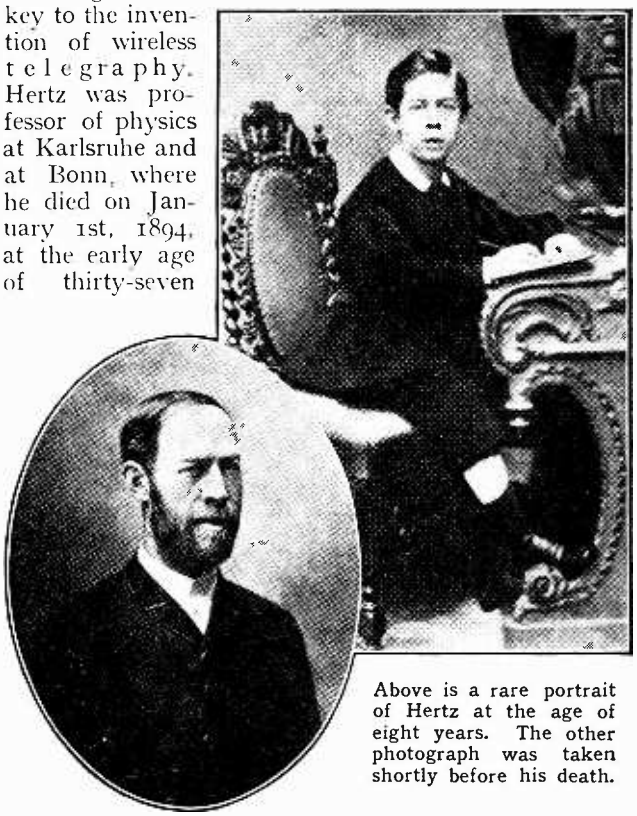
Aluminium chassis and coil screen (White Bros. & Jacobs)
Paxolin panel, 12 in.×12 in.×¼ in. (Wearite)
1 Primary tuning coil (Wearite)
1 Secondary ,, ,, (Wearite)
1 Four-point push-pull switch (Telsen)
1 Two-point ,, ,, ,, (Telsen)
(Benjamin, Bulgin, Claude Lyons, Colvern, Igranic, Junit, Lotus, Ormond, Red Diamond, Sovereign, W.B., Wearite.)
1 Dual screened gang condenser, 0.0005 mfd. (Special "Experimenter's Model"; Utility)
1 Condenser dial, high ratio (Utility, Type W.181)
(Ormond).
2 Flexible couplings (insulated) (Utility)
(Ormond, Cyldon)
2 Universal compensating condensers, with brackets (Utility)
1 Special indicator condenser, 50 mmfds. (Utility)
1 Special variable condenser, 0.0003 mfd., with spindle extension and knob (Utility, "Mite")
1 Slow-motion differential reaction condenser, 0.0003 mfd. (Polar)
1 Variable resistance, 5,000 ohms (Wearite)
(Claude Lyons, Colvern, Watmel).
1 Special choke coil, 0.3 henry (R.I., Wearite, Kinva, Magnum, Formo).
4 Valve-holders, skeleton type (W.B.)
(Burton, Graham Farish, Junit, Lotus, Telsen).
2 Inter-valve transformers (R.I. "Parateed")
(Climax, Ferranti, Igranic, Varley).
1 L.F. choke (Ferranti, B.8)
(B. & J., Bulgin, Challis, Clarke Atlas, Climax, Formo, Igranic, R.I., Savage, Sound Sales, Telsen, Trix, Varley).
1 H.F. choke ("Kinva")
(British General, Bulgin, Burton, Climax, Igranic, Lissen, McMichael, Telsen, Varley).
4 Fixed condensers, 2 mfd. (T.C.C., Type 65)
2 ,, ,, **1** ,, ,, ,,
1 ,, ,, **4** ,, ,, ,,
(Dubilier, Formo, Hydra, Peak, Sound Sales, Savage, Telsen).
1 Fixed condenser, 0.0001 mfd mica (Graham Farish)
(Dubilier, T.C.C., Telsen)
4 Fixed resistances, 30,000 ohms (Berco)
1 Fixed resistance, 50,000 ohms ,,
1 Fixed resistance, 30 ohms ,,
(Bulgin, Lewcos, Magnum, Varley, Watmel).
1 Grid leak, 0.25 megohm. (Ediswan)
(Dubilier, Graham Farish, Loewe).
1 Metallised resistance, 50,000 ohms (Dubilier, 1 watt)
(Ferranti, Graham Farish, Loewe).
1 Resistance holder (Bulgin Porcelain)
(Dubilier).
1 Potentiometer, 400 ohms (Ready Radio)
(Igranic).
2 Terminal panels (Junit)
(Belling-Lee).
4 Terminals, aerial earth, L.S.+, L.S.− (Belling-Lee)
(Clix, Eelex).
1 Grid-bias battery, 16-volt (Ever-Ready)
(Grosvenor, Pertrix, Siemens).
4 Grid-bias wander plugs, 3−, 1+ (Clix, Vice-grip)
(Belling-Lee, Eelex).

ACCESSORIES.

4 Valves (Mullard), two P.M.2D.X., one P.M.1H.F., one P.M.202 or P.M.2A
1 Cabinet (Apollo)

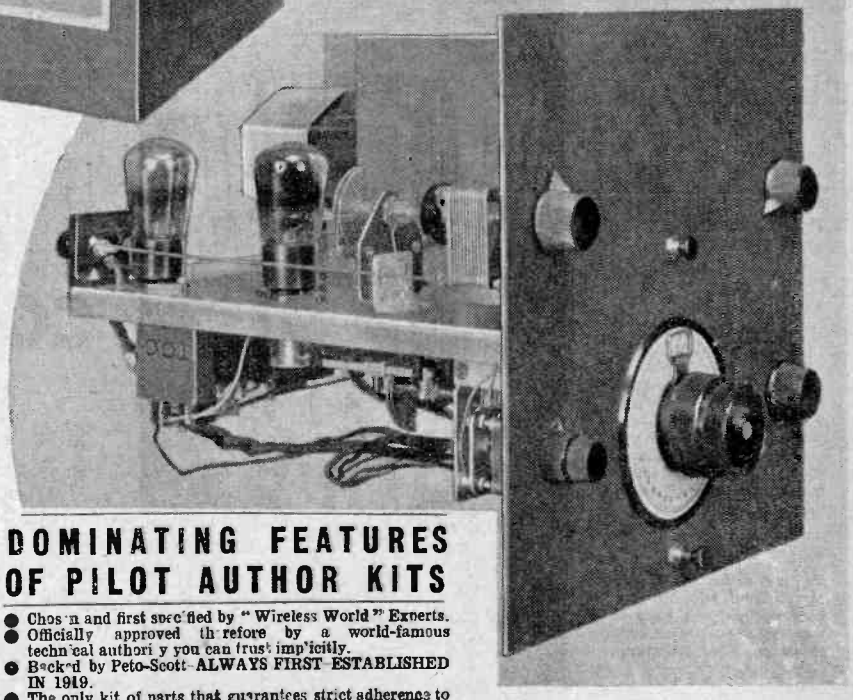
PIONEER OF PIONEERS.

MONDAY last, February 22nd, marked the seventy-fifth anniversary of the birth of Heinrich Hertz, whose discovery of the existence of electro-magnetic waves gave the key to the invention of wireless telegraphy. Hertz was professor of physics at Karlsruhe and at Bonn, where he died on January 1st, 1894, at the early age of thirty-seven years. It is interesting to speculate what part, if he had lived the normal span, Hertz would have played in modern radio development.



Above is a rare portrait of Hertz at the age of eight years. The other photograph was taken shortly before his death.

AUTOTONE
PILOT AUTHOR KIT
EXACT TO SPECIFICATION



THIS IS THE KIT THE AUTHOR USED

Any parts supplied separately. If value over 10/- sent carriage paid, or C.O.D. post charges paid.

	Aluminium Chassis and Coil Screen	10 0
1	**Wearite** Paxolin Panel, 12in.×12in.×¼ Ready Drilled	5 0
1	**Wearite** Primary Tuning Coil	12 6
1	**Wearite** Secondary Tuning Coil	
1	**Telsen** Four-Point Push Pull Switch	1 6
1	**Telsen** Two-Point Push Pull Switch	1 0
1	**Utility** Dual Screened Gang Condenser, 0.0005 mfd. (Special "Experimenter's Model.")	£2/10
1	**Utility** Condenser Dial High Ratio, W.181	
2	**Utility** Flexible Couplings (insulated)	
2	**Utility** Universal Compensating Condensers with Brackets	
1	**Utility** Special Indicator Condenser, 50 mmfds.	
1	**Utility** Special Variable Condenser, 0.0003 mfd. "Mite" with Spindle Extension and Knob	
1	**Polar** Slow Motion Differential Reaction Condenser, 0.0003 mfd.	6 6
1	**Wearite** Variable Resistance, 5,000 ohms	2 6
1	**R.I.** Special Choke Coil, 0.3 henry	3 6
4	**W.B.** Valve Holders, Skeleton Type	2 0
2	**R.I.** "Parafeed" Inter-valve Transformers	17 0
1	**Ferranti** L.F. Choke, B.S.	7 0
1	**"Kinva"** H.F. Choke	2 9
4	**T.C.C.** Fixed Condensers, 2 mfd., Type 65	12 0
2	**T.C.C.** Fixed Condensers, 1 mfd., Type 65	4 6
1	**T.C.C.** Fixed Condenser, 4 mfd., Type 65	5 0
1	**Graham-Farish** Fixed Condenser, 0.0001 mfd., mica	0 6
4	**Berco** Fixed Resistances, 30,000 ohms	5 6
1	**Berco** Fixed Resistance, 50,000 ohms	1 6
1	**Berco** Fixed Resistance, 30 ohms	0 9
1	**Ediswan** Grid Leak, 0.25 megohm	1 6
1	**Dubilier** Metallised Resistance, 50,000 ohms, 1 watt	1 0
1	**Bulgin** Resistance Holder Porcelain	0 6
1	**Ready Radio** Potentiometer, 400 ohms	2 9
2	**Junit** Terminal Panels	1 4
4	**Belling-Lee** Terminals	2 0
1	**Ever Ready** Grid Bias Battery, 16 volts	1 9
4	**Clix** Grid Bias Wander Plugs, "Vicegrip"	0 6
	Connecting Wire, Screws, etc., etc.	Gratis
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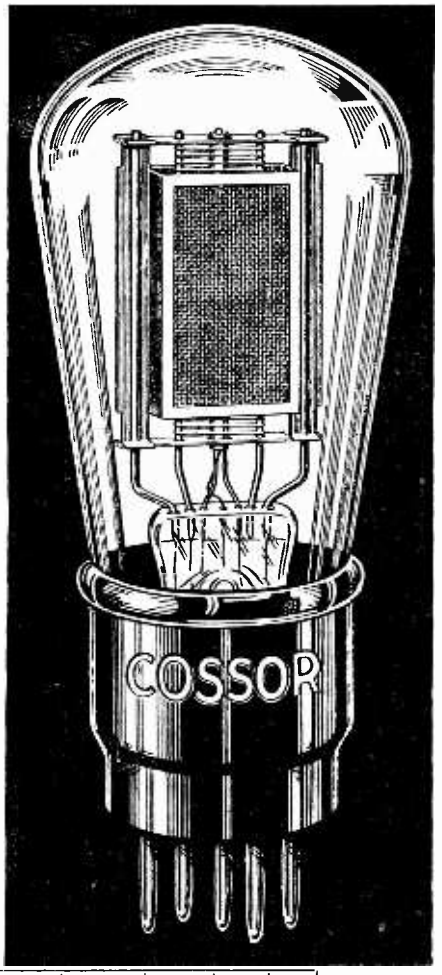

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‡†MVSG	Variable-Mu	200,000	—	2.5	22/6
* MS/PEN A	H.F. Pentode	—	—	4.0	25/-
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* 41 MH	Detector	18,000	72	4.0	15/-
41 MHF	H.F. or Det.	14,500	41	2.8	15/-
* 41 MHL	Det. or H.F.	11,500	52	4.5	15/-
41 MLF	Low Frequency	7,900	15	1.9	15/-
41 MP	Normal Power	2,500	18.7	7.5	17/6
41 MXP	Extra Power	1,500	11.2	7.5	20/-
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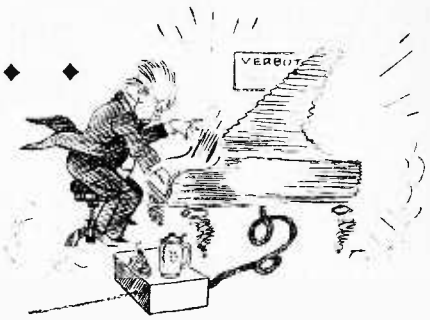


In "der Vaterland."

The Autotone.

By FREE GRID.

I WAS unexpectedly honoured the other day by an invitation to attend a demonstration of the Autotone receiver. To say that I was surprised at the results would be to put it mildly. I have never doubted that extreme sensitivity and selectivity could be got by critical reaction, but, although fully acquainted with the theoretical soundness of the principles underlying the arrangement, nevertheless, my feelings concerning quality were somewhat similar to those I experienced when contemplating my first aeroplane flight, although in that case also I was well grounded in theory. I must confess, however, that although expecting the worst, I was literally flabbergasted by the truly appalling noise which burst forth from the loud speaker.

The fatuous and somewhat patronising smile which had been adorning the countenances of those responsible for this seemingly terrible effort merely broadened into a grin of such dimensions that I feared they would get their mouths hooked up over their ears. After remarking rather acidly that my kennels were packed to capacity already and I needed no further additions at present, I was about to relieve the tenseness of the atmosphere by taking my hat and my leave in a dignified manner when one of the individuals present, with a still wider grin which threatened to

The spider and the fly.

cut the top of his head right off, advanced to the set and to my surprise converted the distressing noises into a tuneful melody not by adjusting the tone control but by manipulating the tuning knob. Subsequent explanations made it clear that I had been the victim of a little gentle leg-pulling, the first item being merely an excerpt from an ultra-modern symphony. To you or me, in our ignorance, such music (?) may be indistinguishable from a riot and civil commotion, but to the true artist the effect is the same as the first glimpse of Manchester to a Mancunian after an enforced exile in the Sunny South.

Impatiently sweeping aside its attendant minions I strode to the set and, seizing the tuning knob, quickly brought in one station after another. Any doubts which I had previously had concerning the quality of reproduction of which the instrument was capable were quickly dispelled. The selectivity and sensitivity were of an order that I would have deemed impossible had I not been handling the set myself, but the most remarkable thing which struck me about the whole receiver was that, although it was actually a "Detector-L.F." arrangement, it was, to all intents and purposes, a one-knob receiver, reaction being as near to constancy as makes no matter.

A Blow to Blasting.

I SUPPOSE that all of us have been annoyed at one time or another by the peculiar blasting that is sometimes caused by piano broadcasts, even in the case of the four-hundred-volts-on-the-plate class of receiver. A certain school of thought attributes this to the fact that the microphone diaphragm, not being a truly aperiodic device, cannot cope with all the different frequencies emitted by the piano, although for the life of me I cannot imagine why they do not apply the same argument to other musical instruments. At any rate, strong support was lent to their theory by an experience which befell me in the Fatherland the other day, whither some friends had taken me to witness a demonstration of a method of overcoming this difficulty.

A special grand piano had been built by a well-known firm in which each wire of the instrument was centred in the gap of an electro-magnet. Thus each note of the piano possessed its own microphone, the wire itself forming the diaphragm and setting up variations in the magnetic flux when it vibrated. There was, of course, no more difficulty in connecting this bunch of microphones to the input of the microphone amplifier than there is in the case of ordinary microphones when several studios are used in the production of a play.

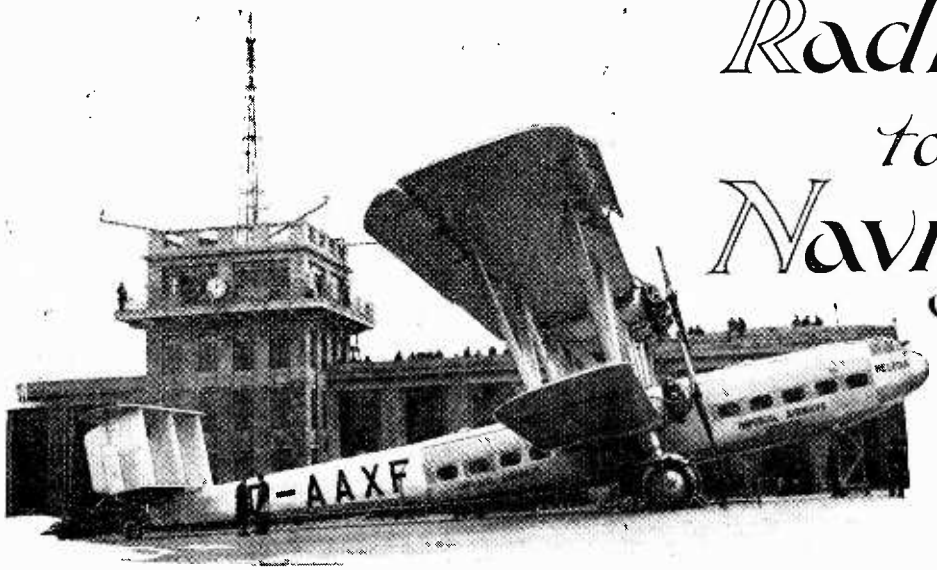
I had the privilege of listening on a good set a few miles away from the experimental broadcasting station at which the piano was being played, and a well-known musician in our company expressed the view that it was, without doubt, the best piano broadcast to which he had ever listened. I was so impressed by the demonstration that I am eagerly looking forward to the installation of an experimental piano at one of the B.B.C. studios. Incidentally, I may mention that the instrument is no larger than an ordinary full-size grand piano.

Too Selective.

A FRENCH author, with whom I decline to sympathise, was on the horns of a dilemma the other evening. Apparently Daventry and Radio Paris were simultaneously broadcasting reviews of the latest book he had perpetrated. "I wanted to hear both," he wails, "but could not. It was a maddening predicament!"

This is what comes of using one of these modern selective sets.

Radio Aids to Air Navigation



The air liner "Helena" photographed beside the control tower at Croydon aerodrome.

By LAURENCE A. SWENY.

Guidance by Day and Night.

SOME of the early post-war amateurs will still, no doubt, remember visiting the Croydon direction-finding station in the days before "2MT" and "2LO" diverted their attention to work in the great field of broadcasting. This latter, with its twin attraction, the higher frequencies, has robbed the aeronautical D/F services in this country of a lot of their one-time interest, but development has been continuous since those days of 1921-1922, and this article will give a general idea of the progress achieved in the provision of navigational assistance to the commercial air-liner.

The use of aeronautical D/F services having, by 1927, become commonplace in N.W. Europe, the co-ordination of the various stations and the organisation of networks, each with a control station, was undertaken at an International Aeronautical Conference at which Great Britain, France, Belgium, Holland, and Germany were represented. As a result of these deliberations the air-routes passing over these countries, or contiguous to them, were divided up into areas, to which a control station and two or more collaborating stations, all working on the International Aircraft Frequency of 333 kc/s (900 metres), were assigned to each. In flying from London to the Continent pilots of commercial aircraft have at their disposal four networks of direction-finding stations. Between London and the French coast their control station is Croydon, the collaborating stations being Lympne and Pulham. Then, from the French coast onwards to Paris, aircraft can claim help from the Le Bourget (Paris) control station, with its collaborating stations at Lympne and Valenciennes.

THE need for giving aircraft accurate guidance through fog and clouds has been appreciated ever since the inauguration of the commercial air services between London and the Continent in 1919. *This article describes the methods now in use whereby a pilot can keep in constant touch with the ground stations and find his exact position within three minutes.*

If, from the French coast, the route runs to Amsterdam, then Rotterdam is the control station, the collaborating transmitters being Pulham, Brussels, and, if required, Lympne.

Brussels is the control station on the route between the French coast and the Belgian capital, and the collaborators are Lympne and Rotterdam.

Bearings on Request.

By standardising radiotelegraphic and radiotelephonic procedure, the International Aeronautical Conferences have largely overcome the language difficulty brought about by the number of different nationalities using the Continental air-routes, as well as effecting speedy operation. The time taken in England between the request for D/F assistance and the transmitting of the required information by the control station averages three minutes.

Upon a call for D/F aid being received, the control station of the area over which the aircraft is flying instructs the pilot to transmit for half a minute, during which it and the collaborating stations take bearings. As soon as the aircraft transmission ceases, the D/F stations exchange by radio the bearings obtained, the control station being responsible for plotting them on special maps, determining the resultant position and transmitting it to the aircraft.

In addition to the determination of position, D/F stations are very often called upon to supply single bearings to aircraft desiring to set a course for them.

Radio Aids to Air Navigation.—

An extension of this scheme, whereby the utilisation of the reciprocal of a bearing, to which has been added the magnetic variation for the particular district, gives the pilot a figure which, when he has applied compass deviation and made allowance for "drift," constitutes the course to be flown in order to reach the D/F station. This was first tried at Croydon in 1923, and has since been found of great use, since, providing he pays due regard to compass deviation, the pilot can, by obtaining a series of "magnetic reciprocal bearings," as they are termed, leave himself almost entirely in the hands of the D/F station, obtaining automatic correction for "drift," as well as an assurance that he will eventually arrive over the D/F station, which, in this country at all events, means an aerodrome.

This method is frequently used by pilots when approaching Croydon in darkness or bad weather, for it is then that accurate course-keeping is essential to avoid "over-shooting" the aerodrome.

Flying Through Clouds.

Almost every pilot has his particular method of using D/F information. At times it is used as a means of establishing positions, at others to check a course. Often a pilot has been known to fly above the clouds from Paris to London, relying solely on information received from the D/F stations. When low clouds or bad visibility are prevalent over the Surrey hills the pilots of a famous air-line fly in or above the clouds, obtaining D/F assistance from Croydon to enable them to navigate their aircraft whilst at a safe height to the low ground to the north of the aerodrome before dropping to a suitable altitude from which to approach the landing ground.

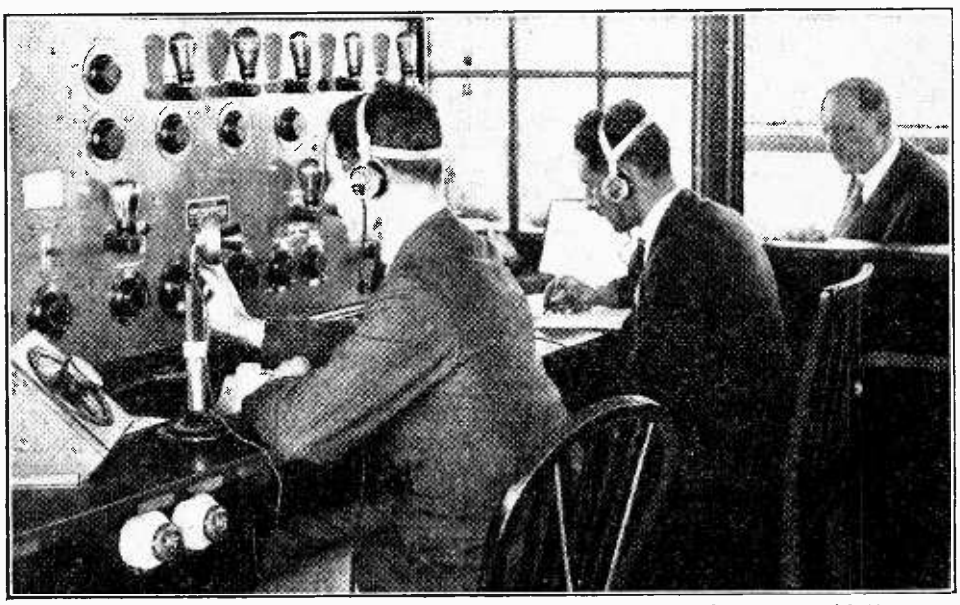
The Bellini-Tosi system has till quite recently been found entirely satisfactory for all the work that it has been called upon to do in the aeronautical D/F services; in addition, it is comparatively easy to erect and maintain. As is well known, the system is primarily composed of two triangular or rectangular aerials arranged at 90° to one another. Unfortunately, it is inherently productive of errors at night owing to its susceptibility to vertically polarised waves. No one who listens regularly could be unfamiliar with the phenomenon known as "fading" that occurs when distant stations are being received at night, and which is due to the reflection of that portion of a given radio emission which is shot into space at large angles to the surface of the earth. The broadcast listener under these conditions receives signals from distant stations varying in strength and quality from moment to moment: the result of these nocturnal disturbances in the ether is, however, far more serious to the Bellini-Tosi D/F station.

As the determination by radio of the true bearing of a transmitting station is, quite obviously, entirely dependent upon the uninterrupted reception of the horizontal portion of the emitted wave, any interference from that portion of the wave arriving at the D/F station at large angles to the horizontal, and similarly polarised, will displace the apparent bearing.

The E.M.F.s due to vertically polarised waves are set up in the horizontal members of a Bellini-Tosi aerial system, and are imposed upon those due to the horizontal portion of the wave, which are induced into the vertical or angular members, and the resultant E.M.F. has no final relationship to the wave's true direction.

With the advent of regular night mail and freight services on the air routes, this drawback to the conventional D/F aerial system became a serious problem. A solution giving considerable promise of immunity from "night-effect" has been provided by the adoption of the Marconi-Adcock system.

During the War 1914-1918 Adcock evolved a modification of the Bellini-Tosi aerial system in which the effect of abnormally polarised waves was overcome by an arrangement in which the E.M.F.s in the horizontal members of the aerial were cancelled out. The practical application of Adcock's original system presented certain difficulties which rendered its use a somewhat costly and complicated matter. The Marconi Company has recently produced a modified version which, whilst retaining the inherent advantages of its parent, is comparatively easy to erect and operate.



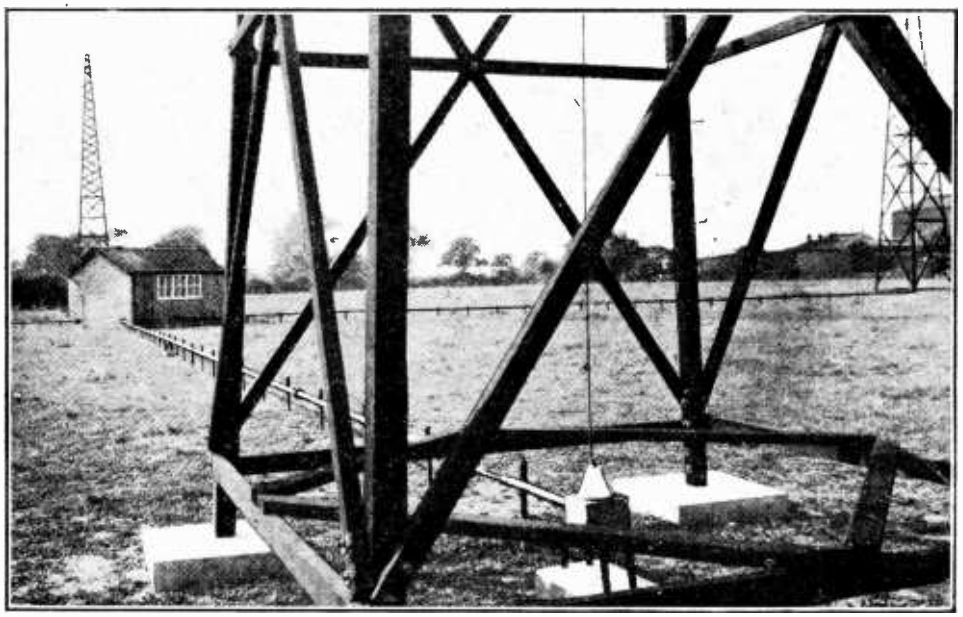
Courtesy: Imperial Airways.

Operators at work in the control tower at the London Airport, Croydon. In the background, in the outlook room, can be seen the traffic controller.

Radio Aids to Air Navigation.—

Briefly, the system consists of four wooden masts, one at each corner of a square, each containing a vertical aerial. At its base each aerial is connected to a horizontal feeder, which is contained in, although insulated from, a copper tube earthed at frequent intervals along its length. Each feeder is led at a low height above the ground to a normal radiogoniometer and receiver. Being completely screened, it is impossible for the horizontal members of the aerial system to be influenced by abnormally polarised waves. The receiver itself is also very completely screened in order to prevent any direct pick-up in the numerous circuits. This is very important, since quite a small amount of electrical leakage in a receiver of such high efficiency would result in currents being set up which would have the effect of displacing bearings.

The first station of this type in Great Britain has recently been erected at Pulham, and the experience gained so far indicates that it is capable of establishing a hitherto unapproachable standard of accuracy in D/F operations at night.



The Pulham D.F station, showing the Marconi-Adcock screened feeder system.

There can be little doubt that for air routes over which night services are operated, D.F stations of a type immune from "night effect" will be a necessity if the day standard of accuracy is to be maintained, and, while the D/F organisation of European and certain Empire airways remains unchanged, there can be little doubt that this will be the trend of development, and it is of interest to note that the erection of another Marconi-Adcock station is projected at Lympne, Kent.

The Radio-Beacon.

America, in the early days of air transport, was at a disadvantage, lacking the direct war-time experience gained in air operations on this side of the Atlantic. For a time the great trans-Continental air-mail route between New York and the Pacific seaboard was operated without any radio aid to navigation. When, with the extension of air services, the need made itself evident, the United States Government tackled the problem from a new angle, their aim being to provide a method whereby directional aid could be made available simultaneously to any number of aircraft flying over a given route. The Bureau of Standards had undertaken in 1920 the development of directive transmitters, and this principle was adopted for use on the commercial airways.

The system consists of two loop antennæ placed at an angle with each other. Waves emitted from this type of aerial are at equal intensities along a line bisecting the two antennæ, any deviation to one side or other resulting in an increase in the intensity of the emission from the corresponding aerial. By setting up a transmitter of this kind so that the bisecting line lies along the direction of an air route, and by providing means for the identification of the emissions from each aerial, a radio path is formed which can be easily followed by an aircraft fitted with receiving instruments.

Two of the main advantages of the "aural radio-beacon" are (*a*) that it relieves the pilot flying along the course marked out from strain when bad weather conditions are encountered, (*b*) that it provides automatic compensation for "drift." It does not, however, provide pilots with any indication of exact position. This information is very necessary at times; for instance, to denote the point of intersection of two air routes equipped with radio-beacons, where a change of course might be required and perhaps a change in receiver tuning to pick up the signals from the other beacon. To meet this drawback small, low-powered transmitters—known as marker-beacons—emitting a Morse characteristic for identification purposes, have been evolved. The wavelengths on which they operate are those used by the radio-beacons themselves; but, owing to the small power used, attenuation of the wave radiated is so rapid that signals are only audible within a very small radius. When used to mark intersecting routes these stations send out their characteristics on the wavelengths employed by the radio-beacons serving each route, and so act as radio signposts.

The aural system, although quite satisfactory in fulfilling its primary purpose, i.e., that of marking out airways, has drawbacks, not the least being the strain imposed upon pilots by the reception over long periods of the continuous "on-course" signal. The Bureau of Standards has, therefore, been experimenting for some

Radio Aids to Air Navigation.—

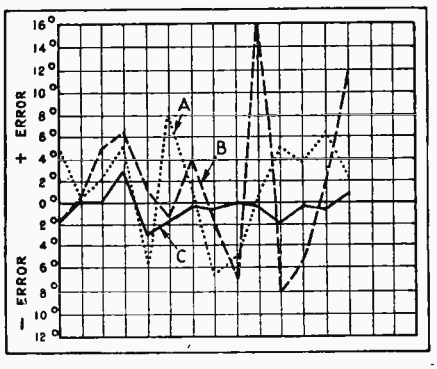
time with a radio-beacon in which low-frequency modulation takes the place of the interlocking Morse signals.

Briefly, the loops of the transmitting antennæ are energised continuously, the carrier frequency in each loop being modulated at 86.7 cycles per second and 65 cycles per second respectively. Two vibrating metal reeds, mechanically tuned to the modulation frequencies emitted by the radio-beacon and actuated by small electro-magnets connected to the output circuit of the aircraft receiver, are placed conveniently within the view of the pilot. As with the aural type of beacon, signals of equal intensity are transmitted along a line bisecting the two loops of the antenna; therefore, the aim of the pilot using the visual method is to maintain the two reeds at equal amplitude.

Britain's New Beacon.

The success of the radio-beacon on the American airways and its possibilities as a means towards the eventual solution of the fog-landing problem have evoked lively interest amongst aeronautical authorities in Europe. The credit for the erection of the first station of this kind on this side of the Atlantic belongs to France, for an aural beacon defining the course between Paris and Dover has been in regular operation at Abbeville since the early part of 1931.

Owing to the amount of communication exchanged between aircraft and ground stations, and the fact that a great number of aircraft radiotelephone installations are pilot-operated, the employment of the aural radio-beacon in the European aeronautical radio organisation is not entirely without drawback, for, since it is clearly impossible to allow radio-beacons to emit within the waveband allocated for air-to-ground communication, a change in the adjustment of the aircraft receiver is necessary in order to pick up the directional transmissions, which may mean failure to receive urgent weather or other information transmitted by aerodrome stations.



A graph showing the comparative accuracy of bearings taken during a night test by two Bellini-Tosi D/F stations A and B (broken lines) and a Marconi-Adcock station C (continuous line) on an aircraft.

With a view to overcoming this difficulty, a visual radio-beacon is shortly to be placed in experimental operation at the airport of London, Croydon, and it is hoped that by the employment of two receivers in aircraft—one tuned to the beacon wavelength, the other to the aircraft communication wavelength—it will be possible for the two services to be carried on simultaneously without serious interruption.

B 23

An attempt has been made to give a survey of the application of D/F in its many forms to aerial navigation since the end of 1918. Its continuous development to date has resulted in the progressive reduction of the liability to human error and of susceptibility to the vagaries of natural phenomena. Work is now being carried on with a view to the still further elimination of the human element. Apparatus, such as the Busignies Radio Compass, developed by the International Telegraph and Telephone Company, and recently described in *The Wireless World*, permits of the automatic summation of E.M.F.s in combined "vertical" and directional aerials, and gives visual indication of the bearings obtained. Other workers strive towards the perfection of systems capable not only of taking bearings automatically but of giving to a pilot sitting in his aircraft miles away automatic indication on a map of the course that he is flying. Twenty years ago Rudyard Kipling took a leap into the future and wrote of the Aerial Board of Control, which, in A.D. 2065, possessed aircraft equipped with chart tables upon which the progress of a flight unrolled itself, degree by degree. The present rate of development leads one to believe that the world will not have to wait 133 years before the fantasy of 1912 becomes a material fact.

"THE WIRELESS WORLD"

Information Bureau

CONDITIONS OF THE NEW SERVICE.

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

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

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

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

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

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

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

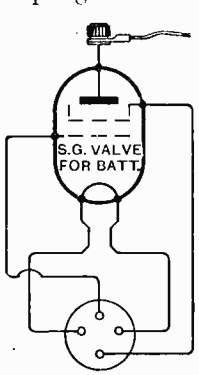
A KEY TO VALVE CONNECTIONS

Explaining the Standard Symbols.

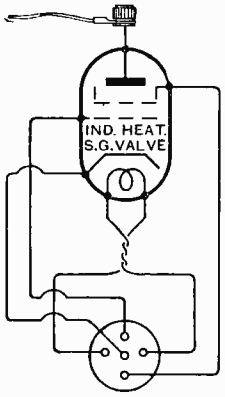
AS a topic of interesting discussion "valve legs" may have its rivals, and some readers may even feel that an apology is due for introducing the subject. When, however, it is remembered that the number of electrodes in the case of some valves has been nearly doubled in the last few years, readers—especially those who have lately taken up wireless—may indulgently agree that a brief survey of the present position is useful, if not absolutely necessary.

The recent introduction of the variable-mu amplifier both for batteries and mains, the indirectly heated mains rectifier, the mains pentode with independently heated cathode, calls for new symbols when these valves are shown in a circuit diagram. Another development is the metallisation of H.F. and detector valves—a valuable asset with modern high-amplification sets.

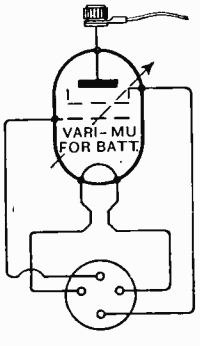
Reference to the diagrams where the standard connections are given schematically, reveals that there are ten different valve symbols in general use, and, while there are other semi-obsolete types existent, it has not been considered worth while to include them. Next to each symbol, and to the photograph of a typical valve of its class, is a sketch giving the relative pin positions when looking at the base of the valve with the bulb remote from the observer. Taking the valves in the order in which they would be used in a receiver, the battery screen-grid valve would come first. As high-frequency energy is here being amplified, it is essential that the terminals and internal leads to the anode and grid should be spaced as far apart as possible. This has led to the standardisation, in this country, of the anode terminal at the top of the glass bulb and of the control grid terminal in the normal position in the base. The screening grid is connected to the pin which would ordinarily be the anode in a three-electrode valve. It is usual to employ metallised S.G. valves, the advantages conferred being a reduction of anode-grid capacity and the prevention of unwanted external coupling.

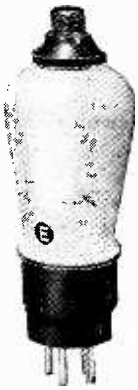


Cossor 220.S.G. Battery S.G. valve.



Mazda AC/S2. Mains S.G. valve.





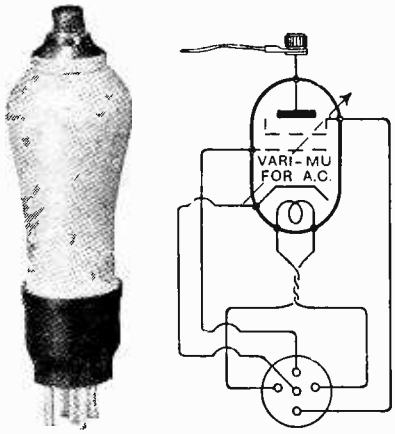
Cossor 220.VSG. Battery variable-mu.

When looking at the base of a battery metallised valve and turning it so that the control grid is "north," the filament pin which is connected to the metal coating, and so should be joined to L.T. minus and earthed, is "west." Should the "eastern" filament pin (grid being north) be taken to L.T. minus and the coated bulb of comparatively large area inadvertently allowed to touch any earthed metal screen in the set, the L.T. battery will be short-circuited.

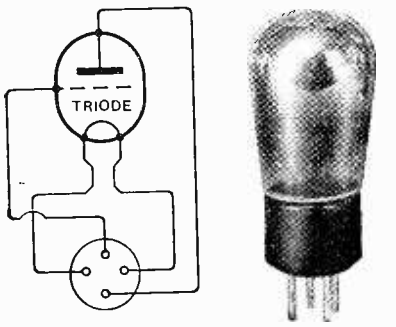
All mains screen-grid valves, both for D.C. and A.C. supplies, are now made with indirectly heated cathodes as the directly heated type have not proved successful. The contact pins have the same relative positions as those of the battery S.G. valves, the heater connections taking the place of the filament leads and the cathode or emitter being brought to an extra pin in the centre of the base. To prevent stray fields, which would probably cause hum, the leads which carry the heater current are usually twisted together, as shown in the symbol for this type of valve. Mains S.G. valves are available metallised for the same reason as battery S.G. valves, but it must be remembered that the large area of metal coating increases the anode filament capacity, and any condenser used to shunt the cathode bias resistor should be non-inductive. Metallised mains valves have the metal coating connected to the cathode pin, and an accidental short-circuit of the cathode bias resistance must be avoided.

The new variable-mu valves are essentially screen-grid valves in which the control grid wires are not uniformly spaced. The effect of this is to produce an H.F. valve with a mutual conductance which varies over a wide range with change of control grid bias. (It should be noted that "variable-mu" is an abbreviation of "variable mutual conductance" and not of

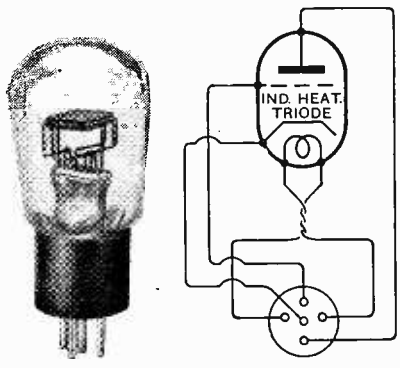
"variable-μ" or amplification factor). To represent this large change of overall amplification which the valve exercises, an arrow is used across it which, as a symbol, has come to mean a continuously



Osram VMS4. Mains variable-mu.



Mullard PM2A. Battery triode



Mullard 354V. Mains triode.

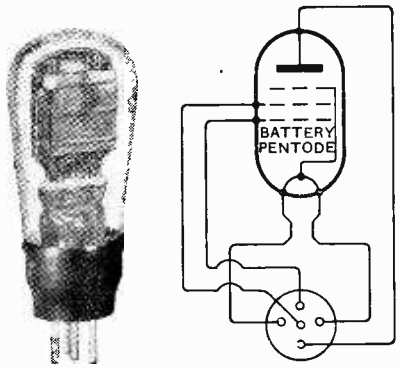
variable control. The notes concerning contact-pin disposition and metallisation of the ordinary S.G. valve apply equally to variable-mu valves.

Of the triode which has been with us for so many years little need be said beyond the advent of metallisation where the working impedance is above, say, 8,000 ohms, so that detectors and first L.F. valves may benefit from efficient valve screening. The indirectly heated triode has a fifth pin in the centre of the base connected to the cathode.

Taking the pentode next we find that its connections are somewhat confusing and care must be taken in the wiring of the valve holder. Whichever type is considered, the anode, control grid, and heater or filament pins are the same as those of the triode already discussed, but with the battery or mains directly heated pentode the auxiliary grid is brought out to the centre pin in the base corresponding to the cathode connection in an ordinary mains valve.

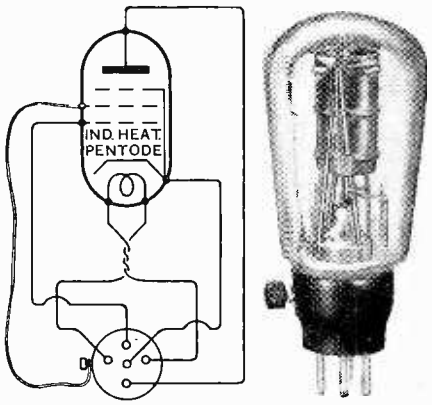
The indirectly heated pentode always contains a centre base pin for cathode connection and a side terminal on the base for the auxiliary grid. Should, therefore, a directly heated pentode with five base pins be replaced by an indirectly heated type also with five pins, the cathode will receive some 200 volts in excess of its requirements. Before making the change the centre socket of the valve holder should be connected to the bias resistor and the disconnected lead joined to the side terminal.

With regard to A.C.-mains rectifiers, the full-wave valve is by far the most popular. It contains two anodes, one being joined to the pin which is normally the control grid and the other to the anode pin. Considerable interest attaches to the indirectly heated full-wave rectifiers, which not only have an increased capacity for overload, but, by reason of the slow heating of their emitters, no dangerous surge voltages are developed when switching on and

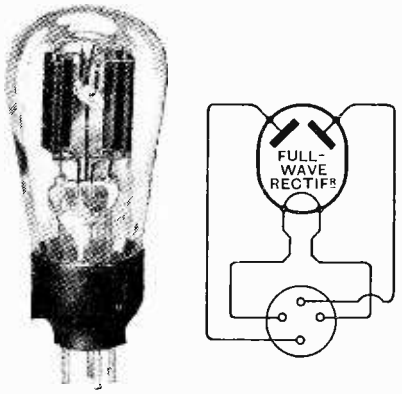


Mazda Pen.220. Battery pentode.

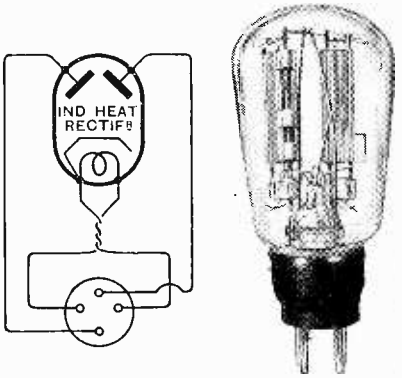
smoothing condensers are safeguarded from breakdown. The cathode in these valves is internally connected to the heater.



Mazda AC/Pen. Mains pentode.



Osram U.12. Full-wave rectifier.



Mazda UU60/250. Indirectly heated rectifier.

With so many valve types and such a multiplicity of connections we owe a debt of gratitude to the Valve Manufacturers Association that standardisation is complete. For the same class of valve any maker's product will have contact points in the same relative positions.

FIXED RESISTANCES and

Part I.—The Reason for their Inclusion in a Receiver.

By A. L. M. SOWERBY, M.Sc.

IF he really tried, an ingenious designer could probably find a plausible excuse for the inclusion of thirty or more resistances in one modern circuit. An attempt in this direction is shown in the circuit of Fig. 1, although, since no more than twenty-one resistances have been accommodated, it may perhaps be regarded as a half-hearted effort. Nevertheless, it will serve reasonably well as a mine from which to dig examples of the uses to which resistances are put in modern sets. It is proposed in this article to discuss each of the resistances in turn, giving in each case the reason for its inclusion and allotting a value that will fulfil the particular needs of the circuit chosen.

Before embarking upon this, it is necessary to fill in one or two points in connection with the details of the circuit. It is assumed that V_5, the output valve, is of the high-voltage type, consuming a fairly large anode current at an anode voltage of 400; as the astute reader will see, this provides an excuse for several extra resistances, for it will be necessary to cut down the voltages reaching the anodes of the remaining four valves, all of which, being of the indirectly heated A.C. type, are rated for a maximum of 200 volts.

Dividing our favours with strict impartiality among the four principal valve-makers, we will use the valves given in the following table. Operating data, drawn from *The Wireless World* Valve Data Sheet, are included, for we shall need these figures as the groundwork in finding resistance values. The information relative to the detector valve is put in brackets, because the figures refer to amplifying conditions. They will not apply when the valve is used for detection.

TABLE I.

Position.	Valve.	Volts on Screen E_{s}.	Screen Current. I_{s}.	Volts on Anode. E_{a}.	Anode Current. I_{a}.	Volts on Grid. E_{g}.
V_1 } V_2 }	Cossor MSG/LA ..	80	1	200	5.25	1.75
V_3	Mazda AC/HL ...	..	..	(200)	(6.5)	(3)
V_4	Mullard 164V	—	..	200	8.5	8.5
V_5	Marconi LS6a	—	..	400	63	91

The first point that emerges from the figures in the table is that we shall require the eliminator to deliver an overall voltage of 491 volts, this being the sum of anode and grid voltages required for the last valve. For convenience in calculation we will increase this to the round figure of 500 volts, assuming that the odd

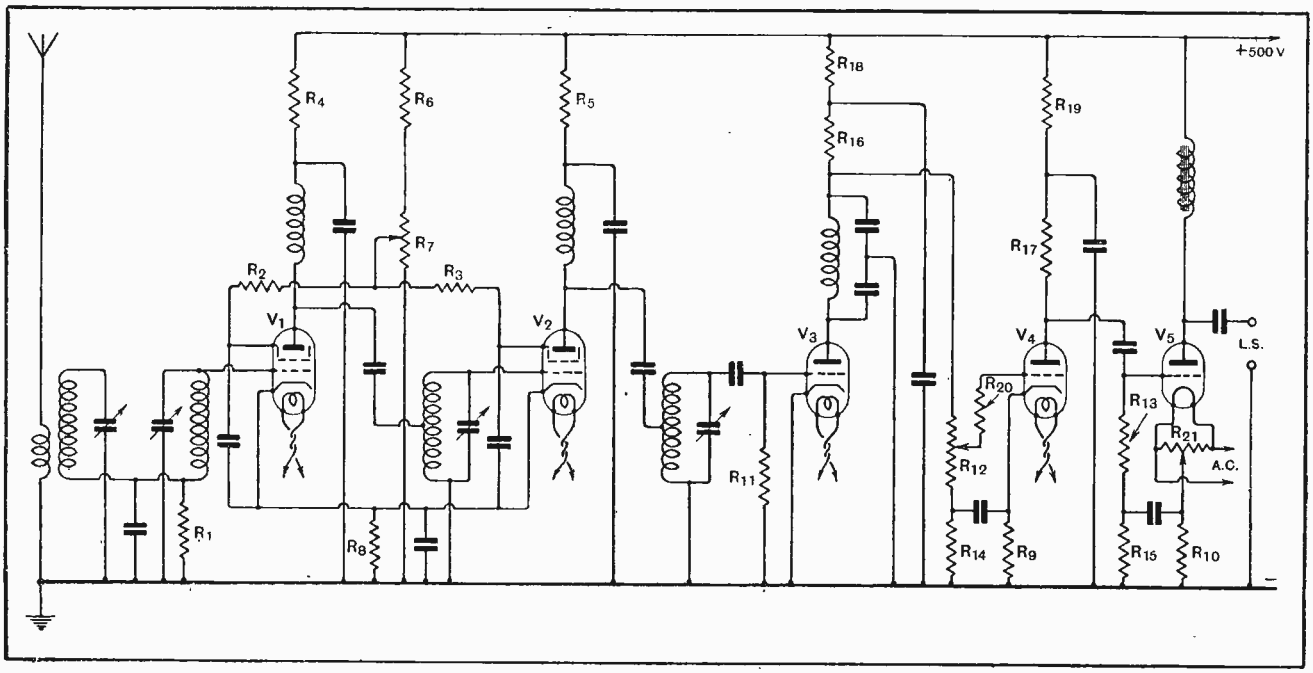
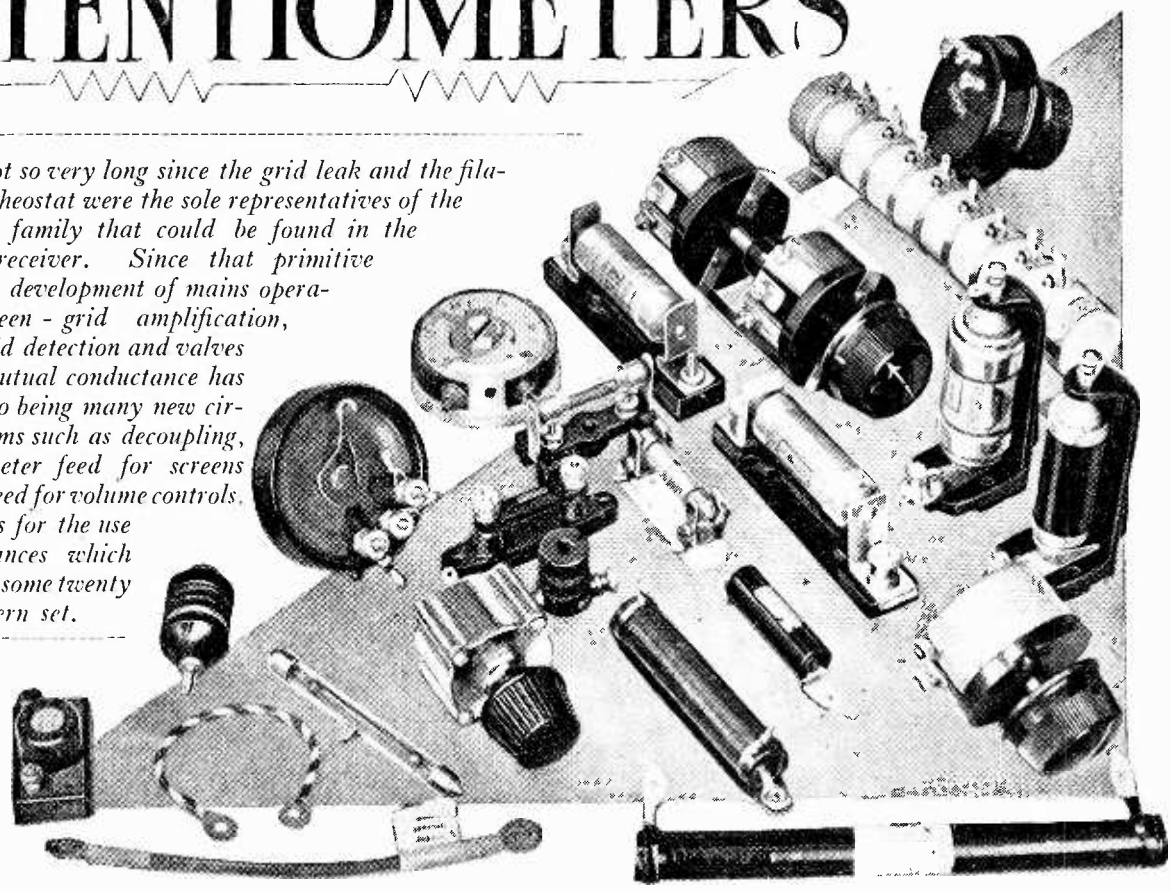


Fig. 1.—The circuit diagram of a complete receiver, containing no fewer than twenty-one resistances. The text deals with the purpose and choice of each.

POTENTIOMETERS

IT is not so very long since the grid leak and the filament rheostat were the sole representatives of the resistance family that could be found in the average receiver. Since that primitive epoch the development of mains operation, screen-grid amplification, power-grid detection and valves of high mutual conductance has called into being many new circuit systems such as decoupling, potentiometer feed for screens and the need for volume controls. Each calls for the use of resistances which may total some twenty in a modern set.



nine volts will be dropped across the d.c. resistance of the output choke.

In working out voltages in a wireless set, it is convenient to adopt a version of Ohm's law which, though extremely handy, is not quoted in textbooks. Usually one is told that voltage equals current multiplied by resistance, the units being volts, amperes, and ohms respectively. Amperes, however, do not occur in any quantity in the anode circuits of ordinary valves; their place is taken by milliamperes, which are thousandths of a full-grown amp. If we replace amps. by milliamps. in using Ohm's law, our calculations will automatically lead to ridiculous answers because the system of units has been upset. We can restore the balance, however, quite readily by using thousands of ohms instead of single ones as the unit of resistance. Ohm's law, in its wireless version, will therefore read: "Current (in milliamps) multiplied by resistance (in thousands of ohms) equals voltage (still in volts)."

Applying this to the output choke just mentioned, it is clear that if it drops nine volts at a current of 63 milliamps, its resistance will have to be $9/63 = 0.143$ thousands of ohms, or 143 ohms. In practice, such a choke would usually have a slightly higher resistance than this, but we will accept the mildly improbable figure just found for the sake of keeping the overall voltage at the convenient round figure of 500 volts. Bearing this in mind for use when we want it, we can begin the consideration of Fig. 1.

Bias and the Band-pass Filter.

The first resistance on the list, R_1, is placed in shunt with the coupling condenser of the input filter. If the circuit from the grid of the first valve is traced out, it will be found that in the absence of this resistance there is no way back from the grid to earth except through a condenser. The omission of R_1 would therefore mean that it would be impossible to apply bias to the grid of the first valve. Rearrangement of the filter as in Fig. 2, so that the coils returned directly to earth, and the coupling condenser was placed in the common return-lead of the two variable condensers, would get over the difficulty without making the insertion of R_1 necessary, but the rotors of the tuning condensers would no longer be at earth potential, with the result that it would be impossible to gang all the tuning condensers together without going to the trouble of a special insulated spindle. Since it is usually both easier and cheaper to insert R_1 than to use special tuning condensers, the arrangement of Fig. 1 is very widely adopted.

Since the resistance is really only needed to supply a conducting path to the grid, it matters very little

Fixed Resistances and Potentiometers.—

what value is chosen for it. The only essential condition is that the resistance should not be so low that the coupling condenser is virtually short-circuited. Five thousand ohms, for example, would do very well; so also would a megohm. It is found, however, that if the resistance is made too high, valve-noise is accentuated, and there is a danger of hearing a hiss as a perpetual background. The tendency, therefore, is to restrict the resistance to values not much exceeding the 5,000 ohms just mentioned; a value of that order will in consequence be chosen.

Decoupling Resistances.

The two resistances next in numerical order, R_2 and R_3, are both included to prevent high-frequency currents flowing in the screen circuits of the high-frequency valves from finding their way either from one screen to the other or into the wiring generally. Such stray currents have to be avoided, especially in a two-stage set, as their presence is very likely to lead to unwanted oscillation of the high-frequency stages. R_2 and R_3, in conjunction with the condenser between each screen and its cathode, provide a complete decoupling scheme for the screens of the valves. Since the impedance of the condensers should be very low, there is no need to choose high values for the resistances; any value above some 500 ohms will prove effective. An outrageously high value, such as half a megohm, would reduce the voltages on the screening grids to too low a value to allow the valve to deveop its full amplifying powers, but there is n exact "correct" value for such a position as this. One thousand ohms would be a very good value to select, and the resistance should, if possible, be non-inductively wound to eliminate the possibility of spurious oscillation and stray couplings.

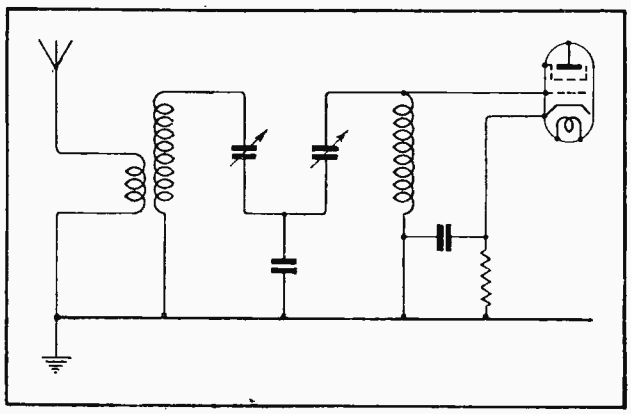


Fig. 2.—Alternative arrangement of filter, in which R_1 is no longer required. The moving plates, however, are now not earthed.

The resistances controlling the voltage applied to the anodes of the two screen-grid valves are numbered R_4 and R_5. In addition to their obvious function of cutting down the voltage to a value which the valves will stand without harm, they act, in conjunction with the condensers connected between one end of them and earth, as decoupling resistances. Their value, of course, has to be chosen so that the voltage dropped across them is correct; the decoupling provided is an incidental advantage rather than the primary reason for their inclusion. The valves suggested for the positions V_1 and V_2 draw an anode current of $5\frac{1}{4}$ milliamps. each at optimum screen and grid voltages; the resistances therefore have to drop 300 volts (the difference between the 500 volts available and the 200 volts required) at this current. Their resistance must therefore be $300/5\frac{1}{4}$, or about 57,000 ohms each.

Since the variation of screen-voltage is used as a means of controlling volume, and since also the anode current drops when the screen-voltage is lowered, the resistance found will not prevent the voltage at the anodes from rising far above the specified 200 volts when the screen-voltage is reduced below the maximum. This rise in voltage is inevitable, and is found in practice to do the valves no harm; it is therefore usual to ignore it, and to be content with the knowledge that at maximum current the voltage on the anode is correct. The positions R_4 and R_5 may therefore be filled by resistances of 60,000 ohms each.

The resistance R_6 and the variable potentiometer R_7, connected in series across the full voltage of the anode-current supply, serve to control the voltages applied to the screens of V_1 and V_2. The series resistance R_6 is included so that when the receiver is in use it will only be possible to apply the rated maximum of 80 volts to the screens; if the potentiometer covered the whole range of voltages up to 500, as would happen if it were used alone, it would be fatally easy to turn the knob too far and ruin the valves. We shall therefore arrange that the highest voltage that can be applied to the valves is 80 volts.

The Screen Potentiometer.

The two screens, between them, draw a current of about two milliamps. To ensure that small variations of the valves from normal shall not seriously upset our calculations, we will arrange that the potentiometer shall draw some five or six milliamps.; a few tenths of a milliamp. more or less drawn by the screens will then be so small a proportion of the total current that it will make a difference of two or three volts at most.

To take 5 milliamps. at 80 volts, R_7 must have a resistance of 80/5, or about 16,000 ohms; the nearest standard value is 15,000 ohms, so we will have to accept this value. At 80 volts this will take $80/15 = 5.3$ milliamps., and both this current and the 2 milliamps. required by the screens will have to flow through the fixed resistance. Across this we wish to drop $500 - 80 = 420$ volts; at the total current of 7.3 milliamps. we shall therefore have to use a resistance of $420/7.3 = 57,500$ ohms. Sixty thousand ohms will be near enough.

If the receiver is to be truly "all-mains" it is necessary to provide grid-bias from the eliminator as well as anode and filament current. A year or so ago it was not uncommon, at least in amateur-built sets, to install a separate eliminator, with its own rectifying

Fixed Resistances and Potentiometers. — valve and transformer, to provide the grid-bias voltages required. No technical objections can be urged against this scheme; it has died out merely because of the increased cost in apparatus that it entails. In modern sets it has become customary to provide the grid voltages from the same source that provides the anode current, so that the single eliminator that does duty for both purposes has to provide a voltage great enough to cover the sum of the highest anode voltage and the highest bias voltage required.

The usual method of producing the bias voltage is at first sight an odd one; instead of giving the grid a negative voltage, the cathode (or, in the case of a directly heated valve, the filament) is positively biased. Since grid voltage has to be reckoned from the cathode, it matters not at all whether the grid is held at earth potential and the cathode biased positively, or whether the cathode is earthed and the grid biased negatively as in a battery-driven set. Either method will serve; the choice is simply one of convenience.

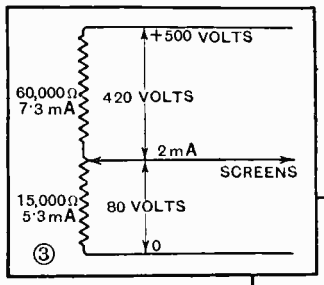


Fig. 3.—Details of the screen-grid potentiometer, showing currents and distribution of voltage.

Positive Cathode or Negative Grid.

The derivation of the positive bias for the cathode is shown in principle in Fig. 4. The diagram shows a resistance-coupled stage reduced to its simplest possible form, and includes the high-tension battery as though it supplied this one valve only. The curved arrow shows the direction of flow of the electrons which make up the anode current. It will be seen that as the electrons flow through the anode resistance R_1 of this circuit, there is a voltage drop across it; one may helpfully visualise it as a piling-up of electrons against the barrier in their path. The end of the resistance next to the anode of the valve is therefore more negative than the end attached to the high-tension battery; we have met this effect before, when, in regarding the direction of flow of current as positive electricity flowing in the direction contrary to that of the curved arrow, we have spoken of a voltage-drop across a resistance in an anode circuit.

If now we turn our attention to the bias resistor R_2 of Fig. 4, it becomes plain that exactly the same effect is taking place there. Electrons forming the anode current have to flow through R_2 exactly as they flow through R_1; and once again the piling-up effect occurs, making the end of the resistance next to the battery more negative than the end nearest the cathode of the valve. By bringing the bottom end of the grid-leak or other component in the grid-circuit of the valve to the point shown, the voltage drop across R_2 is applied between grid and cathode, the former being negative with respect to the latter. Thus the necessary negative bias is applied to the grid.

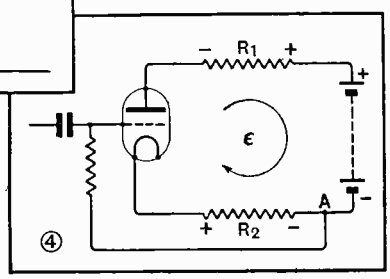


Fig. 4.—Showing how the bias voltages are obtained from a bias resistor such as R_2.

It is usual, in a mains set, to earth the point marked "A" in the diagram (that is, H.T. *minus*), so that the grid of the valve is actually at earth potential. With point A earthed, the cathode of the valve is positive with respect to earth; one may therefore speak of giving the cathode a positive bias, and refer to R_2 as a cathode-bias resistor. From the point of view of the valve, and of the voltages applied to it, its own cathode is its own private "earth" point, in that it has to be taken as the zero point from which to measure anode and grid voltages; when discussing the set as a whole, this point of view is not easy to use, because the various cathodes are all at different potentials. It is for this reason that the "positively biased cathode" convention is tending, in mains sets, to oust the "negatively biased grid" form of expressing the same thing.

Reverting to Fig. 1, the bias for the cathodes (or grids) of the first two valves is provided by the voltage-drop across R_8. The fact that the combined anode and screen currents of the two valves has to flow through this resistance is much less evident here than in the parallel case shown in Fig. 3; careful tracing out of the circuit will show, however, that this is the case. The total current flowing through R_8 is $12\frac{1}{2}$ milliamps., made up of $5\frac{1}{4}$ milliamps. for each anode and 1 milliamp. for each screen. To provide a bias of $1\frac{3}{4}$ volts at this current requires a resistance of $1\frac{3}{4}/12\frac{1}{2}$, or 0.14 thousands of ohms; that is, 140 ohms. Since reduction of the screen-voltage by variation of R_7 will cause both anode and screen currents to decrease, the voltage dropped across the bias resistor will vary with the setting of the volume-control potentiometer. This defect is in practice not found to have any very serious ill-effects, though it is usually advisable to use for R_8 a value rather higher than that found by the calculation just given. For the present case, 200 ohms would be suitable. The variation in bias voltage can be considerably minimised by allowing some other current, independent of the changes brought about by varying the position of the slider on R_7, to flow through the bias resistor in addition to the current actually taken by the valves. In the present case this would most conveniently be arranged by bringing the bottom end of R_7 to cathodes instead of to earth, thereby adding the constant potentiometer current to that drawn by the valves. The total current would then rise to 17.8 milliamps., at which current a resistance of $1\frac{3}{4}/17.8$ thousands of ohms, which is almost exactly 100 ohms, would be required.

The receiver contains two other bias resistances, numbered R_9 and R_{10}. Consideration of the first of these must be postponed until choice has been made of

Fixed Resistances and Potentiometers.—the anode resistances for V_1, and the anode current to be consumed by that valve has been settled. R_{10} can be fixed at once from the data we already have; reference to the table of valve data shows that V_5 draws an anode current of 63 milliamps. and requires a bias of 91 volts. The bias resistor must therefore be made up to $91/63 = 1{,}440$ ohms. The round figure of 1,500 ohms will in practice be used, reducing the anode current by a milliamp. or two and adding a volt or so to the bias.

Where a milliammeter is available, there is a better method of settling the best possible value for the bias resistor. The calculation just made will give a perfectly correct value for a valve which is exactly to maker's specification: But owing to the inevitable variations in manufacture, it is quite likely that the particular specimen we shall actually use will not take exactly the anode current quoted in the catalogue—which, after all, is only claimed to be an average figure. Using the calculation as a basis, it would be advisable to use a fixed resistance of 1,000 ohms in series with a variable resistance of the same value for fine adjustment. With the latter set at maximum the anode current, provided the valve is a normal one, should be less than the required 63 milliamps., and should remain so as the resistance is decreased in value down to 440 ohms, when the nominally correct anode current should be reached. If the valve is not strictly to specification, the required anode current will be reached at some other adjustment of the variable resistance; this adjustment is that which should be used permanently in the set.

(*To be concluded.*)

GENERAL GUSTAVE FERRIÉ.

The Passing of a Pioneer.

THE news of the death, on February 16th, of General Gustave Ferrié, head of the French military wireless service, will have been received with real regret by a large number of wireless amateurs. To most of us the name Ferrié instantly recalls the Eiffel Tower wireless station, which the late General designed and which came to be, perhaps, the most famous of its kind in the world. But, to the amateur, General Ferrié was more than an astute and practical wireless pioneer; from the earliest days he demonstrated an active interest in the amateur movement. An example of his practical sympathy occurred at a meeting of the then Wireless Society of London (now the Incorporated Radio Society of Great Britain), held at the Institution of Electrical Engineers on January 21st, 1914, when, as vice-president, he sent from the Eiffel Tower station a special message of greeting which was received on a syphon recorder and projected on a screen by an epidoscope.

General Ferrié, who was born at St. Michel de Maurienne (Savoy) on November 19th, 1868, commenced his wireless experiences in February, 1898, by being present during the experiments conducted by the young Marconi in wireless working between Wimereux and Dover. In 1900 he began his real life work by creating the French Military Radiotelegraphic Service. He will always be remembered as the man who taught the army the true value of radio in the field. When the War broke out he naturally assumed control of all the army wireless services.

Prolific Research Worker.

He had his triumphs, too, as a research worker, and among his achievements was the development, independently of others, of the electrolytic detector.

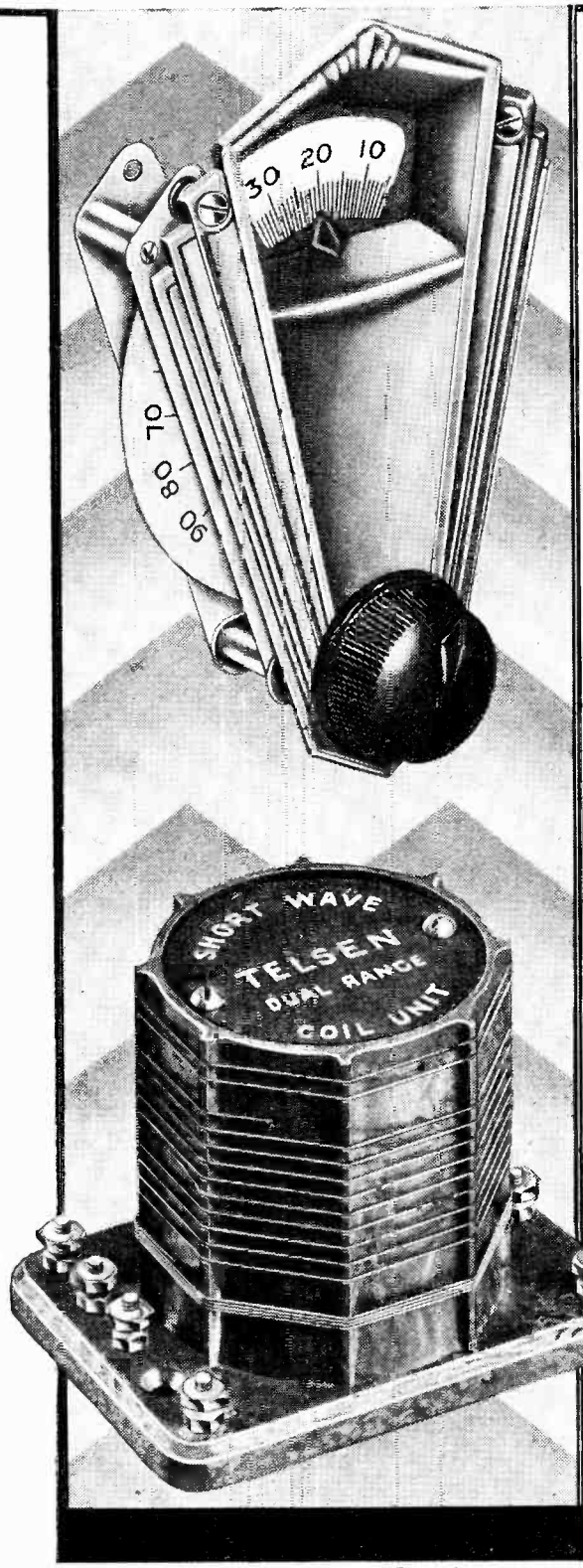
In 1919 *The Wireless World*, in a brief chronicle of some of his more important contributions to the development of wireless, included the following: Thermic Ammeter, Wavemeter and adjustable condenser (1902-1903). Direct Reading Wavemeter (two crossed needles) (1909). Installation for the transmission of time signals: Eiffel Tower Observatory of Paris (1910). Special valves which may be used, as desired, as detector, amplifier or generator (carried out by M. Abraham) (1915).

He was present at the Eiffel Tower on the historic occasion when the American Telephone and Telegraph Company succeeded in telephoning across the Atlantic in 1915, and in recognition of his services he was awarded the Franklin Medal in 1923.

Many other honours came to General Ferrié. He was a Companion of St. Michael and St. George (Great Britain) and, in 1919, was made a doctor of Science, *honoris causâ*, of Oxford University. His own country made bounteous acknowledgment of his services, and it was while he was lying on his death-bed that Marshal Franchet D'Esperey brought him the insignia of the Grand Cross of the Legion of Honour.

Quite recently General Ferrié's help was enlisted by his country in the design of a national broadcasting service, the outcome being the already famous "Ferrié map" for a twenty-station regional scheme, published in *The Wireless World* of January 27th last. There are indications that the scheme may materialise, and that the name of France's greatest wireless personality may be perpetuated in her broadcasting system.

TELSEN SHORT WAVE COMPONENTS



TELSEN ILLUMINATED DISC DRIVE

A good smooth "slow motion" drive is essential for short wave work. The Telsen Illuminated Disc Drive incorporates an improved movement which gives an exceptionally smooth action and a gear ratio of approximately 5-1, and the bold and well proportioned figures make for delightfully easy tuning, and as the dial rotates over the full circle, all types of condensers are catered for. It is fitted with a handsome oxydised silver escutcheon of modern design and the dial may be illuminated by means of an ordinary flash-lamp bulb.

4/6

COMBINED DUAL RANGE SHORT WAVE COIL UNIT

This Unit for the first time brings the construction of short-wave receivers into line with the simplicity of modern practice. When tuned by a .00025 condenser, a wave range of 20 to 80 metres can be covered by the operation of a switch as in ordinary broadcast practice. No coil changing is necessary and no other coils are required, as the unit incorporates windings for aerial, tuning and reaction circuits. The coil is also suitable for use with sets covering all wave bands with a .0005 tuning condenser. In this case the Dual Range feature is not employed.

4/6

The Telsen Short-wave Coil adds the Short Waves without coil changing.

TELSEN
SHORT-WAVE COMPONENTS

CVS-165

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

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

NEWS of the WEEK.

Licence-free Sets "On Appro."

SOME heartburnings should be overcome by the new decision of the Post Office permitting wireless dealers to supply sets on approval for a period of fourteen days without covering them with wireless licences. Dealers must, however, keep a record, open to inspection by the Post Office, showing the name and address of the prospective purchaser, together with the dates of supply and of recovery or sale, as the case may be.

Many Happy Returns!

WGY, the famous station of the General Electric Company at Schenectady, N.Y., celebrated its tenth birthday on Saturday last, February 20th. The station has been notable as a pioneer in broadcasting technique. For example, it was the first to use crystal frequency control, the first to use a condenser microphone and the first to use a power so high as 50 kilowatts. Recently in special tests 200 kilowatts was used.

Wireless Club's Coming of Age.

CLAIMING to be the first in the country, the Derby Wireless Club last week celebrated the twenty-first year of its existence with a well-attended dinner. Several of those present were members who had joined the club at its foundation in 1911.

Mr. S. G. Taylor, President of the club, summarising the Society's history, said it was founded as the outcome of a University extension lecture by Professor G. P. Bailey in the spring of 1911.

Broadcasting a Ghost Hunt.

RADIO Toulouse must be running short of suitable material for outside broadcasts. According to our Paris correspondent, a recent relay was staged at a neighbouring farmhouse reputed to be inhabited by ghosts, but, to the surprise of the station officials, the running commentators were unable to provide a good story, as the ghosts failed to materialise.

A Record of Records.

NEARLY 5,000 double-sided records are listed in the 1932 edition of the "His Master's Voice" Record Catalogue, which now enters into its second decade. We understand that copies of the new edition will be available shortly.

The publication, which consists of over 400 pages, includes an ingenious system of cross indexing, enabling the reader to trace a record of which only meagre details are known.

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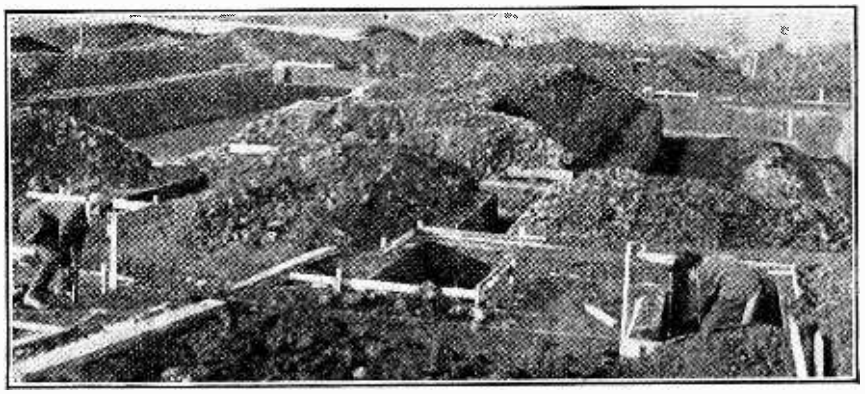
A STATION IN THE MAKING.



A photograph taken last week on the site of the new West Regional broadcasting station at Washford Cross, near Minehead. The foundations are now nearly complete.

Selectivity Debate.

THE extremely topical subject of "Selectivity" will form the basis of an informal discussion to be opened this evening (Wednesday) by Professor C. L. Fortescue, O.B.E., M.A., at a meeting of the Wireless Section of the Institution of Electrical Engineers.

In view of recent progress in investigating the problem of interference, many interesting pronouncements may be expected during the meeting from those who come to give their views and experiences.

The meeting opens at six o'clock.

"Listening British" in Greece.

"A SUPER station, replacing 5XX, which would be the British mouthpiece to the European continent, as Warsaw to-day is for Poland." This is asked for by a British listener in Athens, who has read the report of our Budapest correspondent on reception conditions in Hungary.

Using a *Wireless World* "Foreign Listener's Four," an Athens resident finds 5XX "weak and lost in mush." Northern National is too weak to be intelligible, Northern Regional is swamped by Prague (488.6 metres), while London National, though giving a good signal, is usually spoilt by Moravska-Ostrava (263.8 metres). London Regional is good when an unknown Russian, well within the 9 kc. separation limit, is not working.

The Daventry short-wave station, it appears, is occasionally good, though "very fluky." Sometimes it is untraceable. It is heard in winter at midday, but in summer at night.

Radio Clashes at Shanghai.

APART from the Sino-Japanese conflict, other kinds of warfare rage around Shanghai these days, according to our Washington correspondent. It is a battle of the ether channels. With Chinese land stations and American, Japanese, British, French and other warship radio stations all going full blast, sending reports of the developments to their respective home Governments by code, interference on the short waves is rampant.

But the interference, thanks to the "courtesy of the ether" that is being more or less scrupulously observed by operators everywhere, has not yet broken the lines of communication.

Unconfirmed reports have been received in Washington that the Japanese Government has ordered its amateurs to cease communicating with American amateurs—a likely measure of war, but one about which the American Radio Relay League has heard nothing official.

Listening Hall for the Deaf.

TO provide a deaf person with broadcast reception at a strength he can enjoy, without inconveniencing the more fortunate members of the family circle, has constituted a problem in many homes. In Goerlitz, Germany, the difficulty has been met by providing a special "House of the Deaf," where deaf persons may congregate and hear the programmes through headphones at any strength they desire. The house contains a number of listening rooms equipped with headphone points and the necessary amplifiers.

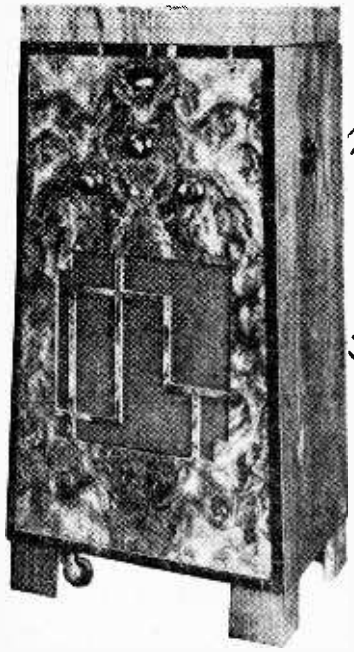
This seems, to us, a rather unnecessary procedure. On most receivers it is quite easy to tap the loud speaker output with headphones and auxiliary volume control.

"The Voice from Heaven."

THE denizens of Taliedo, near Milan, were told it was the "voice from Heaven" (though they may have thought otherwise) when a three-engined Caproni 'plane recently soared over their heads and delivered a loud speaker version of "a joyful chansonette," writes our Italian correspondent. Every note was heard clearly, though the 'plane was flying at an altitude of nearly 3,500ft.

The 'plane carries four banks of amplifying valves, with microphone and gramophone equipment, and it is stated that the maximum amplification will magnify the human voice approximately 1,600,000 times.

It is understood that the equipment is to be used primarily for naval and military purposes.



The MADRIGAL 1932 BAND PASS MAINS THREE RECEIVER

Completely Self-contained. One-dial Control.

IN the early days of broadcasting, largely owing to the poor characteristics of the valves then available, and to the scarcity of reliable technical data, it was a matter of considerable difficulty for any manufacturer to design a receiver possessing a reasonable degree of performance and reliability; to-day, however, conditions are so vastly changed that it is hard to produce a set which does not reach a fair average standard of performance.

Even in those bad old days, however, a few firms managed to get ahead of their contemporaries in the matter of producing receivers which not only gave a good performance within the limits imposed by such handicaps as poor valve characteristics, etc., but were remarkable for their freedom from breakdown and for their compactness and neatness. Numbered among these pioneer firms was R.I., Ltd., and it is not surprising that in these days of almost monotonously good sets one finds it still among the few who lead in the matter of receiver design; thus it is that in the Madrigal receiver one discovers not just a conventional three-valve arrangement but a design in which full advantage is taken of every modern device for getting the maximum results which can possibly be obtained from three modern valves.

The receiver is housed in an extremely attractive walnut cabinet of the pedestal type, and castors are fitted which enable the set to be moved about with the utmost ease. Good points of cabinet design are greatly enhanced by the symmetrical arrangement of the three controls which appear at the front of the instrument. The centre one of these is the main tuning knob which operates the three sections of the ganged tuning condenser through the usual friction drive, giving a reduction ratio of approximately 8:1. The tuning dial, which is calibrated directly in metres, and is illuminated by the customary dial light, is mounted in a convenient position just above the main tuning control. This latter device is flanked on the right by the reaction control and on the left by the volume adjuster, the wave-change and gramo-radio switches being found on the right- and left-hand sides of the receiver respectively; these two latter devices are constructed of moulded material designed to harmonise with the walnut finish of the cabinet.

FEATURES.

GENERAL: Completely self-contained A.C. mains receiver in pedestal cabinet. Single dial control. Moving-coil loud speaker with field winding used as a smoothing choke. Gramophone volume control incorporated in receiver. Provision for mains aerial.

CIRCUIT: Band-pass tuner followed by one H.F. stage coupled to tuned grid circuit of detector. Choke-filter fed L.F. transformer. Combined choke and transformer coupling between pentode output valve and low impedance moving-coil loud speaker. Full-wave valve rectifier.

CONTROLS: (1) Single knob tuning control. (2) Capacity reaction control. (3) Combined radio and gramophone volume control. (4) Internal series aerial trimmer. (5) Waveband switch. (6) Gramo-radio switch. (7) On-and-off switch.

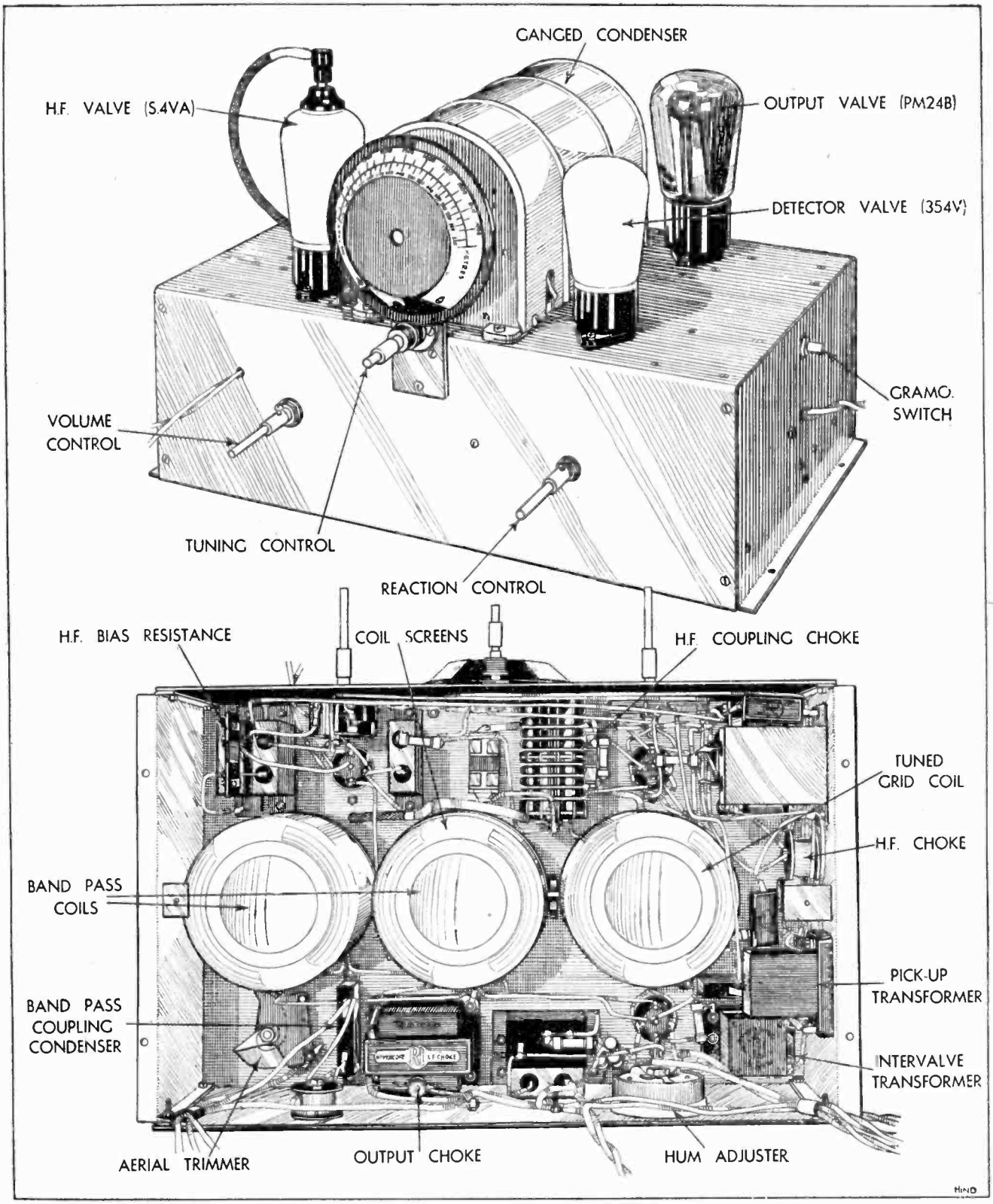
PRICE: £35:0:0 including royalties.

MAKERS: Radio Instruments Ltd., Madrigal Works, Purley Way, Surrey.

The disposition of the principal controls, apart from being æsthetically pleasing, is so convenient that it is disappointing to have to record yet another case in which the user has to get at the back of the set in order to switch it on and off. Advantage is taken of the design of the cabinet to separate the receiver from its power unit, the latter being mounted in the bottom of the container; the result of this is far less congestion on the receiver chassis than is usual, and in addition complete mechanical stability owing to the low centre of gravity thus obtained.

Referring to the circuit diagram, it will be noticed at the outset that use is made of band-pass tuning. Each of the three condensers is provided with trimming arrangements which, however, are the concern only of the factory or service man. An additional trimmer is provided in the form of an aerial series condenser in order that a final adjustment may be made according to whether a large or small aerial is used. It is a great relief to find the controlling knob of this latter condenser mounted on the

BAND-PASS SCREEN-GRID MAINS RECEIVER.



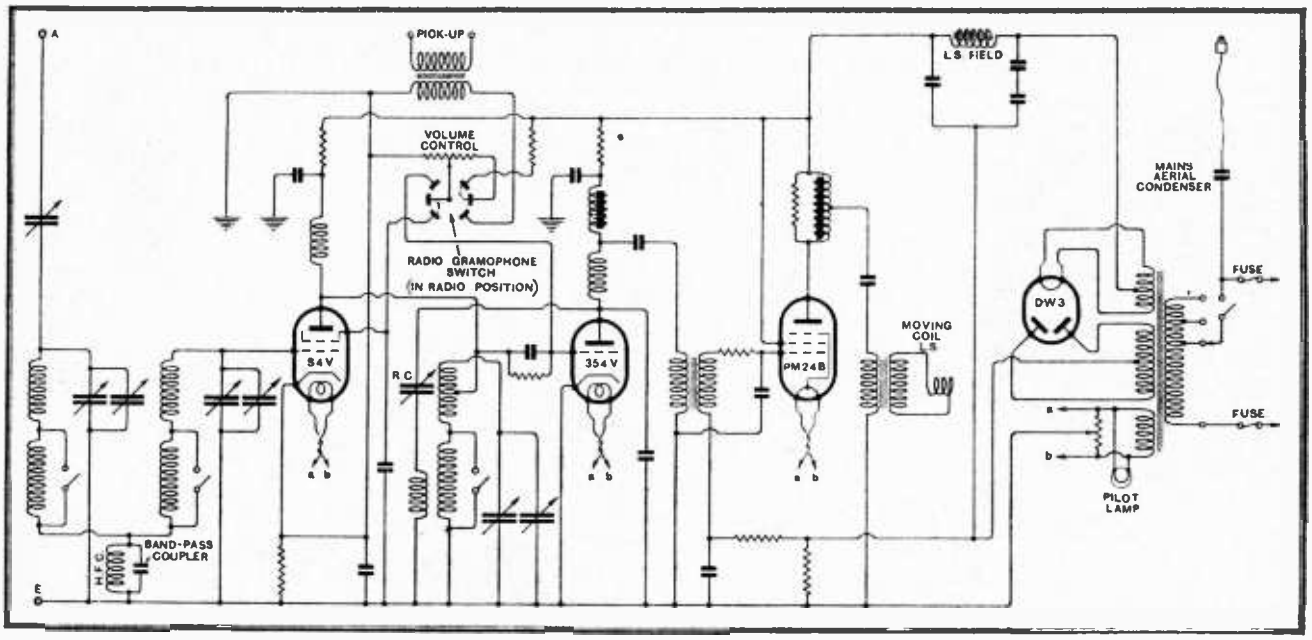
Compact layout and pleasing line are features of this receiver.

The R.I. Madrigal Receiver.—

chassis inside the set rather than on the outside, where it would add to the bewilderment of the ordinary user, who would probably nullify the whole of the designer's efforts by attempting to use it as a volume or selectivity control. A point which is a little unusual is the provision of an H.F. choke instead of a resistance to act as a feed for biasing the grid of the H.F. valve.

Nothing calls for comment in the arrangement for using the mains as an aerial or for coupling the H.F. stage to the detector, but the volume control and the switching arrangement associated with it cannot be ignored. By an ingenious arrangement, the salient features of which will at once be gathered from the circuit diagram, the volume control, which on "radio" varies the screen-grid potential of the H.F. valve in the customary manner, becomes a simple potentiometer across the eliminator; this latter arrangement lessens the likelihood of breakdown owing to the fact that each condenser is only called upon to stand half the voltage.

Passing on to the question of performance, it can be fairly said that the receiver has as much sensitivity as could possibly be expected in an instrument having but one stage of H.F. With regard to selectivity, it is natural to expect a high standard of performance when band-pass tuning figures in the design, and this set does not fail to reach it. At nine miles from Brookmans Park it was found that, using an outdoor aerial of average dimensions, the highest wavelength on which the National transmitter was to be heard was 275 metres, and the lowest wavelength on which the Regional came in was 351 metres, thus leaving a considerable silence band between them in which several foreign programmes were receivable. The long wave-



Circuit diagram of the R.I. Madrigal receiver. An unconventional yet effective L.F. intervalve coupling is used.

thrown across the secondary of the pick-up transformer when the switch is thrown to the "gramophone" position; by the same action the H.F. valve is paralysed by having the H.T. supply to its screen grid cut off. The rectifier is of the distortionless grid type which has so largely come to the fore lately, and it is followed by the customary parallel-fed transformer, but an unusual point is the provision of an L.F. choke instead of the more customary resistance in the plate circuit of the detector valve.

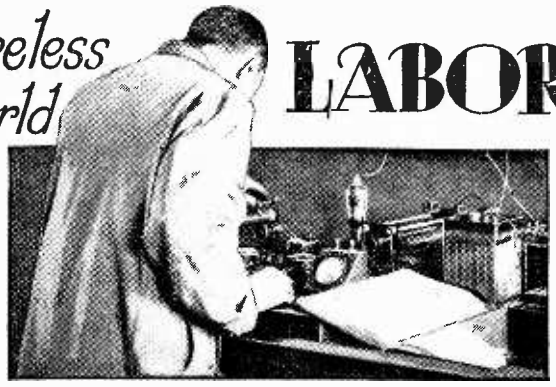
Coming to the output valve, it will be noticed that a condenser as well as the usual resistance is associated with the control grid of this valve in order to keep out any H.F. energy which has got by the barrier set up in the plate circuit of the detector valve. Among other points worthy of comment are the output coupling arrangements between the pentode and the loud speaker and the provision of two series condensers at the point of maximum-potential difference, namely, directly

band yielded, in addition to 5XX, a bag of seven stations of good programme value. Coming to the question of quality, it is pleasant to be able to record that there was a complete absence of box resonance, which contributes so largely to the thumping noise which, unfortunately, passes for bass in so many receivers to-day.

The mains aerial, although completely free from hum, was a little disappointing, but this was definitely not due to the set, but to the peculiarities of the electric supply mains in the particular locality in which the receiver was tested. To sum up, it may be said that the general standard of performance was distinctly above the average for this class of receiver; with regard to reliability, there was such strong evidence of careful workmanship that there is little likelihood of electrical or mechanical failure.

Next Week's Set Review:—
FERRANTI CONSTRUCTOR'S A.C. S.G.3.

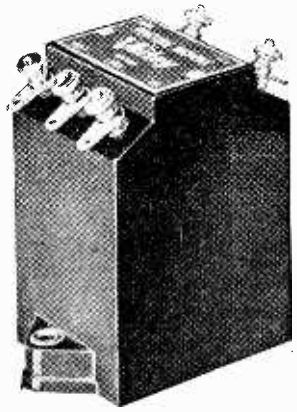
Wireless World LABORATORY TESTS



Review of New Radio Products.

VARLEY PENTODE NICHOKE.

This special output choke has been designed for use with the highly efficient battery-type pentode valves as exemplified by the Marconi and Osram types P.T.2 and the Mazda PEN.220 and

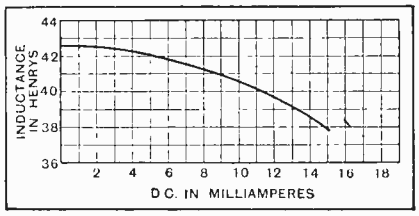


Varley Pentode Nichoke with three tappings.

PEN.220A. Under normal working conditions the inductance is maintained at a satisfactorily high level. To assure correct matching between the valve and the loud speaker three tappings are provided, giving the following step-down ratios, viz. : 1.25 : 1, 1.75 : 1, and 2 : 1.

The maximum D.C. current the choke will carry is given as 15 mA., and it will be seen from the curve that with this value of D.C. flowing the inductance is a shade under 38 henrys The measured D.C. resistance of the choke is 720 ohms, and the price is 12s. 6d.

The makers are Varley, Oliver Pell Control, Ltd., Kingsway House, 103, Kingsway, London, W.C.2.



Inductance curve of Varley Pentode Nichoke with various amounts of D.C. flowing.

TUNEWELL COMPONENTS.

Some samples of recently introduced Tunewell components, the makers of which are Turner and Co., 54, Station Road, New Southgate, London, N.11, have been sent in for test. These include specimen spaghetti resistances, push-pull switches, and a panel-mounting type fuse holder. The resistances are constructed from British drawn wire, space-wound on a centre core, and with an outer protective covering of silk braid. Resistances up to 2,000 ohms are wound with a silk-covered wire, and they are rated to carry a considerably heavier current than the larger sizes. For example, values of from 300 to 750 ohms will carry 50 mA., while those from 1,000 to 2,000 ohms carry 40 mA. Over 2,000 ohms and up to 100,000 ohms, the current rating is from 10 mA. to 4 mA., according to the value of the resistance.

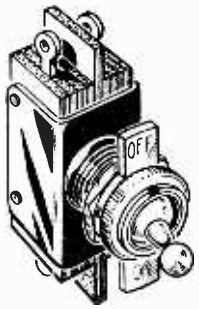
So far as the majority of the specimens tested is concerned, the actual resistance values were substantially in agreement with the marked values, the average discrepancy being less than 10 per cent. Prices of these resistances are very reasonable, ranging from 9d. each for some of the smaller sizes to 2s. each for the higher values.

The push-pull switches are made, so far, in two- and three-contact types, and consist of a D-shaped moulding carrying two or three spring contacts, as the case may be. A metal contact on the tip of the plunger joins the springs electrically when in the "on" position. A single-hole fixing bush is fitted, and the prices are 1s. and 1s. 3d. for the two- and three-point switches respectively.

The panel-mounting fuse holder is turned from solid Erinoid, and is designed to take the tubular-type screw-in fuse lamps. The special fuse lamps are obtainable with a safety limit of 100 mA. or 250 mA., and they cost 6d. each; the price of the holder is 9d.

"B.A.T.-ARROW" TWO-POLE SWITCH.

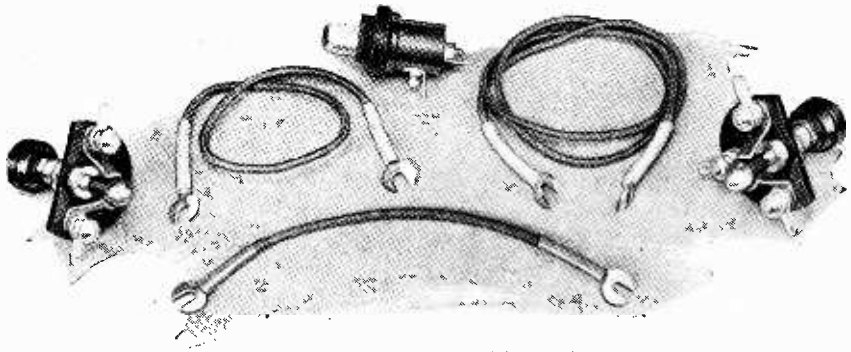
This is one of the latest additions to the range of miniature toggle-action switches handled by Claude Lyons, Ltd., 40, Buckingham Gate, London, S.W.1. It is a double-pole model, making and breaking two separate circuits simultaneously, and is capable of handling up to 750 watts at a maximum potential of 250 volts. From tests made we are able to confirm that the switch, despite its small size, is quite capable of dealing with this amount of power, as owing to the snap action arcing does not occur.



Lyons "B.A.T.-Arrow" double-pole toggle switch.

The sample examined has a threaded bush $\frac{3}{8}$in. long, but by removal of the back locking nut the switch can be fitted to panels up to $\frac{3}{8}$in. in thickness. As the fixing bush is completely insulated from the contacts, the switch can be mounted direct on metal panels, and insulating bushes are not necessary.

With indicator the price is 3s. 9d., and 3s. 6d. without.



Selection of Tunewell components, comprising switches, resistances and fuse holder.

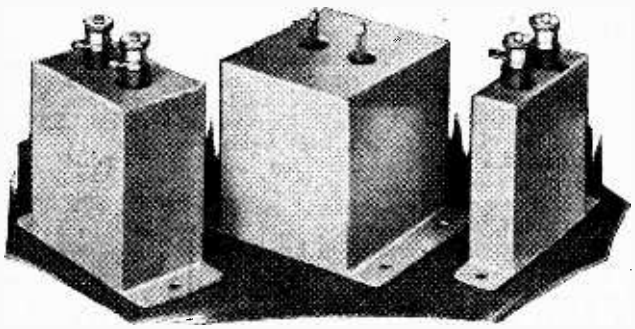
CHANGE OF ADDRESS.

We learn that the Sifam Electrical Instrument Co., Ltd., have arranged to manufacture Sifam instruments in this country, a factory having been acquired for this purpose. The address is York Works, Browning Street, London, S.E.17, and the telephone number is Rodney 3573.

PEAK CONDENSERS.

Despite their comparatively small size, "Peak" condensers are rated as 1,500-volt D.C. test type, so that their normal maximum working voltage is of the order of 750 volts D.C. For the average mains receiver these condensers should prove ideal, since the working potential will rarely exceed 300 volts at the maximum, so that a generous factor of safety is assured.

The 1-, 2-, and 4-mfd. sizes are available fitted either with terminals or soldering tags, the prices being 2s. 8d., 3s. 9d., and 6s. 9d. respectively. A 0.1-mfd. size fitted with soldering tags costs only 1s. 10d.



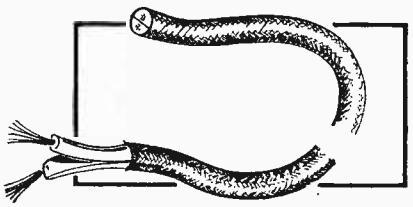
Wilburn "Peak" 1,500-volt D.C. test condensers.

In addition to the above range there is a double condenser of 0.1+0.1 mfd. tested at 1,000 volts A.C., and fitted with tags; the price of this is 2s. 6d. Supplies of these reasonably priced condensers are obtainable from Wilburn and Co., 23, Bride Lane, London, E.C.4.

GOLTONE "AKROS" FLEXIBLE CORD.

A new design of flexible cord suitable for use with all types of portable electrical equipment, including mains units, mains sets and the like, has been introduced by Ward and Goldstone, Ltd., Frederick Road, Pendleton, Manchester. Hitherto, when two separate flexible conductors have been embodied in a single cable, cotton filling has been necessary in order to provide a circular external finish, but in the "Akros" design the insulation on each conductor is semi-circular in shape, and the addition of a cotton braided outer covering only is required to provide the desired contour and finish.

This new cord has good insulating properties, is flexible, does not kink, and has an attractive appearance. "Akros" cords are made in various sizes, ranging from 14-36 flex to 110-36 flex, the latter being intended for very heavy-duty work. In cotton finish the smallest size costs 17s. 6d. per 100 yards, while 23-36 size,



Goltone "Akros" flexible cord.

which is equivalent to ordinary electric light flex, costs £1 2s. 6d. per 100 yards.

CATALOGUES RECEIVED.

The new wireless and electrical catalogues just issued by J. J. Eastick and Sons, 118, Bunhill Road, London, E.C.1, contains some 328 pages devoted to descriptive matter and illustrations of the proprietary receivers, accessories, valves, and components handled by this well-known wholesale house. The "Eelex" specialities are included also.

The current issue of the Telsen Radiomag contains eight page-size blue prints and constructional details of sets embodying Telsen components. In addition, the full range of Telsen components is illustrated and described. The price is 3d., and copies can be obtained from The Telsen Radiomag, Thomas Street, Aston, Birmingham.

MORE COMPONENTS FOR THE POWER RADIO-GRAM.

SINCE the issue of *The Wireless World* for February 3rd went to press more components for the "Power Radio-Gram" have been submitted for test and approval. Among these are several items of mains equipment, made by W. Brian Savage, of 292, Bishopsgate, London, E.C.2. The first is a mains transformer (type PRG) designed specifically for this receiver and sold at the low price of 46s. As this component is made to deliver the bare output required for the set, it is exceptionally compact, and on test was found to be entirely satisfactory.

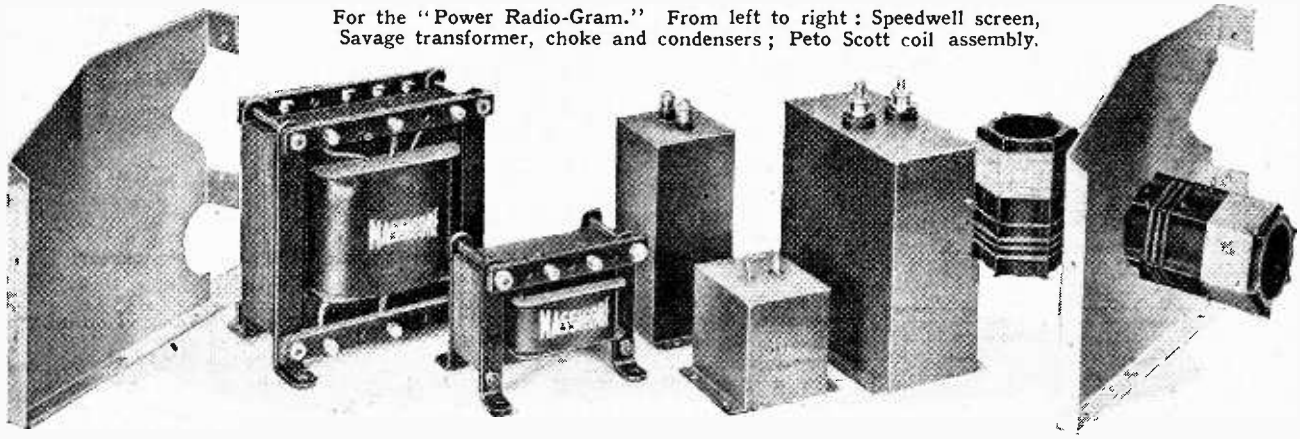
Two Savage chokes have also been tested. The type L.34, which is suitable for use as the mains smoothing choke (CH_2 in the circuit diagram), has a resistance of 360 ohms, with an inductance of approximately 23 henrys at 100 milliamperes. This costs 14s. 6d.; a lighter choke, type CC.36, at 11s., is quite adequate for smoothing the supply to the earlier valves of the set.

The same firm also submit a range of high-voltage paper condensers, which are sold at extremely moderate prices. The 4-mfd. type, rated at 500 volts D.C., costs 5s., and at 750 volts D.C., 11s. Two-mfd. condensers to work at 500 volts cost 3s., and for the same pressure the 4-mfd. size cost 6s. 3d. All are working voltages.

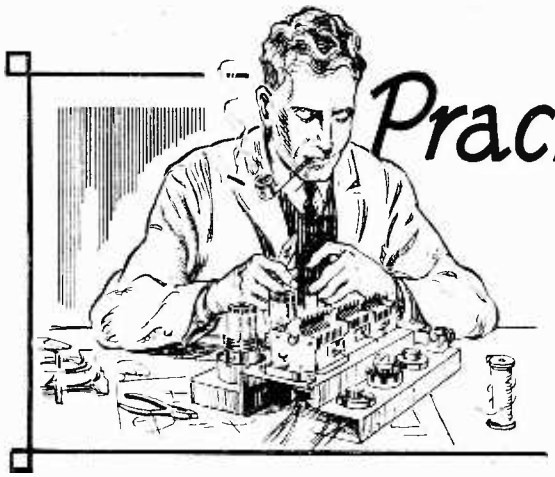
The Speedwell Metal Co., of 276, Broad Street, Birmingham, are producing an aluminium screen made exactly to specification, which is sold at 1s. 6d.

A complete coil assembly, with screen, made by the Peto Scott Co., Ltd., of 77, City Road, London, E.C.1, was found to function quite satisfactorily.

The firm of W. T. Lock, Ltd., of St. Peter's Works, Bath, the makers of the cabinet used for the original model, draw our attention to the fact that where space is limited, prospective constructors of the "Power Radio-Gram" may prefer to use their 16in. cabinet, which is of similar design.



For the "Power Radio-Gram." From left to right: Speedwell screen, Savage transformer, choke and condensers; Peto Scott coil assembly.



Practical Hints and Tips

Simplified Aids to Better Reception.

THERE is a distinct tendency nowadays to simplify the operation of receivers by linking together mechanically as many controls as possible; but it is certain that all the possibilities in this direction have not been fully explored. This is partly due, no doubt, to the lack of suitable components.

Take, for instance, a case where it is desired to inter-connect a variable condenser and a high-resistance potentiometer. All condenser rotors turn through 180 degrees, but rheostats or potentiometers, whether of the wire-wound or graphite track type, are almost always arranged for a rotation of 300 degrees or more. At first sight, it might appear to be impossible to "gang" together such components as these.

LINKED CONTROLS.

Fortunately the difficulties are not insuperable, and, as an example of what may be done, we may take a case where a series aerial condenser is used as a volume control, and at the same time provision is made for desensitising an H.F. valve simultaneously by means of a screening grid potentiometer coupled to the same spindle. (See Fig. 1.) This is admittedly not the most useful application of the principle, but it will serve very well to illustrate the point.

In this case the inability to rotate the potentiometer spindle through more than 180 degrees is not of necessity a disadvantage; by rotating the body of the potentiometer before finally linking together the two spindles, a setting can be found at which the position for optimum screening grid voltage (from the point of view of sensitivity) corresponds with the "all in" position of the series condenser. Connections must, of course, be arranged so that a reduction in aerial feed capacity is accompanied by a suitable reduction in screening grid voltage. Care must be taken to see, however, that this voltage is never so low that the H.F. valve is unable to deal properly with the signal input from a near-by station, and to attain this object it may be necessary to fit one or more external resistances in series with the potentiometer.

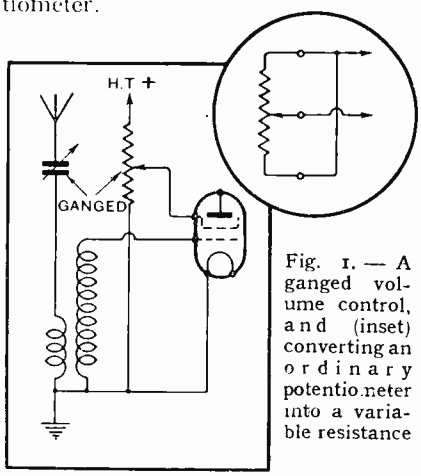


Fig. 1. — A ganged volume control, and (inset) converting an ordinary potentiometer into a variable resistance

Another possible solution of difficulties of this sort lies in the conversion of a 300-degree potentiometer into a plain series resistance by connecting together the ends of the resistance element, which, incidentally, must have twice the maximum ohmic value that will finally be required. External circuit connections are taken from the centre contact, and from the interconnected ends (see inset).

ALTHOUGH it has its disadvantages, the fact that energy can be absorbed from an oscillatory circuit by another circuit tuned to the same frequency is often of great value to the wireless experimenter. This absorption effect, the presence of which can be determined either by visual or aural means, can only take place, of course, when there is appreciable coupling between the two circuits, and so at once there is suggested an excellent way of determining whether excessive interaction exists between circuits which should be isolated from each other.

INTERACTION BETWEEN TUNED CIRCUITS.

As an illustration, we may consider a conventional H.F. stage which is found to be unstable. This instability may be caused by stray magnetic or capacitative couplings between grid and plate circuits, and it is an easy matter to satisfy oneself on this point by the absorption method of testing.

Briefly, the procedure is to remove the H.F. valve, and temporarily to join the aerial to the high-potential end of the H.F. coupling coil through a very small condenser. A fairly weak signal should be tuned in as accurately as possible, and then the input grid circuit should be tuned to the same wavelength. If there is any obvious diminution of signal strength on passing through the point of resonance it may be taken quite definitely that interaction is taking place to an undesirable extent. Consequently, experiment should be made in the direction of improving screening or removing other causes of unwanted coupling.

A similar procedure is sometimes useful in tracing unwanted couplings in a band-pass filter.

Broadcast Brevities.

BOAT TRIPS BY BROADCAST.
The "O.B." Department at Hamburg giving their listeners an account of a sail round the harbour. A short-wave transmitter is in use.

By Our Special Correspondent.

5XX to Move.

THE B.B.C.'s 25-acre estate at Daventry will eventually be left in the sole possession of the Empire broadcasting station. The removal of the Midland Regional transmitter to a site nearer Birmingham, as already reported in *The Wireless World*, will, it has been decided, provide a good opportunity for moving the long-wave transmitter at the same time.

A Central Site.

It looks as if these two stations will remain the Siamese twins of the British broadcasting system, for the two transmitters will be re-erected side by side on the new site. This arrangement should satisfy Midland listeners and the country at large, for it will place the National transmitter as nearly as possible in the geographical centre of England.

Two Points of View.

East Anglians may quibble, but I doubt whether they will notice any appreciable diminution in signal strength, and they will at least have the satisfaction of knowing that what is their loss (if any) is the Welshmen's gain.

Scottish Doubts.

DESPITE the triumphal opening of the Scottish Regional Station in a few weeks' time, grave doubts are being expressed as to whether the new transmitter will do very much useful work north of a line drawn from Aberdeen to Fort William, and it is now considered that the first practical 7-metre relay stations may be operating in the Highlands. Inverness is badly in need of local transmissions and there are other northern towns which certainly deserve a much better service than the B.B.C. has yet been disposed to give them.

Falkirk Testing Next Month.

The first modulated test signals from Falkirk will go out in a month's time, and thereafter the experiments will follow the formula which has proved so satisfactory in the introduction of Brookmans Park and Moorside Edge. At first transmissions will be confined to the 376.4-metre wavelength; transmissions on 288.5 metres will follow, and gradually the two will be sandwiched into the daily programme periods as listeners adapt their sets to the new conditions.

The Mobile Transmitter.

A good deal of testing with unmodulated waves has already been carried out at Falkirk with very satisfactory results, but the B.B.C.'s mobile transmitter has now returned to London, and will soon be off again in the direction of Watchet to carry out tests in the West Region.

"Othello" on Sunday.

ON Sunday, March 13th, a departure from the usual type of Sunday programme will take place. An important performance of "Othello" is to be given from a studio with a "star" cast which includes Henry Ainley (Othello), John Gielgud (Iago), Leslie French (Roderigo), Gwendolen Evans (Emilia), and Peggy Ashcroft (Desdemona). Val Gielgud and E. A. Harding are responsible for the adaptation and production which will hold the stage for an hour and a half.

Musician's Surprise Item.

SIR THOMAS BEECHAM was the most surprised person in London last week when he found himself textually and pictorially identified with an alleged movement by musicians to boycott the B.B.C. He immediately protested to Savoy Hill, and showed that, far from opposing the B.B.C., he had only recently put forward two constructive suggestions, viz.: (a) that the B.B.C. National Symphony Orchestra should not be overworked, as he believes it is, and (b) that it should not be broadcast except when giving public performances.

An Important Convert.

The conversion of Sir Thomas Beecham to a belief in the value of broadcasting has been one of the most significant musical tributes which the art has received in recent years, and it would indeed be a pity if outsiders succeeded in raising fresh strife.

But I feel sure that they won't.

That Sunday Story.

I MUST make a confession. Until I had read two-thirds of last week's newspaper story anent the approaching upheaval in the B.B.C.'s Sunday arrangements, I actually believed it. But when I learnt that, presumably to suit the sacredness of the day, Henry Hall would play slow fox-trots, I was overcome by a cruel sense of proportion.

The "D.G." Speaks.

Sir John Reith, I learn, has expressed himself very strongly apropos the rumours which have got about concerning these suggested changes in the whole character of the Sunday programmes.

"The present policy, which follows the tradition set when broadcasting in this country first started, will not be altered," says Sir John.

And that, of course, is that.

Raw Recruits.

IT is significant that Henry Hall is including some entirely fresh talent in the new B.B.C. Dance Orchestra. At least three of its members have come straight from musical colleges, never having performed professionally in any orchestra, either of the dance or what (*pace* Henry Hall) one may call the legitimate variety.

The Instruments We Shall Hear.

Readers who like to know just what instruments are "coming through" on their loud speakers may be glad to learn the exact composition of the new orchestra. In all, there will be thirteen instrumentalists and one singer.

The instruments comprise four treble saxophones, one trumpet, drums, trombone, two violins, one oboe, piano, one double bass, and one guitar. But this is not all. The guitar player will sometimes set his instrument aside and perform on the tenor saxophone.

Enter the Oboe.

As far as I know, this will be the first appearance of the oboe in any dance band, either British or foreign.

Will this open the doors to other orchestral instruments? When will the harp come along? It would certainly help with those "hot Amens" on Sundays.

CORRESPONDENCE.

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

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

INFORMATIVE ADVERTISING.

Expert or Tyro?

IF I may be allowed to continue the correspondence on this interesting subject, I would like to put forward a number of conclusions arrived at after some years of experience in wireless advertising.

To my mind the basic difficulty in advertising wireless goods is the diversity of the public to which one has to appeal. At one end of the scale is the truly technical wireless enthusiast, and at the other is the out-and-out tyro, who is nevertheless a very valuable customer. For this reason wireless advertising presents a rather unique problem. Are we to fill our advertisements with technicalities to the delight of the expert, or shall they contain the "magic of the ether" kind of story? The solution is, I think, to steer a central course by introducing sufficient technical matter to please the man who knows his subject well, yet not overdo it so as to frighten the newcomer.

The essential features are accuracy and an appreciation of the type of information required. The buyer of wireless goods, particularly of components, requires to know just how many henrys or ohms or what the wavelength range is. He may not know how or why, but if his wireless journal tells him that he requires a volume control of 500,000 ohms he will not buy a resistance which is described merely as a "volume control."

One of the first rules of advertising is "knowledge of goods," and never was the importance of this as marked as in the case of wireless advertising. WALTER M. YORK.

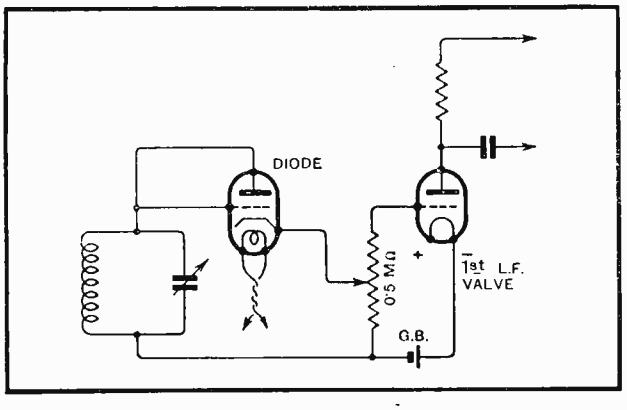
London, N.W.10.

DIODE DETECTION.

Softness of Tone.

MR. KIRKE'S article on the diode detector interested me very much, and I immediately tested this form of detection and compared it with my own particular type of diode which I have had in use since 1929. I found that the quality of tone was harder and less sympathetic, and certainly less realistic in the case of the "Kirkifier," good as it undoubtedly is.

The idea of reverting to the diode for distortionless rectification is entirely due to Mr. Kirke, and I still prefer his system to any form of leaky grid detection. The diode I use was the result of experiments in connection with the "Kirkifier," and I do not think that anyone with an ear for good quality would



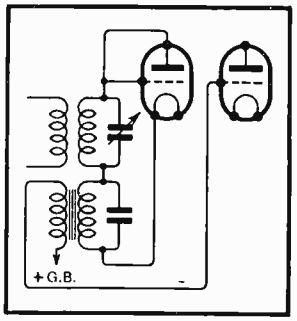
dream of abandoning my particular circuit for another. Perhaps the most striking feature is the softness of tone associated with this form of rectification, and its sensitivity is fully equal to that of the "Kirkifier."

I give the circuit of my diode detector in its simplest form, followed by a single stage of amplification, in the hope that your readers may be sufficiently interested to try it out.

London, N.W.6. NOEL BONAVIA-HUNT.

For Quality and Selectivity.

FROM the article by Mr. Colebrook in *The Wireless World*, June 10th, 1931, and the very interesting contribution by Mr. Kirke in your issue of February 3rd, 1932, it would appear that the diode detector is emerging from the obscurity into which it was forced by the advent of the triode, and experimenters in search of quality and selectivity might do worse than turn their attention to it.



The accompanying diagram of a circuit which I have had in use for over twelve months may interest some of your readers.

The anode of the detector is shown connected to the grid, as results with this arrangement are rather better than when the anode is left free.

With a suitable valve and 3-1 intervalve transformer this combination of diode and L.F. stage gives greater signal strength than an ordinary grid-leak detector. E. H. SUMNER.

London, E.C.1.

TECHNICAL TERMS.

Esperanto a Solution?

"R. H.'s" interesting article on the chaos of wireless technical terms as between countries is very timely. But I do not think the problem will either solve itself or be solved by the specialised use by Siemens of Latin. The scientists, the mathematicians, the pharmacists, and others have been in need of a standardised vocabulary for much longer than wireless fans, yet they have not gone far towards their goal.

Latin has, I think, been utilised by them to some extent, but the strain of adapting an old and almost dead language to modern needs is too great. There is, however, what I am told amounts to a simplified and modernised Latin available for us in Esperanto. A "ham" whom I heard talking on the subject assured me that the technical terms required in wireless were all there, and that, moreover, the language was usable as an ordinary spoken tongue, and not only as a code. I have heard parts of Esperanto broadcasts from Söttens, Langenberg, Lille, etc., and it certainly sounded quite well. Can any of your readers give any information as to the extent that Esperanto is used in wireless to-day? J. G. EARLE.

London, S.E.23.

FREQUENCY RANGE OF RECORDS.

The Amplitude of Upper Frequencies.

THE letter you have published by "N. P. S." must no doubt voice the opinion of many of your readers who find cause for alarm in the present tendency to eliminate the upper frequencies on gramophone discs in order to avoid needle scratch. But why stop at asking that the upper frequencies should merely be *retained?*

The solution of the problem of scratch would lie rather in actually increasing the amplitude of recording of frequencies above 3,000 cycles. This would result in the ratio between the amplitudes of the higher audio frequencies and scratch imparted to the armature being so great that the scratch would be negligible. It would then only be necessary to use a pick-up—or amplifier—with a falling curve above 3,000 cycles to enjoy a full range of frequencies unspoiled by scratch.

Watford, Herts. F. C. L. EVELEIGH.

READERS' PROBLEMS.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found elsewhere in this issue.

A Punctured Condenser.

WHEN the insulation of a smoothing or by-pass condenser breaks down, the source of the trouble usually becomes painfully evident. Due to the short circuit a heavy current will flow, and in most cases some other component in the associated circuits will become overheated or will even break down.

But when there is a limiting resistance in series of such a high value that a heavy current cannot possibly flow, even when a high voltage is applied, there will be no visual indication of the condenser breakdown. This, we think, explains the trouble experienced by a reader, who sends a sketch of his simple D.C. mains eliminator, which is used to supply H.T. current to a detector-pentode set. The eliminator circuit in question is reproduced in Fig. 1.

Our correspondent states that when the set is connected to the eliminator in the normal manner no signals whatever are obtained, but on taking current for all circuits (detector anode, pentode screen, and pentode anode) from the "maximum" output terminal marked "pentode plate," moderately good results are obtained, although reaction control becomes "fierce" and the output valve becomes unduly warm. It is stated that all feed resistances have been tested carefully.

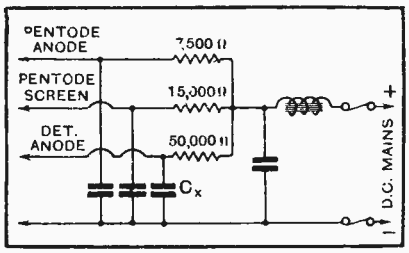


Fig. 1.—A breakdown in the condenser C_x will entirely stop reception, but, due to the high value of the associated feed resistance, no obvious short-circuit will take place.

If we assume, then, that these resistances are all in order, it is fairly certain that the trouble is due to a breakdown in the condenser marked C_x, which is associated with the feed resistance for the detector anode circuit. If we are right in this assumption, it will be realised that there will be a total absence of H.T. voltage on the detector anode, and, moreover, that, as the current flowing through the 50,000-ohm resistance cannot amount to more than a few milliamps., this component will probably not be damaged.

Once Again.

SEVERAL readers have asked whether it is possible to connect a pick-up to the "Wireless World Two." It should hardly be necessary to say that the answer to this question is in the affirmative. The method of connection is exactly the same as in the case of any other receiver employing a grid rectifier, numerous diagrams of which have appeared in this and other sections of the journal from time to time.

Reducing Watts Wastage.

SOME readers are still a little hazy concerning the difference between an indirectly heated valve intended for use on A.C. mains and a similar valve intended for use on D.C. mains. There is, of course, no fundamental difference whatever, except in the matter of the *distribution* of the filament wattage, which in both types of valve is the same, namely, 4.

Whereas in the case of the A.C. instrument the wattage is made by the product of 4 volts 1 ampere, it is found that a higher voltage and a correspondingly lower current are used in the case of valves intended for use on D.C. mains.

There is, of course, no reason why an A.C. valve should not be used on D.C. mains, but if this is done it would be necessary in the case of the ordinary 220-volt D.C. mains deliberately to waste over fifty times the wattage required by the valve. If the voltage is doubled the amount of watts it is necessary to waste is halved, and it may be remarked that 8-volt D.C. valves were the first to make their appearance. Later, D.C. valves requiring the same wattage but taking it in the form of ¼ amp. at 16 volts made their appearance, and with these it was only necessary to waste a quarter of the amount of watts which it is necessary to waste if a standard A.C. valve is used on D.C. mains. There are also 30- and 40-volt D.C. valves now available consuming but 0.1 ampere.

H.F. and L.F. Decoupling.

A NON-INDUCTIVE resistance offers the same opposition to the flow of any type of current—direct, L.F., or H.F.—and its resistance value will be independent of frequency. A correspondent, who is concerned with the ohmic values commonly specified for decoupling purposes, accepts the accuracy of this axiom, but is at a loss to see why a decoupling resistance of only a few hundred ohms is commonly inserted in an H.F. circuit, whereas a value of many thousands of ohms is used for the corresponding purpose in the L.F. amplifier.

This matter should become clear if it is realised that a decoupling resistance is only effective when it is used in conjunction with a by-pass condenser.

When decoupling an H.F. circuit it is practicable—and economical—to use a by-pass condenser of negligible reactance, and in consequence the value of resistance necessary to deflect almost all the H.F. component through this low-resistance path amounts only to a few hundred ohms.

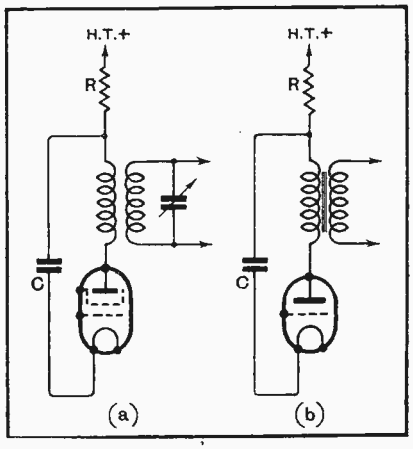


Fig. 2.—Decoupling in H.F. and L.F. circuits. Relative efficiency is largely a matter of the ratio between by-pass condenser reactance and resistance.

In an L.F. amplifier, on the other hand, we have to deal with currents of very low frequency, to which the largest capacity of by-pass condenser that can be economically used offers a reactance of an appreciable number of ohms; therefore, to satisfy the same conditions as in the previous case, a very much larger decoupling resistance is necessary.

In the accompanying explanatory diagrams (Fig. 2) decoupling resistances and condensers are marked R and C.

A Correction.

IN the second instalment of the article in which the "Power Radio-Gram" was described it was stated that the output valve bias resistor R. consisted of a 500-ohm. 3-watt resistor in parallel with one of 100 ohms, 1 watt.

This is a fairly obvious error. The two resistors should, of course, be connected *in series*.