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EDITORIAL COMMENT.

The Tuning Note.

HABIT plays an important part in our daily lives, but there are habits which may be useful at first, but which, almost unnoticed, can develop to a point where they become an absurdity.

We suggest that the B.B.C. tuning note comes within this category, for originally it was introduced at a time when receivers were not too reliable, the majority of the valve sets depended upon reaction for operation at any distance, and the tuning note was considered to be a convenient method of enabling the listener to tune in accurately to the transmission and get over his fiddling and adjustments before the actual programme began, so that inadvertent oscillation due to adjustment of the set would not mar neighbours' enjoyment of the programme. The power of the broadcasting transmitters has been increased, and receivers to-day are sufficiently reliable and accurate in their calibration for us to believe that it is unnecessary to have a tuning note as a prelude to the start of every transmission. Very often under present conditions the early part of the programme is missed because, in order to be tuned to it when it starts, it is necessary also to be tuned to receive the tuning note, and since the intensity of the tuning note is much greater than that of the programme when it commences, if we turn down the volume to a point where the tuning note can be tolerated, then the volume at the commencement of the programme is often so weak that the beginning of the item is lost.

With the times of the transmissions so widely published as they are to-day, and the settings for the tuning dial so well known, there seems to be really no longer any excuse for the B.B.C. to continue to put out the tuning note. It has served its purpose in the past, but it is obsolete to-day, and could, we think, well be dispensed with.

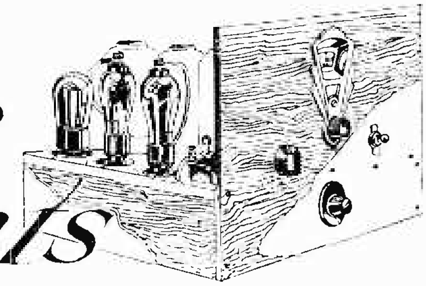
If the B.B.C. for any reasons of their own consider that some introductory signal to their transmissions is essential, it should surely be easy to find some satisfactory substitute for the ear-splitting howl of the tuning note. Even the interval signal is to be preferred, although we would certainly hesitate to express approval of the interval signal of to-day, which has met with so much criticism from listeners all over the country.

100 Divisions or 180 Degrees.

AT this time of the year when manufacturers are concentrating on designs for production next season, it is opportune to draw attention to details of design which merit consideration, and, in particular, to refer to instances where standardisation could be adopted. One direction in particular where we think it would be well for manufacturers to agree upon a standard is in the calibration of tuning dials. There was a time when with the flat dial it was almost universal to divide into 180 degrees, but later, when edgewise scales were introduced, 100-division scales were quite widely adopted in place of 180 degrees as a matter of general convenience. For a variety of reasons we favour standardisation of the 100-division scale, but it is disappointing to find that there are still quite a number of manufacturers who continue to adhere to the 180 degree marking. It seems the time is opportune for abandoning the older method and for manufacturers to agree to standardise the scale of 100 divisions.

It would be interesting to have the views of readers on this point because, after all, the final decision should rest with the users of receivers whose requirements and wishes it is the business of the manufacturer to meet.

Superheterodyne Improvements



A Summary of the Tendencies in Modern Design.

By W. T. COCKING.

THE popularity of the various superheterodynes which have been described in *The Wireless World* has sufficed to show that the way in which they fulfil the modern need for a highly sensitive and selective receiver, which is also capable of giving first-class quality of reproduction, is greatly appreciated. Since these receivers were designed, however, development in radio has proceeded apace—variable-mu valves have been introduced, single-dial tuning systems have been simplified, and the possibility of highly selective filters used in conjunction with tone correction on the lines of the Stenode has come to be recognised. The net result is that enormous scope has been presented for improvement in superheterodyne technique.

One of the most serious difficulties attendant upon superheterodyne design has always been the elimination of background noise. It has recently been pointed out by the present writer[1] that for a minimum of background noise the aerial circuit should be as efficient as possible. Logically, therefore, a single tuned aerial circuit should be employed, and used with optimum coupling to an efficient aerial. Both theory and practice show, however, that at least two tuned circuits must be used to precede the first detector if second channel and other special sources of interference[2] are to be reasonably small. It is only possible to employ a single tuned aerial circuit and still have two tuned circuits before the first detector if a preliminary stage of H.F. amplification be used.

The oscillator is one of the chief sources of background noise[3], however, and, as a result, it is found that the lower the value of I.F. amplification the lower is the noise level. If the I.F. amplification be reduced to such a value that the background noise is negligible, however, the sensitivity of the set suffers seriously, and in order to maintain the overall amplification it is necessary to add a stage of amplification preceding the first detector. It will thus be seen that on two counts a preliminary stage of H.F. amplification is desirable, for in two different ways it helps to keep the background noise generated within the receiver at a low level.

IN this authoritative study of the latest trend in superheterodyne design the author foreshadows some notable developments of the greatest interest to amateurs. In the clearest terms it is shown that for a modern superheterodyne to be free from background noise and modulation interference a signal-frequency amplifying stage with a variable-mu valve is almost essential. A high degree of selectivity and quality is ensured by the inclusion of selective tuning circuits together with a tone-correcting valve, on the Stenode principle.

The Variable-mu Valve.

It has previously been pointed out, however,[4] that preliminary H.F. amplification cannot be used with ordinary screen-grid valves on account of the cross-modulation which occurs at short distances from modern high power transmitters, and it has been for this reason that earlier designs have not included such a stage of amplification. The variable-mu valve has characteristics much less curved than those of any other screen-grid valve, and as a result it is less prone to cross-modulation. The reduction in cross-modulation, in fact, is so great that in most cases its possibility can be ignored. Provided that variable-mu valves are employed, therefore, a stage of preliminary H.F. amplification is now practicable, and full advantage can be taken of its capabilities in reducing background noise.

Still another advantage results from the use of variable-mu valves, and this is in connection with the volume control, a feature which has always presented considerable difficulty in superheterodynes. It is, of course, essential to use a control which acts to reduce both the signal input to the first detector and the value of the I.F. amplification, and such a control has hitherto often necessitated the employment of ganged potentiometers.

[1] "Background Noises," *The Wireless World*, December 30th, 1931.

[2] "Why The Whistles?" *The Wireless World*, March 9th, 1932.

[3] "The Intermediate Frequency Amplifier of the Superheterodyne," by A. L. M. Sowerby, M.Sc., *The Wireless World*, December 17th, 1930.

[4] "The Selectivity of the Superheterodyne," *The Wireless World*, May 13th and 20th, 1931.

Superheterodyne Improvements.— Where variable-mu valves are used in both the preliminary H.F. stage and in the I.F. stage, however, this dual control can readily be obtained by varying their grid bias voltages simultaneously by a single potentiometer.

It will be seen, therefore, that an up-to-date superheterodyne would include a preliminary H.F. stage with a low gain I.F. stage. Variable-mu valves would be used with volume control by variation of their bias voltage, and two tuned circuits would precede the first detector. A skeleton circuit of the early stages of such a receiver would take the form shown in Fig. 1, where details not of fundamental importance are omitted.

The I.F. Circuits.

Some attention must now be devoted to the question of adjacent channel selectivity, for this is obtained largely in the I.F. circuits, and it will be assumed that the actual frequency employed is the value of 110 kc., which has been standardised by *The Wireless World*. There are two main methods by which high selectivity can be obtained without a sacrifice in quality. In a superheterodyne, band-pass filters which give a flat-topped resonance curve over a range of 5,000 cycles on either side of resonance combined with a very sharp cut-off outside that limit can be used. Alternatively, it is possible to use very selective and sharply tuned circuits, and ignore the sideband cutting which will inevitably take place; the quality can then be restored by the use of tone correction in the L.F. circuits, and this is, in fact, the principle which has been adopted in the Stenode Radiostat method of reception.

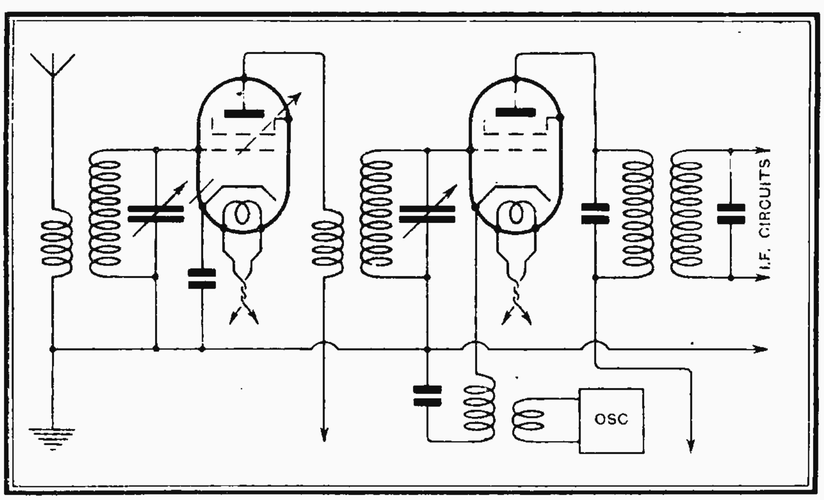


Fig. 1.—The essential circuit, shorn of unnecessary detail, of the early stages of a modern superheterodyne. A single tuned circuit precedes the preliminary signal-frequency amplifier and a variable-mu valve is used.

Before deciding which is the better method to employ at the present time, it is as well to examine carefully the factors involved. It is fairly generally known that freedom from modulation interference can be secured by the use of a linear second detector, provided that at the detector the ratio of the carrier of the wanted station to that of the unwanted station is sufficiently high. The problem, therefore, resolves itself into a consideration of the methods whereby the necessary selectivity can be achieved.

Now, when stations are spaced by 9 kc., and it is desired to reproduce audio frequencies up to 5,000 cycles only, either band-pass filters or ultra-selective circuits with tone correction can be used without affecting the final result, for with either method it is possible to obtain the requisite ratio of wanted to unwanted signal voltages. It should be pointed out that tone correction is theoretically capable of the better results, for there is no necessity as regards modulation interference for imposing the foregoing upper limit to the overall frequency response, nor is there theoretically any limiting factor to the frequency separation of stations. Unfortunately, however, modulation interference is the least serious trouble encountered at the present time.

Heterodyne Interference.

With any method of reception, limits to the frequency response are imposed by the necessity for avoiding heterodyne interference, for there is no known method by which heterodyne whistles may be removed without also removing musical notes of the same frequency. With a 9-kc. station separation, therefore, a tone-corrected set is capable of reproducing frequencies up to about 8,000 cycles only, for the elimination of the whistle caused by the heterodyne note between adjacent carriers. A greater problem is set by sideband heterodyning, however, for even with a 9-kc. station separation, momentary audible beats may occur at almost any frequency within the audible range.

Fortunately, however, by far the greater proportion of the audible beats occur at frequencies higher than 5,000 cycles, and they may consequently be eliminated by deliberately cutting off these higher frequencies. It will be seen, therefore, that whatever method of reception be employed, frequencies higher than 5,000 cycles cannot be reproduced without running into the danger of a serious amount of interference due to sideband heterodyning. The position may be summarised in a few words: frequencies higher than 5,000 cycles cannot be reproduced with band-pass filters, firstly, because it is impracticable to obtain freedom from modulation interference if the response be made higher; and secondly, because of the necessity for securing reasonable freedom from sideband heterodyning; frequencies higher than 5,000 cycles cannot be reproduced with a tone-corrected receiver because of sideband heterodyning.

It will be clear, therefore, that with the present broadcasting conditions either method of tuning may be employed with no theoretical difference to the ultimate

Superheterodyne Improvements.—

results. Should a method of eliminating heterodyne whistles be evolved, however, there can be no doubt that the principle of tone correction would ultimately supersede the band-pass circuit. In the absence of any such method, however, we are at liberty to choose the tuning system on grounds other than those of pure selectivity.

Now, band-pass tuning is rather more familiar than tone correction, and the required flat-topped resonance curve can readily be obtained. It is exceedingly difficult, however, to secure both the flat-topped resonance curve and sufficient selectivity to render modulation interference negligible with a reasonable number of tuned circuits and an economical construction.

Difficulties of this nature do not arise with tone correction, and it is readily possible to make the adjacent channel selectivity as high as desired. It is not usually practicable to obtain the required selectivity from a single circuit of very low decrement, however, and when it is obtained by means of a number of cascade circuits, it becomes comparatively difficult to secure sufficient tone correction for the sideband cutting. A single tuned circuit at 110 kc., for instance, may easily reduce a 5,000-cycles note to one-tenth of its normal value, and three such circuits in cascade will reduce it to one-thousandth. The L.F. circuits, therefore, must amplify a 5,000-cycles note 1,000 times as much as a 50-cycles note to secure the proper balance between bass and treble.

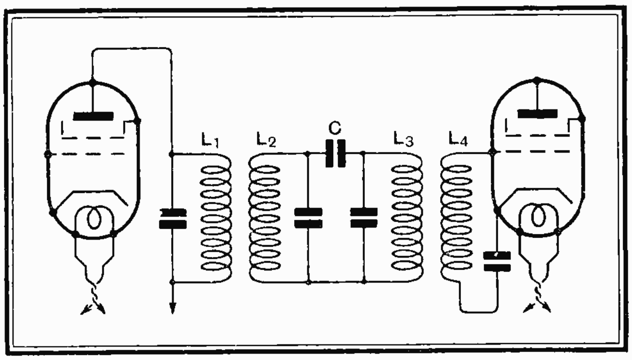


Fig. 2.—A four-stage band-pass filter for the intermediate-frequency amplifier used in conjunction with an L.F. tone-correcting stage.

Now, an amplification of 1,000 times cannot be secured from a single stage of L.F. amplification, and it will be seen that it would be necessary to employ two stages of tone correction, and this would add considerably to the cost of the receiver. It will, of course, be realised that these remarks apply only to the case where cascade circuits are used, for if the selectivity be obtained by means of a single very sharply tuned circuit the case is entirely different. Provided that the selectivity exceeds a certain figure, a fixed compensation ratio of 100/1 is needed for the frequency range of 5,000/50 cycles, and this is more readily obtainable.

Band-pass to Avoid Critical Tuning.

All sharply tuned circuits suffer from one disadvantage, however, when they are employed in a mains-operated superheterodyne—the tuning is exceedingly critical. This is not in itself a disadvantage, but, as the tuning is effectively carried out by the adjustment of the oscillator frequency, it will be seen that if the oscillator frequency wanders during reception, the set will be thrown out of tune. In a sharply tuned mains superheterodyne, therefore, it may be found that fluctuations in the mains voltage, which would normally pass unnoticed, have the effect of detuning the receiver.

It will thus be seen that neither band-pass tuning nor tone correction is alone perfect in a superheterodyne. Both theory and practice show, however, that a judicious combination of the two is eminently suitable, and that by this combination the disadvantages of each are removed. If, for instance, a band-pass filter is built which will give a flat-topped resonance curve over a range of only some 2,000 cycles on either side of resonance, enormously high adjacent channel selectivity can be obtained, while the circuits are not so sharply tuned that fluctuations in the mains voltage have any serious effect.

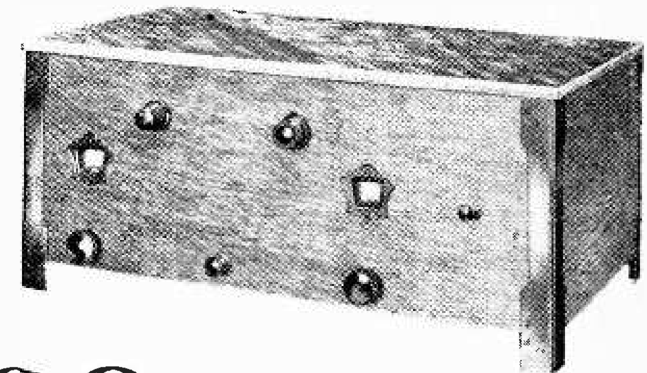
With such a filter, frequencies of 5,000 cycles are reduced to about one-eighth of their correct value, and so a single tone corrector or stage designed to amplify 5,000-cycles notes eight times as much as 50-cycles notes will allow of a flat overall response curve being obtained. A special design of the tone corrector is, of course, necessary; for, as the I.F. circuits pass frequencies up to 2,000 cycles without attenuation, the L.F. characteristics must also be flat for frequencies between 50 cycles and 2,000 cycles. The design of suitable circuits, however, is not difficult, and the arrangement is eminently practical.

Suitable types of tone corrector are very simple and inexpensive. It is usually the design of the band-pass filter which is more complicated, but a suitable type has been evolved, and it consists of a four-stage filter, as shown in Fig. 2, used in conjunction with the now familiar two-stage type. The four-stage filter consists of two pairs of mutually coupled coils, L_1, L_2 and L_3, L_4, and the two coils L_2 and L_3 are loosely coupled together by means of a small condenser C.

It will be seen, therefore, that it is readily possible to build a superheterodyne which will permit of selectivity being obtained which is so high that for most purposes modulation interference may be said to be non-existent. Such a receiver may be given also an overall frequency response so good that the quality of reproduction is practically indistinguishable from that given by a purely local station quality receiver. In addition, the various other improvements which have taken place have permitted the introduction of a distortionless volume control and of the reduction of background noise to a point where it is inaudible on most transmissions.

These features represent an important advance in receiver design, and this is particularly the case when it is remembered that they are accompanied by a simplified construction, adjustment, and operation of the set. A receiver has been designed which embodies the points which have been discussed in this article, and on test it has fully proved the various theoretical details involved. It will be described in next week's issue.

The Battery V-M Three



(Concluded from page 318 of previous issue.)

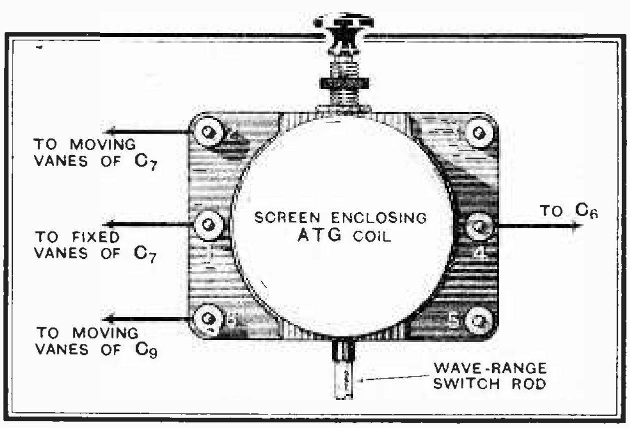
Constructional Data and Notes on Performance.

By W. I. G. PAGE, B.Sc.

IT will be found that the receiver, the theoretical considerations of which were given in last week's issue, is extremely easy to build. There are no soldered joints and the construction can be completed using only a screwdriver and a means of making a number of holes in the wooden panel and baseboard. Metal screening plates have been dispensed with—the only shielding being that provided by the makers around one coil and above the two variable condenser assemblies. A measure of protection against unwanted fields is given by the use of metallised H.F. and detector valves, and the layout is so arranged that grid and anode leads are as short as possible.

When components other than those used in the original set are chosen it should be borne in mind that considerable alteration in the H.F. amplifier layout may result in oscillation taking place before the bias volume control reaches maximum, especially when the lead marked X (see circuit diagram in last week's issue) is joined to terminal 1 of the A.T.G. coil. Liberties may undoubtedly be taken with the positioning of the parts which go to make up the L.F. amplifier. The detector stage is so arranged that the grid lead is well screened by the metal case of the variable condenser C_7, the latter also serving to isolate the 210 H.F. valve. The grid leak and condenser are connected by the shortest paths possible to their respective valve-holder terminals.

Having drilled the panel and secured it by means of five wood screws and two metal brackets to the baseboard, the two variable condenser assemblies should next be mounted. Leads—considerably longer than will finally be necessary—should be connected to the rotor and stator terminals and brought out beneath the domed screening covers which do not quite extend to the baseboard. Having connected the various earth leads to the legs of the condensers, the screening covers should be screwed home tightly, for as soon as the various small components are mounted close by, the screws holding the covers become somewhat inaccessible. The band-pass and intervalve coils linked mechanically by the waveband switch rod are next arranged on the baseboard, taking care to locate the BPF coil base so that there is no strain on the switch points, otherwise reception may be noisy or intermittent.

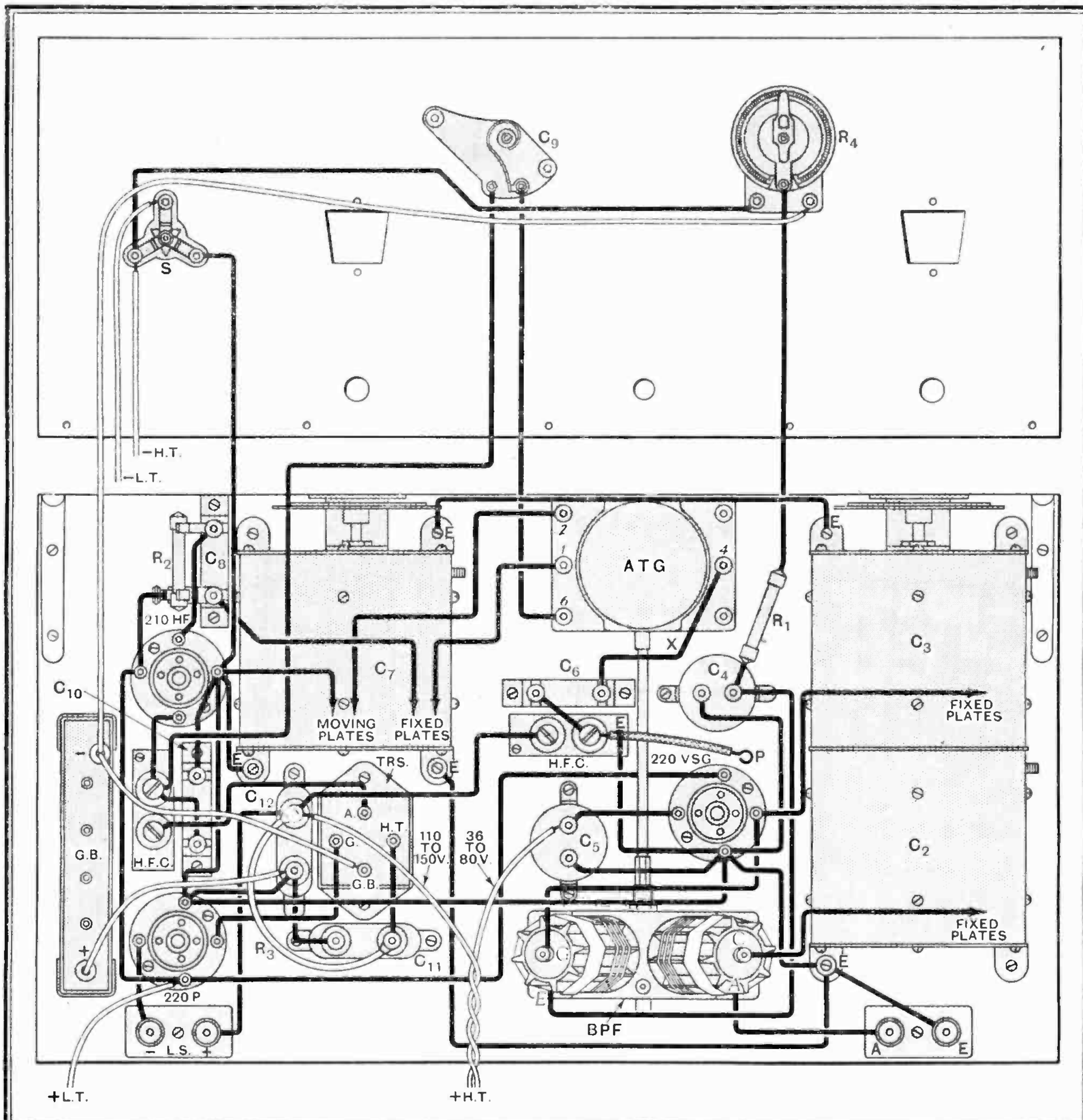


The numbered terminals and connections of the screened tuned grid coil (ATG). The lead from C_6 may be taken to either No. 1 or No. 4.

The assembly of the remainder of the components should present no difficulty when reference is made to the various photographs and drawings appearing herewith, and in last week's issue. To economise, the non-inductive resistance R_1 is not held in clips but suspended by means of its own leads between the centre terminal of the potentiometer R_1 and one terminal of C_4. The set as shown in the various illustrations contains a 9-volt bias battery, but the end clips can be altered to accommodate one of the 16½-volt type if necessary. If there is a local station of considerable power and at the same time a large aerial is used, it will be found that 9 volts

The Battery V-M Three.—negative bias will not reduce the mutual conductance of the 220.VSG valve sufficiently, and signals may still overload the detector. In these circumstances there are two courses open—either to increase to 16½ bias or to be content with the 9-volt grid battery, and decrease the screening grid volts to as low a figure as 36.

This last procedure might be open to criticism on the score of rectification and cross-modulation due to the curved characteristic with such a low screen-grid potential, but as consistent distant-station listening would demand a higher voltage the objection can hardly be upheld. Should it be decided to employ an output valve giving some 350 milliwatts, then a 16½-volt bias battery is essential, but the total anode current would exceed the normal discharge capabilities of a small dry battery and either the large-capacity type or an H.T. accumulator would need to be pressed into service. To control volume



General wiring plan of baseboard and panel components. A 9-volt grid battery is shown but in localities where the field strength is high, this may be replaced by one of 16½ volts. The components C_4 and R_1 should be non-inductive.

The Battery V-M Three.—
any potentiometer with a value of 25,000 ohms or over will be satisfactory, and a graded track, while being very convenient, is not essential. If a component is selected in which the resistance element is not uniform for equal radial movements of the slider, it should be arranged that the end where there is the slowest change of resistance be connected to earth. The potentiometer should always be shunted across the whole of the bias battery although the output valve, according to its maximum grid swing, may require a lesser voltage, in which case three wander plugs will be needed.

Although the anode lead of the S.G. valve is quite short, it is essential to screen it by means of flexible metallic tubing earthed to the valve-holder socket corresponding to the valve pin of the 220.VSG marked E. Should the original layout be modified in such a way as to lengthen or to change the course taken by the reaction leads, earthed metal screening may also be used for them to ensure stability.

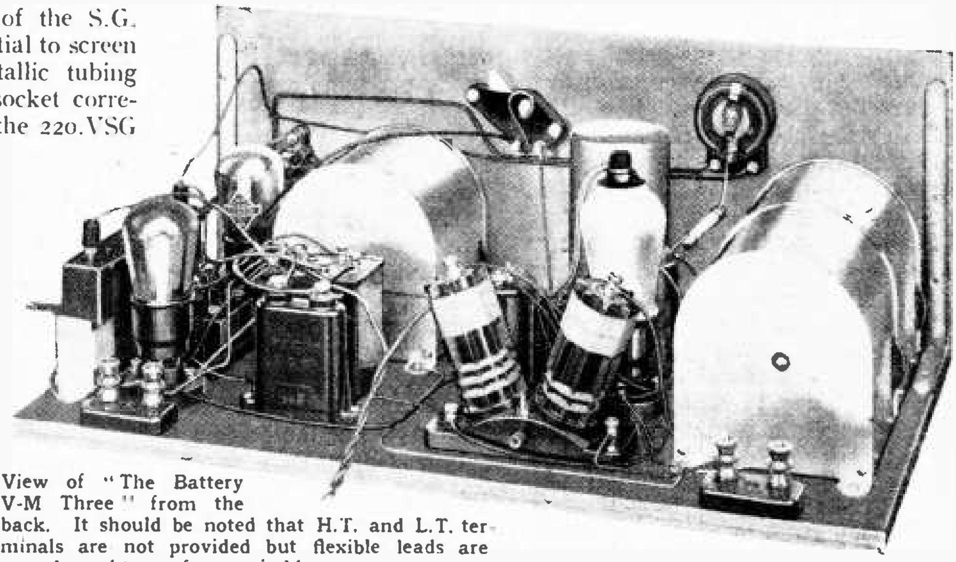
The panel controls comprise two-dial tuning, bias volume control, reaction, and two push-pull switches —one for changing the waveband and the other for breaking L.T. and bias circuits. Of the first of these little need be said, as the two dials run in step well enough—the inductance of the ATG coil *when screened* being the same as that of the band-pass secondary. The only trimmer which will have a decided effect in bringing the two ganged condensers into simultaneous resonance is that in parallel with C_3 (nearest the panel). Having tuned in a fairly weak station near the lower end of the medium band, using reaction, adjust the trimmer referred to for maximum signals, when it will be found that ganging is substantially correct throughout. To test for this it is only necessary to see that signals from any station are reduced when the trimmer is moved slightly in either direction.

Economy of H.T. Current.

As the volume control has an important effect on the anode and screen current of the H.F. valve, it is as well to tune in the desired transmission to a volume level below that required and to bring up the strength with reaction. This ensures a minimum drain on the H.T. battery, and incidentally improves the selectivity. The volume is increased with clockwise rotation of the potentiometer. With regard to changing over the waveband, the switch must be pushed for long waves and pulled for short. The L.T. switch (with three contacts) is depressed in order to break the bias and filament circuits.

The receiver will be found to give quite a good account of itself amidst the welter of European stations. With the combined help of the reaction and volume controls and the band-pass filter a degree of selectivity is obtained such that all the more important stations can be properly separated. There is a sharp cut-off on either side of resonance, and the sensitivity when the full mutual conductance of the 220VSG is used is sufficient to ensure good quality reception from the majority of stations having an entertainment value. During a single evening's test some thirty stations were received at good loud speaker strength and there was no difficulty whatever in separating, for instance, Rome from Stockholm.

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



View of "The Battery V-M Three" from the back. It should be noted that H.T. and L.T. terminals are not provided but flexible leads are brought out from suitable components.

NEW BOOKS.

Pitman's Electrical Educator (2nd Edition). Edited by Sir Ambrose Fleming, M.A., D.Sc., F.R.S.; for electrical students, electricians, contractors, power engineers, and those engaged on the commercial side of the electrical industry, the various subjects being treated by well-known authorities. In three volumes, pp. 1.640 (in all), with copious illustrations, plates, and diagrams. Published by Sir Isaac Pitman and Sons, Ltd., London, price (complete) 72s. net.

Motor Racing, by S. C. H. Davis, is a graphic account of the author's experiences during ten years of racing which can hardly fail to interest all those who delight in reading true and intimate descriptions of thrilling speed, daring risks skilfully taken, unflagging energy and exciting finishes. After a short account of his youthful experiences and the early history of motor racing, he gives vivid descriptions of some of the more important races in which he took part, from the first big race in England in 1921 to the Brooklands meeting in 1931, when he was unfortunate to crash and break his leg.

The book, which is illustrated with thirty-two full-page photographs, six maps, and several sketches by the author, is published by Messrs. Iliffe and Sons Ltd., and may be obtained at the offices of *The Wireless World*, 116-117, Fleet Street, E.C.4, price 7s. 6d.

The British Radio Annual and British Radio Supplement, Vol. 1, 1931 (the Organ of the British Radio Institution), comprising short articles on the Application of Radio to Geography, Television Progress, Wave Motion and Sound Amplification, Loud Speakers, Radio Relaying, and similar subjects by well known writers. Published by the British Radio Institution (secretary, Mr. J. D. Fox, 25, Kingswood Drive, King's Park, Glasgow), price 2s. unbound, or 5s. in spring-backed binder.

UNBIASED

By

FREE GRID.

Coming Shortly.

I SEE that a county journal which enjoys a wide circulation in a district which the Post Office detector van is shortly scheduled to visit naively informs its readers that "the detector van will easily be recognised by its distinctive colour and its circular frame aerial on its roof." I wonder why on earth they give the game away like that. Surely it would pay the Postmaster General to disguise it as a greengrocer's van or a winkle barrow?

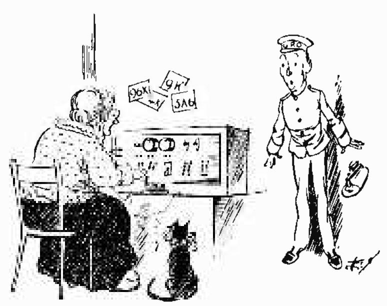
I suppose, however, that we must not poke fun at this announcement as the G.P.O. sleuths, when about to visit a district, always make a point of stimulating the national Press to shout the fact from the house-tops. I mentioned this point the other day to a leading light at St. Martin's le Grand, and he told me that it was done because it had such a salutary moral effect and caused pirates to scuttle off to the Post Office immediately, thus saving the trouble and expense of prosecuting them. As I told him, however, there was a very grave danger that, on the other hand, the public might wrongly suspect that the van was merely a gigantic bluff, more especially since, so far, in not a single case where a prosecution had been undertaken had any evidence been given that a detector van had been responsible for tracing the offender.

Black Sheep.

I HAVE always had such a high opinion of the amateur transmitting fraternity in this country that it is hard to have to record that there are quite a few incompetents among them. There are, of course, black sheep in every community, and amateur transmitters cannot hope to be exceptions to this rule; but I wish they would direct their attention to calling over the coals some of their number who, no matter how high their technical reputations, are woefully inefficient as wireless operators. I am thinking not only of badly slurred dots and dashes, but of the exceedingly slow speed adopted by some of them. In fact, one or two amateurs are so slow that it seems incredible that they could ever have passed the P.M.G.'s twelve words per minute test.

Transmitters may reply that I am a miserable B.C.L., and if my own selfish broadcast listening is not interfered with I have no right to complain. I would agree, but, unfortunately, the *reason* for this inefficient operating may be something extremely serious, and it behoves me, as well as all other law-abiding citizens, to lift up our voices in protest when there is any reason to suspect that the law of the land may have been tampered with.

I am told, on very high authority, that when the morse speed test is conducted at the G.P.O. or at other centres no precautions whatever are taken to see that the person presenting himself for examination is the person who had made application for the licence. Even the elementary precaution of a photograph, which is demanded from candidates for a wireless operator's certificate and which the Passport Office also demand, is neglected.



Vulgarly called an eye-opener.

It may well be asked, am I surmising a state of affairs which *may* exist, or have I definite knowledge? I can only advise those whose concern it is to look into this matter; if they do, they will, in all probability, have what may be vulgarly called an eye-opener.

My Bad Scare.

MAINS-DRIVEN electric clocks are not exactly radio, but I have had such a bad scare just lately that I make no apology for recommending all who are on frequency-controlled A.C. mains to follow my example and buy one straight away.

The reason for my urgent advice is simply explained. On the wall opposite my bed there hung until recently an ancient and reasonably accurate clock in a glass case, complete with two weights, pendulum, and—this is most important—a second hand.

Waking the other morning with a feeling of acute discomfort under my heart, I promptly invited all the morbid fears resulting from introspection by foolishly taking my own pulse; and, equally as promptly, I got them by finding, to my horror, that it was only forty-eight. Further drastic tests confirmed this figure, and, after feverishly looking under the headings of Angina Pectoris and Aortic Regurgitation in a Home Medical Dictionary now in course of publication in weekly parts (only the A's and B's have as yet appeared), I felt that my worst forebodings were about to be fulfilled, and feebly called for pen and paper in order to make my will.

Mrs. Free Grid, however, who is nothing if not practical, sent for the local medico, who arrived in great haste in answer to the S.O.S. After putting in some swift work with the stethoscope, and extracting from me by cross-examination the information that I had supped heavily and at a late hour the previous evening, he brutally ordered me "medicine and duty" in a manner reminiscent of Army days; at the same time, he suggested that if I really was morbidly interested in taking my own pulse I had better buy a clock in which the second hand revolved once a minute instead of once in about two-thirds of that time.

Enquiry among horological friends has brought to light the fact that in the case of many otherwise reasonably accurate clocks the so-called second hand is purely ornamental and not to be relied upon. Needless to say, I have lost no time in acquiring a mains-driven instrument in which the second hand *is* accurate.

The Importance of Volume Level.

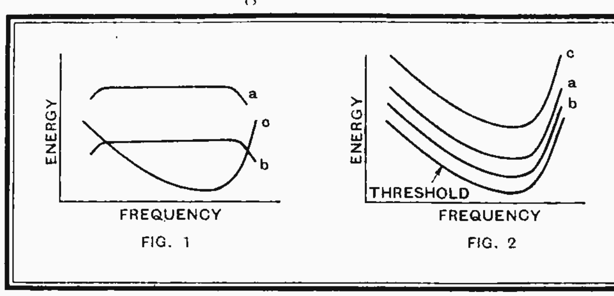
Maintaining a Balance Between High and Low Notes.

By R. RAVEN-HART.

The author discusses an important aspect of intensity of reproduction in relation to the original performance which is broadcast, and leads us to the conclusion that changes in volume level effected at the receiver must inevitably mar quality, except under the conditions where reproduction is at the same intensity as the original, and that the only satisfactory alternative is to develop a new technique for broadcasting where the conductor himself makes the corrections necessary and not the control engineer or the listener at his receiver.

IN articles dealing with the question of volume control and the desirability of favouring the low (and very high) notes when reducing volume, a curious fallacy, explicit or implicit, appears to have become firmly established.

Roughly speaking, the argument put forward is this: the straight-line overall frequency response curve of an ideal amplifier (Fig. 1 a) is compared with the threshold sensitivity curve of the ear (Fig. 1 c); all these curves are supposed to have both vertical and horizontal scales logarithmic, the vertical representing energy and the horizontal frequency. The statement is then made that, if the volume is reduced, the low and high frequencies will reach the threshold values and thus become inaudible (Fig. 1 b). In a more complete form, the fact is stated that the intensity of sound to the ear is conditioned by the distance on a logarithmic scale above the threshold of hearing at the particular frequency in question. Hence, as the volume level is lowered, this distance is reduced more rapidly for the low and high frequencies than for those in the centre of the scale, so that we should use a discriminatory volume control to make up for this.



Diagrams illustrating the effect of changes in energy upon quality of reproduction when the volume level is varied. Fig. 1 illustrates (a) ideal amplifier curve; (c) threshold sensitivity curve of the ear; (b) loss of high and low frequencies when volume level is reduced. Fig. 2.—Curves of frequency response of the ear at various volume levels above threshold.

The fact which seems to be overlooked is that this condition is by no means inevitable in practice, and that the determining factor is not an electrical matter at all, but depends solely on the balance of the orchestra or instrument at any particular moment. Suppose, for instance, that at a certain moment this balance is such that the listener in the studio hears every part of the scale of frequencies as equally loud; the energy curve in the studio must therefore be parallel to the threshold curve (Fig. 2 a). If now we assume perfect straight-line frequency transmission and reception, we can alter the volume as much as we like at the receiving end by means of a simple resistance control (assuming such to be independent of frequency) and thus obtain such curves as Fig. 2 b and c; in fact, we *must* employ such a volume control—any form which favours one band of frequencies at the expense of another will completely spoil the balance.

Nevertheless, the need for favouring the low (and, if possible, also the high) notes in reducing the volume does normally exist, as we all know; where is the catch? At first sight one is tempted to blame the apparatus (transmitter or receiver, including microphone and loud speaker respectively), and to say that if the curve at the studio were like Fig. 2 a, and, thanks to perfect apparatus, reached our ears still in this form, then frequency-true volume control would be perfect; but that, as the apparatus would change the curve of Fig. 2 a into something like that of Fig. 3, we are for this reason forced to favour the low and high notes when reducing volume in order to prevent them cutting the threshold line and becoming inaudible.

As a matter of fact, however, this is in reality equally fallacious; we must, in the last resort, go back to the studio again and consider the conditions there—and here an interesting point of broadcasting policy crops up, perhaps not of great importance for the moment, but one which will become more and more vital as apparatus is improved.

Now, a scale of equal strength in measured energy (Fig. 1 a), or, as judged by the ear (Fig. 2 a), is one thing, and orchestral or instrumental music quite another: it is, of course, utterly impossible to say what sort of a curve it may have at any given moment; but there is, at any rate, a fair probability that the bass will be weaker (as judged by the ear) than the middle register, and very likely the extreme high notes will also be weak (thus judged). That is, we may expect a curve vaguely resembling Fig. 4 a.

If, now, this be perfectly picked up by the microphone, perfectly transmitted, perfectly received, and heard from a perfect loud speaker, it will be a faithful reproduction of the original as regards balance *only* if

The Importance of Volume Level.—put out at the full original volume; and the more the volume is reduced below that level the falser will the balance become, until, finally, low and high notes are lost altogether. The falsity occurs, however, the moment we reduce the original volume, since the distances above the threshold will cease to bear the proper relations to one another; we do not need to go to the point where low and high notes are lost to spoil the balance of the original.

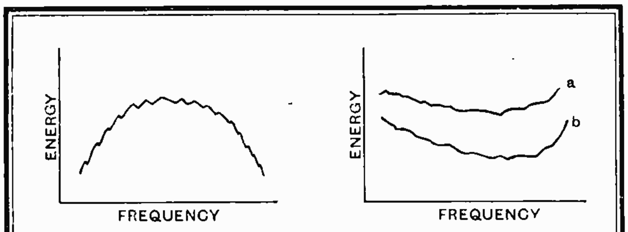


FIG. 3 FIG. 4

Curves illustrating various effects of imperfections in apparatus and their influence on reproduction.

Under these conditions, the use of a volume control which favours the low and the high notes will restore the balance.

Unfortunately, however, these conditions are not permanent. If a moment later the orchestra were putting out something in the nature of the curve of Fig. 5 a, where bass and high notes predominate, our discriminatory volume control would give us something like 5 b, with horrible results. (And such a curve is by no means unlikely; consider, for example, the re-entry in the bass of a fugue subject, or parts of the Tannhäuser Overture). In the same way, if the bass in the orchestra were weaker than in the curve 4 a, then our volume control (which we have assumed put right the unbalance of this curve due to reduction of volume) will not discriminate sufficiently in favour of the bass notes, and they will probably be lost altogether.

A little consideration will show that the same is true where the transmission and reception is not true to all frequencies; whatever the conditions, a discriminatory volume control can only deal with the average balance.

Three Alternatives.

It therefore appears, theoretically, that we can have a perfectly balanced reproduction in one of two ways only: either by always having the same orchestral balance and designing our volume control to suit this (and to suit also such unbalance as the transmitter, receiver, and loud speaker may add) or by reproducing at full original volume. The first is, of course, absurd—the latter very rarely possible. There is, however, a third possibility: a "typical" volume level does exist, hard though it may be to define it—the sort of thing that "nicely fills" a smallish modern room. This being the case, it is perfectly feasible to work backwards, always assuming for the moment a perfect receiver and a perfect transmitter, and thus to distort the curve of Fig. 4 a to something of the form of Fig. 4 b, so that reproduction *on the typical level* shall be perfect. This "distortion" or correction could not, of course, be done by built-in filters, etc., since it would have to vary from moment to moment—if the bass was more prominent (Fig. 5 a) less correction would be needed; if weaker, relatively more would be required.

Assuming, then, that we can fix a typical volume level, it might be feasible for an inspired control engineer who was also a consummate musician, to make these corrections; but the true solution should be obvious—it is the *conductor* who should make them, just as it is the conductor, and not the control engineer, who should see to it that the limits of loud and soft suitable to broadcasting are not exceeded. If the orchestra plays normally and the control engineer brings up the ppp and keeps the fff from blasting, one gets a result like Fig. 6 a to represent a crescendo, which, to the studio listener, sounds like Fig. 6 b; if, on the other hand, the conductor knows his job, he scales down all parts of this crescendo, and not merely the ends of it, and gives us Fig. 6 c. There is, of course, one vital condition attached; that the conductor be not forced to put out hybrid performances theoretically suited both for the concert listener and for broadcasting!

A Question for the B.B.C.

The question of policy referred to is, then, whether the broadcasting authorities should put out music with the normal balance, so that, even with perfect apparatus, it will appear unbalanced except at a volume equal to the original (thus favouring the few who can afford to do this at the expense of the many who cannot); or whether they should not rather attempt to fix a "typical volume level" and unbalance the music so that, when reduced to that level, the balance will be restored For the moment it may be regarded as academic, perhaps; but it is desirable that it should

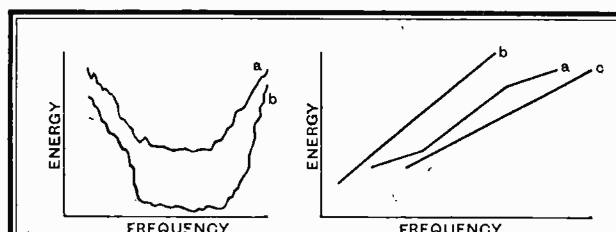


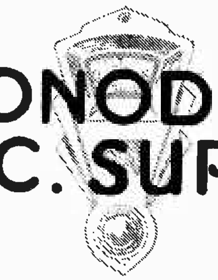
FIG. 5 FIG. 6

Fig. 5 illustrates the distorting effect where bass and high notes predominate as in (a), and a discriminatory volume control effect (b). Fig. 6 indicates three renderings of a crescendo: (b) as heard by the Studio listener; (a) as controlled by the Control Engineer in attempting to bring up the soft passages and avoid blasting where the intensity of sound reaches too high a level; (c) represents how all parts of the crescendo could be scaled down by a conductor appreciating the new technique required.

be stated before it becomes vital. At the same time, it seems desirable to point out that discriminatory volume control is of its very nature a make-shift, and must cause unbalance as the nature of the music transmitted changes.

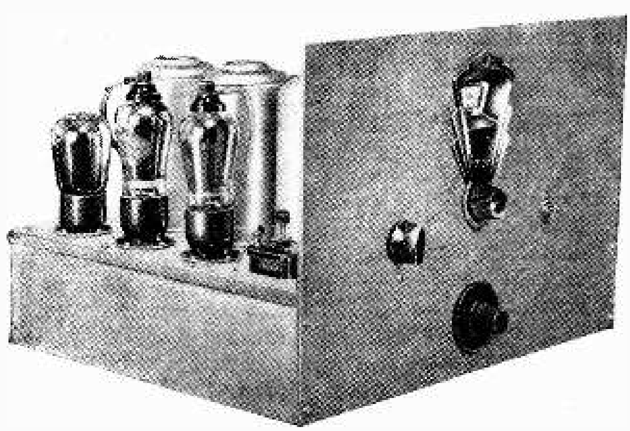
In Next Week's Issue—

Wireless World



MONODIAL A.C. SUPER

An ultra-selective superheterodyne giving high-quality reproduction. Employing a combination of selective tuning and tone correction on the Stenode principle the selectivity is such that any stations separated by 9 k.c. can be received without modulation interference. No fewer than 120 different transmissions were logged during tests.



LIST OF PARTS.

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

1 **Fixed condenser,** 2 mfd., 400 volt, D.C. test **(Dubilier, Type BB)**
1 **Fixed condenser,** 1 mfd., 400 volt, D.C. test **(Dubilier, Type BB)**
(Ferranti, Formo, Peak, T.C.C., Telsen).
5 **Fixed condensers,** 0.1 mfd., 500 volt, D.C. test, non-inductive **(Dubilier, Type 9200)**
(T.C.C., Telsen).
2 **Fixed condensers,** 0.01 mfd. **(Dubilier, Type 620)**
1 **Fixed condenser,** 0.001 mfd. **(Dubilier, Type 620)**
1 **Fixed condenser,** 0.0001 mfd. **(Dubilier, Type 620)**
1 **Fixed condenser,** 0.0005 mfd. **(Dubilier, Type 620)**
(Ferranti, Hydra, Loewe, T.C.C., Telsen).
1 **Fixed condenser,** 0.0001 mfd. **(Dubilier, Type 670)**
(T.C.C.)
1 **Potentiometer,** 5,000 ohms **(Watmel)**
(Colvern, Claude Lyons, Rothermel).
1 **Semi-fixed condenser,** 0.0005 mfd./0.002 mfd. **(R.I. "Varicap")**
(Formo).
1 **5-way insulated connector** **(Wilburn)**
1 **Variable condenser,** 0.0005 mfd., 3-gang, screened, superhet. type, with trimmers on the right **(British Radiophone)**
1 **Slow-motion dial,** for above **(British Radiophone)**
2 **Metallised resistances,** 100 ohms, 1 watt **(Dubilier)**
3 **Metallised resistances,** 1,000 ohms, 1 watt **(Dubilier)**
1 **Metallised resistance,** 6,000 ohms, 1 watt **(Dubilier)**
1 **Metallised resistance,** 25,000 ohms, 1 watt **(Dubilier)**
1 **Metallised resistance,** 30,000 ohms, 1 watt **(Dubilier)**
2 **Metallised resistances,** 250,000 ohms, 1 watt **(Dubilier)**
1 **Metallised resistance,** 7,500 ohms, 2 watts **(Dubilier)**
1 **Metallised resistance,** 10,000 ohms, 2 watts **(Dubilier)**
(Colvern strip type, Claude Lyons).

Features of the Set.

Seven-valve A.C. superheterodyne with single tuning control.

Variable-mu H.F. stage ; screen-grid first detector ; triode oscillator ; variable-mu I.F.; power grid 2nd detector ; tuned tone-corrector valve and triode output stage.

Eight tuned circuits with band-pass intermediate frequency tuning. Oscillator tuning kept in step by specially shaped vanes in gang condenser.

Volume control by bias variation on both variable-mu valves.

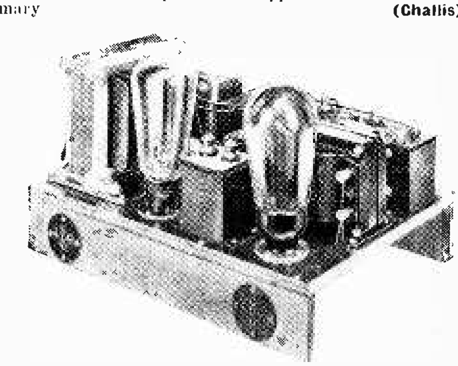
Local-distance switch and provision for free field current for moving-coil loud speaker. Undistorted output 2,500 milliwatts.

3 **I.F. transformers,** 110 k.c. **(Colvern "Colverdynes")**
6 **Valve-holders,** 5-pin **(Clix chassis-mounting type)**
1 **H.F. choke** **(Wearite, Type HFO)**
1 **H.F. choke** **(McMichael Binocular Junior)**
1 **Battery cable,** 7-way **(Harbros)**
(Belling-Lee).
1 **Set of B.P. canned coils** **(Varley "Square Peak" BP19)**
4 **Ebonite shrouded terminals** **(Belling-Lee, Type B)**
(Burton, Clix, Eelex, Igranic, Swain).
1 **Change-over switch** **(Claude Lyons, B.A.T. 729)**
1 **Switch** **(Claude Lyons, B.A.T. 728)**
Metal screened sleeving **(Goltone)**
(Lewcos, Harbros).
1 **Venesta board,** aluminium faced, 12in.×14in.×$\frac{3}{8}$in. **(Peto Scott)**
1 **Panel,** oak faced ply, 14in.×9$\frac{1}{2}$in. **(Peto Scott)**
Plywood $\frac{3}{8}$in., screws, wire, systoflex, etc., etc.

ELIMINATOR.

4 **Valve-holders,** 5-pin **(Clix chassis-mounting type)**
1 **Fixed condenser,** 2 mfd., 1,000 volt, D.C. test **(Dubilier, Type LSA)**
1 **Fixed condenser,** 2 mfd., 500 volt, D.C. test **(Dubilier, Type LSB)**
2 **Fixed condensers,** 4 mfd., 1,000 volt, D.C. test **(Dubilier, Type LSA)**
1 **Fixed condenser,** 2 mfd., 500 volt, D.C. test **(Dubilier, Type BC)**
1 **Fixed condenser,** 1 mfd., 400 volt, D.C. test **(Dubilier, Type BB)**
1 **L.F. choke,** 10 henrys **(Sound Sales)**
(Ferranti B2)
1 **L.F. choke,** 30/20 henrys **(R.I. "Hypercore")**
1 **Mains transformer,** 210/240 volts, 40/100 cycles, 350+350 volts, 100 mA., 4 volts 6 amps. centre-tapped, 4 volts 2$\frac{1}{2}$ amps. centre-tapped, 4 volts 1 amp. centre-tapped, with screened primary **(Challis)**

The output stage and eliminator equipment are built as a separate unit and joined to the receiver by multiple cable in conjunction with a 5-pin plug and flush-mounting valve-holder.



2 **Plugs,** 5-pin **(Bulgin, P9)**
1 **L.F. transformer** **(Ferranti, AF5)**
1 **Metallised resistance,** 10,000 ohms, 1 watt **(Dubilier)**
1 **Metallised resistance,** 50,000 ohms, 1 watt **(Dubilier)**
1 **Metallised resistance,** 700 ohms, 2 watts **(Dubilier)**
1 **Metallised resistance,** 1,000 ohms, 2 watts **(Dubilier)**
1 **Metallised resistance,** 25,000 ohms, 3 watts **(Dubilier)**
(Colvern strip type, Claude Lyons).
1 **Venesta board,** aluminium faced, 9in.×12$\frac{1}{2}$in.×$\frac{3}{8}$in.
Plywood $\frac{3}{8}$in., screws, wire, systoflex, etc., etc.
Valves: 2 Marconi V.M.S.4, 1 Marconi M.S.4, 1 Mullard 164V, 2 Mullard 354V, 1 Osram PX4, 1 Mazda UU120/350.

Approximate cost of parts (excluding valves), 17 gns.

Portadyne CHALLENGER

Four-valve Battery-operated Transportable Receiver.

FEATURES.

General.—*Self-contained four-valve receiver, battery-operated, wave-band switching, cone loud speaker, roller-bearing turntable.*

Circuit.—*One H.F. stage, tuned grid coupling, grid detector, two L.F. amplifiers with transformer coupling. Variable-coil reaction.*

Controls.—*Semi-ganged tuning, combined wave-change and "on-off" switch, reaction control.*

Price.—*£12 17 6.*

Makers.—*Portadyne Radio Ltd., Gorst Road, North Acton, London, N.W.10.*

THE self-contained battery-operated receiver has always enjoyed a large measure of popularity, as undoubtedly it will continue to do, for, being entirely independent of the orthodox aerial and earth connection, it can be used anywhere and at any time. During the past year or so such far-reaching improvements have been made in the design of battery valves that to-day the self-contained set compares very favourably indeed with many receivers requiring the addition of an external aerial and earth.

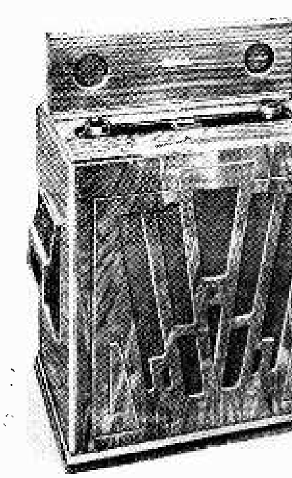
The cabinet work and general finish have not escaped the attention of the designers, for, no matter how efficient the electrical circuits may be, final judgment will be influenced always by the appearance. So far as this applies to the Portadyne Challenger transportable set, first impressions are definitely favourable; the well-made walnut cabinet is both attractive and modern in its conception, the front being occupied wholly by the loud speaker fret, while all controls are grouped on a small recessed panel let into the top of the cabinet. Normally, these are obscured by a hinged lid.

The set is entirely self-contained. and, although sockets are provided at the back for the attachment of an external aerial and earth, it is doubtful if any material advantage is to be gained by their use. For, despite the fact that one H.F. stage only is employed, an exceedingly high order of sensitivity has been attained, so that most of the principal British and European broadcast stations can be received on the frame at good strength.

A straightforward four-valve circuit is used with, as stated above, one H.F. stage coupled by a tuned-grid circuit to a grid detector. Following this are two transformer-coupled L.F. amplifiers, with the loud speaker, consisting of a Celestion movement, connected directly in the anode circuit of the output valve.

It is interesting to note that reaction is obtained by means of a variable coil, which in this particular case is fully justified, as regeneration is under perfect control, the set going into oscillation smoothly and without the slightest trace of backlash. This perfect control of reaction is an asset when working the set in its most sensitive state.

Although the two circuits are tuned by separate condensers, edgewise controlled drum dials are fitted, the right-hand one carrying a wavelength-calibrated scale. In addition, this has engraved on it a curved diagonal line, while a similar line is engraved on the transparent scale attached to the left-hand dial. When these lines coincide both circuits are in step. This method of semi-ganging is exceptionally helpful when searching for distant stations; furthermore, the wavelength calibration is very accurate.



The selectivity is good for a set with but two tuned circuits, as exemplified by the fact that in the north of London, some twelve miles from Brookmans Park, the two London programmes could be separated easily, even when the frame aerial was set for maximum pick-up from Brookmans Park. With the frame turned at right-angles, five alternative programmes were received at good volume.

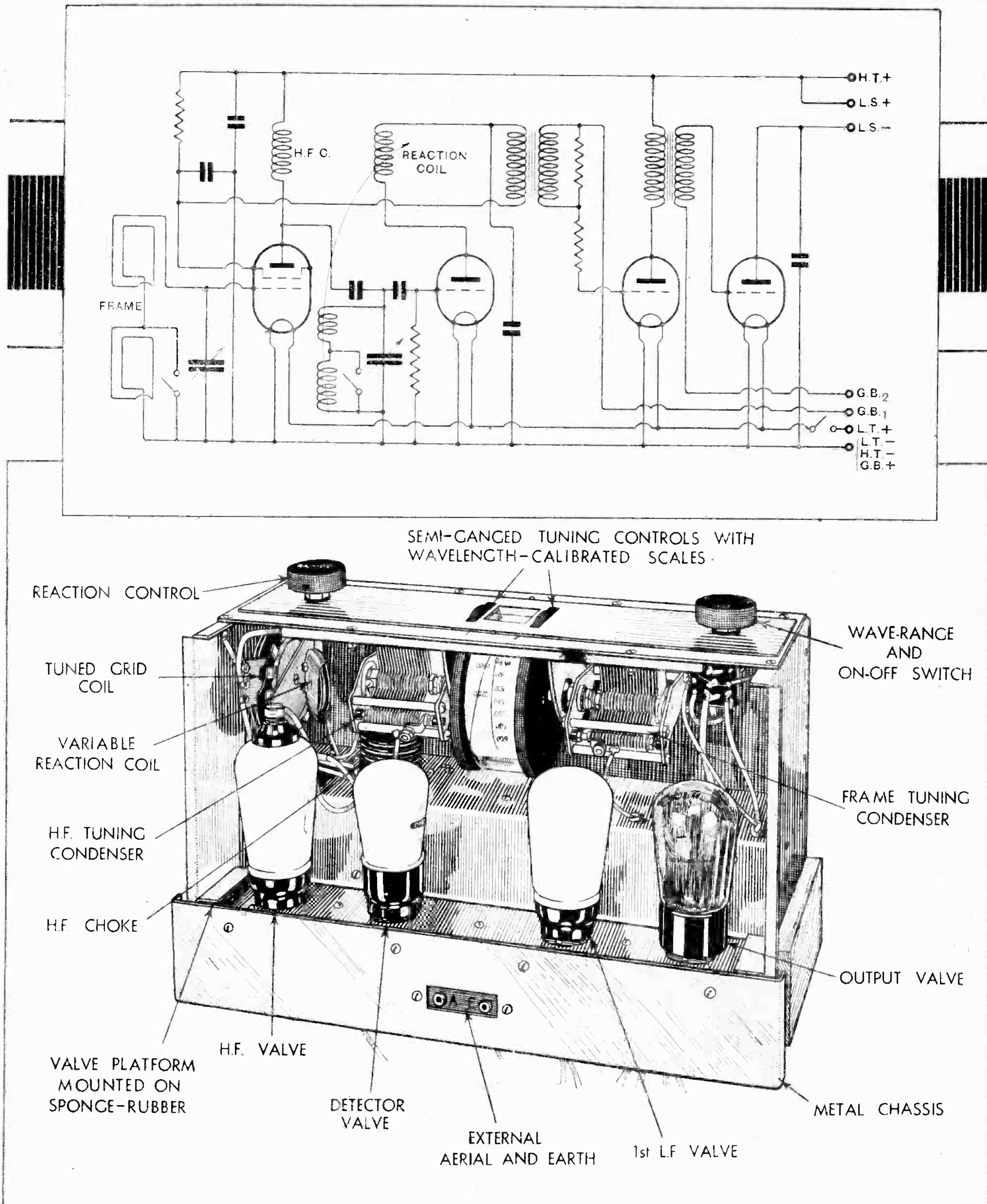
After sunset, and during the evening, twenty British and Continental stations were tuned in well on the medium waveband, while the long waves contributed an additional nine. Numerous carrier waves were passed through, a few of which could be resolved, and, under more favourable conditions some of these would attain a programme value.

At the lower end of the scale, Cork was received well even before sunset, while Budapest at the upper end, provided an enjoyable programme. Thus the sensitivity is well maintained over the whole range.

Daylight reception is very satisfactory indeed, as some twelve medium-wave stations were received well, in addition to four on the long waves, Radio Paris being exceptionally strong.

Provided the volume is kept to a reasonable level, reproduction is exceptionally good for a set of this type. Speech is clear and crisp; there are no noticeable resonances, while the upper and middle registers of orchestral passages are well supported by the bass response. On the whole, the reproduction is exceedingly well balanced. It should be stated that these results are not achieved at the expense of the H.T. battery, as the total anode current is but a shade under 7 mA.

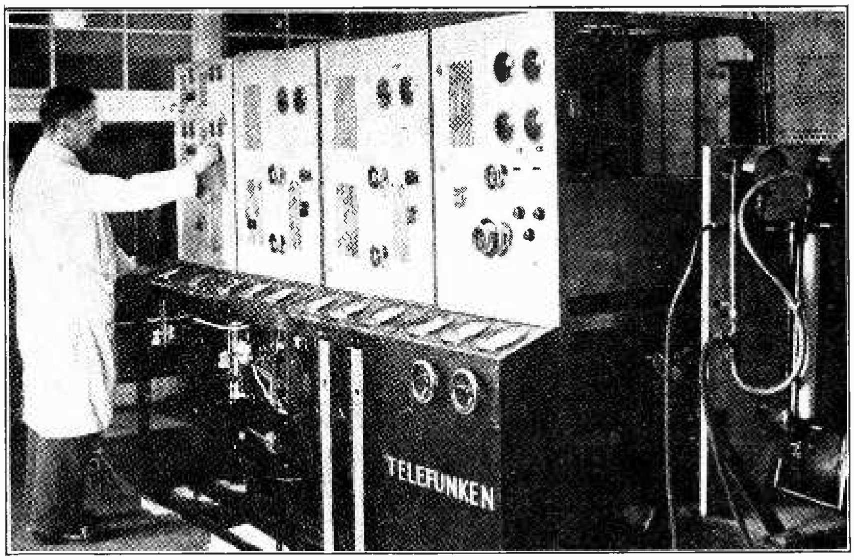
TRANSPORTABLE RECEIVER WITH GOOD ALL-ROUND PERFORMANCE.



The circuit diagram and chassis details. The inclusion of wavelength calibration is an interesting refinement.

CURRENT TOPICS

Events of the Week in Brief Review.



GERMAN SHORT-WAVE DEVELOPMENTS. The new short-wave transmitter which has just been completed for the German Reichspost by the Telefunken Company. Test transmissions are to begin shortly.

Sponsored Programmes for Europe.

THE most formidable move yet towards the establishment of pan-European advertising over the ether will be made within the next few weeks when the new Luxembourg 200-kilowatt transmitter begins testing. According to exclusive information from Luxembourg, we learn that the station authorities are establishing a network of agencies for the collection of advertisements and sponsored programmes from all parts of Europe.

The company operating the station is controlled by French capital, and its director is M. Henri Etienne, the founder and former managing editor of the well-known French radio journal, *L'Antenne*. Contracts have already been arranged with the Havas Agency for French publicity and news, while German news will be supplied by the Wolffsbureau. German sponsored programmes will be obtained through the semi-official Reichpostreklame. Thus in Germany a semi-State body will be obtaining advertisements from German firms for a foreign station, the German stations declining to accept more than a very limited amount of publicity material, and that only in the mornings.

The wavelength of Luxembourg will be 1,250 metres. At present tests are being carried out on the same wavelength on a small transmitter between 17.30 and 18.00 (G.M.T.).

The Four Million Mark.

GERMAN licence figures reached 4,000,000 on March 1st, though it is worth noting that 350,000 of the licences are held by invalids and unemployed persons.

Amateur Radio Film.

PROBABLY the first sound film dealing with amateur radio activities is now being shown at a number of London cinemas and will tour the provinces during April and May. The film is released in the Gaumont "Sound Mirror" (No. 79), and shows Mr. H. L. O'Hefferuan, the well-known operator, at work at his station G5BY at Croydon.

America Bars Baird Television.

OUR Washington correspondent reports that the U.S. Federal Radio Commission has barred the introduction into America of John Logie Baird's television system. The Commission held that, although the application was in the name of WMCA, an American company, the proposed station would be operated jointly with Baird Television Corporation, Ltd., a British concern. According to the Commission the granting of a licence would, in effect, give undue authority to the British company in violation of the section of the Radio Law prohibiting alien ownership or directorates of companies holding wavelength privileges in the United States.

"Radio-Rouen."

"RADIO-ROUEN" is the title given to an association of listeners who hope to provide the capital of Normandy with a studio ultimately to be connected to one of the State broadcasting stations. A cynical French journal, which, it seems to us, might be better employed in encouraging radio developments, compares this first step with "the purchase of a can of petrol prior to the acquisition of an automobile."

Broadcasting the Koran.

THE development of wireless seems to be overcoming Turkey's most sacred prejudices and traditions. Recently, for the first time in history, verses of the Koran, translated into Turkish and sung in the Saint Sophia Mosque, were broadcast by the Stamboul Station.

The Parliamentary buildings in Ankara have now been equipped with amplifying apparatus. Three microphones in the great hall are connected to two powerful amplifiers, which not only make all speeches audible in every part of the Chamber of Deputies, but transmit them to the Palace of the President of the Republic and to the Administrative buildings in the surrounding district.

The Telephone Habit.

SWISS listeners are unambitious so far as long-distance listening and alternative programmes are concerned, for, according to statistics, 5.8 per cent. of the population receive their programmes by telephone, only 3.8 per cent. using wireless sets.

The Flash-Arc.

"THE Flash-Arc in High Power Valves" is the title of the paper by Mr. B. S. Gossling, M.A., to be read at the meeting at 6 o'clock this evening of the Wireless Section of the Institution of Electrical Engineers.

At 7 p.m. on Friday next, April 8th, a paper by Mr. H. R. Harbottle, B.Sc. (Eng.), on "Some Acoustic and Telephone Measurements," will be read at a joint meeting of the Wireless Section and the Meter and Instrument Section.

Germans Decline Soviet Offer.

THE Russian broadcasting authorities recently approached the German Reichrundfunk offering transmissions from the Leningrad Opera House. In declining the offer, the Germans advanced as the main objection that there are no direct land lines from Leningrad to Germany which would be good enough to transmit musical frequencies. According to our Berlin correspondent, the German authorities are emphatic in their denial of any desire to relay Russian programmes.

Gramophone Companies' Scheme.

A SCHEME to centralise the manufacture of the products of Columbia Graphophone Company, the Gramophone Company, and the Marconiphone Company is in progress. Under the scheme the Electric and Musical Industries, Ltd., will pool the scientific and manufacturing resources of the three companies with a view to general economy and increased efficiency. Manufacture will take place at the E.M.I. factories at Hayes. The products to be dealt with in this way will be radio-gramophones, gramophones, and records. The work will be transferred from the existing factories. Where possible, transference of labour is being made. The scheme, it is stated, will not affect the separate entities of the three companies.

Hindenburg, Too!

M. DOUMERGUE, the former President of France, has a rival wireless "fan" in the person of President Hindenburg. The recent electoral campaign in Germany has revealed the fact that every evening at 9 o'clock, after a day crowded with receptions, conferences, and other State functions, Germany's "grand old man" sits down by his wireless set and delights in tuning in various German stations. It appears that the President generally selects programmes of light music and popular songs, though a military march from any transmitter is a sure magnet. To some extent the President is a prisoner of the State, but he considers that radio restores to him much of his liberty.

Broadcasting from a Train.

THE limit in broadcast stunts seems to have been reached by the American Columbia Broadcasting System on Sunday evening, March 27th, when a nation-wide broadcast was provided by an orchestra in a dining car of the Washington to Baltimore express train. The programme was picked up by a number of short-wave stations along the route, a short-wave transmitter being carried on the train The preliminary tests apparently showed that practically the full range of orchestral and musical frequencies could be relayed from the train without too much distortion or loss of "tone," but it is not mentioned whether the roar of the moving vehicle also came over at a satisfactory volume. Unless this were the case, it seems to us that the experiment must have failed in its object, if any.

Would They Pay?

A VERY bold step has been taken by the Sanabria Television Corporation of Chicago. In advertisements in the Press the Corporation is asking, somewhat timidly, whether listeners would be willing to pay a small monthly sum for the sake of receiving good television entertainment.

It is common knowledge that the average American listener looks with horror on the slavish licence system of Europe, and fails to understand why the man in the street should not be allowed to tap the "free ether" without payment. Recognising this psychological obstacle, the Corporation puts its request in this form: "Would you pay a small monthly sum, which would be charged on much the same basis as your gas and electric bills, for the privilege of seeing the world's greatest entertainment and athletic events, as well as world news, the minute it happens, right in your homes?"

Readers of the advertisements are asked to indicate their reactions, either by letter or on the accompanying coupon. At present the replies are being kept secret.

Battery Eliminators: U.S. Patent Decision.

UNLESS the Supreme Court reverses the latest decision of the Circuit Court of Appeals at Philadelphia, holding that the "socket power unit" now commonly used to eliminate batteries in radio receiving sets has not been infringed by the Radio Corporation of America, dreams of vast riches for the two men claiming to be the inventors of the device appear to have gone glimmering, writes our Washington correspondent.

Royalties on practically every set ever produced which derives its power from house alternating current lighting mains would have been due to Percival D. Lowell, Francis W. Dunmore, and the Dubilier Condenser Corporation had they won the suit. It has been estimated that $10,000,000 was involved.

The decision of the Court of Appeals has been awaited nearly two years.

Recourse is now open for Lowell and Dunmore, who licensed Dubilier to use their patent with a condition that Dubilier finance the litigation, only to the Supreme Court of the United States. Whether they will appeal remains for their lawyers to decide.

A Lively Programme.

DESPITE the fame of the Eiffel Tower station as an efficient distributor of telegraphic and telephonic information, the French radio journal, *Haut Parleur*, contends that the broadcasting studio lacks the atmosphere desirable for presenting artistic programmes. On March 21st, at one of a series of concerts sponsored by our contemporary, the programme began in a rather "feverish atmosphere" as the result of a dispute between two announcers. This circumstance may explain why Mlle. Suzanne Feyrou, while singing her first number, began to swoon, and, "after several oscillations, fell heavily in front of the microphone." Apparently the announcer at once closed the microphone circuit. When the singer had recovered consciousness, Mlle. Berthe Sylva resumed the concert with "Les Poupées de Minuit," but she broke down with emotion. Two male singers were left to complete the concert. What the *Haut Parleur* objects to is not that the distressing incident should have occurred, but that it is being accused of having staged the affair to obtain special publicity!

Radio Reparations.

FIGURES just issued regarding Germany's reparation payments to France during 1931 reveal that "payments in kind" included 11,152 tons of wireless, telephonic, telegraphic, and electric supplies.

Little Tale.

THE other day a very perturbed member of the staff of a Paris broadcasting station upbraided an announcer for want of care in his remarks at the microphone. The offender had just announced the formation of a new musical group known as the Mozart Circle (*Cycle Mozart*).

"Regardez!" exclaimed the clever one. "Free advertisements are forbidden! Who is the maker of this bicycle?"

The Barnyard Club.

THE social spirit has always been well to the fore in American amateur radio, and clubs of all kinds abound within the ranks of the American Radio Relay

SOMETHING NEW. This picture is not a variation on the "wireless in coalmine" theme. It shows a party of Australian "O.B." men trying to interest listeners with a description of a cable tunnel below the streets of Melbourne.

League. The most unusual, however, appears to be the Barnyard Club, formed by a group of amateurs in the 9th Radio District. To be eligible for membership a transmitter must own call letters with a zoological significance, and at present the eleven amateurs to qualify hold "W9" call-signs, followed respectively by the letters BUL, CAT, COW, DOG, DUC, EGG, FLY, HEN, HOG, HOS, and OX.

Radio in the Cradle.

AN unusual honour has come to Henry Lee Carter, of Rochester, New York, who is reputed to be the world's youngest licensed radio transmitter. This child of ten years has been appointed an official relay operator of the American Radio Relay League, a distinction held by only 4 per cent. of the total number of licensed amateurs in the United States and Canada.

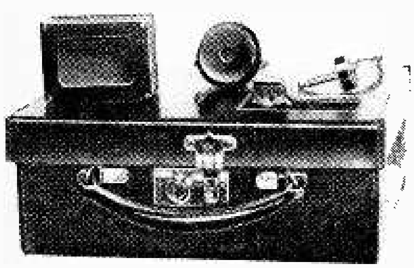
Light Cells.

"LIGHT Sensitive Cells in the Service of Man" is the title of the lecture to be given by Dr. Frederick H. Constable, F.Inst.P., this evening (Wednesday) at 8 o'clock, at the Royal Society of Arts, John Street, Adelphi, London, W.C.2. The paper will be illustrated by lantern slides and experiments: specimens of Radiovisor and other apparatus will also be exhibited.

DEAFNESS TREATED BY RADIO METHODS.

By A CORRESPONDENT.

"WHAT is radio doing for the deaf?" was the question recently raised in *The Wireless World*. The answer is that progress of a very definite character has been made during the past year. The fundamental discovery is that the deliberate introduction of distortion into the audible spectrum is of as much practical value to the deaf person as the deliberate introduction of distortion into the optical system of a person suffering from defective vision, which is the modern treatment for all cases of astigmatism.



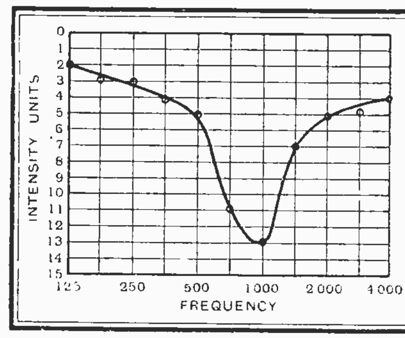
A hearing aid, constructed of wireless components, which can be adjusted to suit a patient's prescription.

A person requiring a pair of spectacles goes to an optician and has his sight tested; a prescription is made, and a pair of lenses are subsequently delivered, with the assurance that they will suit the person for whom they are intended; but until recently the vending of deaf aids has been done on unscientific lines, which explains why one finds so many deaf people with a number of instruments lying about unused. The reason for this becomes clear if we make a little practical experiment by wearing another person's spectacles. Haphazard methods can be just as ineffective in the selection of deaf aids as in the choice of spectacles; each patient must be prescribed for individually.

In a hearing device based on wireless principles, which has been produced by Radio Aid, Ltd., the characteristics may be altered at will by the manipulation of filter circuits to a prescription.

The characteristic of each instrument is taken by a laboratory apparatus similar to that employed in radio practice for ascertaining the performance of amplifiers, loud speakers, etc., so that the overall response characteristic of each deaf aid is known to a fine limit. The remaining piece of apparatus required to complete the system of "Scientifically prescribed hearing aids for the Deaf" is the Audiograph, shown below. This consists of a small oscillator with a five-octave frequency range whereby a patient's minimum acuity may be plotted by means of a calibrated output for each half-octave. The Audiograph also includes a deaf-aid circuit with seven different filter circuits so that the effect of each filter may be demonstrated to the patient.

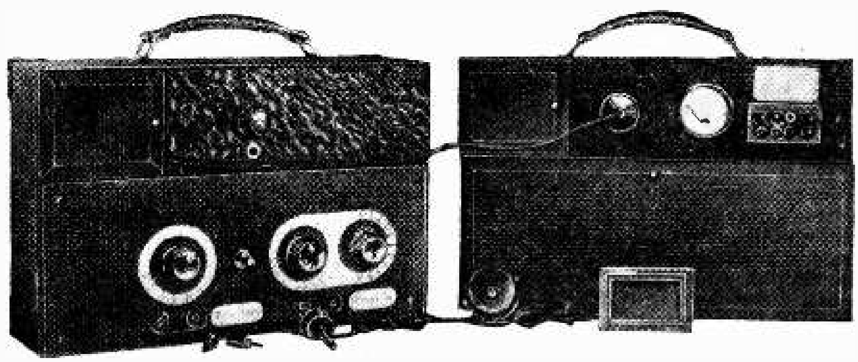
The Audiograph has been made conveniently portable, and can be sent to any part of the world for the purpose of making prescriptions. This means that a hearing aid can now be built to a prescription sent by post, which is of enormous value to sufferers in Colonial or remote districts. It is understood that, in due course, every important town will have its representative properly trained in the use of the Audiograph



A typical audiograph chart. The patient in this case suffers from aural stigmatism.

and with a good general knowledge of the problems which beset the deaf.

There should be good openings for any young man with practical experience in radio wishing to take up this work as a profession.



The Audiograph hearing tester. A small oscillator with a five-octave frequency range enables the patient's aural perception to be plotted by means of a calibrated output.

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 presented, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Problems 29 to 31 have been previously given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

QUESTION 29.—**A certain voltmeter has a resistance of 64 ohms per volt. If the maximum reading on the meter is 100 volts, how much current will be passed at full-scale deflection?**

Answer—15.6 mA.

Both moving-iron and moving-coil meters depend for their action on the magnetic effects produced when an electric current passes through a coil. This electromagnetic action, however, has no effect on direct current, and will not concern us in using the instrument except, of course, in actuating the needle pointer. We may simply treat the voltmeter as a pure resistance which has, in addition, the property of indicating the P.D. existing between its terminals. The amount of the resistance varies considerably between different types of instrument. The usual method of rating it is to state the number of ohms resistance for every volt scaled on the instrument. In our example, this rating is 64 ohms per volt, and, since the meter will read up to 100 volts, the total resistance will be 64×100, or 6,400 ohms. Note that *this resistance is always operative in the meter whatever the actual scale reading may be.* In other words, whenever we apply this meter to measure the P.D. between two points, we thereby connect them by a new shunt path of 6,400 ohms in addition to whatever resistance may originally have been between them. The introduction of this shunt is, of course, the whole snag in using voltmeters of the magnetic type; as soon as the instrument is applied, current is diverted through it, and complications ensue! The remedy is naturally to use a meter of as high a resistance as possible, but, even so, the difficulty is never entirely surmounted.

The resistance of the present meter is 6,400 ohms, and, assuming it to register correctly the presence of 100 volts across its terminals, the current passed by the instrument at full-scale deflection is simply deduced from Ohm's law, i.e.:

$$I = \frac{E}{R} = \frac{100}{6{,}400} = 0.0156 \text{ ampere}$$

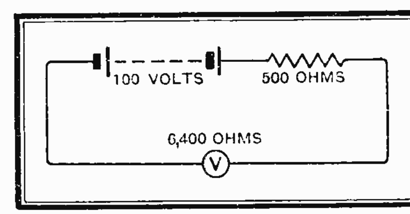
$$= 15.6 \text{ mA.}$$

QUESTION 30.—**If the voltmeter in question were placed across an H.T. battery of 100 volts and internal resistance 500 ohms, what would be the meter reading, and how much current would be passed by the instrument?**

Answer—93 volts. 14.5 mA.

In the diagram the internal resistance of the battery is shown for convenience as external to the e.m.f.;

The P.D. of the battery as measured by the voltmeter is 93 volts.



the voltmeter V being applied across the whole. Since the meter resistance is 6,400 ohms, the total resistance in the circuit which must be overcome by the e.m.f. of 100 volts is $500 + 6{,}400$, or 6,900 ohms.

Accordingly, when the meter is in position, the current passing is

$$\frac{E}{R} = \frac{100}{6{,}900} = 0.0145 \text{ A.} = 14.5 \text{ mA.}$$

But it was found above that the maximum possible current of 15.6 mA. is taken by the meter when the P.D. across it is 100 volts.

Therefore, when connected to the battery, the P.D. across it will be $\frac{14.5}{15.6} \times 100$, or 93 volts (approx.).

The same result may be obtained in another way by considering the diagram already referred to. The total e.m.f. in the circuit, viz., 100 volts, is apportioned between the meter resistance and the internal resistance of the battery in the ratio of 6,400 to 500.

I.e., the voltage drop across V is $\frac{6{,}400}{6{,}400 + 500}$, or $\frac{64}{69}$ of the whole. Therefore, the P.D. across the meter is $\frac{64}{69} \times 100 = 93$ volts (approx.) as before. The remaining 7 volts of the battery e.m.f. is, of course, lost in overcoming the internal resistance.

The P.D. between the battery terminals when the meter is in circuit is, actually, only 93 volts. This figure depends partly on the internal resistance and partly on the nature of the load imposed on the battery. In the case we are considering, the latter is simply the resistance of the meter itself, since the battery is otherwise entirely on open circuit. It will be seen in the next problem how the P.D. may be altered by the use of a different meter.

Nuts to Crack.—

QUESTION 31.—**If a 100-volt meter rated at 1,000 ohms per volt were applied to the same battery, what would be the reading and the current taken?**

Answer—99.5 volts; 0.995 mA.

This voltmeter is a "high-resistance" instrument, and its resistance is obviously $100 \times 1,000$, or 100,000 ohms.

Referring once more to the figure, it will be seen that the total resistance in the circuit when the meter is connected is now 100,500 ohms. The P.D. across the meter is, therefore, $\frac{100,000}{100,500}$ of the total e.m.f., i.e., $\frac{1,000}{1.005} \times 100$, or 99.5 volts.

Again, the current in amperes is given by dividing the total e.m.f. in the circuit (100 volts) by the total resistance (100,500 ohms). This gives 0.000995 ampere, or 0.995 mA. The same result may be obtained by dividing the P.D. across the meter (found above to be 99.5 volts) by the meter resistance (100,000 ohms).

NEXT SERIES OF PROBLEMS.

QUESTION 32.—**It is desired to operate a power-grid detector valve with 100 volts on the plate and a mean anode current in the neighbourhood of 8 mA. If the H.T. supply is 260 volts, what value of feed resistance would be required in the anode lead, and what power must it be able to handle?**

QUESTION 33.—**A four-valve set is supplied with filament current from an accumulator the voltage of which is 2.04 when the set is running. If one of the valves is rated to take 0.12 ampere at 1.8 volts, how should it be connected to the filament supply?**

QUESTION 34.—**A resistance of 50,000 ohms is rated to take 20 watts. What is (a) the maximum direct current that may be passed through it without danger, and (b) the maximum amplitude of A.C. that may be similarly passed?**

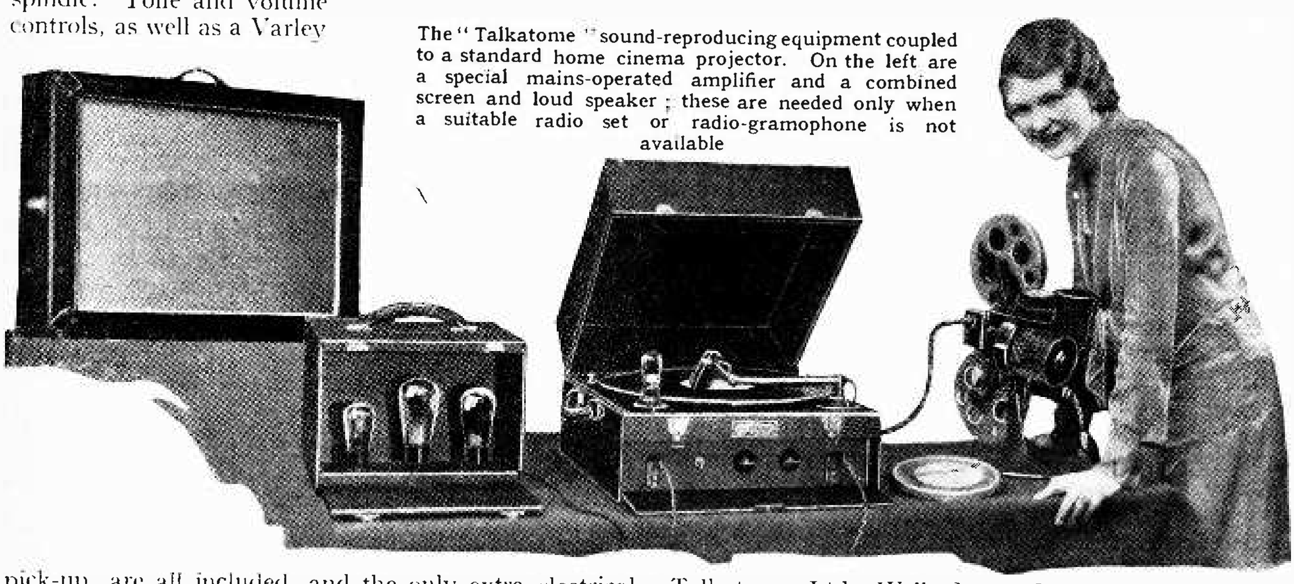
NUTCRACKER.

"TALKATOME" HOME TALKIES.

Synchronised Turntable for Converting Silent Film Projectors.

HOME cinema enthusiasts who have 16 mm. projectors will doubtless be interested in the recently introduced "Talkatome" equipment, by means of which their apparatus may be converted from "silent film" to "talkie."

The essential part of the new system consists of a synchronised turntable for large-diameter disc records, which are run at $33\frac{1}{3}$ revolutions per minute by means of a flexible coupling linked to the projector sprocket spindle. Tone and volume controls, as well as a Varley pick-up, are all included, and the only extra electrical connections necessary are leads between the turntable and the pick-up terminals of an existing radio receiver or radio-gramophone, and to the mains for supplying current to a lamp.



The "Talkatome" sound-reproducing equipment coupled to a standard home cinema projector. On the left are a special mains-operated amplifier and a combined screen and loud speaker; these are needed only when a suitable radio set or radio-gramophone is not available

Practically any of the well-known projectors—Ensign, Kodascope, Bell and Howell, etc.—may be operated with the "Talkatome"; where necessary a small gear box is supplied with the coupling mechanism in order to correct the turntable speed. Synchronism of film and sound at the moment of starting is ensured by a clear indicating mark on the record and a "start" indicator on the film. Operation seems to be entirely simple and straightforward, and perfect synchronism is maintained.

The success of an appliance of this sort obviously depends to some extent on the availability of a lending library of films, embracing a range of subjects catering for all tastes. Realising this, the manufacturers (British Talkatome, Ltd., Wells Street, Jermyn Street, London, S.W.1), have already prepared a well-chosen nucleus, comprising travel, educational, comedy, and other films, including a number of examples from the Co-Optimists' repertoire.

The complete synchronised turntable costs 25 guineas; a special amplifier and a combined screen loud speaker are also available for purchasers who do not already possess suitable apparatus.

Broadcast Brevities

By Our Special Correspondent.

Next Winter's International Relays.

WITH the general improvement in the land lines on the Continent, elaborate arrangements are already in contemplation for international relays next winter. I hear that the B.B.C. is especially interested in the possibilities of securing first hand operatic performances from those homes of opera, Germany and Austria. At present no relays have been actually arranged, but as soon as work on the southern European section of the land-lines system is completed, the broadcasting organisation will get busy on a scheme of mutual co-operation.

Copyright Anomalies.

Apart from technical difficulties in these big European schemes, there is the copyright question. At present, all kinds of anomalies exist: for example, several performers in a Vienna opera might be heard in Britain, while it would be necessary to "fade out" others whose contracts forbade them to broadcast except in certain countries.

I am glad to hear that the copyright question will come up for consideration at the International Wireless Conference at Madrid in September.

Problems for Madrid Delegates.

This five-yearly event (the last Conference of the kind was at Washington in 1927) promises to assume even more importance this summer, particularly from the point of view of the broadcast listener. The only danger is that, with so many aspects of wireless to discuss, the delegates may be disinclined to give broadcasting all the attention it deserves. Questions which call for imperative discussion include wavelength revision and electrical interference.

Non-stop.

JACK PAYNE and his boys made a non-stop night of it on Wednesday last, for immediately their high-speed broadcast programme was over they gathered up their instruments and were wafted by charabanc to the northern suburbs for a music hall engagement a few minutes later.

With these comet-like appearances and disappearances at Savoy Hill, Jack Payne is probably unique.

Composure in the Studio.

He also seems to be the only broadcaster who can defy the general rule that artistes shall arrive at the studio at least ten minutes before they are due to appear.

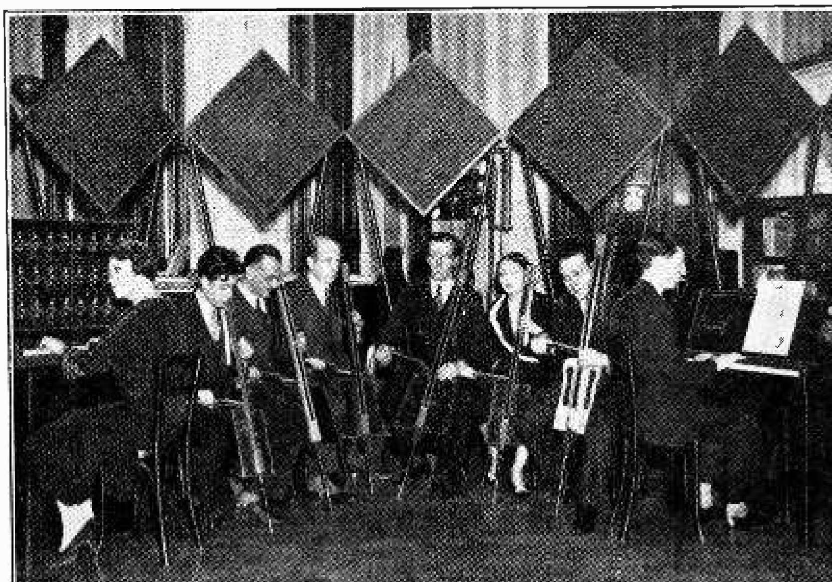
The rule was formulated several years ago when it was found that the microphone ruthlessly discloses any sign of flurry or haste. The B.B.C. prefer that the artistes shall have time to compose themselves before approaching the microphone.

Last Minute Improvements.

Many artistes elect to turn up half an hour or more before zero hour, and there are certain speakers who have been known to arrive at least an hour beforehand with the idea of polishing up their manuscripts and seizing the *mot juste* in the studio itself.

The Announcer's Responsibility.

Within reasonable bounds, speakers are allowed to alter their manuscript up to the last moment, though in the case of each alteration the announcer must be consulted. It is left to the discretion of this important individual to decide whether the proposed alteration requires submission to the Talks Department.



A BAND OF OSCILLATORS. On Friday last, April 1st, Leon Theremin and his assistants gave an orchestral concert in the Carnegie Hall, New York, using electrical oscillators. The "orchestra" is here seen rehearsing. Note the loud speakers in the background.

A Trans-European Audition.

A FORMER Zeppelin commander, Captain Breithaupt, may take part in the new "Hazard" series of Saturday broadcasts if the unusual test to which he must submit proves satisfactory. The Captain will go to a Berlin studio and speak into a microphone connected by trunk line to the G.P.O. in London, his voice being relayed from thence to Savoy Hill. The judges will have to decide whether the Captain's English is suitable for broadcasting.

Talks by Successful People.

These "Hazard" talks will not be unlike the very successful "Escape" series of last year, the difference being that the speakers will have wider scope in the choice of thrilling experiences. Another series of talks which should have a special appeal to the ordinary man will be "Rungs of the Ladder," beginning at the end of April. In these talks leaders in many fields will tell of their early struggles towards success, and the contributors will include Lord Beaverbrook, Lord Ashfield, the Poet Laureate, Mr. C. B. Cochran, and the Rt. Hon. J. H. Thomas.

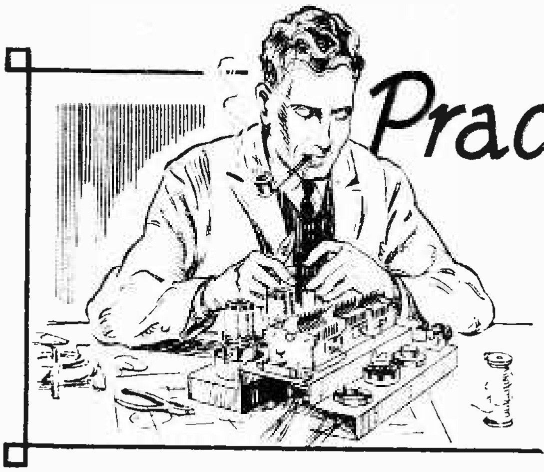
"There are Crimes and Crimes."

PROBABLY the most successful of the twelve broadcasts in the Great Plays series which the B.B.C. arranged four years ago was "There are Crimes and Crimes," by August Strindberg. A broadcast version by Dulcima Glasby was given in 1928, and now Miss Glasby has taken the original play afresh and prepared a new adaptation which will be heard on April 25th (National) and 26th (Regional).

Miss Glasby, whom listeners will remember as the author of "Obsession," has been engaged in the work of adaptation for the microphone for five years, and in that time has prepared 185 long plays and nearly 100 shorter pieces.

Broadcasting Perpetual Youth.

THE B.B.C. have turned down the proposal of a hearty old gentleman of 103 that he should broadcast a series of talks on the secret of perpetual youth. I believe the intention was to associate the talks with a form of treatment for which one pays money, hence the ban; all the same, one feels sorry that a centenarian should be left to nurse his secret in silence, and I have a feeling that, in due time, when we have listened to a few more broadcast thrillers, there will be a public demand for rejuvenation and the old gentleman will come into his own. That is, if he can be found.



Practical Hints and Tips

Simplified Aids to Better Reception.

IN the design of A.C. mains receivers it is more or less conventional practice to insert protective fuses in series with the power transformer primary and the supply leads. This plan is theoretically sound, and is generally satisfactory; should a short-circuit develop across any one of the transformer secondary windings, the fuse will "blow."

SAFETY FUSES FOR A.C. SETS.

It is hardly an exaggeration to say that any practical system of fusing must include a primary fuse, or, better, a pair of fuses, which affords enough protection to satisfy most requirements. But, useful as this simple arrangement can be, it does not altogether obviate the risk of damaged components in the H.T. feed circuits in the event of a partial short-circuit. Here we are always dealing with resistances of more or less high value, and with relatively small currents, and an overload of perhaps two or three hundred per cent. in an individual anode circuit may be responsible for a very small percentage increase in the current flowing in the primary circuit. Therefore, as a supplement to primary fuses, it is worth while to consider the fitting of extra fuses in the H.T. circuits. As an additional reason for doing so at the present time, it may be pointed out that very satisfactory fuses which are designed to deal with the relatively small currents handled in the circuits in question are now manufactured by several firms.

It is not suggested for a moment that it is worth while going to the trouble of fitting a fuse in every anode circuit, but it is urged that something more than the ordinary precautions are likely to be worth while in an ambitious set where a good deal of energy is handled, especially when the receiver is of an experimental nature, where alterations in the circuit are constantly being made.

In sets employing a full-wave valve rectifier there can be little doubt that the best position for extra fuses is directly in the leads between the H.T. transformer secondary terminals and each of the anodes of the valves, as indicated in Fig. 1. Almost complete protection is afforded; even the rectifying valve itself is safeguarded against an overload.

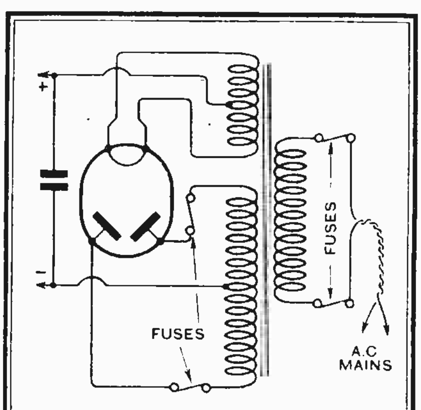


Fig. 1.—Fuses connected in series with the rectifier anodes as an additional precaution against the effects of H.T. short-circuits.

WHEN a self-contained portable set, of the type in which the aerial and loud speaker are mounted in the lid, begins to give trouble, or suddenly becomes completely silent, experience shows that the fault may often be attributed to a defective connection between the frame aerial or loud speaker and the receiver unit.

SOME "PORTABLE" HINTS.

These leads are sometimes arranged in such a way that they are subjected to stresses when the lid is opened and closed, and thus they develop a tendency after continued use to fracture at the point of flexing.

In the case of some of the cheaper portable sets it may be found that the frame-aerial leads are taken to a pair of sockets mounted close together on a small terminal panel of very indifferent insulating material. Occasionally, efficiency can be improved to a noticeable extent by removing the sockets entirely and substituting direct connections by means of flexible wire of good quality between the two units. It may be necessary to knot the flex in order to prevent it pulling through the hole.

When a portable set shows a tendency towards instability, or towards the production of a continuous high-pitched whistle which is more or less unaffected by tuning, it is worth while trying the use of screened wire for the loud speaker connections. Relatively high self-capacity in these leads is a matter of small importance, and so the type of armoured wire sold for motor car work is suitable, and there is no need to employ the low-capacity wire which is nowadays recommended for use in H.F. circuits. Needless to say, the screening should be earthed by as short a path as possible.

IT will be fairly obvious that a loud speaker feed condenser, working in conjunction with a choke filter output system, is called upon to withstand the full D.C. voltage that is applied to the anode of the output valve when the conventional method of connection, as shown in Fig. 2 (*a*) is employed. Consequently, a relatively expensive high-voltage condenser must normally be chosen for this position in a modern high-power output stage. Superimposed upon the D.C.

FEED CONDENSER ECONOMY.

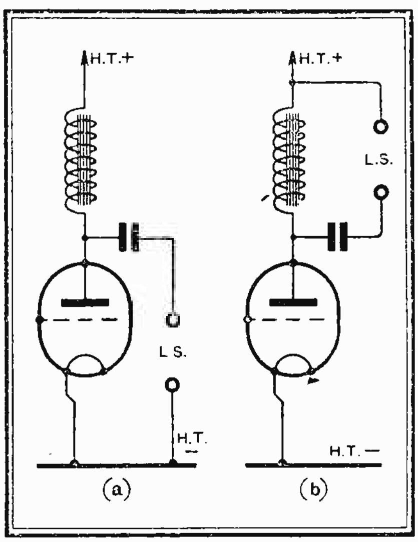


Fig. 2.—Alternative connections of choke-filter output circuits.

voltage there are also the amplified speech-frequency voltages built up across the choke, and so it will be seen that the feed condenser has no easy task.

The method of connection in question has the important advantage that the anode circuit is to a great extent "decoupled" when the loud speaker is fed in this way; signal frequency impulses are largely deflected from the source of H.T. supply by the action of the choke.

When the extra decoupling afforded by "earthing" the loud speaker is not necessary, the output circuit may be rearranged as in Fig. 2 (*b*). Here the choke filter output does not contribute anything towards decoupling the H.T. feed circuits, but practically no D.C. voltage is applied to the condenser, which may accordingly be of the low-voltage type.

This is an argument in favour of arranging a pentode output circuit with a centre-tapped choke, as in Fig. 2 (*b*), with the low-potential end of the loud speaker joined to H.T. plus instead of to earth. In this particular case the loss of decoupling, as compared with the alternative scheme, is in any case negligible. Of course, an extra condenser may be inserted in the second connection to the loud speaker, in order to isolate the instrument from D.C. voltages, but by doing this the advantage of economy is lost.

THE complete theoretical diagram of a mains-operated receiver—even of a simple two-valve set—may appear to the uninitiated to be an alarmingly complicated affair, but its apparent complexity will almost always be dissipated when the various individual circuits of which the whole is composed are considered one by one.

A.C. CIRCUITS DISSECTED.

It is almost impossible, even for the expert, to master the essentials of a complete circuit at a glance; what he does, consciously or subconsciously, is to trace each grid and plate circuit, noting as he does so the method of linkage between each of them. The beginner, as soon as he appreciates the need for a similar procedure, will find himself making rapid progress towards a true understanding of the subject. All that he needs in order to make a start is a knowledge of what is comprised in grid and plate circuits, and, to give himself confidence, an appreciation of the fact that even the most multi-valve set is nothing more than a chain of many such simple circuits, all connected in cascade.

For the benefit of those who wish to understand the conventional representations of receiver circuits, and incidentally in doing so to acquire much useful working knowledge, a skeleton diagram is reproduced in Fig. 3. In it, the main conductive grid and anode circuit of typical H.F. and detector stages are drawn in heavy lines to distinguish them from auxiliary or linking connections.

In tracing either of the circuits associated with a valve, a start should be made at the cathode terminal (marked X). For instance, the H.F. grid circuit comprises a bias resistor shunted by a by-pass condenser, and a tuned circuit consisting of a coil shunted by a variable condenser; these two components should be regarded as a unit.

The same bias resistor is common to the H.F. anode circuit, which is completed through the source of H.T. voltage and an H.F. choke. The condenser C serves merely to pass on energy to the circuit connected to the detector grid.

Referring to the detector anode circuit, it will be seen that the D.C. conductive path is completed through a decoupling resistance, but if we were considering signal frequency energy only, it would be correct to consider the circuit as being "returned" to cathode through the by-pass condenser C_1.

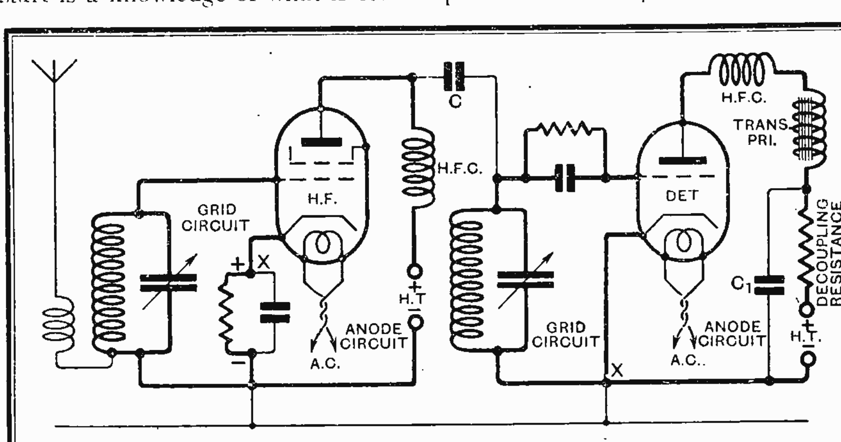


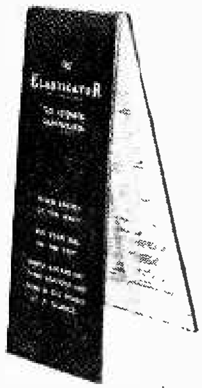
Fig. 3.—High-frequency and detector stages of an A.C. receiver, with the main grid and anode circuits in heavy lines. The diagram is simplified by showing separate sources of H.T. supply for each anode circuit.

Laboratory Tests

ON NEW RADIO PRODUCTS.

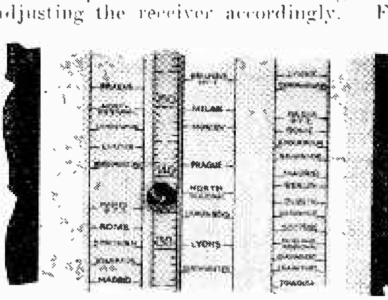
TRIX "ELASTICATOR" STATION INDICATOR.

With a modern selective receiver of average sensitivity, so many foreign stations can be tuned-in that to identify them all is a tedious process if one has to rely on the announcers. With a view to simplifying this procedure Eric J. Lever (Trix), Ltd., 8-9, Clerkenwell Green, London, E.C.1, have introduced a most ingenious device, consisting of a stout cardboard folder, on the inside of which is marked the majority of the stations likely to be heard in this country. Three columns are provided, and the relative positions of the various stations are located as they would appear on the tuning dial if the condensers used are log-mid-line, square law, or straight-line frequency. Adjacent to each column is a blank space in which is stretched a rubber strip marked on one side with divisions 0-180, and on the other 0-100. This represents the tuning scale, and is fixed in position, as shown in the lower illustration, by drawing pins.



Trix "Elasticator" for identifying broadcast programmes.

The procedure is to tune in three stations that can be definitely identified, and then adjust the rubber strip so that the condenser readings fall adjacent to these stations on the chart. It should be possible now to identify any other station by comparing the chart with the condenser settings, or alternatively foreign stations can be found by ascertaining their respective condenser settings and adjusting the receiver accordingly. For very accurate readings it might be worth while to insert a number of drawing pins at frequent intervals as more stations are identified. The price of this most useful device is 3s. 6d.



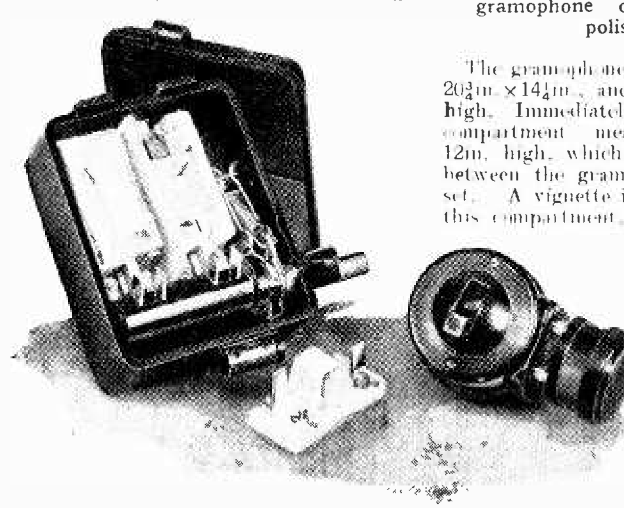
A section of the Elasticator showing the flexible strip held by a pin.

STANDARD ELECTRICAL FITTINGS FOR MAINS RECEIVERS.

Although there are numerous specially designed switches, fuses, and plug and socket connectors available for incorporating in mains-operated receivers, many of the standard electrical fittings used in domestic apparatus are equally well suited for this purpose. Owing to the specialised methods of manufacturers and the large quantities required, these fittings are available at attractive prices.

An exceptionally compact double-pole mains switch incorporating two fuse holders, which would seem to be ideal for use with a power radio gramophone, figures among the electrical fittings made by J. A. Crabtree and Co., Ltd., Lincoln Works, Walsall, known as the "50-50" Switch fuse; it is capable of handling up to 10 amps. at 250 volts, but the complete unit measures only $3\frac{1}{8}$in. $\times$ $4\frac{1}{2}$in. $\times$ 2in. The switch and fuses are completely insulated, being enclosed in a neat moulded case, and the price is 5s. 8d.

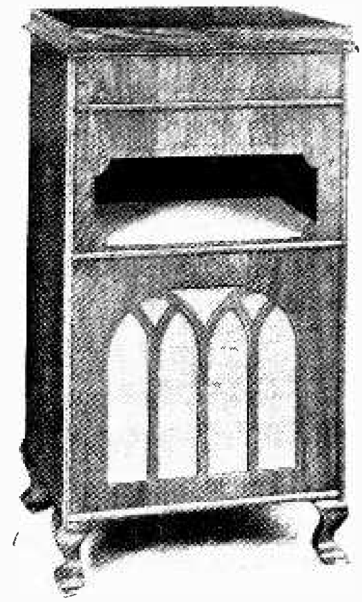
Another useful fitting is the "Lincoln" Switch-socket, which is a single-pole quick make-and-break switch with a two-pin plug attachment. The body of the switch and the plug consist of "Jacobite" mouldings, and there are no exposed metal parts. The 5-amp. size, finished in two colours, namely, with white bases and brown covers, costs 34s. 8d. per dozen. An all brown or all-white finish is available at a small extra charge.



Crabtree "50-50" switch fuse and "Lincoln" switch socket.

PICKETT'S "MASTER GRAND" CABINET.

Since so many of the popular kit and home constructor's sets now have provision for gramophone reproduction, the acquisition of a gramophone motor and other associated components, together with a suitable cabinet, provides all the necessary equipment for the construction of a complete radio gramophone. The "Master Grand" radio gramophone cabinet made by Pickett's, Albion Road, Bexley Heath, is well suited for this purpose, as the dimensions of the receiver compartment are such that it will accommodate most of the well-known makes of home constructors' sets.



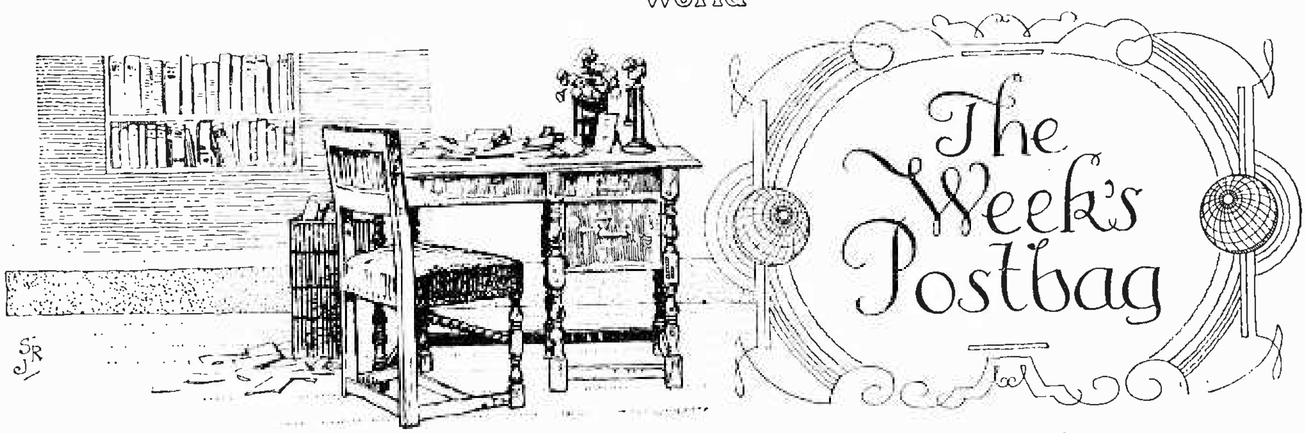
Pickett's "Master Grand" radio-gramophone cabinet finished in polished oak.

The gramophone compartment measures $20\frac{3}{4}$in. $\times$ $14\frac{1}{4}$in., and is a little under 4in. high. Immediately below is the receiver compartment measuring 21in. $\times$ 14in. $\times$ 12in. high, which gives ample clearance between the gramophone motor and the set. A vignette is fitted to the front of this compartment, the opening in which will be cut to accommodate the size of the panel to be used.

The bottom compartment is very roomy, and in addition to housing the loud speaker, provides ample space for the batteries or the mains equipment, as the case may be. A baffle is fitted, the opening in which is 8in. in diameter.

There is very little ornamentation on the cabinet, and in this respect it is in keeping with modern styles, but it is substantially made and well finished. The overall height is 42in., and the price, in polished oak, is 65s.

We have received from the Electrical Trading Association, Ltd., Aldwych House, Aldwych, London, W.C.2, an illustrated folder giving all the essential data relating to the latest range of ETA valves. In all there are nineteen different types accompanied by their characteristic curves.



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

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

SELECTIVITY AND TONE CORRECTION.

THERE is perhaps a joy with many in obtaining something for nothing, and I must confess, on reading the letters of your correspondents, Messrs. Skilbeck and Leng, in your issue of 16th March, to a feeling that the public were to be placed in possession of the benefit of Dr. Robinson's inventions and brains free of royalty or charge.

However, the legal views expressed by these correspondents, although plausible, do not seem to be the considered opinion of men "learned in the law."

Had Mr. Skilbeck looked more closely into the matter he would have discovered that the case he cited, Proctor *v.* Bayley, 6, R.P.C.106, *was* actually reversed by appeal, and, furthermore, the point at issue was not applicable to his argument.

If Mr. Leng's views on the subject of the scope of a patent were accepted, surely it would mean the death blow to inventors and patent agents, because it would deny the existence of master patents.

I wonder if the further advice given, and the opinions expressed by these two correspondents are based on a surer foundation than their legal opinions, but I have my doubts!

Bromley. H. W. REGINALD ROOM.

AMPLIFIERS AND "TONE CORRECTION."

I SHOULD like to endorse the views expressed recently in *The Wireless World* relative to "tone correction" as affecting the future of amplifier design.

It is my belief that not only will "tone correction" be applied to the work of correcting high-note attenuation (resultant upon side-band cutting), but it will be called upon also to make good the limitations of such devices as "pick-ups," "gramophone records," "microphones," "loud speakers," etc.

I will go farther and say that the principle will find a use in the alleviating of certain types of acoustic imperfections.

The principle of "tone correction" has not enjoyed much favour in the past because it has been generally believed that a quest of "linear response" for every component was the only logical and scientifically correct approach towards realistic reproduction.

In the light of present-day knowledge it is only too obvious that perfect linear response from every component is never likely to become commercially practicable.

Modern components and accessories give exceedingly good frequency response, covering as they do, in many cases, a band of frequencies from 50 to 6,000 cycles, with perhaps not more than 6 decibels attenuation at the extremities; nevertheless, this range of frequencies is inadequate and must be extended.

It is obvious that the principle of "tone correction" must be called in, since it offers a simple, cheap, and scientifically correct method of dealing with the problem.

In order to understand clearly the technical principles involved in affecting correction of tone by the method under discussion, it is well to cease to regard an amplifier as an assemblage of valves and miscellaneous components, and to regard it instead as an electrical network of composite form comprising the familiar elements of "ohmic resistance," "inductive reactance," and "capacitive reactance."

Regarded thus, we discover a network resembling that of the well-known "filter" structure. Such a network is amenable to straightforward analysis in keeping with the general theory of "transmission" known to telephone engineers.

There is an important difference, however, between the "amplifier" type of net work and the "filter" (or "attenuation equaliser") network of orthodox design.

Briefly, the difference is this, that whereas the orthodox filter works into an impedance of *finite* magnitude, the filtering elements in the amplifier (i.e., the coupling elements) work into impedances of *infinite* value (theoretically).

This difference greatly simplifies the design of a filter.

As soon as this point is properly appreciated by those engaged in the study of sound transmission we shall witness some revolutionary changes in amplifier design.

In conclusion, I would like to add that some time ago I developed a special valve coupling device for the purpose of obtaining practical interpretation of the above reasoning by the aid of which I have been able to cover a considerable amount of experimental ground. For this reason I feel I am qualified to voice an opinion. GEORGE E. POHU.

London, W.13.

EMPIRE BROADCASTING.

IN your issue of June 3rd, 1931, there was a letter from a Mr. Chapman on this subject, giving his opinion of G5SW after a four months' tour of the West Indies.

As one who spends six months every year in the colony of Trinidad and Tobago, and has done so for the past twelve years, I should like to express some further opinions on the subject, now that we are at last promised something better than G5SW.

At this time of year—October to February—G5SW is seldom more than a carrier wave which cannot be resolved, and in December is seldom even a carrier wave that can be found at all even on a 1-v-2 set. As against this, Pontoise has been at fair to good L.S. strength all through December, 1931, on 25.63 m.—G5SW being on 25.53 m. The great circle distance and path is almost identical in both cases, and therefore the signal strength should be about the same in each case. Actually the results from G5SW are what might be expected at this time of year at 4,000 miles on this waveband. The reason for the good signal strength from Pontoise is to be found in its aerial, which is a directional one—E.W. from 9 p.m. G.M.T. to closing down. This alone would make a difference, but hardly account for it all, and it seems probable that the aerial of Pontoise is capable of giving quadrant elevation to the axis of the beam to overcome corrections necessary for changing height of the Heaviside Layer for time and season.

Be this as it may, there can be no doubt that the question of suitable aerials is just as important as different wavelengths, and might possibly solve the problem of efficient Empire-wide service at less cost than the latter.

The letter quoted above referred more particularly to programme matter. This, I know, is very thorny and stony ground—what is one man's meat is another's poison. Let me therefore state that, so far as I am aware, I do not possess "an abnormally shaped brow," but that I do enjoy good talks and good plays—*when I can hear them*. With all the best intentions and equipment it is still impossible to guarantee that every word shall be distinctly audible on short waves. Under such conditions talks and plays are only exasperating to those who would like to hear them, and anathema under any conditions to those who object to being educated willy-nilly by the B.B.C.—*pace* Sir John Reith and the schoolmasters who largely control its outputs. Those who know the West Indies, but do not belong here, will have no difficulty in placing the majority of listeners, actual and potential, in the Caribbean in the correct category of the above alternatives.

Pontoise gives us news in French and English every evening—nation really speaking unto nation. I am not suggesting that the B.B.C. should do this or send out their programme announcements in five languages as from PCJ, but the spirit of both stations comes nearer the fulfilment of the B.B.C.'s motto than does their policy of shouting the same programme simultaneously from four or five transmitters at the rest of Europe—a policy which has so annoyed our neighbours, has led to obvious reprisals, and may end in all listening in Europe becoming impossible.

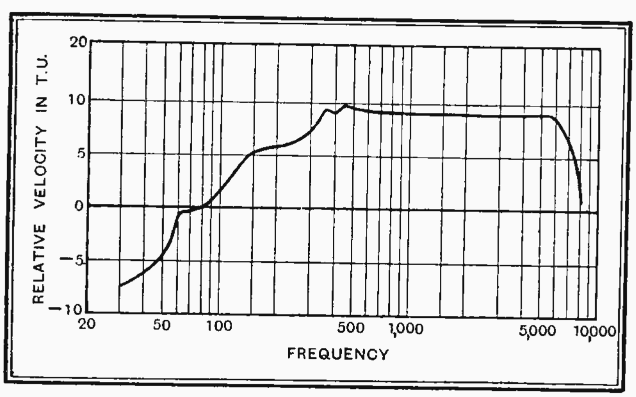
60° WEST.

RECORD "CUT-OFF."

MR. GILBERT PACKMAN asks what conditions govern the point at which a wax record cutter begins to fall off in point of frequency response, and how this is determined.

The frequency range of a good electro-magnetic recorder is from approximately 30 to 5,500 cycles. A typical frequency characteristic is shown in the accompanying illustration. The device operates in linear manner over the range of amplitudes involved in speech and music, but the response falls off below about 250 cycles, this falling characteristic is necessary in order that the maximum loudness be obtained from a record for a given spacing between grooves without cutting over from groove to groove.

In order that a lateral oscillation in a groove may represent constant intensity of sound or a constant energy over a range of frequencies, not the *amplitude* of the oscillation, but the *velocity* (which is proportional to the product of the amplitude and the frequency), must be maintained constant.



Curve of a Western Electric wax cutter.

With a good electro-magnetic recorder constant *velocity* is obtained from about 250 to 3,500 cycles. Below 250 cycles an approximately constant amplitude is maintained. If, therefore, sounds of constant absolute intensity are to be recorded over this range of 30 to 250 cycles, there is equal tendency for sounds of the different frequencies in this range to over-cut the record groove.

Attenuation of these lower frequencies in the recording apparatus may be effected by a suitable electrical network, but actually the mechanical construction of the recorder provides the progressive attenuation in most cases. Examination of a modern record will show frequencies as low as 25 cycles recorded, but the high cut-off is sharp. The present-day tendency to use mineral matter very finely screened as an abrasive has resulted in the surface sound of a good-class record being raised in pitch, although not much reduced in intensity, and if it is possible to make the abrasive still finer (say 1,000 mesh or so), the high frequency response of the recorder will no doubt be raised.

Modern commercial needle points are quite capable of following high-frequency undulations up to at least 10,000 cycles.

London. A. L. M. D.

THE REGIONAL SCHEME.

From Capt. P. P. Eckersley, M.I.E.E., formerly Chief Engineer of the B.B.C.

YOUR special correspondent, in the issue of your paper dated March 16th, under the heading of "Broadcast Brevities," seeks to prove the Regional Scheme a failure.

I can state categorically that, were it not for interference from foreign stations, the practical performance of the Regional Stations would be exactly the same as was theoretically calculated. A distinguished committee under the chairmanship of Dr. Eccles recommended the Regional Scheme on the basis of my calculations.

The "failure" of the scheme is that reception conditions in a 5.0 to 2.5 and less millivolt field limit the total receiver reception band width to about 10,000 cycles (frequency response up to 5,000 cycles). Thus, in these areas the properly designed receiver gives a performance equal to a gramophone. The fact that a great many receivers are so poorly designed as to spread their response over a wider gamut is hardly blameable upon the transmission scheme.

If the Union Internationale de Radiodiffusion had implemented the expressed policy of the Technical Committee and evolved successive new plans on the basis of the old, even the above-stated limitations would not exist.

The limitations to an upper limit of 5,000 cycles for receiver frequency response does not militate seriously against the listeners' pleasure, and the great majority of listeners get a higher upper limit than this. Most of those who could get the higher response do not, in fact, use it.

The misunderstanding of the "crystal set" heading of pioneering days, a heading invented by non-technical journalists, is almost too *vieux jeu* to merit discussion, but for your correspondent's information crystal reception used to be a synonym for a service area (10 millivolts per meter) reception. I thought all special correspondents were by now aware of this fact.

Perhaps your correspondent's suggestion that the transmission scheme was a failure was prompted by the difficulty receiver designers find in meeting modern conditions, and a realisation that even designers of receivers which are heralded by the sponsors as "revolutionary" are still behind that very simple technique which does in fact solve all modern reception problems. The Regional Scheme was studied and calculated. Calculations accord exactly with practice. The receiver would benefit if similarly treated.

P. P. ECKERSLEY.

Bush House, Aldwych, W.C.2.
Standard Radio Relay Services, Ltd.

INFORMATIVE ADVERTISING.

WITH reference to the correspondence appearing in *The Wireless World* regarding informative advertising, may I put before you the following point of view?

It seems obvious to me that the majority of the regular readers of your journal have a fair technical knowledge in radio matters, and I congratulate you on the way you cater for them. Contrast some of the advertising matter with, say, your test reports of new apparatus; in one we have, perhaps, an illustration and some reading matter claiming super results, in the other we have a short summary and facts in the shape of curves, etc., which are definitely of value. In short, my suggestion is that manufacturers generally should draw up adverts on the lines of your reports, and specially for your journal; they can please themselves about putting the highly coloured "box-office" literature in other journals and the lay Press. I can assure you that I will not purchase any component unless I know something of its characteristics either from manufacturers' literature or from your reports or recommendations.

Tolworth, Surrey. E. C. HOAR.

READERS' PROBLEMS.

Improved Volume Control.

IN the new D.C. version of the "Wireless World Three," volume is controlled by means of a potentiometer which increases the normal negative bias of the H.F. valve and simultaneously reduces aerial input by imposing a progressive partial short-circuit between aerial and earth. This arrangement has the advantage that the potentiometer moving contact is at earth potential, and it has been asked whether a similar scheme could be adapted to the "Wireless World A.C. Three."

In practice, this system of volume control is found to be adaptable to almost any type of set, and, so far as the A.C.

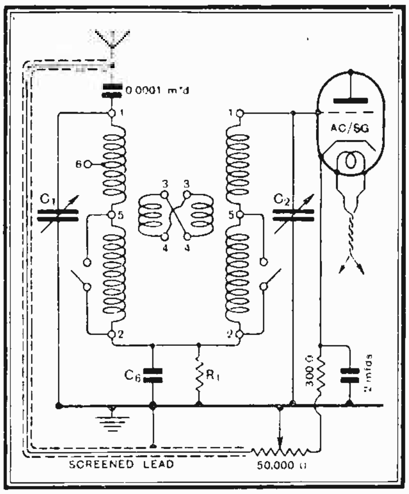


Fig. 1.—Double-acting system of input volume control for the A.C. version of the "Wireless World Three."

receiver in question is concerned, may readily be applied in the manner shown in Fig. 1 To avoid all risk of instability, it is wise to screen the lead between the aerial terminal and the potentiometer, as this connection must inevitably be fairly long. The screened lead should preferably be of the low-capacity type, consisting of fine wire in sleeving, covered with metallic braiding, which, of course, is earthed.

"Autotone" Controls.

IT has been suggested that the "Autotone" receiver might be modified by removing the "indicator" and reaction condensers from the front panel and mounting these components in such a position that they would only be accessible while initial adjustments were made.

As reaction control is practically automatic, and as the indicator is required mainly as an aid to carrying out the operation of "ganging," there is something to be said for this suggestion, but only so far as medium-wave reception is concerned. As stated in the descriptive article, no attempt is made in the design to obtain entirely automatic control on the long-wave band, and therefore it is desirable that the trimming (or indicator) and reaction condensers should be in a fairly accessible position, in order that the minor adjustments which will be necessary on the long waves may be made. Admittedly, means could be devised both for automatic control of reaction and for the maintenance of extremely accurate "ganging" on both bands, but this would tend to complicate the receiver without offering any commensurate advantage.

Niceties of Adjustment.

SEVERAL readers have asked for suggestions as to how, by a suitable procedure in operating, they can attain the best possible performance from receivers that are admittedly deficient in the matter of selectivity. Most of these receivers are of the popular H.F.-det.-L.F. type and in many cases are not fitted with band-pass input circuits.

Assuming that no drastic alterations are to be made to the receiver, the best possible way of overcoming an inherent lack of selectivity is, briefly, to provide a means of limiting input from the aerial, and then to compensate for loss of sensitivity introduced in this way by applying reaction.

Aerial input can readily be reduced to almost any desired extent by fitting a series aerial condenser; of course, reaction control must be as smooth and progressive as possible if full use is to be made of it. In operating a set in this manner, the guiding principle should be to reduce input just sufficiently to attain the necessary selectivity: an excessive reduction will certainly necessitate the use of more reaction than is compatible with good quality of reproduction.

Discharging Smoothing Condensers.

A READER has noticed that when his H.T. eliminator was used to feed a receiver with battery valves, a charge always remained in the various high-capacity smoothing and by-pass condensers for a considerable time after switching off the receiver, and a spark could be produced by short-circuiting the condenser terminals. Now, after rebuilding his receiver and fitting indirectly heated A.C. valves throughout, he finds that there is no evidence of a residual charge in any of the condensers, and accordingly suspects that the insulation of his set is less good than previously.

We do not think that his suspicion is justified. The heating elements of A.C. valves tend to cool down slowly and consequently these valves always draw anode current for many seconds after their L.T. circuits have been interrupted; consequently, all the condensers in question, which are in parallel with the anode circuits, will be discharged in the normal course of events, and will not retain a residual charge for long after the set has been switched off.

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 on the next page.

Its Master's Voice.

A REQUEST has been received for information as to how the "Power Radio-Gram" may be operated with a microphone for "public address" work; it is desired to arrange a switch so that the instrument may be used to reproduce gramophone records and radio signals as well as to amplify the output of the microphone.

This is quite easily arranged by modifying the detector grid circuit in the manner shown in Fig. 2. Instead of the simple "on-off" radio-gramophone switch employed in the original receiver, a single-pole change-over switch with an "off" position must be substituted, connection being made as indicated in the diagram. For radio reproduction, of course, the switch S_1 will be in the "off" position.

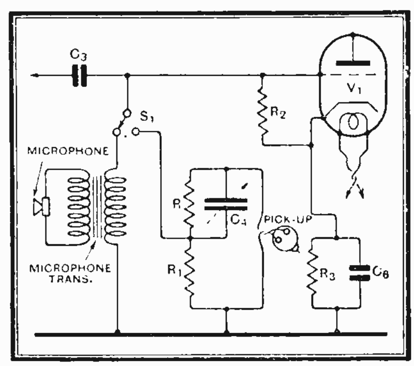


Fig. 2.—For radio, records, or "public addresses": connecting a microphone to the "Power Radio-Gram." Microphone battery omitted.

When the microphone is in use, amplification may generally be regulated satisfactorily by means of the existing volume control, but if the microphone happens to be of so sensitive a type that there is a possibility of overloading the first valve, some form of input volume control must be added.

Simplifying Circuit Diagrams.

IT is asked why the filament or heater circuits of D.C. valves are generally drawn in heavy lines in published circuit diagrams, although in A.C. or battery sets this method of representation is generally reserved for the "base line" or common earth connection.

This practice is adopted merely with a view to simplifying the circuit, and to prevent confusion in cases where bias voltages are developed across series-connected filaments or heaters. Even in the case of a modern circuit with indirectly heated D.C. valves, where matters are generally arranged so that the anode current does not pass through the heating elements, there is something to be said in favour of this arrangement.

"Autotone" Wave-range Switching.

THE wave-range switching of the "Autotone" receiver is inherently simple, as the operation of changing over from long to medium waves is effected merely by joining four points to earth by means of a single switch. In the original receiver, a Telsen four-point push-pull switch was employed; it was slightly modified by making a connection between the moving contact blades and thence to earth.

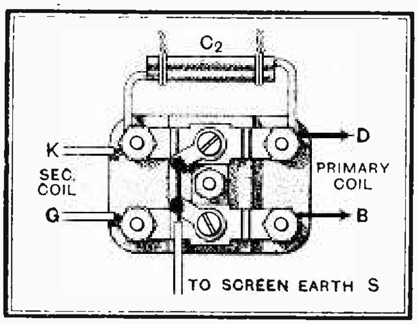


Fig. 3.—Details of the "Autotone" wave-range switch wiring. The moving contact blades are connected to earth by a short flexible lead.

This last detail of construction is perhaps not fully understood, and the matter will be made clear by redrawing the part of the practical wiring plan concerned (see Fig. 3). This sketch shows that the moving contact blades are joined together by placing soldering contacts under the heads of their securing screws.

An Impending Conversion.

SEVERAL readers seem to appreciate the fact that the recently described "Wireless World D.C. Three" is very similar to the A.C. version of the same set, and is, therefore, suitable for conversion when their existing D.C. supplies are changed to A.C. at some future time.

To make the receiver suitable for A.C. operation, no structural alterations to the chassis would be necessary, but, of course, the heating elements of the valves would be wired in parallel instead of in series, and appropriate A.C. valves would be substituted.

The mains equipment in the upper compartment would be almost entirely changed, but, as the apparatus associated with the D.C. version is anything but elaborate, no great sacrifice would be entailed. As for the loud speaker, it would, perhaps, be a good plan to use an instrument of the permanent-magnet type, as the conditions for A.C. and D.C. working are somewhat different. On changing over to A.C., a smoothing choke and a resistance of the combined ohmic value necessary to reduce voltage to a sufficient extent would be employed in place of the loud speaker field, which was used as a smoothing choke in the A.C. model. Alternatively, a loud speaker with a 2,500-ohm field winding could be employed, a voltage-reducing resistance being connected in series while it is operated from D.C. mains.

Lost Volts.

IT is well known that, in order to obtain automatic grid bias, a sacrifice of H.T. voltage equal to the amount of bias must be made. As to whether this loss of H.T. voltage affects all the valves in the receiver depends on the method of biasing employed.

A practical case is put to us by a reader, who has an H.T. unit which is estimated to give 280 volts when delivering the current which his receiver is expected to consume. The output valve requires a bias of 30 volts, and it is asked whether he should work on a basis of 280 volts or 250 volts when estimating the values of voltage-reducing resistances for the earlier valves.

If all the valves are biased in the modern method, by means of a resistor in their individual cathode leads, then it may be assumed that, in the case in point, 250 volts will be applied to the anode circuit of the output valve, but the full H.T. output of 280 volts (less any loss in other bias resistors) will still be available for the anode circuits of preceding valves.

But if we were dealing with a battery-operated set, where the only practicable method of biasing is to insert a resistor in the common H.T. negative feed lead, the H.T. supply voltage for all valves would inevitably be reduced by the amount of bias voltage needed for the output stage.

Function of the Grid Condenser.

GRID circuit rectification takes place actually "on the grid" of the detector valve, and so, if high-note loss is to be avoided, the grid condenser must be of low capacity, in order that its reactance may be high over the whole gamut of audible frequencies. A large grid condenser would act as a by-pass to rectified L.F. impulses, the leakage path being completed, of course, through the grid coil.

This point does not seem to be appreciated by one of our correspondents, who says that his local-station "quality" receiver has a large margin of sensitivity, but appears to be slightly deficient in high note response. He proposes to try the effect of a considerably larger grid condenser, hoping that this will have the desired result of preventing loss of the higher audible frequencies.

Unfortunately, the proposed alteration will have exactly the opposite effect to that required by our reader, and is not to be recommended on any grounds: it is seldom that a larger grid condenser than 0.0001 mfd. is recommended for a modern receiver.

The substitution of a *smaller* condenser than at present might conceivably be worth while in this case.

"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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AND RADIO REVIEW
(21st Year of Publication)

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EDITORIAL COMMENT.

B.B.C. and Volume Level.

SO many improvements and refinements have been introduced by the B.B.C. in the matter of transmission and the presentation of programmes that faults which remain are perhaps all the more glaring on that account. There is one practice for which the B.B.C. is responsible which is particularly objectionable to listeners, and, despite the fact that we know that listeners have constantly complained of it, there seems to be no serious attempt made on the part of the B.B.C. to effect a remedy.

When we set the volume control of our receivers to what gives us a satisfactory intensity at the commencement of a programme, and settle down to enjoy the transmissions in comfort remote from the set and the speaker, we are, we think, entitled to feel that from that point onwards, provided the programmes are to our liking, we can enjoy them to the point of forgetting that we are listening through the medium of the complicated piece of electrical apparatus which constitutes our receiver. But the B.B.C. will not have it so; it seems that with deliberate intent they determine to interrupt our enjoyment, and often exasperate us with their variations in intensity of transmission. It should not be necessary for the listener to have his finger continually on the volume control after once he has adjusted it to his liking on, say, the first item broadcast. Suppose the first item is an orchestral piece received at a volume which is satisfactory for the average room; then as soon as that item is finished on comes the announcer, and his voice comes through as if he were himself trying to reach his listeners direct without the medium of the ether. The voice is strong enough to be heard not only in the room but some way down the road as well! Sometimes the control engineer appears to have sympathy for the listeners, and the volume is abruptly cut down after the announcer has got over the first few words; but, even so, it has been enough to jar our nerves and destroy the pleasant atmosphere left at the conclusion of the previous item. No readjustment is made at the transmitter when the next musical item begins, and we find that the intensity has fallen almost to a whisper.

Some years ago we recollect that we raised this question with the B.B.C., and were told that the reason for the greater intensity at which speech was put out was because in the case particularly of those who used crystal sets it was necessary to make this contrast in order that speech should be readily intelligible. Such an answer might have carried weight at the time, especially as the power of the stations was then much less, but to-day there is surely no excuse for it.

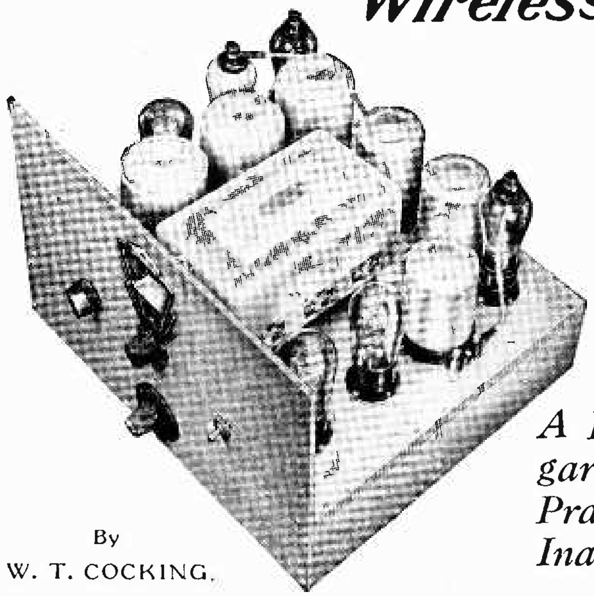
It surely must not be suggested that after all these years of experience the engineers have failed to effect a remedy for so outstanding a shortcoming in their part of broadcasting technique!

The Monodial A.C. Super

IN this issue a description is commenced of a new superheterodyne receiver, the constructional details of which will be continued in the following number.

We commend this receiver specially to our readers because we are confident that it is an outstandingly good job. A great many technical advances have taken place within recent months which, applied to the design of superheterodyne receivers, produce a result of outstanding merit. The present design is the result of many months of careful development work, and we believe that electrical as well as mechanical snags have been entirely eliminated, so that the constructor can go ahead with the greatest confidence.

The outstanding features of the set are extreme selectivity, freedom from background noises and whistles, and quality of an extremely high order.



Wireless World

MONODIAL A.C. SUPER

A Receiver which can be Confidently Regarded as Embodying the Most Advanced Practice in Modern Superheterodyne Design. Inaudible Background and Ultra-selectivity Incorporating Stenode Principles.

By
W. T. COCKING.

THERE can be little doubt that faithful reproduction is the primary requisite of a broadcast receiver. High quality alone, however, is insufficient for the complete enjoyment of broadcasting, for this can only be attained when the reproduction contains everything transmitted by the desired station and nothing from any other source. The ideal receiver, therefore, must be capable of reproducing the whole range of audible frequencies without distortion, and it must be sufficiently selective to eliminate interference from all sources, while the set itself must not introduce noises.

In the past, these exacting requirements have been incapable of fulfilment, except in the case of a purely local station receiver with which neither interference nor set noises are usually of any importance. Recent developments in radio, however, have resulted in the possibility of building a set which, so far as the more powerful of distant stations are concerned, may truthfully be said to approach very closely to the ideal. The complete attainment of all the attributes of the ideal receiver is, of course, still impossible.

A theoretical account of the latest circuit developments was given in last week's issue of this journal, and it may be said that a set built in accordance with the principles there outlined will give a very satisfying performance. Full reproduction of all audible frequencies up to a limit of about 5,000 cycles is possible, while retaining a degree of selectivity sufficient to eliminate interference when receiving the stronger of distant stations. The high quality and freedom from modulation interference are retained on the weakest stations, but the possibility of sideband heterodyning from adjacent stronger stations has not yet been overcome. Except when the receiver is being worked at a point

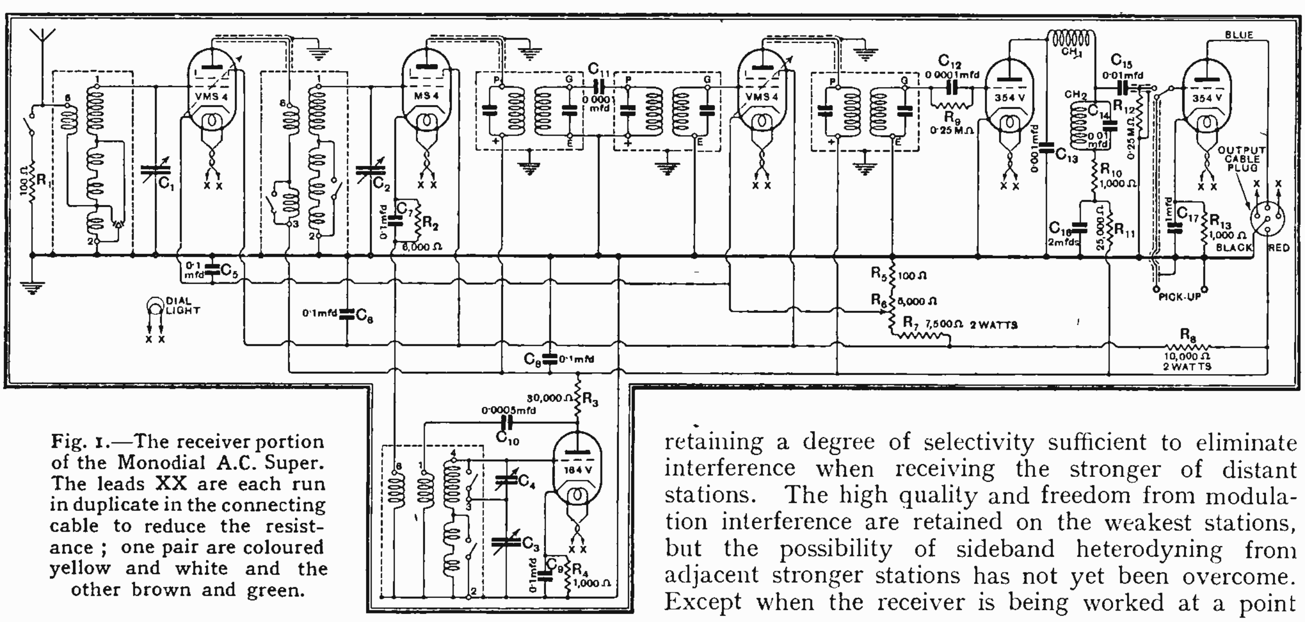


Fig. 1.—The receiver portion of the Monodial A.C. Super. The leads XX are each run in duplicate in the connecting cable to reduce the resistance; one pair are coloured yellow and white and the other brown and green.

Monodial A.C. Super.—
approaching its maximum sensitivity, at which point even the weakest stations are normally receivable at good strength with any reasonably efficient aerial, noises introduced by the set itself are so low as to be inaudible.

In view of the fact that the circuit principles have already been fully described, in the present article we shall proceed to the actual constructional details of a practical receiver, and consider only those precise details which, although not affecting the general principles, are by no means unimportant, and upon which the success or failure of a receiver so largely depends. The circuit diagram of what may be termed the receiver portion of the apparatus is shown in Fig. 1 and that of the power unit, which includes the mains equipment and the output stage, in Fig. 2, and it will be seen that the former unit contains six valves which are employed in an H.F. stage, first detector, oscillator, I.F. stage, second detector, and tone corrector stage.

The Pre-Selector.

In order to keep second channel interference at a minimum, two tuned circuits are used to precede the first detector, and as an H.F. stage is employed, one takes the form of the aerial tuning circuit, while the other provides the H.F. intervalve coupling. The total selectivity of the signal frequency circuits, therefore, is rather greater than with the more customary band-pass filter, while their characteristics are such that a negligible amount of sideband cutting is introduced.

For maximum efficiency the so-called aperiodic aerial coupled is used, and the switching is so arranged that on both wavebands the aerial load is substantially constant, thus avoiding ganging errors. The circuit, whose inductance is matched to that of the intervalve coupling, is tuned by one section C_1 of the special 0.0005 mfd. three gang condenser. In order to avoid cross-modulation and to provide a distortionless pre-detector volume control, the H.F. valve is of the V.M.S.4 variable-mu type, and is coupled to the first detector by means of an H.F. transformer. A transformer coupling is used in preference to other methods, partly because of its simplicity, and partly because a high resistance in the first detector grid circuit can be readily avoided. This circuit is tuned by the second section C_2 of the gang condenser, a section which is in every respect identical with C_1.

The M.S.4 first detector is employed as an anode bend rectifier, and is self-biased in the usual way by a 6,000 ohms resistance R_2, shunted by a 0.1 mfd. condenser C_7, in its cathode lead. A valve with a comparatively low mutual conductance has been deliberately chosen for use at this point, since it has been found to introduce less background noise than more efficient types, and it has also a greater signal input handling capacity.

The oscillator is a separate 164V. valve with its grid circuit tuned. It is biased by the 1,000 ohms resistance R_1, shunted by the 0.1 mfd. condenser C_9, in its cathode lead, and its H.T. supply is taken from

Features of the Set.

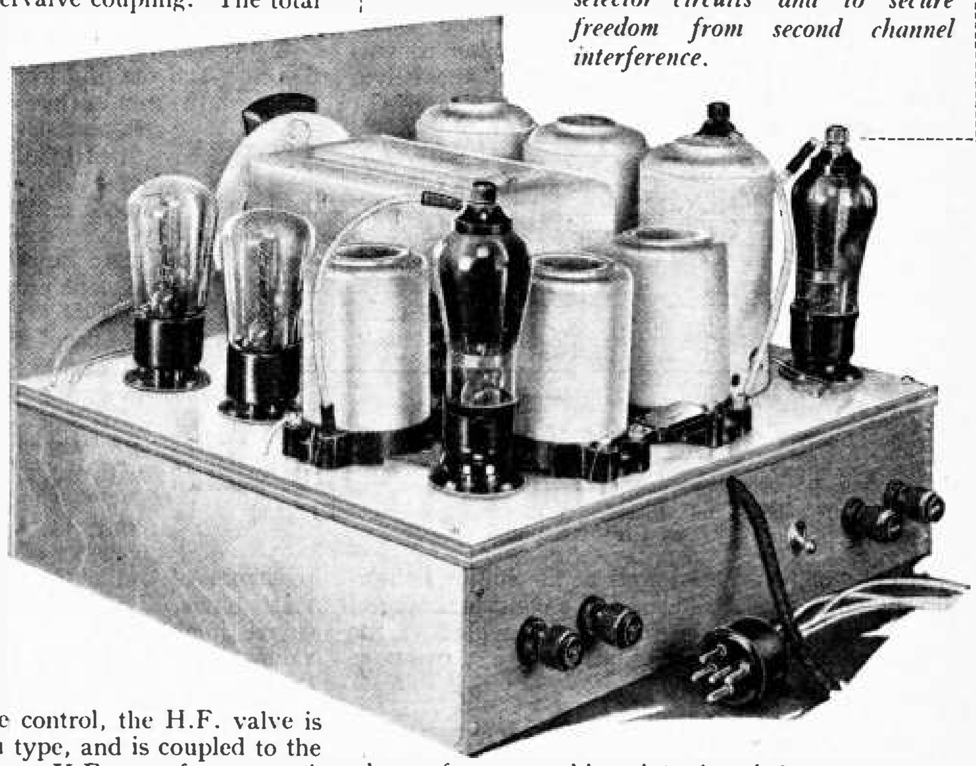
Single-dial seven-valve A.C. superheterodyne with variable-mu H.F. and I.F. stages.

Screen-grid 1st detector, and triodes for the oscillator, 2nd detector, tone corrector and output stage.

Special band-pass filters with a total of eight tuned circuits and one stage of tone correction allow of high-note reproduction up to 5,000 cycles with extremely high selectivity.

Volume control acting simultaneously on the grid bias of both variable-mu valves with additional local-distance switch. Free field current for moving-coil speaker. Undistorted power output 2,500 milliwatts.

Special oscillator tracking arrangements to simplify ganging of the oscillator and pre-selector circuits and to secure freedom from second channel interference.



Monodial A.C. Super.—

the common 200 volts line through the 30,000 ohms resistance R_3. The reaction coil is shunt fed from the anode circuit through the 0.0005 mfd. condenser C_{10}, and the coupling between the first detector and oscillator circuits is provided by means of a coupling coil connected in series with the first detector cathode lead.

The medium waveband tuned oscillator winding has an inductance considerably less than that of the two pre-selector circuits, and it is tuned by the third section C_3 of the three-gang condenser. This section of the condenser has plates specially shaped so that the correct frequency displacement of 110 kc. between the oscillator and pre-selector circuits is accurately maintained over the whole of the medium waveband, without the necessity for using special tracking condensers. This correct ganging, however, is not maintained automatically on the long waveband, and it is necessary to introduce a series padding condenser C_4, which is adjustable over a capacity range in the neighbourhood of 0.001 mfd., and which is short-circuited on the medium waveband by a switch built into the coil base. Ganging adjustments are thus reduced to a minimum, and it is readily possible to obtain the accurate alignment of circuits which is so essential for the avoidance of second channel interference.

The primary circuit of a four stage filter tuned to the intermediate frequency of 110 kc. is included in the anode circuit of the first detector. This filter consists of two pairs of mutually coupled coils, themselves coupled together by the 0.0001 mfd. condenser C_{11}

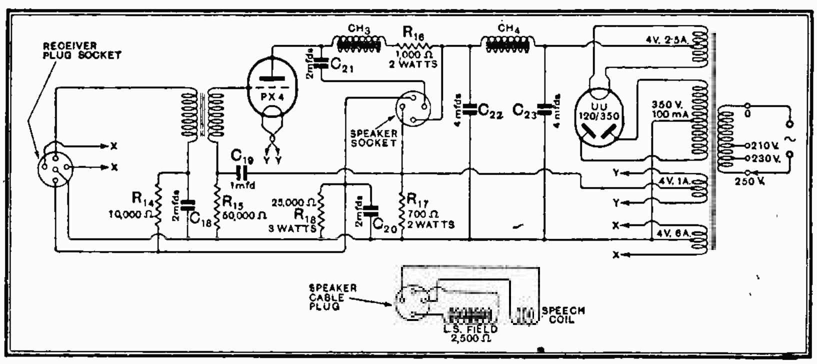


Fig. 2.—The power unit, including the output stage, which is built as a separate unit.

between the high potential ends of the coils. Following this filter is the I.F. stage, which consists simply of a single V.M.S.4 variable-mu valve coupled to the second detector by means of the usual type of two-stage filter.

The Voltage Supply Circuits.

Since the valves do not all operate upon the same signal frequency, it has been found possible largely to dispense with de-coupling without any fear of introducing unwanted feed-back effects. The anode voltages of the two variable-mu valves and the first detector are all taken directly from the common 200 volts line, with a single 0.1 mfd. condenser C_8 shunted to earth. The screen grids are similarly fed from the same tapping on a voltage divider shunted across the H.T. supply, and with another 0.1 mfd. condenser C_6 shunted to earth. This voltage divider is made up of R_8 and R_7, which have values of 10,000 ohms and 7,500 ohms respectively, and are of the 2-watt type, in series with the 5,000-ohm volume-control potentiometer R_6, and the 100 ohms resistance R_5. The cathodes of the two variable-mu valves are joined together and taken to the slider of the volume control, while a 0.1 mfd. condenser C_5 is shunted to earth.

The bias impressed on both the variable-mu valves, therefore, is the same, and varies from a maximum of some 60 volts to a minimum, provided by the voltage drop along R_5, of 2.5 volts. A complete control of volume is thus obtained by means of a single potentiometer, for the amplification of both the H.F. and the I.F. stages is controlled simultaneously. It has been found, however, that distortion may sometimes occur when receiving a strong local station at low volume, and for local reception some means of reducing the aerial input is often desirable. A "Local-Distance" switch is fitted, therefore, whereby a resistance R_1 of 100 ohms may be connected at will between the aerial and earth terminals.

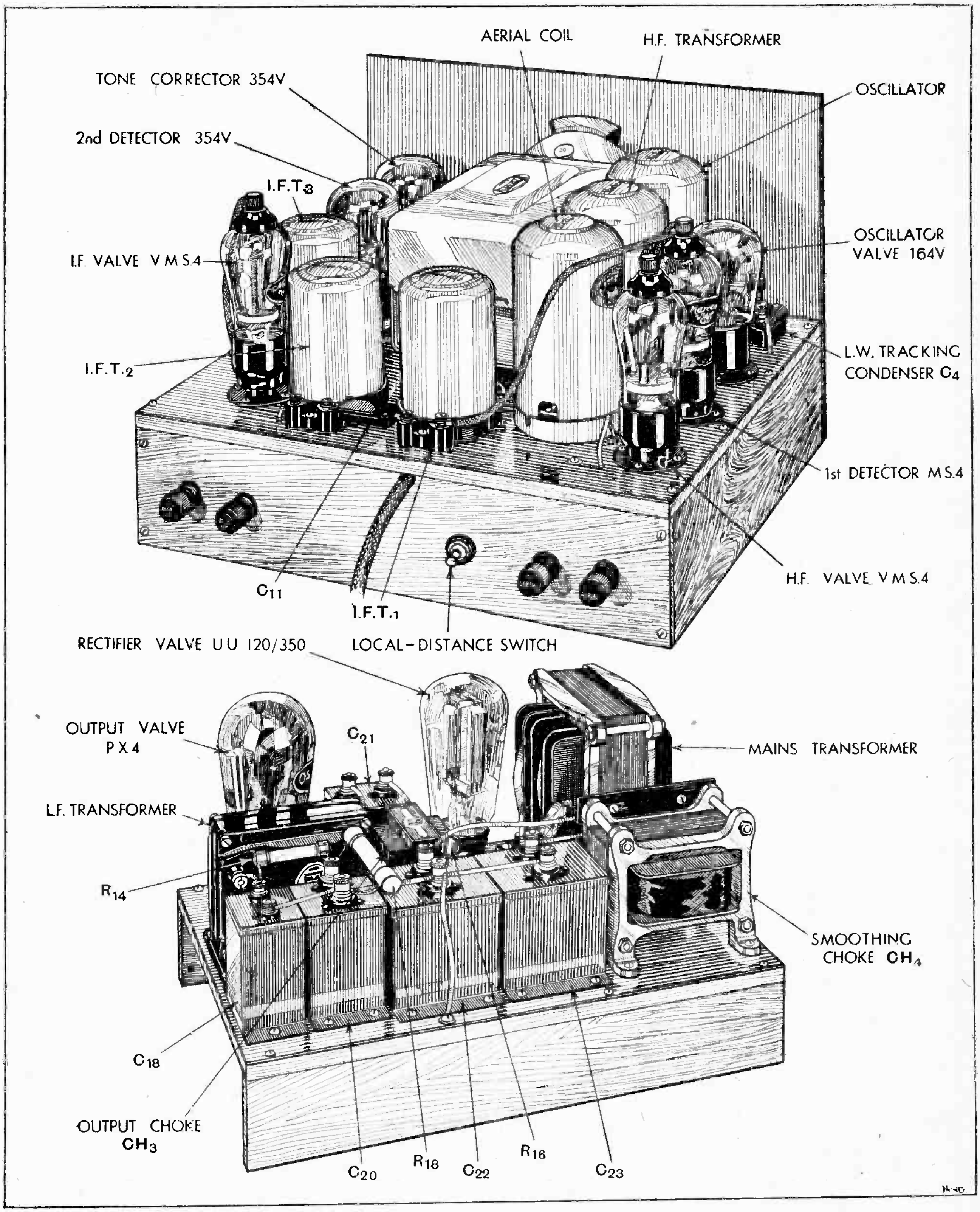
Tone Correction.

A 354V. type valve is used as a power grid second detector, and the grid leak and condenser, R_9 and C_{12}, are given the usual values of 0.25 meg. and 0.0001 mfd. respectively. The usual I.F. filter is fitted to the anode circuit, and consists of a high-inductance choke Ch_1 and a 0.001 mfd. condenser C_{13}, but the inter-valve coupling is of an unusual type, since its purpose is to provide a degree of tone correction for the sideband cutting of the tuned circuits. In place of the usual resistance, therefore, a network of capacity, inductance, and resistance is employed.

This network consists of the parallel resonant circuit, Ch_2 and C_{14}, in series with the 1,000 ohms resistance R_{10}. At low frequencies the coupling is provided only by the circuit resistance, which consists of R_{10} in series with the choke resistance of 250 ohms, giving an effective value of 1,250 ohms. For quite high audible frequencies, the circuit impedance does not greatly depart from this value, and so the stage amplification remains fairly constant at a low value. When a certain frequency is passed, however, the impedance, and hence the amplification, rises rapidly until the resonance frequency of some 5,000 cycles is reached, and the amplification is nearly equal to the amplification factor of the valve.

The choke Ch_2 has a value of 90,000 μH., and it is important that in this case the specified component be employed, for the compensation obtained is dependent not only upon the inductance, but also upon the choke resistance. The shunt condenser C_{14} has a capacity of 0.01 mfd., and so gives a resonance fre-

ULTRA-SELECTIVITY WITH HIGH QUALITY.



The receiver and eliminator units. The output stage is included in the mains chassis so as to localise all high-voltage equipment.

Monodial A.C. Super.—

quency of about 5,000 cycles. The intervalve coupling is completed by the usual 0.01 mfd. grid condenser C_{15} and a 0.25 meg. grid leak R_{12}, while the detector anode circuit is fed from the 200 volts line through the 25,000 ohms de-coupling resistance R_{11} with a 2 mfd. condenser C_{16} shunted to earth. The radio-gramophone switch is connected to give a single-pole change-over action, and is joined directly in the grid circuit of the 354V. tone corrector or first L.F. valve, which is biased by a 1,000-ohm resistance R_{13}, shunted by a 1 mfd. condenser C_{17} in its cathode lead.

LIST OF PARTS.

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

1 Fixed condenser, 2 mfd., 400 volt, D.C. test **(Dubilier, Type BB)**
1 Fixed condenser, 1 mfd., 400 volt, D.C. test **(Dubilier, Type BB)**
(Ferranti, Formo, Peak, T.C.C., Telsen).
5 Fixed condensers, 0.1 mfd., 500 volt, D.C. test, non-inductive **(Dubilier, Type 9200)**
(T.C.C., Telsen).
2 Fixed condensers, 0.01 mfd. **(Dubilier, Type 620)**
1 Fixed condenser, 0.001 mfd. **(Dubilier, Type 620)**
1 Fixed condenser, 0.0001 mfd. **(Dubilier, Type 620)**
1 Fixed condenser, 0.0005 mfd. **(Dubilier, Type 620)**
(Ferranti, Hydra, Loewe, T.C.C., Telsen).
1 Fixed condenser, 0.0001 mfd. **(Dubilier, Type 670)**
(T.C.C.)
1 Potentiometer, 5,000 ohms **(Watmel)**
(Colvern, Claude Lyons, Rothermel).
1 Semi-fixed condenser, 0.0005 mfd./0.002 mfd. **(R.I. "Varicap")**
(Formo).
1 5-way insulated connector **(Wilburn)**
1 Variable condenser, 0.0005 mfd., 3-gang, screened, superhet. type, with trimmers on the right **(British Radiophone)**
1 Slow-motion dial, for above **(British Radiophone)**
2 Metallised resistances, 100 ohms, 1 watt **(Dubilier)**
3 Metallised resistances, 1,000 ohms, 1 watt **(Dubilier)**
1 Metallised resistance, 6,000 ohms, 1 watt **(Dubilier)**
1 Metallised resistance, 25,000 ohms, 1 watt **(Dubilier)**
1 Metallised resistance, 30,000 ohms, 1 watt **(Dubilier)**
2 Metallised resistances, 250,000 ohms, 1 watt **(Dubilier)**
1 Metallised resistance, 7,500 ohms, 2 watts **(Dubilier)**
1 Metallised resistance, 10,000 ohms, 2 watts **(Dubilier)**
(Colvern strip type, Claude Lyons).
3 I.F. transformers, 110 k.c. **(Colvern "Colverdynes")**
6 Valve-holders, 5-pin **(Clix chassis-mounting type)**
1 H.F. choke **(Wearite, Type HFO)**
1 H.F. choke **(McMichael Binocular Junior)**
1 Battery cable, 7-way **(Harbros)**
(Belling-Lee).
1 Set of B.P. canned coils **(Varley "Square Peak" BP19)**
4 Ebonite shrouded terminals **(Belling-Lee, Type B)**
(Burton, Clix, Eelex, Igranic, Swain).
1 Change-over switch **(Claude Lyons, B.A.T. 729)**
1 Switch **(Claude Lyons, B.A.T. 728)**
Metal screened sleeving **(Goltone)**
(Lewcos, Harbros).
1 Venesta board, aluminium faced, 12in.×14in.×⅜in. **(Peto Scott)**
1 Panel, oak faced ply, 14in.×9½in. **(Peto Scott)**
Plywood ⅜in., screws, wire, systoflex, etc., etc.

ELIMINATOR.

4 Valve-holders, 5-pin **(Clix chassis-mounting type)**
1 Fixed condenser, 2 mfd., 1,000 volt, D.C. test **(Dubilier, Type LSA)**
1 Fixed condenser, 2 mfd., 500 volt, D.C. test **(Dubilier, Type LSB)**
2 Fixed condensers, 4 mfd., 1,000 volt, D.C. test **(Dubilier, Type LSA)**
1 Fixed condenser, 2 mfd., 500 volt, D.C. test **(Dubilier, Type BC)**
1 Fixed condenser, 1 mfd., 400 volt, D.C. test **(Dubilier, Type BB)**
1 L.F. choke, 10 henrys **(Sound Sales)**
(Ferranti B2)
1 L.F. choke, 30/20 henrys **(R.I. "Hypercore")**
1 Mains transformer, 210/240 volts, 40/100 cycles, 350+350 volts, 100 mA., 4 volts 6 amps. centre-tapped, 4 volts 2½ amps. centre-tapped, 4 volts 1 amp. centre-tapped, with screened primary **(Challis)**
2 Plugs, 5-pin **(Bulgin, P9)**
1 L.F. transformer **(Ferranti, AF5)**
1 Metallised resistance, 10,000 ohms, 1 watt **(Dubilier)**
1 Metallised resistance, 50,000 ohms, 1 watt **(Dubilier)**
1 Metallised resistance, 700 ohms, 2 watts **(Dubilier)**
1 Metallised resistance, 1,000 ohms, 2 watts **(Dubilier)**
1 Metallised resistance, 25,000 ohms, 3 watts **(Dubilier)**
(Colvern strip type, Claude Lyons).
1 Venesta board, aluminium faced, 9in.×12½in.×⅜in.
Plywood ⅜in., screws, wire, systoflex, etc., etc.
Valves: 2 Marconi V.M.S.4, 1 Marconi M.S.4, 1 Mullard 164V, 2 Mullard 354V, 1 Osram PX4, 1 Mazda UU120/350.

Approximate cost of parts (excluding valves), 17 gns.

The coupling between this valve and the P.X.4 output stage is by means of a 3.5-1 ratio transformer, which is fitted in the power unit, and the tone-corrector anode circuit is de-coupled by the 10,000-ohm resistance R_{14} and the 2-mfd. condenser C_{18}. The output valve, which delivers some 2,500 milliwatts to the speaker, is biased by the 700-ohm (2 watts) resistance R_{17} connected between negative H.T. and the centre tap of its filament-heating winding on the mains transformer, and its grid circuit is de-coupled by a 50,000 ohms resistance R_{15} and a 1 mfd. condenser C_{19}. A choke-feed output circuit is employed with a 20H. choke Ch_3 in series with a 1,000 ohms 2 watts resistance R_{16}, whose purpose it is to prevent excessive anode voltage being applied to the output valve. The loud speaker or output-transformer primary is, of course, fed through the 2 mfd. condenser C_{21} in the conventional manner.

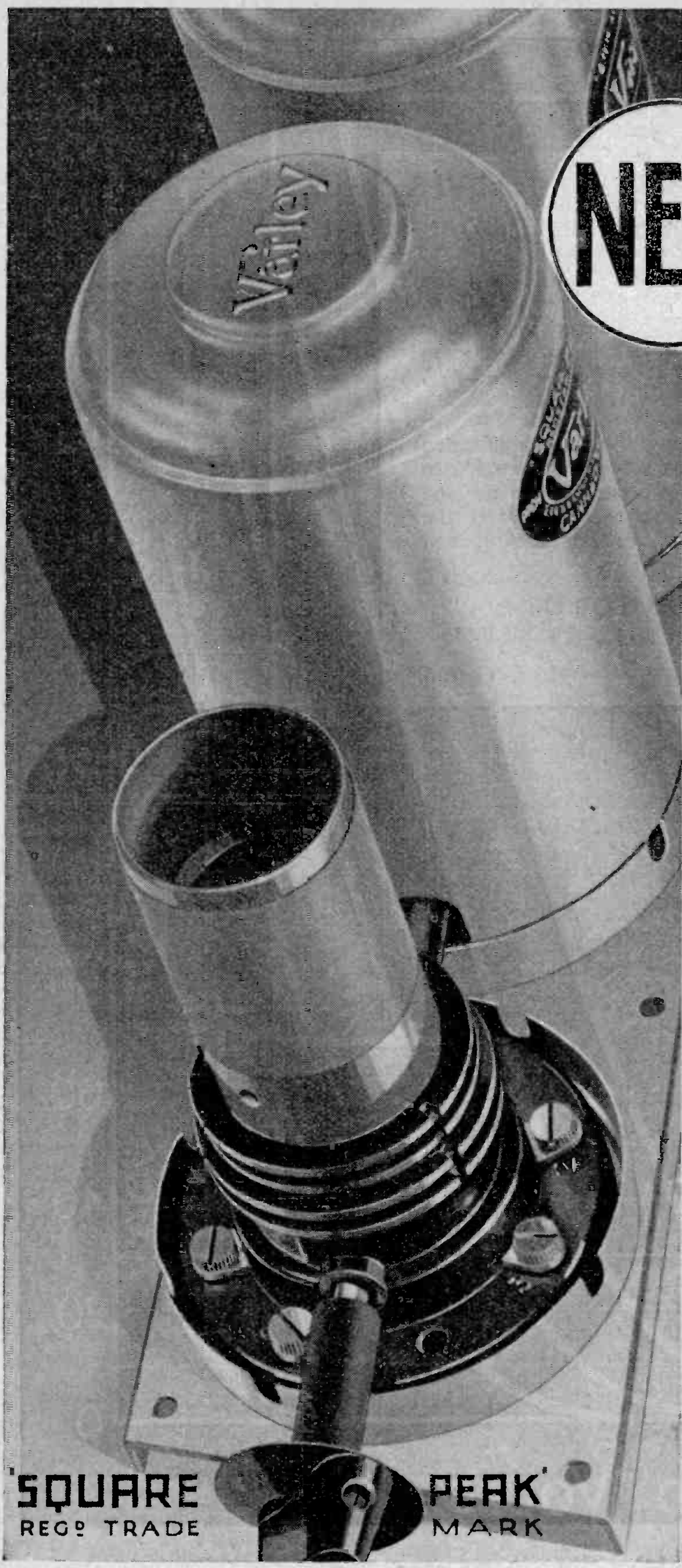
The Power Unit.

A U.U.120/350 valve rectifier is used, and delivers some 360 volts at 100 mA. across the 4 mfd. condenser C_{23}. The whole current is smoothed by the 10H choke Ch_4 in conjunction with another 4 mfd. condenser C_{22}, and the supply for the output valve is then tapped off. The remainder of the current, some 50 mA., flows through the 2,500-ohm field winding of the moving-coil loud speaker, where it is still further smoothed in conjunction with the 2 mfd. condenser C_{20}. In order to provide sufficient current for adequate field excitation under all conditions, a 25,000-ohm 3 watts resistance R_{18} is connected across this condenser, where it also tends to stabilise the anode voltage of the early valves.

The mains transformer carries secondaries giving voltages of 350-0-350 volts at 100 mA. for H.T., 4 volts at 2.5 amps. for the rectifier filament, 4 volts at 1 amp. for the output-valve filament, and 4 volts at 6 amps. for the six early valves and the light illuminating the dial.

Now it is well known that modulation hum is usually due to the presence of H.F. currents in the mains being transferred to the receiver circuits through the capacity between primary and secondary windings. It is the usual practice to eliminate this undesirable effect by connecting condensers between the mains and earth, so that the H.F. currents are by-passed to earth and do not enter the circuits of the receiver proper. While this scheme is very effective, it has been found that in cases where the earth lead is very long, there is a tendency for background noise to be increased. Since every possible precaution against background noise has been taken in this receiver, an alternative method of eliminating modulation hum has been thought advisable. The primary of the mains transformer is electrostatically screened from the secondaries by means of earthed copper strips interposed between the windings, and it has been found that this method is as effective as the older scheme. Constructional details will be given in the next instalment.

A specimen receiver is available for inspection by readers at the Editorial Offices, 116/117, Fleet Street, E.C.4.



NEW

SUPER—HET COILS

For single dial control

With these coils **single knob control is obtained** without using any 'padding' condensers on the medium waves, and with only one additional fixed condenser on the long waves. The intermediate frequency is 110 k.c.

Supplied as a complete unit comprising single control aerial, intervalve and oscillator coils. Rotary Switches with self-cleaning gold-silver alloy contacts. Switch control insulated between coils.

List No. BP.19. 3-gang unit on aluminium base-plate. **30/-**

Varley

(Proprietors: Oliver Pell Control Ltd.)

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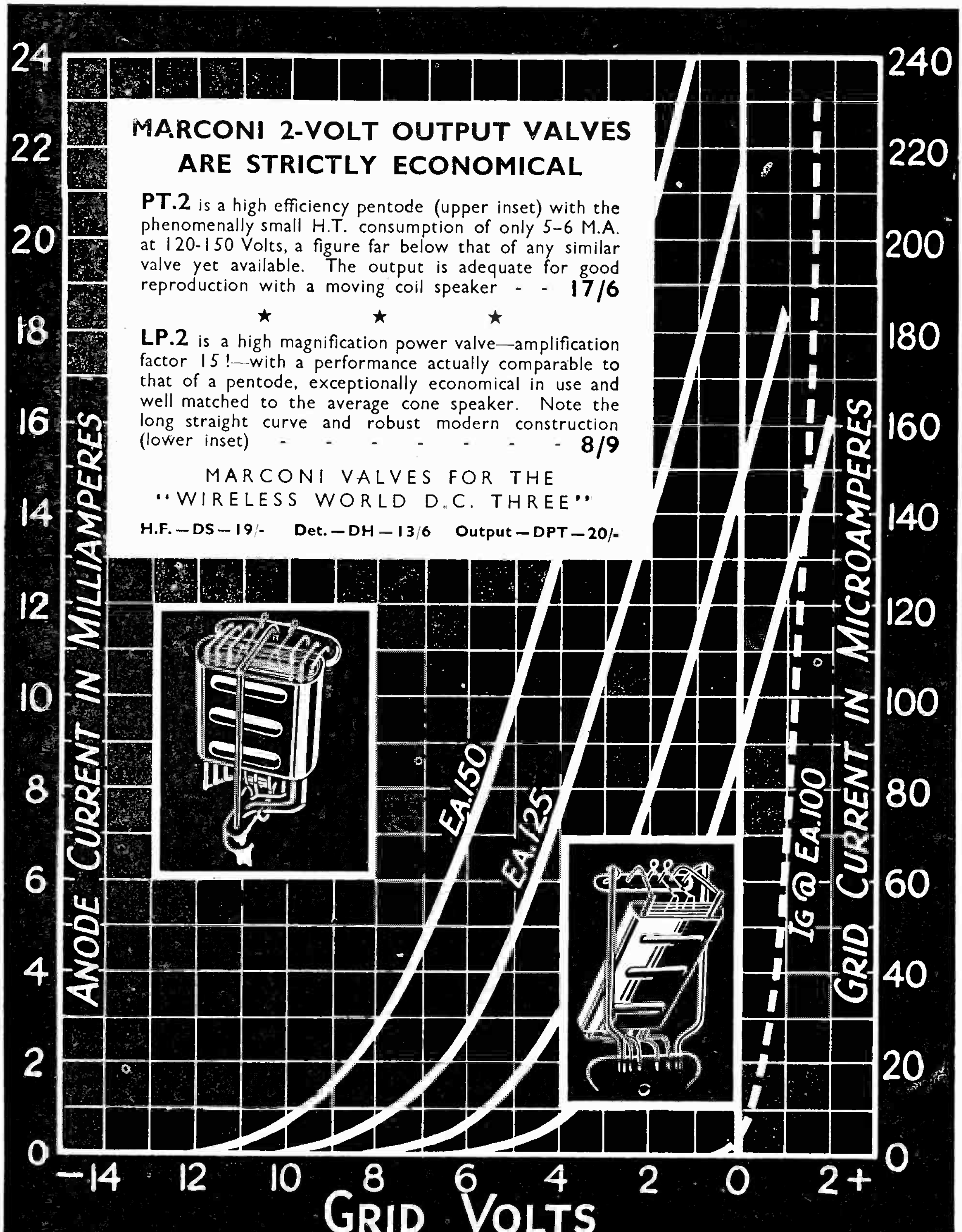

MARCONI 2-VOLT OUTPUT VALVES
ARE STRICTLY ECONOMICAL
PT.2 is a high efficiency pentode (upper inset) with the phenomenally small H.T. consumption of only 5–6 M.A. at 120-150 Volts, a figure far below that of any similar valve yet available. The output is adequate for good reproduction with a moving coil speaker - - 17/6
★ ★ ★
LP.2 is a high magnification power valve—amplification factor 15!—with a performance actually comparable to that of a pentode, exceptionally economical in use and well matched to the average cone speaker. Note the long straight curve and robust modern construction (lower inset) - - - - - - - - 8/9
MARCONI VALVES FOR THE
"WIRELESS WORLD D.C. THREE"
H.F.—DS—19/- Det.—DH—13/6 Output—DPT—20/-
ANODE CURRENT IN MILLIAMPERES
24
22
20
18
16
14
12
10
8
6
4
2
0
GRID CURRENT IN MICROAMPERES
240
220
200
180
160
140
120
100
80
60
40
20
0
EA/150
EA/125
IG @ EA.100
−14 12 10 8 6 4 2 0 2+
GRID VOLTS

Automatic Grid Bias

How to Avoid Instability and Loss of Bass.

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

IT is quite an old idea to use the H.T. supply to provide grid bias. It was used in commercial broadcast receivers at least eight years ago, and was known long before that. But it has become general only with the introduction of mains-driven receivers. There are quite a number of points to be considered in applying automatic grid bias, and serious loss of amplification, quality, or stability may be introduced by seemingly unimportant departures from the best system of connections. The principal factors which enter into the problem are:—

(1) Nature of power supply—A.C., D.C., or batteries.

(2) Type of valve cathode—directly or indirectly heated.

(3) Method of coupling valves.

The elementary circuit is shown in Fig. 1, in which coils represent intervalve couplings of any type. R is the biasing resistance, and is chosen to drop the necessary bias voltage when the valve anode current flows through it. It is assumed for the present that there is no other current which can pass through the resistor except the anode current, and the screen current if S.G. valve or pentode. If reference to *The Wireless World* "Valve Data Chart" or other source of information shows, for example, that the bias should be 7 volts and that the anode current at that setting is 5 mA., then the bias resistance is 7/5 thousand ohms, 1,400 ohms. Most valves require between 500 and 2,000 ohms.

THERE is something unusually attractive in the idea of obtaining grid bias from the H.T. supply, but this need not blind us to the fact that certain disadvantages such as loss of bass, instability and modulation hum may be incurred unless special precautions are taken. These are fully discussed in this article.

This simple circuit is the basis of all automatic grid-bias systems, but as it stands it would not be satisfactory, because it passes on to the grid not only the steady voltage due to the anode-feed current, but also all the variations due to "signals." A little thought will show that these voltage variations apply themselves to the grid in such a way as to oppose those arriving legitimately via the intervalve coupling, and the result is that the amplification is cut down by perhaps 50 per cent. or more. In following the action of any of these circuits it is essential to remember that the grid voltage (whether steady or varying) is reckoned from the *cathode,* not from earth or – H.T. In the old days one got so used to making earth the starting point that it is easy to drop into the habit and forget that the cathode is not always connected to earth.

To overcome this difficulty the resistor may be shunted by something which has no effect on the steady current—and consequently on the bias voltage—but which short-circuits the varying currents and prevents them from influencing the grid. Such a device usually goes by the name of a condenser. The question then arises, what capacity is required? This is decided by the lowest frequency which the valve is required to handle. Thus if it is an H.F. stage the lowest frequency is usually 150 kc. (2,000 metres), and at this frequency a condenser as small as 0.1 mfd. has a reactance of only about 10 ohms, which is low enough to cause negligible loss. At higher frequencies the reactance is proportionately less. In a L.F. amplifier the lowest frequency which should be passed with substantially no loss is variously estimated, but 50 cycles is a usual figure. A 1-mfd. condenser, such as is often used for this purpose, is not much good, for it has a reactance of about 3,000 ohms. It is, in fact, rather worse than useless, for, although a plain resistance reduces amplification, it does so uniformly at all frequencies, whereas if a 1-mfd. condenser is used it cuts off largely at low frequencies, but passes the highest frequencies at full amplification, a fault which, unlike the former one, cannot be made good by the relatively simple process of increasing the general amplification. Even 10 mfd. does not prevent appreciable loss if the amplifier and the loud speaker are capable of doing justice to the lowest frequencies.

Electrolytic Condensers.

From this difficulty there are two ways of escape, the choice between them depending mainly, but not entirely, on a comparison of the cost. The first method is the straightforward or brute-force one of making the condenser large enough. Prior to the development of the electrolytic condenser it was impracticable to do so, but now it is possible to get 50 mfd. or more into a tiny case such as is used to house 0.01-mfd.

Automatic Grid Bias.—

condensers. These are limited to about 12 volts under working conditions, but there are others of reasonable bulk and cost which are rated at higher voltages. It is wise to adhere to these ratings, as beyond a certain voltage the leakage through the condenser rises rapidly and alters the bias voltage by reducing the effective bias resistance. Another and even more essential requirement is to connect the condenser the right way round, with the positive or red terminal to the cathode, as otherwise it does not function properly at all.

The other method employs a device to render an ordinary low capacity effective. The reason why it is not effective when connected straight across the bias resistor is that at low audio frequencies it does not form a path which is virtually a short-circuit across the 1,000 ohms or so of the bias resistor. If the latter were 100,000 ohms, then a 1-mfd. condenser, which is

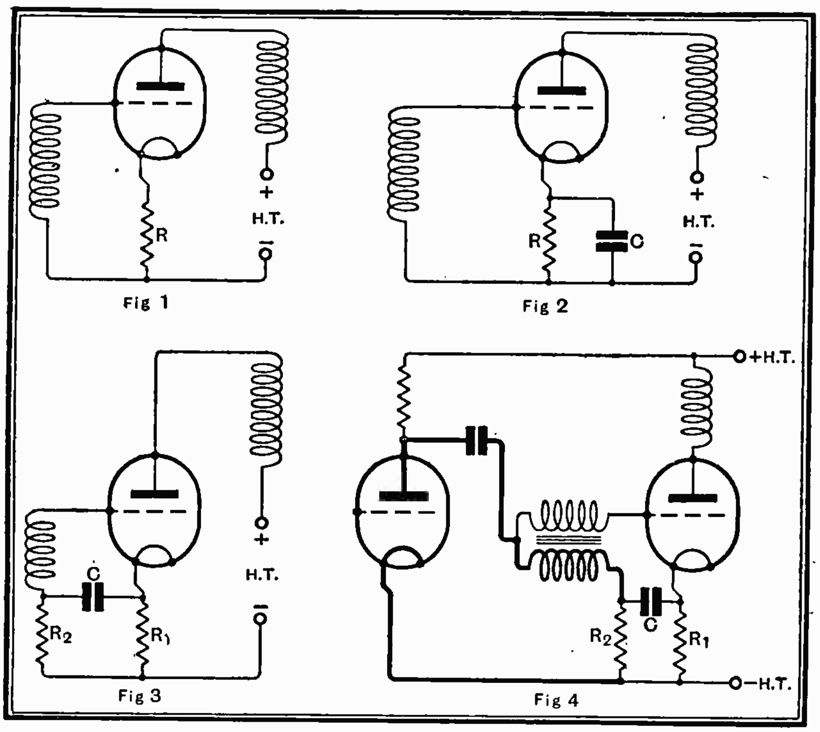

Fig. 1.—The simplest self-bias circuit where the anode current flows through the resistance R. Fig. 2.—By shunting the bias resistor by a condenser C, low frequencies are attenuated. Fig. 3.—The grid is here decoupled by R_2 and C, and low frequencies are not lost. Fig. 4.—With parallel-fed couplings the filter of Fig. 3 is partially ineffective.

3,000 ohms at 50 cycles, would constitute a short-circuit, but the difficulty is that 100,000 ohms would be far too much for biasing purposes. But by connecting them as in Fig. 3 these conflicting requirements can both be met, for R_1 is chosen to be suitable for biasing, and R_2 for decoupling. Suitable values for R_2 and C are 100,000 ohms and 1 mfd. respectively, and, as R_2 carries no appreciable current, an ordinary small "leak" type of resistor is satisfactory.

It has been hinted that the cost of the components is not the only consideration when choosing between the two methods. The latter method has an objection, often overlooked, which the former does not. If the intervalve coupling is inductive, such as a transformer connected in the standard manner, all is well. But capacity coupling is becoming increasingly popular, even with transformers, which are now often connected on the parallel-feed system. Resistance and choke couplings (with the exception of the rarely used "direct coupling") are necessarily capacity coupled. With any of these arrangements the filter circuit of Fig. 3 is liable to be unexpectedly ineffective. The reason will be clear by looking at Fig. 4, which shows part of the circuit relating to the previous valve, in this case coupled by parallel-fed transformer. The circuit emphasised by a heavy line is in parallel with the filter resistor, and consists of the valve itself, the coupling condenser, and the primary of the transformer. This path therefore sets a limit to the efficiency of the filter, and it is of little use increasing the resistance of R_2 beyond a moderate figure, for the effectiveness of doing so becomes increasingly less. Increasing C is also useless, for it encourages currents due to the voltage variations across R_1 to flow via it and the heavy line path, reproducing the variations across the primary of the transformer, which in this case are stepped up, and the total audio voltage between grid and cathode is therefore very considerable. The filter system is quite useless in this case, and has been known in practice to be the cause of very poor results. The evil is less extreme in a resistance or choke-coupled amplifier, but is enough to rule out the filter method as shown. The simple Fig. 2 system, with an appropriate condenser, is free from this defect, as it prevents appreciable audio voltages from being set up at all.

Common Bias Resistance.

There is, however, an alternative system which avoids both the trouble due to the feed-back via the preceding valve, and the use of large condensers, and in most cases it is also possible to avoid the use of a separate R_1. If the cathode of the first valve in Fig. 4 is connected to the cathode of the second valve, the trouble associated with that circuit disappears. The only drawback is that the current to *both* valves must now pass through R_1, together with current to any other valves which are similarly connected. Usually this objection is not very serious, if the valve which is being biased is the output valve, because in a properly organised receiver the output valve takes the vast majority of the total anode current, and the feed to the other valves need not influence the problem very deeply. The bias voltage is still controlled *mainly* by its own valve. But the special merit of the scheme is the way it fits into the usual type

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of A.C.-driven receiver, in which the whole H.T. feed necessarily passes through some sort of smoothing choke, in which process valuable volts are lost, particularly if the choke consists of the loud speaker field. These volts may be harnessed for bias purposes. For some reason which nobody has made clear, the smoothing choke is usually connected in the positive H.T. lead, but it is quite as well in the negative side—in fact, is less likely to give trouble there. It is a pure coincidence if the volts dropped in the choke happen to be exactly right for bias, but failure to achieve this happy state of affairs need cause no difficulty, and Fig. 5 represents part of a typical A.C. receiver circuit in which provision is made not only for the power-valve bias but for bias to another valve also, and as many different voltages may be supplied as are necessary. In most modern designs, however, the only bias required other than that to the output valve is for H.F. valves, and is better provided by a resistor in each individual cathode lead, shunted by a condenser of the order of 0.1 mfd.

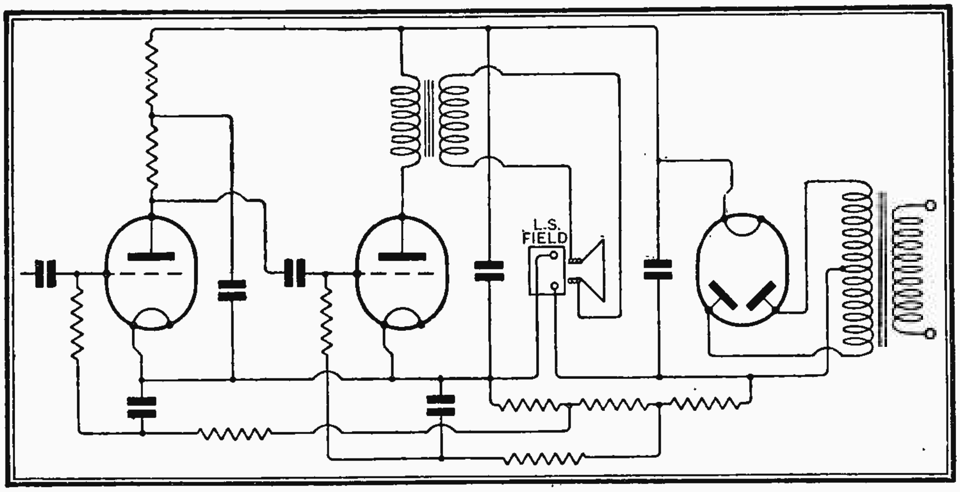

Fig. 5.—With cathodes joined together and a single source of bias, the objections to the circuits given in Figs. 3 and 4 are overcome.

Reducing Hum.

It is obvious that in the arrangement shown in Fig. 5 the decoupling resistors serve not only their primary purpose, but also that of reducing hum which would otherwise result from the use of an unsmoothed source of voltage. If necessary, more than one stage of resistance-capacity filter may be used. It is essential to keep any audio or hum voltage from the H.F. bias, for, though it would not be amplified directly by the H.F. circuits, it would modulate the carrier waves of received stations and in that way render itself obnoxious. The values of the resistors across the smoothing choke are chosen to divide the available voltage into the correct amounts for bias, and should total up to a figure very much greater than the impedance of the choke, in order to avoid reducing its effectiveness. Something of the order of 100,000 ohms is generally about right, and the same value may also be used for the filter resistors as before.

So far no provision for feeding filaments or heaters has been shown in any circuits. In A.C. receivers (with which we are principally concerned) this has little influence on the matter, for the heaters can be connected quite independently of the cathodes, and need not restrict circuit design, except that it is sometimes a little difficult to get rid of hum unless the heaters are connected direct to the cathodes without the interposition of bias resistors. With any of the recommended grid-bias systems already described, this difficulty should not arise, and in any case it is no immense hardship to run a separate heater winding for the detector, or any valve which gives trouble in this respect. Even this should certainly not be necessary with proper design. The cathodes are often joined to the centre point of the heater winding, but usually this also is an unnecessary precaution, and the practice of connecting one side of the winding to earth is a sound one.

The use of directly heated valves in modern A.C. receivers is confined to the output stage, which is some-

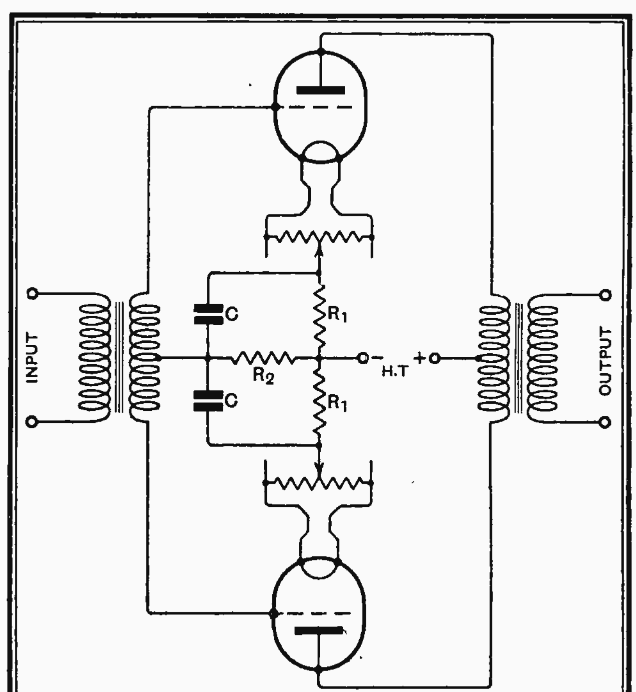

Fig. 6.—A satisfactory separate biasing scheme when using two directly heated output valves in push-pull.

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times of this type, and then, of course, it is essential to regard the centre-point of the filament as the cathode, to which return connections are made. It is generally

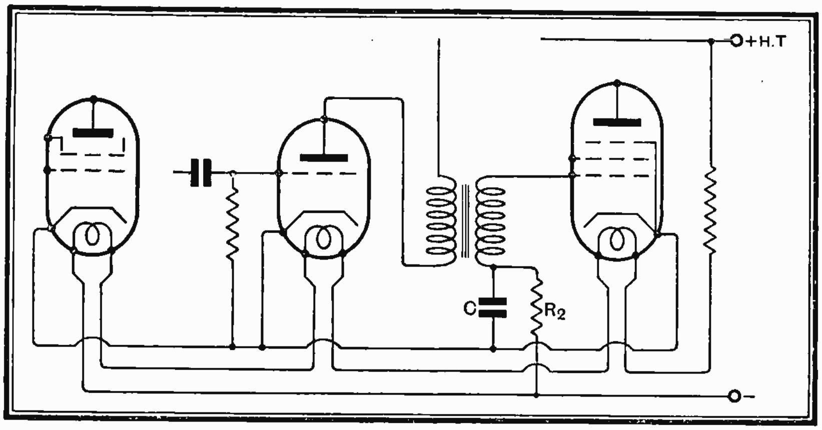

Fig. 7.—Showing a method of obtaining bias for the last valve in a D.C. receiver using the volts dropped in the heaters of the first two valves.

possible to run the heaters of the other valves from the same transformer winding, unless the output valve is of the high-power type requiring more than 4 volts. A case that requires special consideration is a push-pull output stage, in which, owing to the fact that power valves of the same type vary enormously in characteristics—much more than would be tolerated in other components—it is practically essential to bias the two valves separately in order to balance them sufficiently to derive the advantages of push-pull. If this is done, even though the bias resistors may be fixed, the compensating action of automatic bias brings the anode currents

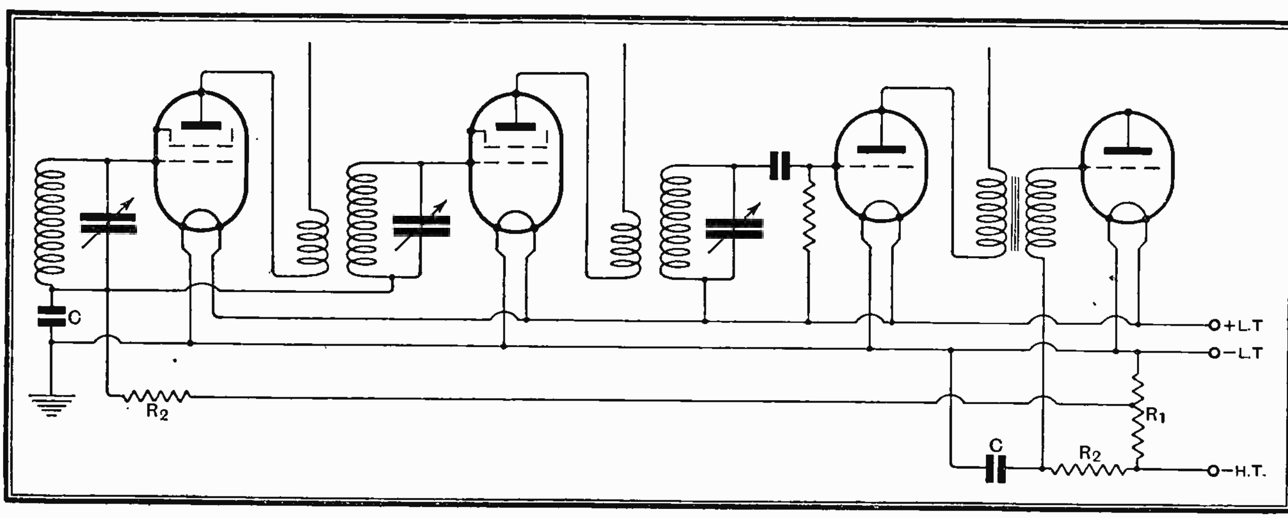

Fig. 8.—Automatic bias for a battery receiver. Anode circuit decoupling would be necessary.

of somewhat different valves very nearly equal, owing to the very high mutual conductance of modern valves. If variable bias *is* indulged in, it is advisable to make only a portion of the toal bias resistance variable, as the possibility of reducing the bias to zero, or to a small value, is not a desirable one. Fig. 6 illustrates a suitable system when directly heated output valves are used. R_1R_1 are the usual biasing resistors, and R_2 and CC the filter components; R_2 should be rather low if large valves with very high conductance are used, because otherwise there is a danger of certain slight valve defects, which would otherwise go unnoticed, leading to serious falling off in performance. About 25,000 ohms and 2 mfd. is enough, or R_2 may be omitted and electrolytic condensers used—a sounder plan. Separate filament supplies are, of course, essential with directly heated valves, but not with indirectly heated valves, which are now sufficiently well designed to permit of considerable potential differences between cathodes and heaters, and the latter can safely be connected to −HT. Centre taps may be taken as shown, to resistors of about 10 ohms, or to tappings on the transformer windings themselves.

The term "automatic" grid bias is generally taken to connote not only the absence of an independent battery, but also the property of self-adjustment, which is a feature of a grid-bias supply that depends on the anode current. In the latter sense automatic grid bias is not altogether a satisfactory proposition in receivers driven from D.C. mains (assuming the use of I.H.C. valves), for the only way of obtaining it is by a resistor between cathode and heater. Although the ripple on a D.C. supply is relatively small in amplitude, it is high in frequency, and, therefore, not only extremely audible when present to a small extent, but liable to be introduced into forbidden territory by stray capacities. Therefore it is good practice to connect all the cathodes together and to the various return leads, and to link this to the heater circuit at one point only, preferably at the detector. The system which corresponds to that

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of Fig. 5 for A.C. mains cannot be fairly described as automatic, in that the anode current forms only a small part of the total, which is mainly that necessary for the heaters, and hence the bias voltage is virtually fixed. It at least has the merit of simplicity, for, in order to conserve the precious volts for the output valve, use is generally made of a pentode or other type requiring only a few bias volts, and hence these are normally obtainable from the voltage drop in the heaters. Thus in the skeleton circuit of Fig. 7 the volts dropped in the heaters of the first two valves are applied via the usual little filter R_2C to provide bias for the third. Suitable values are 25,000 ohms and 1 mfd.

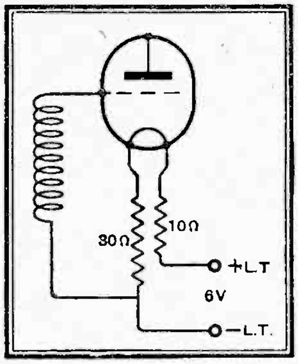


Fig 9.—Odd bias values for a two- or four-volt valve supplied by a six-volt accumulator can be got by inserting resistances in both filament legs.

The usefulness of automatic grid bias is limited when applied to battery-driven receivers, because it is not practicable to run the filaments from separate batteries as would be necessary in order to apply the methods of Figs. 2-4 independently to more than one valve. A modification of Fig. 5 is possible, however, and the appropriate skeleton circuit forms the subject of Fig. 8, which requires no explanation. As already emphasised, the decoupling filter for the H.F. valves is there to prevent modulation of received carrier waves by audio voltages developed across R_1. It should be noted that these are communicated also to the various anodes, for R_1 is equivalent to a high resistance in the H.T. battery, and therefore anode circuit decoupling is necessary. On the whole, it is very questionable whether "free" grid bias is so very gratuitous after all.

Bias for Battery Sets.

There is just one other method that may be mentioned of obtaining bias in battery sets, though it is of limited interest now that 2-volt batteries have become almost universal. If, for example, a 6-volt battery is used, with 6-volt valves for the output stage, the irritating little biases necessary for the other stages may be obtained by using 2- or 4-volt valves with a fixed resistor in the negative lead, or possibly one in both sides to get odd voltages. Suppose that 3 volts are required and that the 2-volt valve takes 0.1 amp. Then a 30-ohm resistor is used in the negative side, to drop 3 volts for bias, and the remaining 1 volt is absorbed by 10 ohms on the positive side, as shown in Fig. 9. The grid is thus made 3 volts more negative than the negative end of the filament.

At the beginning, in dealing with the process by which the correct value of bias resistance is arrived at (Fig. 1), it was stipulated that only the valve current should flow through it. In some cases, however, as with anode-bend detectors or variable bias volume controls, it is desirable to augment the valve current by connecting a shunt or potential divider from some positive point to the cathode. It is then necessary to take into consideration the current thus introduced into the bias resistor by adding it to the current which passes thermionically by way of the valve.

BOOK REVIEW.

THERMIONIC VACUUM TUBES AND THEIR APPLICATIONS. By Professor E. V. Appleton, M.A., D.Sc., F.R.S. Pp. vii+117, with 68 Figures. Messrs. Methuen and Co., Ltd., London, 1932. Price 3s. net.

FOR some years now Messrs. Methuen have made a special feature of publishing authoritative scientific works in a popular form and at a reasonable price, and have thereby earned the gratitude of many students to whom the information thus provided was not otherwise readily available. The "Monographs on Physical Subjects," to which the present volume belongs, have already established a reputation for lucidity and scientific accuracy, and Professor Appleton's book on Thermionic Vacuum Tubes fully maintains this standard.

The subject is, of course, a wide and growing one, and it is obviously impossible within the compass of a hundred odd pages to do more than lay a firm foundation for subsequent studies. This task, however, the author has discharged with wonderful completeness, his survey including a precise analysis of the internal "mechanism" of modern valves—or, as he prefers to call them, thermionic tubes—as well as an account of some of their applications in various departments of physics and electrical engineering.

Initial chapters on the construction of thermionic valves and their emission are followed by the mathematical derivation of the standard "space-charge" equations for the diode, and in a subsequent chapter the modifications necessitated by the introduction of the grid in the case of the triode are clearly demonstrated. The mathematics employed assumes a fair working knowledge of calculus methods, but it may be pointed out that, even so, such mathematical knowledge is in no wise essential to an adequate understanding of the salient features of the discussion.

Perhaps the three most interesting chapters in the book from a purely wireless point of view are those dealing with the three main applications of the triode—as amplifier, rectifier, and oscillation generator. These chapters contain a masterly summary of much modern valve theory which is only to be found in the writings of various authors scattered through the pages of many scientific periodicals. In thus collating the substance of these researches the author has performed an undoubted service to the serious student, and the exhaustive lists of references which conclude each chapter are indicative of the completeness of his survey.

Where so many topics are dealt with in so short a space, it is inevitable that the treatment accorded to many of them should be in the nature of a summary of essentials, a feature which should commend the volume to those who desire to have a "revision course." The book is, perhaps, written more from the point of view of the physicist than that of the wireless engineer: nevertheless, students of wireless who are desirous of improving their knowledge of the valve will find themselves well repaid by a careful reading of it. The volume is of pocket size, well produced, and of clear type. The diagrams are carefully drawn and easily followed—though in one instance, Fig. 30, the conventional symbols for the batteries N seem to have been inserted with reverse polarity. Altogether, this little book can be confidently recommended as containing a wealth of reliable information at an astonishingly low price.—W. A. B.

Next Week's Set Review:—

THE HALFORD SUPERHET RADIO-GRAMOPHONE

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 presented, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Problems 32 to 34 have been previously given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

QUESTION 32.—**It is desired to operate a power-grid detector valve with 100 volts on the plate and a mean anode current in the neighbourhood of 8 mA. If the H.T. supply is 260 volts, what value of feed resistance would be required in the anode lead, and what power must it be able to handle?**

Answer—20,000 ohms; 1.28 watts.

The principle of dropping volts through an anode-feed resistance has often been described in *The Wireless World*. It will be evident that the potential drop across the supply resistance is equal to the difference between the H.T. potential source and the voltage on the plate. The P.D. across the resistance is thus 260 − 100, or 160 volts. We are, moreover, given the value of the mean current which this resistance must carry, viz., 8 mA., or 0.008 A. The value of the resistance is therefore obtainable by our never-failing standby, Ohm's Law, as follows:

$$R = \frac{E}{I} = \frac{160}{0.008} = 20{,}000 \text{ ohms.}$$

In selecting a resistance for this duty, care must be taken to see that the type chosen is capable of handling an amount of power well in excess of actual requirements. The power dissipated in the resistance is, of course, given by $E \times I$ watts, where $E = 160$ volts and $I = 0.008$ ampere.

Thus the power lost in resistance $= 160 \times 0.008$ watts $=$ 1.28 watts.

A resistance rated at, say, 3 watts or over would be quite suitable, and leave ample margin of safety.

QUESTION 33.—**A four-valve set is supplied with filament current from an accumulator whose voltage is 2.04 when the set is running. If one of the valves is rated to take 0.12 ampere at 1.8 volts, how should it be connected to the filament supply?**

Answer—Through a resistance of 2 ohms.

The accumulator voltage is here in excess of the desired filament voltage by 2.04 − 1.8, or 0.24 volt. This excess voltage must, therefore, be taken up or disposed of in some way, and the most convenient method of doing this is to insert a small resistance in one of the filament leads. The value of this voltage-dropping resistance will be given in ohms by the usual process of dividing the P.D. across it by the current passing through it or by the quotient $\frac{E}{I}$, in this case $\frac{0.24}{0.12}$, or 2 ohms. Needless to say, the power rating of the resistance should be adequate to pass the necessary current without overheating.

QUESTION 34.—**A resistance of 50,000 ohms is rated to take 20 watts. What is (a) the maximum direct current that may be passed through it without danger, and (b) the maximum amplitude of A.C. that may be similarly passed?**

Answer—(*a*) 20 mA, (*b*) 28.28 mA.

The power in watts which is expended in passing a direct current of I amps. through a resistance of R ohms is given by the expression I^2R. For the case of direct current, therefore,

$$20 = I^2 \times 50{,}000, \text{ so that } I^2 = \frac{20}{50{,}000} = \frac{1}{2{,}500},$$

$$\text{therefore } I = \frac{1}{50} \text{ amp.} = 20 \text{ mA.}$$

In the case of an alternating current of pure sine form, the same power formula I^2R will apply on the understanding that I now represents the effective or R.M.S. value of the current. This R.M.S. value is always 0.707 times that of the amplitude. In the present case the value found above for I, viz., 20 mA., will be the R.M.S. value, and is thus only 0.707 times the value of the maximum amplitude. Accordingly, we can write:

$$\text{Maximum amplitude} = \frac{20}{0.707} = 28.28 \text{ mA.}$$

The frequency of the alternating current is, of course, immaterial.

NEXT SERIES OF PROBLEMS.

QUESTION 35.—**An unmodulated carrier wave of 1,000 kilocycles frequency has an amplitude of 0.8 volt at the grid of a detector valve. If it is now modulated 50 per cent. at audio frequency, what is the voltage amplitude of the L.F. modulating wave?**

QUESTION 36.—**What is the unmodulated R.M.S. input voltage to the grid in Question 35, and what will be the extreme values of R.M.S. voltage variation at the grid during the modulated signal?**

QUESTION 37.—**Unsatisfactory reproduction is obtained from a set in which the 2,000-ohm loud speaker is connected directly in the anode circuit of a small power valve. The H.T. battery is found to have a P.D. of 155 volts on load, and the mean plate current of the power valve is 15 mA. What voltage is thus lost to the plate of the valve?**

NUTCRACKER.

Current Topics.

Events of the Week in Brief Review.

British Programmes from France.

A BAN on British sponsored programmes from *Radio Paris* and other French stations becomes a possibility in view of a statement contained in a "Blue Book" just issued by the French Senatorial Finance Commission. Correspondence on the subject of sponsored programmes is published. Among the letters is a reply by the Minister of Posts and Telegraphs to a private complaint of the "intolerable" amount of foreign publicity programmes, "one Paris 'poste' station being allowed to transform itself into a station of British commercial interest." In the Ministerial reply these words occur: "General measures tending to restrain publicity in foreign languages and to regulate political transmissions are already envisaged."

The French radio Press interprets this statement as signifying that *Radio Paris* will very soon be forbidden to carry on its present publicity programmes.

The Autotone in Birmingham.

READERS in the Midlands who are constructing the Autotone may be interested to know that a completed receiver of this type is now on view at the Birmingham Offices of *The Wireless World*, Guildhall Buildings, Navigation Street.

Captain P. P. Eckersley.

CAPTAIN P. P. ECKERSLEY'S wide circle of friends will wish him a speedy recovery after the operation for appendicitis which he underwent last week.

We understand that in a few weeks' time Captain Eckersley is leaving England for Australia, where he is to spend some months in advising the Government in the reorganisation of the Australian broadcasting service.

Luxembourg's Wavelength.

THE high-power station at Luxembourg referred to in these columns last week is actually being constructed at Junglinster, a village 15 kilometres from the city. There is still some doubt as to whether the wavelength of 1,250 metres will be suitable, and the first tests will show if the German air service stations, which operate on the same wavelength, will be interfered with. If this were the case, the German Post Office would promptly complain, and a wavelength change would be imperative.

Bigger and Better.

THE National Radio Exhibition will this year, for the first time, occupy the Grand Hall, Olympia, and on that account alone will probably be the most spectacular yet held in this country. The Exhibition will open a month earlier than usual—that is, on August 19th—and it is hoped that many provincial visitors holiday-making in the capital will thus be able to attend. Although the Show will occupy 100,000 square feet of floor space, the manufacturers hope to fill this vast area with the greatest ease, at the same time allowing visitors more elbow room than in years past.

Radio Tests in the Arctic.

PROFESSOR E. V. APPLETON, who is well known to readers for his researches on the transmission of wireless waves, is to lead the second of two Arctic expeditions which are being sent out by twelve countries during the year beginning on August 1st. While one of the parties, led by Mr. J. M. Stagg, will study meteorology at Fort Rae in Northern Canada, Professor Appleton's expedition will proceed to Tromso in Norway to make wireless observations. It is hoped to solve several problems connected with wireless echoes and the possible effect of the aurora borealis.

General Ferrié's Successor.

GENERAL APPIANO has been appointed to succeed the late General Ferrié as Chief of the French Military Wireless Services. Although General Appiano is not a technical expert, he is thoroughly conversant with the administration of military wireless, with which he has had experience since 1911. He was the Director of a radio telegraphic mission to Russia from 1916 to 1918.

Free Listening for Unemployed.

THE German Post Office has further simplified the conditions under which unemployed persons can obtain free wireless licences. Hitherto, these were available only to persons who had owned a licence for six consecutive months before making application. Now, however, free licences are available to unemployed persons who have paid for a licence during any six months after January 1st, 1931. Our Berlin correspondent fears that this new ruling will play further havoc with German broadcasting finances. At present one in twelve of Germany's listeners obtains his licence free of charge.

Good for the Builders.

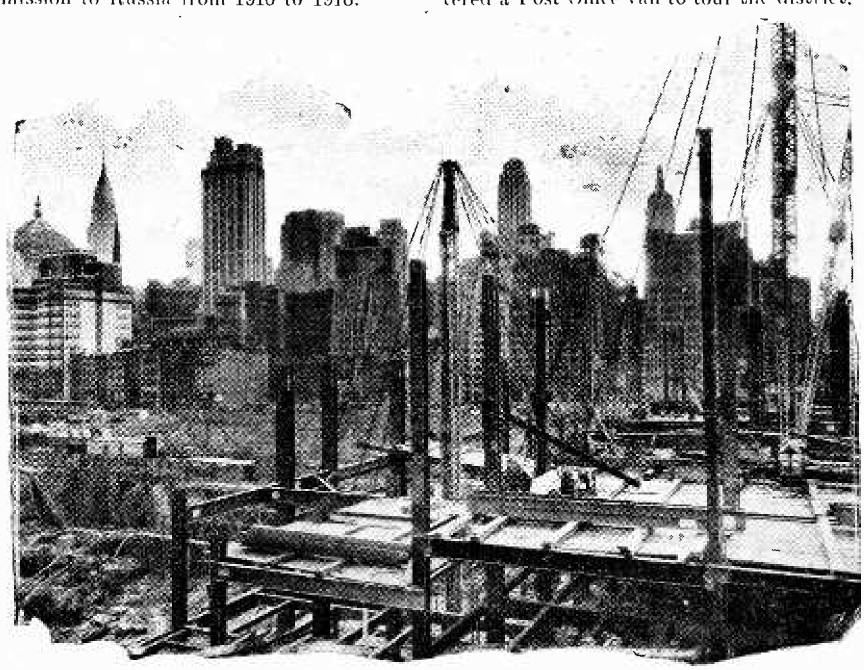
"EVERY man who can afford it," said Mr. J. B. Milner in his presidential address last week to the National Federation of Housebuilders, "insists on a detached house—on account of the wireless fiend next door who turns on his wireless while he is in the bath in the morning, and switches it off just before he goes to sleep, and not always then."

Mr. Milner might have added that it's an ill wind that blows nobody any good.

Free Licence Scheme.

THE sinister shadow of the Post Office wireless detector van is helping to popularise the scheme of a Birmingham firm, which now offers free licences to the purchasers of a special set. Apparently there are many folk who, while objecting to the payment of 10s., do not hesitate to spend considerably more on a good receiver when the licence is "thrown in."

It is possible that the firm would attain still more success if they chartered a Post Office van to tour the district.



NEW YORK'S "RADIO CITY." This recent photograph gives an idea of the vastness of the Rockefeller site in New York which will soon be the hub of American broadcasting activities.

PRACTICAL HINTS AND TIPS

Simplified Aids to Better Reception.

IT is common knowledge that a moving-coil loud speaker sounds shrill and "tinny" if used without a baffle board. The movement of the cone sets up sound waves in the air, but, at low frequencies, circulating currents are set up between the front and the back of the cone, which allows the energy to be dissipated without producing sound waves at these frequencies. A large diaphragm will get over the difficulty, but the most practical method is to use a baffle, and the dimensions of the baffle directly govern the strength of bass reproduction.

HOW LARGE A BAFFLE?

Various opinions have been expressed as to the minimum dimensions of a satisfactory baffle, but as these reflect various degrees of taste, the reader will find the accompanying diagram interesting, in that it will enable him to choose a baffle which will satisfy his own particular requirements. It is quite straightforward, but there are one or two points that crop up in practice which should be borne in mind. Most commercial moving-coil loud speakers have a cut-off at about 100 cycles per second, so there is nothing much to be gained by having a baffle larger than about 3ft. 6in. square with such a loud speaker, but if one has a loud speaker which will really go down to 50 cycles, then a large baffle is very necessary if the performance is not to be impaired.

The baffle may be either a flat board or a box (which usually takes the form of a compartment in the cabinet housing the receiver). The effective dimensions of the latter can easily be calculated, the diameter of an equivalent flat board being equal to twice the distance from the centre of the front opening, round the side, to the speech coil.

It is not often realised that the material from which the baffle is made has a considerable influence on its efficiency. It is desirable that hardwood, such as oak or mahogany, up to an inch thick, if possible, be used, otherwise the wood itself will vibrate at the lower frequencies, and reduce the effectiveness of the baffle by as much as 50 per cent. Cheap cabinets made from light plywood panels assembled on a framework should have the loud speaker compartment lined with hardwood of the requisite thickness, either glued on to the outside panels or fixed firmly in position about a quarter of an inch away, the intervening space being filled with felt or similar material.

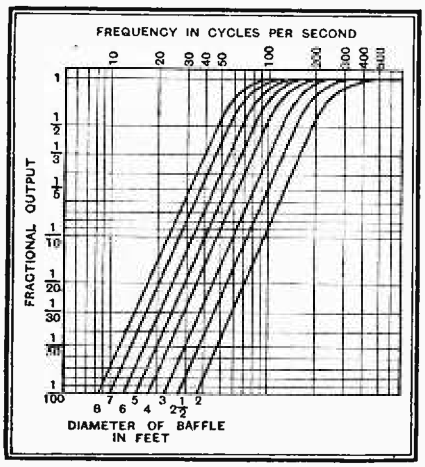


Fig. 1.—Showing the loss of low-frequency response brought about by the use of loud speaker baffle-boards of various sizes.

IT should not be forgotten that the grid circuit of every valve, irrespective of its function in the receiver, must be completed to its cathode or filament through a path conductive to D.C. current. It is not enough that the circuit should be completed through a condenser; unless a parallel leakage path be provided, a charge will accumulate on the condenser, and the circuit will become choked and practically inoperative.

A POINT TO REMEMBER.

One is apt to forget this when dealing with mains-operated receivers with automatic bias; from a cursory examination of a circuit diagram it is not always obvious at a glance that the necessary conductive path is provided.

This axiom may be applied when searching for a fault; unless continuity is shown between grid and cathode terminals of the valve holder it can be assumed quite definitely that something is wrong in the circuit.

FROM a technical point of view the only real difference between the various forms of band-pass filter coupling in common use is with regard to the manner in which the selectivity or broadness of tuning of the various devices changes as the receiver is tuned over the waveband to be covered. In other words, it is true enough to say that at a given wavelength any type of filter is equally good, provided that the effective coupling between the component circuits is adjusted to the same value.

BAND-PASS FILTERS COMPARED.

It follows, therefore, that when provision is to be made for variation of coupling, that the choice of the actual method employed may be governed entirely by convenience and by the apparatus available.

In practice, a "constant width" filter is almost always to be preferred to one which needs frequent adjustment of coupling, but this does not apply to the tuned I.F. circuits of superheterodynes, which always operate at the same wavelength.

LOW-VOLTAGE D.C. MAINS.

THOSE who have a low-voltage D.C. supply—in the order of 100 to 150 volts—are at a distinct disadvantage when designing a receiver to operate directly from the supply system. True, there is no particular difficulty about the filament or heater circuits, as modern indirectly heated D.C. valves of, say, the 16-volt type may be used in the conventional manner. But the question of H.T. voltage is something of a problem. Without any additional source of voltage, the supply to the anodes is obviously limited to something below the mains pressure, and anything less than 200 volts is hardly adequate for modern needs, at any rate when mains valves are to be used.

If an attempt is to be made to attain the best possible reception in adverse circumstances of this nature, it is to be recommended that, for the purpose of H.T. supply, the mains voltage should be supplemented by a battery; of course, dry cells could be employed, but this course is anything but economical, except, perhaps, in the matter of first cost, and it is a good plan to employ an H.T. accumulator battery, as the cells may readily be charged from the mains during the time that the set is out of use.

It will be convenient to fit a charge-discharge switch to the receiver itself, in order to avoid the need for disconnecting the cells each time that they are to be charged.

What is probably the best way of overcoming the handicap of a low-voltage D.C. supply is illustrated diagrammatically in Fig. 2. For purposes of explanation, it is assumed that the receiver is to be of the popular H.F.-det.-L.F. three-valve type, with 16-volt indirectly heated D.C. valves, and that current is supplied at 110 volts. It will be seen that the heater and cathode circuits are entirely conventional, but that when the battery switch is in the left-hand position the voltage of the accumulator cells is added to that of the mains for supplying the various anode circuits.

The value of the limiting resistance R_1 is calculated on the basis of the assumptions made above, and, of course, will need modification if the mains voltage be changed, or if any alteration be made in the type or number of the valves.

It is impossible to assign a definite value to the resistance R, through which the cells are charged. The purpose of this resistance is to limit the charging current to the value recommended by the makers of the battery.

It should also be pointed out that the total voltage of the supplementary battery should be appreciably less than that of the mains, or the cells will never be fully charged; with a 110-volt supply the battery may contain from 40 to 45 cells.

Finally, the reader may be reminded that the "Wireless World D.C. Three," recently described in this journal, may be modified on the lines suggested in cases where the D.C. supply is appreciably below 200 volts.

LOUD SPEAKER FEED CIRCUITS.

WHEN a receiver is fitted with a conventional choke-filter circuit for feeding the loud speaker, it must not be imagined that in every case a double-wound transformer or a direct loud speaker connection may be substituted at will. As the result of making this change it is not unusual to find that low-frequency oscillation is produced.

The reason for this is not far to seek. The filter-feed system contributes a great deal towards the attainment of stability, because it helps to decouple the output circuit by deflecting audio-frequency impulses from the source of H.T. supply. In this respect a transformer is no better than a direct connection.

Problems of this nature will often arise when substituting a moving-coil loud speaker with a built-in transformer for an instrument of the moving-iron type. If instability should be produced as a result of making the change, there are two remedies: the decoupling of the earlier stages may be improved by fitting resistances of higher value and larger by-pass condensers; or the built-in transformer in the loud speaker may be "filter-fed" by means of a choke.

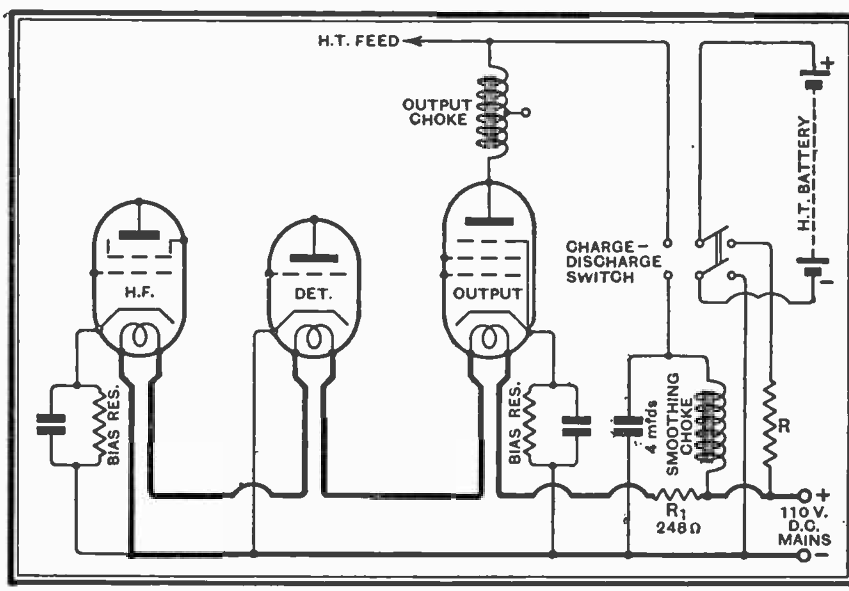


Fig. 2.—Making the best of low-voltage D.C. mains: skeleton diagram showing cathode-heater connections for indirectly heated D.C. valves, and also an auxiliary accumulator battery for increasing anode voltage.

The Magnification of the Tuned Circuit.

What It Is, and What It Does.

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

THE writer has recently published a series of articles on screened coils, in one of which there was a fairly full discussion of the distinction between series losses, expressed as the series resistance *r*, and parallel losses, expressed as a dynamic resistance R. It was further pointed out that the *total* losses, with which one deals in designing a set, and with which one is primarily concerned as the measure of the efficiency of a complete tuned circuit, may be expressed in either of the two forms to the exclusion of the other.

In quoting the high-frequency resistance of a circuit it is quite usual simply to state the value of *r* that corresponds to the sum total of losses. There is no special virtue in stating the losses in this form, which is perhaps the least important of any; it is often done because total losses are most conveniently measured in terms of series resistance. Other forms of expression have to be derived from *r* by calculation.

The most usual alternative, that of expressing total losses in terms of equivalent parallel resistance, which is the same as the dynamic resistance of the tuned circuit, is distinctly more useful to the designer of a set, for the dynamic resistance plays a very important part in the calculations that form part of the work of design. The dynamic resistance of the tuned circuit must be known before an estimate can be made of the amplification to be expected from each stage of the high-frequency amplifier, and the same information is required for determining whether the completed amplifier will oscillate or will be absolutely stable.

THE articles on coil efficiency by the present writer published in this journal in September last contained references to the advantages to be gained by expressing the properties of a coil in terms of magnification rather than by the more general method of stating the series or parallel resistance. This alternative has a number of merits, notably in connection with selectivity measurements.

Defining Magnification.

Besides these two better-known modes of summing up the performance of a tuned circuit, there is another. One may give the *magnification* of the circuit. This quantity, which is symbolised by the letter "*m*," is not a plain unvarnished statement of either series or parallel resistance alone, but involves also the inductance of the coil and the frequency or wavelength at which the information applies. It is obtained by dividing the reactance X of the coil[1] by the equivalent series resistance *r*, or, alternatively, by dividing the dynamic resistance by the reactance.

In symbols $m = X/r$ and since $R = X^2/r$, m is also equal to R/X.

Regarded merely as a "goodness factor" of the tuned circuit, *m* may be considered as a kind of half-way house between the series resistance and the dynamic resistance. Since a lower value of *r* represents a more efficient coil, $1/r$ would be quite a logical unit for expressing "goodness." A 10-ohm coil would then have a "goodness" of 0.1 mho[2]; a 20-ohm coil a "goodness" of only half this value, or 0.05 mho.

If the coils had an inductance of 200 microhenrys, and the resistances referred to a wavelength of 300 metres, each would have a reactance of X=1,258 ohms. The magnifications of the two tuned circuits would therefore be 1,258 × 0.1 = 125.8 and 1,258 × 0.05 = 62.9. These figures are obtained by multiplying the reactance of the coil by the "goodness factor."

If we repeat the process and multiply the magnification in its turn by the reactance, we arrive at the dynamic resistance X^2/r or Xm. In the cases given, R comes out at 158,000 ohms and 79,000 ohms.

How the Name Arises.

It will have been noticed that while $1/r$ was given in mhos, and R was given in ohms, no unit was quoted for *m*. This absence of unit is quite correct, for *m* is a pure ratio, obtained by dividing reactance (in ohms) by series resistance (also in ohms). The amplification factor of a valve is a familiar case of another pure number derived as a ratio, and bears a recognisable similarity in name to the magnification we are discussing.

The term "magnification" arises in a way that needs a simple diagram for its elucidation. In Fig. 1, (*a*) represents a simple tuned circuit supplied with energy from an aerial; L, C, and *r* are the three constants that determine the tuned circuit. If we suppose that the current flowing in the aerial is such as to induce a voltage E_0 into the coil L, we can replace the aerial by a fictitious but convenient generator in series with the tuned circuit, as at (*b*). The reactance of the coil L and the condenser C will make the current circulating in the tuned circuit quite difficult to compute, except at the frequency to which the circuit is tuned. At this frequency the

[1] The reactance of a coil is $X = 2\pi f L$ ohms where f = frequency and L inductance.

[2] The "mho," or "reciprocal ohm," is the unit of conductance. The general principle is that the less it resists, the more it conducts.

The Magnification of the Tuned Circuit.—
reactances of L and C counterbalance one another, and the current flowing (I) will be given by $I = E_0/r$, as in a simple D.C. case to which Ohm's Law applies.

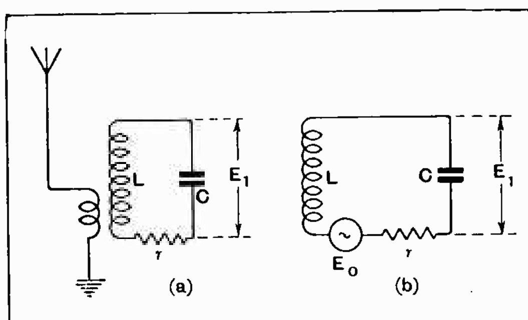
This current, flowing through the coil, will set up across it a voltage equal to the current multiplied by the reactance of the coil; this voltage, E_1, which is that applied across grid and filament of the first valve in the set, will therefore be given by $E_1 = IX$. Replacing I by its value in terms of E_0 and r, we see that $E_1 = X.E_0/r$, which rearranges into $E_0.X/r$. But we have seen that X/r is equal to m, the magnification of the tuned circuit, so we can write $E_1 = E_0 \times m$. In other words, the voltage derived from the aerial is magnified m times by the tuned circuit before it is applied to the first valve of the set. The origin of the term "magnification" is now evident.

As has been shown, the series resistance of the tuned circuit is that which is usually measured, and so is often convenient for a comparison of alternative coils under fixed conditions. Similarly the dynamic resistance is that required for design calculations involving stage gain and stability —what uses, then, are left for which the magnification is more convenient?

In comparing the design of two coils of different inductance values it is not fair to make the comparison either on the basis of r or on that of R. That this is so can be most easily realised if we consider the rather artificial case of two identical coils in series being compared with one of them alone; naturally, the excellence of design of one alone is the same as that of two in series. In case (*a*), Fig. 2, the series resistance r is 8 ohms; the dynamic resistance at 1,000 kc. is $(2\pi fL)^2/r = (942)^2/8 = 111{,}000$ ohms.

In case (*b*), r is 16 ohms, while R is $(1{,}884)^2/16 = 222{,}000$ ohms. Comparing r-values, two coils are half as good as one; comparing R-values, two coils are twice as good as one. Both these conclusions are true for certain purposes; regarded as a commentary upon the design of the coils, as distinct from the mere choice of inductance-value for a particular purpose, both results are evidently absurd, and we must turn to a further consideration of magnification values.

If now we compare m-values, in the first case we find that $m = 942/8 = 118$; in the second case, $m = 1{,}884/16$, which also comes to 118. Since the two coils are identical, this is exactly the result we want to express excellence of coil design, as distinct from correct choice of coil constants for their purpose in a set.



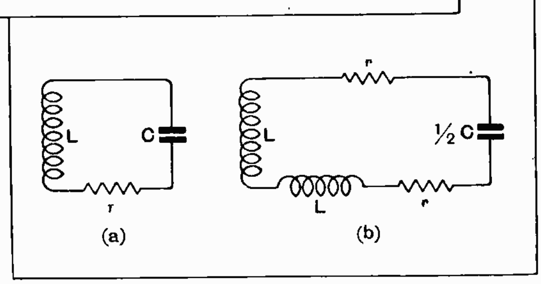


Fig. 1.—Simple tuned circuit upon which is based the use of the term "magnification." If the aerial in (a) induces a voltage E_0 into the coil L, we can replace it by a generator as in (b). As shown in the text E_1 is m times E_0, where m is the magnification.

Fig. 2.—If the two coils in (b) are each identical with that in (a), the magnification of the two tuned circuits is the same. Both r and R, however, are twice as great in (b) as in (a).

In comparing two coils of about the same inductance, or for finding the resistance that a 205-microhenry coil would have if stripped down to 200 microhenrys, as in the case of the writer's recent measurements on screened coils, the magnification must always be used as the basis of calculation.

Selectivity Controlled by Magnification.

A further feature of the magnification is that with any one coil it is more nearly constant over the wave-range covered than either r or R. Some recent measurements, covering the wave-range from 200 to 550 metres, gave results according to which r varied from 7.85 to 27.4 ohms, R varied from 60,000 to 130,000 ohms, while m varied from 69 to 92½. None are constant, or even nearly constant, but m shows the least variation of the three. Ratios of maximum to minimum values are:—

$$r = 3.5:1 \quad R = 2.16:1 \quad m = 1.34:1$$

Thus, if only one figure is to be used as a rough criterion of the excellence of a tuned circuit, it will usually be best, because most definite, to quote the magnification.

But these various points fade into complete insignificance beside the great fact that the selectivity of a tuned circuit depends *only* on its magnification, and not at all upon its resistance, either series or dynamic. That is to say, so long as we keep magnification constant, r and R can be varied as we please without making the slightest difference to selectivity.[3] It follows, therefore, that for all design calculations that involve the determination of selectivity, whether as a virtue in tuning out unwanted stations, or as a fault in preventing the complete reproduction of side bands, it is necessary to base all work on the magnification of the proposed circuits. Those who are interested in such calculations are referred, not only to the article cited, but also to pages 56 and 57 of "Radio Data Charts," where an abac will be found which greatly facilitates the necessary work. From it the curves which accompany this article were all deduced.

The only other factor, besides m, that enters into the determination of selectivity is the wavelength to which the circuit is tuned and about which the selectivity is required. Two tuned circuits, both having a magnification of 100, but intended for use on different

[3] See "Selectivity in Plain Terms," *The Wireless World*, Oct. 16th, 1929, p. 432.

The Magnification of the Tuned Circuit.—

wavelengths, will have quite different selectivity characteristics. One may cut side bands badly, the other may allow two stations differing in frequency by many kilocycles to be heard simultaneously.

Fig. 3 gives the resonance curves that are yielded by a tuned circuit of magnification 100 at the different wavelengths indicated on the curves themselves. It will be noticed at once that, as the wavelength is increased, the selectivity, and with it the loss of side bands, becomes steadily greater. The reason for the outstanding difficulty of long-wave reception—that of getting proper reproduction of high notes—is here made amply evident.

In Fig. 4 the same curves are presented on a logarithmic scale.

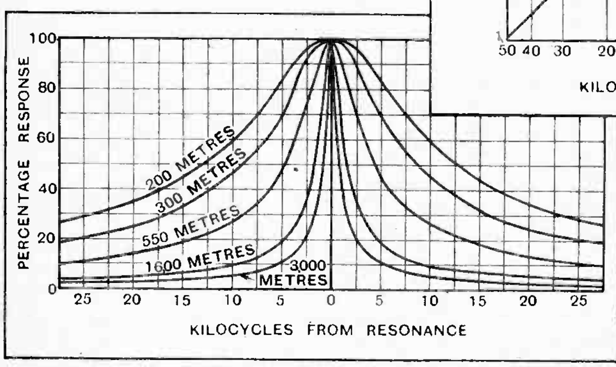


Fig. 3.—Resonance curves at different wavelengths for tuned circuits of magnification = 100. Note the enormous increase of selectivity at the higher wavelengths.

This type of scale has the advantage that it can cover a very wide range of values without undue cramping at either end of the scale, while the curves can be read to the same degree of accuracy at all points. For that reason the logarithmic scale is preferred by the writer for all resonance curves, and the remaining diagrams will be in this form only. Those who are unfamiliar with the logarithmic scale are asked to make a close comparison of these two figures, which convey, each in its own way, the same information. It is especially to be noted that a resonance curve drawn to a logarithmic scale indicates loss of high notes through cutting side bands on the very scale that is most familiar for low-frequency response characteristics. The range of audible frequencies is roughly indicated on each diagram.

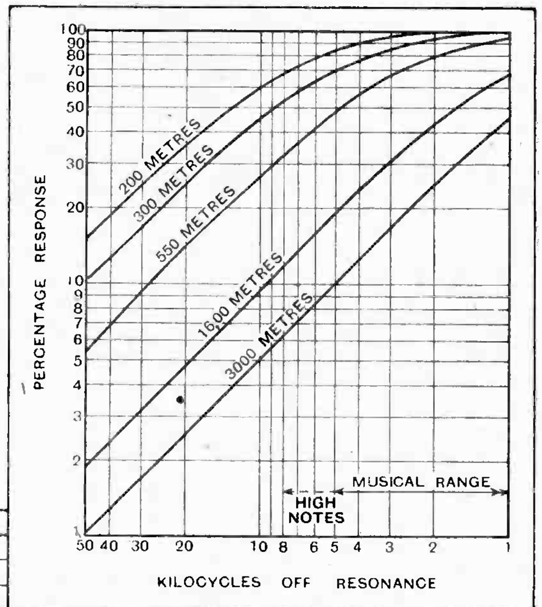


Fig. 4.—The curves of Fig. 3 shown on a logarithmic scale. Note that these curves are the usual type for low-frequency response curves; the musical range is indicated.

Constant Magnification.

In obtaining the same magnification at all the different wavelengths for which curves are given, quite a wide range of dynamic resistances will normally arise. Assuming the values given for the inductances of the various coils, the R-values are shown in the following table. For all cases, $m = 100$.

It will be seen that the condition of constant magnification leads to very wide changes in R over the tuning range 200 to 550 metres, presuming that, as is usual, the same coil is used throughout. It follows that,

Wavelength (Meters).	Inductance (Microhenrys).	Dynamic Resistance. (Ohms).
200	200	191,000
300	200	126,000
550	200	69,000
1,600	3,000	360,000
3,000	3,000	192,000

so long as ordinary tuned circuits are used, the selectivity rises rapidly, and the amplification attained (which depends upon R) drops rapidly on tuning up from 200 towards 550 metres. *(To be concluded.)*

"TELECONITE" WIRE.

THE outstanding property of this wire is its ability to maintain a high insulation resistance under conditions of humidity which would sooner or later have a deleterious effect on other covering materials, including rubber. Designed originally for bell wiring and telephone circuits in mines, it should find many useful applications in wireless technique. It would make excellent material for outdoor loud speaker extensions, and we have used it successfully for the internal wiring of sets. It is ideal for the latter purpose when terminal connections are used on components, as the insulation strips off cleanly, but where soldered connections are made care must be taken not to damage the covering while hot. The base of the covering material is gutta-percha, which softens at temperatures above 130 deg. F. This is not entirely a disadvantage, as it is possible to manipulate the covering while hot to cover up a soldered joint. The breakdown voltage is over 5,000 volts, and the insulation resistance more than 50 megohms per mile, while the dielectric constant is less than 3.5.

The covering is available in a variety of colours, and the price per 110-yard coil is as follows: 20 S.W.G., 5s. 8d.; 18 S.W.G., 7s.; 14/36 flex, 7s. The makers are the Gutta Percha Company, Wharf Road, City Road, London, N.1.

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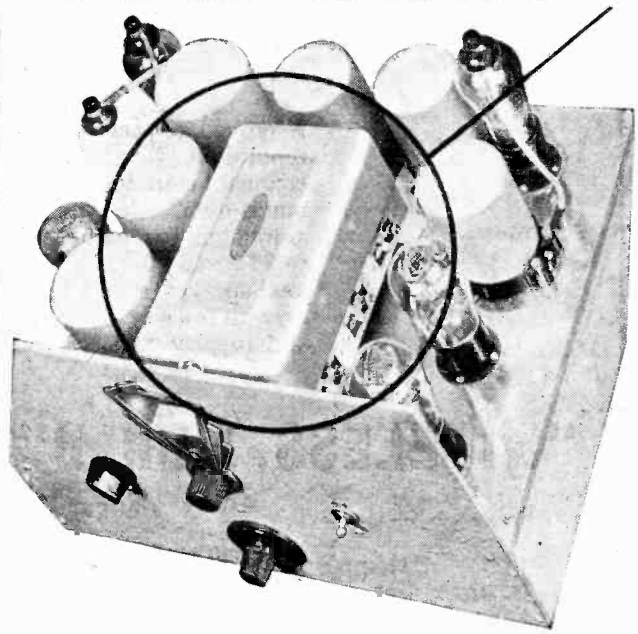

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BROADCAST BREVITIES.

By Our Special Correspondent.

Developments at Daventry.

TO air pilots the B.B.C. ground at Daventry will soon wear the appearance of a gigantic pin cushion. As the 5XX and Midland Regional masts are to remain *in situ* for the next eighteen months, the seventeen aerials of the new Imperial short-wave station will have to be accommodated on a circle of small masts surrounding the older transmitters.

Movable Masts.

These masts will be movable to provide maximum facilities for directional working. Transmission will be possible on all wavelengths between 14 and 50 metres.

It will be very surprising if the new 5SW fails to be a world beater.

A Dream of the Future.

One visionary at Savoy Hill is drumming it into his colleagues that the short-wave station will ultimately be by far the most important of any of the B.B.C. transmitters. *The Wireless World* said so years ago.

He may be looking a long way ahead, but is undoubtedly right.

Prince of Wales at Thiepval.

AT 3 p.m. on Whit Monday listeners will have an opportunity of hearing a speech by the Prince of Wales on French soil. His Royal Highness will be unveiling the war memorial at Thiepval.

Goodbye to Savoy Hill.

NO one should miss the "Goodbye to Savoy Hill" programme which is being put out on May 14th. On examining Lance Sieveking's draft synopsis I find that twelve studios are to be used, all of them for the last time.

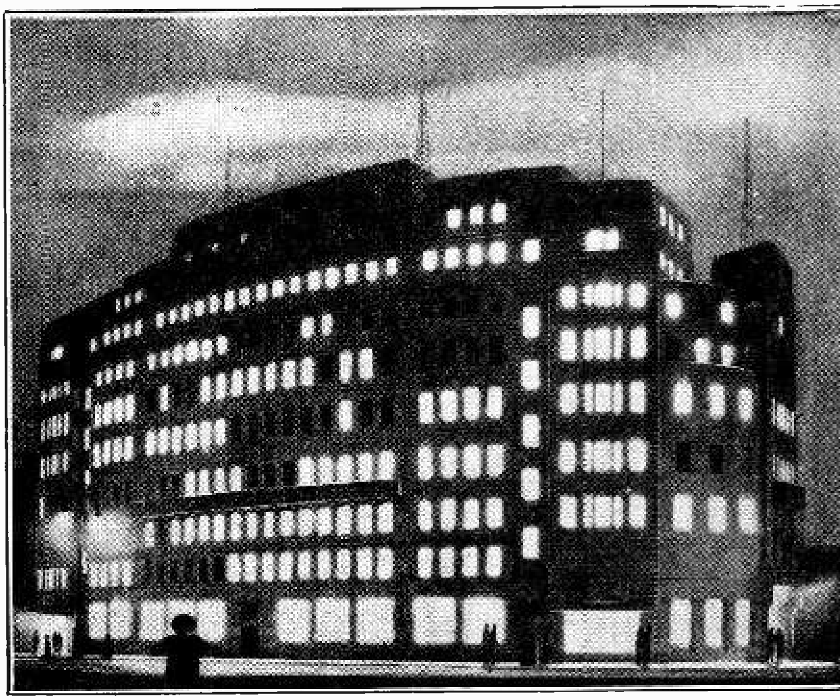
Writtle Set to Music.

A very ingenious idea has been hit upon for an orchestral background. At 9.20 p.m., when the historical panorama begins with the days of the earliest broadcasting at Writtle, we shall hear nothing more than the piccolo or triangle of the orchestra.

A Grand Crescendo.

Gradually, as the tale is unfolded, instrument after instrument will be added, until, towards midnight, the crescendo will have reached its peak and the whole orchestra will be playing.

"Goodbye to Savoy Hill" will be a document in sound—ten years in six chapters. It will be shown that the Great Strike of 1926 "put broadcasting on the map" just as the Great War established flying. Outside broadcasts, kaleidoscopes of memorable events, and a typical broadcasting day in miniature will go to compose this, the last programme from the old building.



AFTER DARK. The first night view of "Broadcasting House." More than half of the staff have already transferred from Savoy Hill and the move should be officially complete by the end of the month.

A Surprise.

The most moving portion of the proceedings will take place at 11.30 p.m., when, one by one, the studios will be cut off for ever in numerical order. Listeners will know in each case they are hearing sounds from that particular studio for the last time.

But Sieveking has prepared a surprise. People must not think that Big Ben sounds the Grand Finale. "Let them hang on for one more minute," says Sieveking, "and they will hear something which has a profound significance for every home in the world."

Ichabod.

Last week I made a dreary tour of a part of the old building which has already been deserted. I saw stripped offices in which the Talks Department had seen visions of an enlightened universe and young men had dreamed dreams of successful radio dramas.

Stacked in a corner of one room were twenty or more telephones. One of them gave a half-hearted tinkle.

It was all very sad.

Anglo-American Programmes.

TO-MORROW (Thursday) will inaugurate an important series of programmes shared jointly by British and American listeners. By special arrangement with the Columbia Broadcasting System of America, weekly features will be broadcast in both countries at 11 p.m. (G.M.T.), supplied alternately by America and Britain.

They are intended to be characteristic of the two nations, and will consist partly of talks and partly of impressionistic broadcasts from famous localities such as Leicester Square, London, and Broadway, New York.

The series will continue for at least eight weeks.

Why Not for Europe?

The scheme is an excellent one and makes one wonder whether the idea could also be exploited for improving relationships between the countries of Europe. The language difficulty is the great obstacle, though no doubt interpreters could help.

Music on Marble.

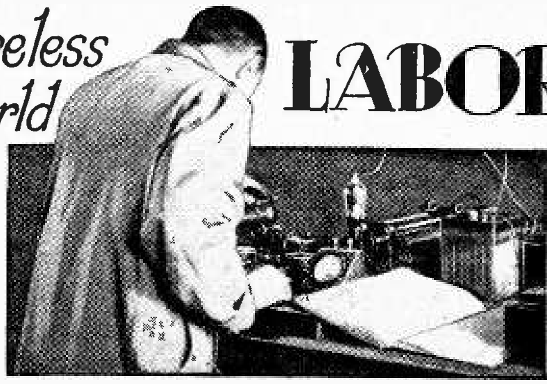
THE oldest piece of music ever transmitted by wireless will be included in a broadcast programme in May. This is a Hymn to Apollo, composed nearly three centuries B.C. It was discovered by a French archæologist at Delphi in 1893. He unearthed a slab of marble upon which the musical symbols were found inscribed. The Hymn is to be used by the B.B.C. for the Chorus of Priests in "Caractacus," by Peter Creswell.

Here's Your Chance.

NOW that we have all listened in carefully to the Adult Education Talks, the B.B.C. ought to arrange a competition for the best English translation of the Latin epitaph, inscription, encomium, or what you will, which glares at one from above the entrance hall of Broadcasting House.

It is strange that an inscription which will be comprehensible to perhaps 0.003 per cent. of visitors should occupy so much space in this all-British home of British broadcasting.

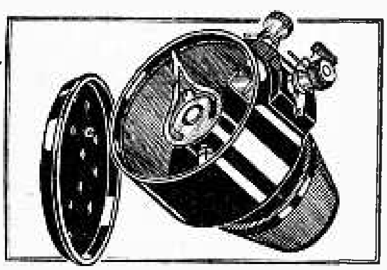
Wireless World LABORATORY TESTS



Review of New Radio Products.

NEW IGRANIC VOLUME CONTROL.

One of the most recent additions to the Igranic range of components is a 3-watt type wire-wound volume control which is available in sizes ranging from 1,000 ohms to 50,000 ohms. Since resistances of this type must necessarily be wound with a very fine gauge wire, especially in



New Igranic wire-wound volume control completely enclosed in bakelite case.

the higher values, particular care must be taken when handling them as the fine wire is easily damaged unless it is well protected.

In the case of the new Igranic component these precautions are unnecessary, for the resistance is entirely enclosed in a bakelite case fitted with a removable back cover liberally provided with ventilation holes.

The moving contact is very light but maintains an even pressure on the resistance at all points, and the action is delightfully smooth. A single-hole fixing brush is fitted and small insulating washers provided for mounting on metal panels.

A large diameter knob is fitted on which is engraved an indicating arrow, and the workmanship and general finish are of an exceedingly high standard.

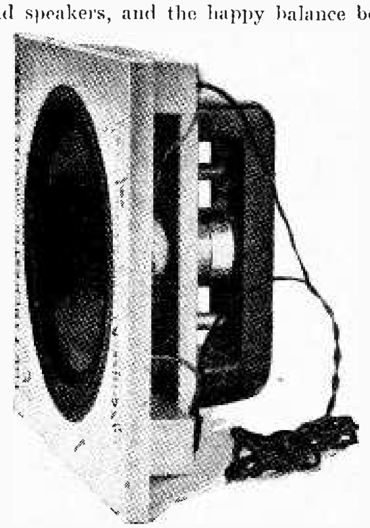
The makers are Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.4, and the price is 5s. 6d. for all values.

LANCHESTER "SPECIAL SENIOR" MOVING COIL.

The design of the chassis is similar to that of other Lanchester loud speaker units previously reviewed, in that the permanent magnet is of the bar type and the diaphragm is assembled in a miniature baffle board ready for fixing either in a cabinet or to a baffle of larger dimensions.

The magnet system is, however, of more generous dimensions, and the pole area is slightly greater than in the standard "Senior" model. As might be expected, this has resulted in improved sensitivity, but a more important result is the strengthening of the output in the lower register below 100 cycles. The characteristic, which is practically level between 100 and 1,000 cycles, actually rises about 5 decibels from 100 down to 50 cycles. This imparts a full round tone to the reproduction, which is unusual in a loud speaker with a diaphragm diameter of only 5¾in. It must not be inferred, however, that the quality is in any way "woolly," for an increased output between 1,500 and 4,000 cycles provides the requisite brilliance to give good balance of tone. There is an appreciable output at 8,000 cycles, but the output at this frequency is between 15 and 20 decibels lower than that at 5,000 cycles.

The reproduction of speech is of the natural and unforced quality which has become to be associated with Lanchester loud speakers, and the happy balance be-



Lanchester "Special Senior" permanent moving-coil loud speaker chassis.

tween bass and treble gives a rendering of music which is entirely satisfying to the ear.

Made by Lanchester Laboratories, Ltd., Spring Road, Tyseley, Birmingham, the price of the chassis alone is 3 guineas, or with input transformer £3 16s. 6d. Cabinet models are also available.

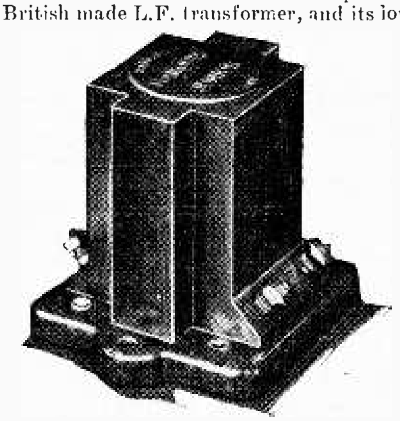
NEW SIEMENS BATTERIES.

The Full-o'-Power range of H.T. batteries made by Siemens Electric Lamps and Supplies, Ltd., 38-39, Upper Thames Street, London, E.C.4, has been augmented by a new series styled the Cadet model. These are made in sizes ranging from 60 to 120 volts, the prices being 5s. 6d. for the first-mentioned, and 11s. for the 120-volt size.

Two grid-bias batteries are included in the series, viz., a 9-volt priced at 1s., and a 16½-volt size at 1s. 9d.

MARQUIS JUNIOR L.F. TRANSFORMER.

This component has been developed to meet the demand for an inexpensive British made L.F. transformer, and its low



Marquis Junior L.F. transformer made in 1:3 and 1:5 ratios.

price of 5s. is made possible by the use of material for the core described as "Stranranis." It is housed in a neat walnut-finished bakelite case measuring 2¾in. × 2⅞in. × 2¼in. overall and is available in two ratios, viz., 1 : 3 and 1 : 5.

The measured primary inductance is 17.2 henrys with no D.C. flowing which, with 2mA passing through the winding, falls to 14.3 henrys. Best results will be obtained when the preceding valve is of comparatively low A.C. resistance, and where one L.F. stage only is employed preference should be given to the higher ratio component.

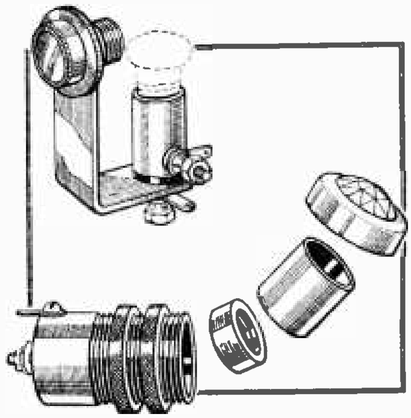
Supplies are obtainable from Chas. Swain, Ltd., 6 and 7, Queensway, Ponders End, Middlesex.

CLARKE'S ATLAS MAINS UNIT. Model D.C. 15/25.

Owing to an unfortunate misunderstanding the price of this D.C. eliminator, the test report of which was published in our issue dated March 30th last, was given as 35s. 6d., whereas the correct list price is 39s. 6d.

BULGIN SIGNAL LAMPS.

A. F. Bulgin and Co., Ltd., Abbey Road, Barking, Essex, have just introduced two very neat signal lamps which can be used, of course, either in battery or mains receivers. The type D9, which costs 2s. 6d., is an exceedingly neat fitting, consisting of a tubular body with a screw-on front in which is mounted a ruby glass window. The bulb is completely enclosed, and when the cap is removed a spring projects the lamp forward, thus greatly facilitating replacement should this be necessary. A loose tubular sleeve is interposed between the lamp holder and the screw cap to relieve the glass envelope of the bulb of the spring pressure.

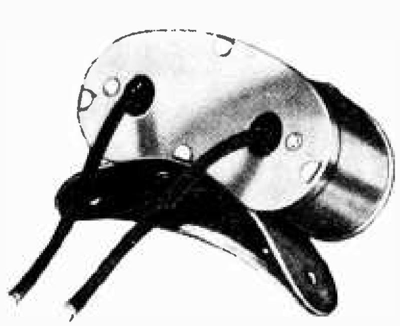


Two types of Bulgin signal lamps for panel mounting.

In the case of the D16 model the lamp is mounted parallel with the panel on a small right-angle bracket which serves as the panel fixing, and supports, also, the glass window. This is an exceptionally neat fitting, and the price is 2s. 3d. Special low-consumption bulbs, in 2-, 4-, or 6-volt types, made especially for the above signal lamps, cost 6d. each.

POWER LINK COMPENSATOR.

The electrical interference produced by small electric motors, even of the size fitted to vacuum cleaners, electric sewing machines, and other domestic apparatus, often attains a magnitude sufficient to render wireless reception impossible.



Weedon power link compensator for eliminating motor interference.

Occasionally the interference takes the form of troublesome crackling only, but, whatever its nature, it is necessary as a rule to switch off the offending machines when listening to broadcast matter. When this expedient is not convenient, the interference must be eliminated at its source. A very effective device for this purpose is obtainable now from J. H. Weedon and Co., Ltd., 26a, Lisle Street, Leicester Square, London, W.C.2. It is described as the "Power Link Compensator," and consists of a network of condensers which are connected across the brushes of the motor. The unit is very compact, and is applicable to either D.C. or A.C. machines, and the price is 7s. 6d.

One of these units was fitted to a small D.C. motor, which was a particularly bad offender. Without the unit connected wireless reception was impossible, as the interference completely obscured even the local programmes, but with the "Power Link Compensator" connected not only was reception possible, but there was not a trace of interference, and this with the set but a few feet away.

There is a leaflet with each unit giving full instructions regarding the correct method of fitting for either D.C. or A.C. machines, as this differs according to the nature of the supply. It is essential to follow these instructions implicitly.

T.C.C. ELECTROLYTIC CONDENSERS.

Home constructors will be interested to learn that the new T.C.C. aqueous-type electrolytic condenser which was reviewed in *The Wireless World*, dated January 13th last, and mentioned as being available to set manufacturers only, is now released for general use. It will be recalled that this is of tubular form and arranged for single-hole fixing with the positive connection at the base.

New T.C.C. aqueous-type electrolytic condenser for chassis mounting.

Three models are now available—an 8-mfd. and a 4-mfd. size for a working voltage of 440 D.C., and a 7-mfd. model for 460 volts D.C. working. The prices are 9s., 8s., and 9s. respectively.

FERRANTI UNIVERSAL VOLTMETER.

This is a three-range voltmeter suitable for use on either D.C. or A.C., and is undoubtedly the ideal instrument for the experimenter, the home constructor, and the service engineer. The meter in question is of the moving-iron type, and has three ranges, reading respectively 0-10, 0-100, and 0-250 volts. A D.C. current of 7.4 mA. gives a full scale deflection on both the 250-volt and the 100-volt ranges, so that the total resistance of the meter is 33,800 ohms on the higher range, and 13,000 ohms on the middle scale. On the 10-volt range the total resistance was found to be 102 ohms.

Measurements can be made to a satisfactory degree of accuracy both on A.C.

Ferranti three-range universal D.C. and A.C. voltmeter.

and D.C. supplies, as the knife-edged pointer permits close reading of the scale, and the average error is quite small, being no greater than the thickness of the pointer. A wide open scale is provided, the length of which is 2¼in. approximately.

The instrument is enclosed in a neat bakelite case with the terminals for the various ranges conveniently placed. At the reasonable price of £3 15s. this versatile instrument represents good value, for it serves the dual purpose of a D.C. and an A.C. voltmeter with three convenient ranges in each case.

The makers are Ferranti, Ltd., Hollinwood, Lancashire.

PARMEKO'S NEW PROGRAMME.

Partridge and Mee, Ltd., 74, New Oxford Street, London, W.C.1, manufacturers of the well-known Parmeko transformers and L.F. chokes, have recently moved into their new factory at Aylestone Park, Leicester, a step which is but a prelude to an extension of their activities. The first announcement of their forthcoming programme is the introduction of a 25-watt two-stage A.C. amplifier in kit form. It is intended primarily for use in large private establishments, public halls, and restaurants, and consists of a Mazda AC/HL valve coupled by a Parmeko constant inductance L.F. transformer to a Mazda PP.5/400 output valve.

High tension is obtained from a Mullard D.W.4 rectifier with the usual smoothing equipment.

The price of the complete kit, less valves, is £14 10s.

A new leaflet entitled "Latest Kabilok News," giving prices and a full description of cabinets for several popular kit sets, has just been issued by W. and T. Lock, Ltd., St. Peter's Works, Bath.

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.

WHERE ARE THE OSCILLATORS?

IN "Broadcast Brevities" in *The Wireless World* of March 9th, the query was put, "Where are the Oscillators?"

With much chagrin I am in a position to inform the writer. They are segregated in my district.

To put it plainly, we have not had a single programme from the London National unspoiled since the inception of that station. We have not had a complete programme from the Queen's Hall since the B.B.C. took it over.

It is the worst district I have yet heard in the whole country, and I have heard a few; it seems like radio Heaven to go to a friend's house in some other part, and probably only hear one or two squeaks all the evening.

Last year we had 159 whole evenings completely *blotted out*, and 49 partially so, due to a generator or other electrical machine. Very often oscillation commences with the first morning programme and finishes at midnight.

Clapham Common, London, S.W.11. E. LYTTON BROOKS.

SUPER-REGENERATION.

SOME time ago a questionnaire was instituted in your valuable journal, and one of the questions put before your readers was one regarding the application of the principles of super-regeneration more particularly to the higher frequencies.

There does not appear to have been any answer to this question published, but in view of the use by the Post Office on their short-wave telephone apparatus of this principle (vide *The Wireless World* report of the P.O. Exhibition at South Kensington) it would be interesting to learn from your readers whether the application of this system is practical and whether any refinements have been added to make the circuit more tractable than when it first appeared—at least as far as the amateur is concerned. The reference to this system in your article on 7½-metre reception prompted this enquiry, as, in the writer's hands, the system gave astonishing results—sometimes—on the broadcasting band.

Erith. H. AUGER.

QUALITY AND FREQUENCY RANGE.

THERE is proceeding at the present time a heated controversy in technical circles with regard to the low-frequency spectrum to be included in broadcast transmissions, but there are two or three vital issues in this discussion which appear to have been neglected. (1) Is it an established fact that the maximum enjoyment from a musical presentation is obtained when the frequency range of the instruments or voices covers the greatest width that the ear can accommodate? In other words, if really low notes of the order of 20 cycles and high notes of the order of 10,000 cycles are supplied by certain instruments, does the performance gain very appreciably in musical value?

(2) Should not a radio receiver be regarded purely and simply as a musical instrument operated on by artists at the studio using the ether as a medium?

(3) Is it essential that "mechanical" musical instruments as opposed to "electrical" devices should be played at the studio in order to satisfy the musical tastes of the listening public?

If the above be admitted, then surely, if a restriction of the frequency band is considered to be in the best interests for the future progress and popularity of the radio instrument, by all means let that step be taken. The piano-maker does not impose on us pianos of inordinate length to cover wide ranges of frequency; such a step would be regarded as impracticable. The performer and the listener must be content with the instrument as it is. Similarly, if radio sets must be bulky and expensive to cover a wide frequency range, by all means let that range be restricted. The artist must learn to develop a new technique to play upon this most modern of new musical instruments.

After all, it must not be forgotten that there is a great listening public growing up who are spending practically the whole of their artistic leisure in listening to musical sounds *via* the gramophone and the radio, and not by actual instrumental performances. The final criterion must be the sensation produced on the ear by certain sound combinations; whether these are produced by a piano, violin, or an ingenious electrical instrument is surely of secondary importance. L. R. MERDLER.

Acton, W.3.

AMATEUR TRANSMITTERS.

RECENTLY in the Press there has been a lot of talk about the restrictions put on amateur transmitters. I, for one, am ready to admit that the restrictions put on the British amateur are far too severe, but at the same time I would suggest that the amateur at the present moment is not making full use of the facilities available.

For example, taking conditious into consideration, I find that the amateur two years ago was much more active than he is to-day. In 1930 the week-end was a busy time for the amateur, and one could hear the same amateur "on the air" night after night. It was obvious that progress was being made.

To-day it is a different story. At the week-end some amateurs are on, but, with the exception of a few, none are on consistently.

The British amateur seems to be losing interest (or is it hope?), while more interest is being taken every day by the Frenchmen and the Dutchmen.

I would like to hear the opinion of other readers on what they believe is the cause of this falling away of interest in amateur radio.

In conclusion, a word of encouragement is due to those stations, and I know quite a few of them, who battle week in, week out, against bad conditions and other restrictions imposed upon them. Their untiring efforts will not be in vain. S. R. S.

VALVE PRICES.

IN your editorial note on valve price reductions in *The Wireless World* for March 23rd you state that "modern types (of valves) are now obtainable at what may be regarded as a reasonable figure for the *first time*." May we, however, venture to point out that our detector valve, HL.210, has been sold at 5s. 6d. for several months past, and our Economy Power Pentode valve, PT.225, has been sold for 12s. 6d.?

Isleworth, Middlesex. LISSEN, LTD.

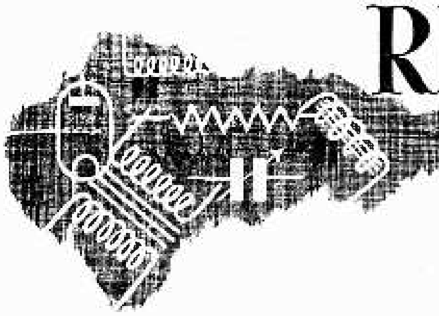
IF the valve manufacturers want to reduce the price of valves, why do they not do so like honest men without any hypocritical eyewash about tariffs? It is their business to fix the price and then sell at it if they can. We, the users, are in their hands, but we do not want our intelligence insulted into the bargain.

Is it not a fact that the only valves reduced in price are those in which they are meeting competition *in spite of the tariffs*?

There is little fear of English valves being beaten on their merits; anyone who has tried their foreign competitors will, I think, agree with this. The salesmanship associated with them is, however, another matter entirely. I presume, for example, that the price of screen-grid valves remains so high because of the poor sales. May I put it to the manufacturers that the demand is so poor because of the price? If the old price had been halved, the demand would have been trebled at least. Can they not see a little red gleam in the fact that such circuits as the "Autotone" are coming into vogue?

Deal, Kent. WILLIAM B. WEST.

READERS' PROBLEMS



Wattage Dissipation.

IT is asked why grid bias resistances of different wattage rating are specified for use in the grid circuit of the "Power Radio-Gram," in spite of the fact that the two elements composing the 600-ohm resistance are connected in series, and so the same current passes through each of them.

Now it is a fact that both the series connected resistors pass the same current, but, as they are of unequal ohmic value, the energy dissipated in them—and consequently the heating effect—is by no means the same. In point of fact, the 500-ohm resistor has to dissipate five times as much energy as the other; hence its higher wattage rating.

Eliminating the Aerial.

THERE still seems to be some misapprehension as to what constitutes a "mains aerial." In general, this is nothing more complicated than a connection, through a small condenser, between one side of the mains and the normal aerial terminal of the set; where the mains supply is alternating current matters are usually arranged as in Fig. 1, where two condensers are shown in series merely as a safety measure. This precaution is a wise one, although the average small mica condenser will often withstand indefinitely a pressure of 250 volts A.C.

The protective condenser C_1 should be of 0.002 mfd. or over, while C may have a capacity of anything between 0.0001 and 0.001 mfd., the best value being usually determined by trial and error. Similarly, an experimental connection should be made to each pole of the mains supply in order to determine which gives the best results.

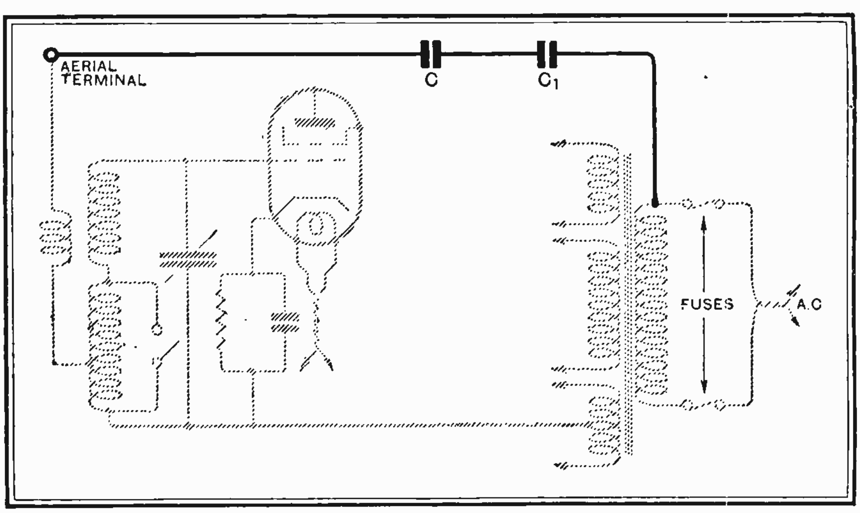


Fig. 1.—A "mains aerial" connection, with protective series condenser.

Moving Coil Displacement.

EVEN when a mains-operated receiver is designed on liberal lines, a certain amount of temperature rise takes place in a number of the components; consequently, when any untoward effect takes place consistently after a short period of working, it is logical to suspect that it may possibly be due to a minute displacement caused by expansion of one of the metal parts.

An effect of this nature is almost certainly responsible for a trouble described by one of our correspondents. He has a commercial three-valve A.C. set, fitted with a moving-coil loud speaker; on first switching-on the set, results are excellent, particularly so far as quality of reproduction is concerned, but after about ten minutes' working the output of the loud speaker is marred by an intermittent rustling or scraping sound, which is particularly evident when deeply-modulated musical passages are being reproduced.

We think it extremely likely that the moving coil of the loud speaker has become slightly displaced in the gap, and after expansion due to heating, it actually makes contact when the amplitude of its movement becomes large. The trouble should not be difficult to remedy, and in any case the correctness of our diagnosis could easily be checked by wiring up an external speaker.

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 on the next page.

Extra Transformer Needed.

A QUERIST, whose receiver is at present fitted with battery valves supplied with H.T. from A.C. mains through an eliminator, wishes to fit indirectly-heated valves throughout. His eliminator includes a 4-volt rectifying valve, and it is asked whether it would not be possible to supply the A.C. valves with heating current through the secondary winding of the transformer which feeds the rectifier.

We fear that this scheme is quite impracticable; the rectifying valve filament is at high potential, and, by connecting the receiver valves in the manner proposed, a difference of potential of some 200 volts or so would be introduced between their heaters and cathodes. Indirectly-heated valves are not intended to withstand this treatment.

Our correspondent will find it necessary to obtain an extra L.T. transformer with a 4-volt secondary.

Heater Connections.

IT has been noticed that in the "D.C. Three" (*The Wireless World*, March 16th and 23rd) the heaters of the D.C. valves are arranged in a somewhat unusual manner; instead of joining one side of the output valve to the detector, and so on to the H.F. amplifier, the detector valve is actually at the negative end of the chain. This is merely a matter of convenience; as stated in the constructional article, the heaters are wired in the order in which the valves are mounted on the chassis.

A querist who wishes to adopt the circuit of the "D.C. Three," but who intends to employ an entirely different layout and method of construction, asks whether it is necessary to follow this circuit detail. It is not; should he find it more convenient, the heating elements may be wired in the more usual sequence.

Stopping Threshold Howling.

A CORRESPONDENT submits for criticism the circuit diagram of a straightforward detector-L.F. set for short-wave reception, which he has just completed; the set is stated to function very satisfactorily, except that when full use is made of reaction a momentary "howl" takes place as the detector valve passes from the non-oscillating into the oscillating condition. Although this state of affairs does not greatly prejudice the performance of the receiver, our reader finds it annoying, and asks for some suggestions as to how it may be prevented.

This effect is always traceable to the action of H.F. currents in the L.F. amplifier, and in a short-wave receiver is often due to a stray reaction between the output and aerial circuits. By providing better filtering for the H.F. component in the detector anode circuit, a cure may often be effected.

We recommend that some or all of the various palliatives suggested in Fig. 2 should be tried. The value of the condenser C may be determined experimentally; it should be as large as it can be made without impairing reaction control, and a second condenser of about 0.0003 mfd. should be connected as shown between the low-potential end of the detector H.F. choke and earth.

A high resistance in the output valve grid circuit will help further to dispose of stray H.F. energy, while the combination of another H.F. choke and by-pass condenser in the output anode circuit should effect a certain cure if the measures already advocated should fail to bring about complete immunity from howling

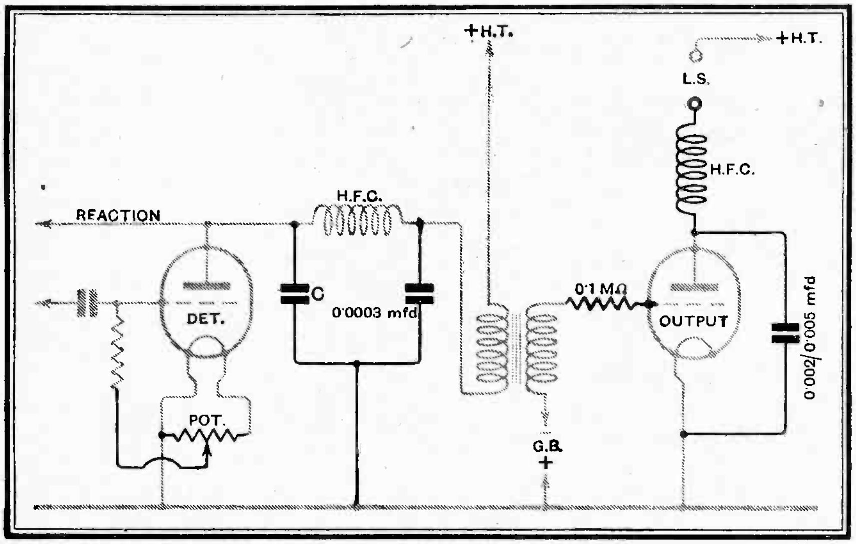


Fig. 2.—Additions made to a standard det.-L.F. short-wave circuit with a view to improving reaction and preventing threshold howling.

H.T. Battery Voltage.

ALMOST without exception, modern valves of the battery-fed type are intended by their manufacturers to be operated at a maximum anode voltage of 150. Consequently, this figure is generally mentioned in constructional articles, and it is an undoubted fact that best results are obtained when full H.T. voltage is applied.

However, the use of a pressure as low as 120 volts—or even 100 volts—is certainly not enough to account for complete failure, and indeed, a very good performance can be obtained with these lower voltages.

This is in answer to a reader whose newly built receiver has so far failed to receive any signals except those from his local station; he suggests tentatively that his difficulties might be due to the fact that the measured voltage of the H.T. battery is no more than 115 volts.

The most obvious result of a low H.T. voltage is a falling-off in power output; so far as sensitivity is concerned, at any rate in a set with reaction, there is usually surprisingly little audible loss as a result of reducing voltage by 20 or 30 per cent. below the maximum rating of the valves.

Screening H.F. Connections.

THE usefulness of metal-cased H.F. leads is now widely appreciated, but it is most unwise to apply the principle of screening indiscriminately when following a published design. By making serious additions to the amount of stray capacity existing in the various circuits—and this addition is bound to occur, however carefully the screening may be done—it may be found impossible to "gang" the set satisfactorily, and in any case the wave-range covered will be considerably reduced.

This is in reply to a reader who, following a published design, has encountered a certain amount of instability, and who suggests that the best way of overcoming the difficulty would be to screen *all* the H.F. leads. It is not clear whether he has modified the original design; if he has, a certain amount of screening may be advisable, but it should not be added indiscriminately; the leads that he suspects to be causing interaction should be screened one by one until stability is attained.

"THE WIRELESS WORLD"

Information Bureau.

CONDITIONS OF THE 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
(21st Year of Publication)

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

QUALITY OF BROADCAST TRANSMISSIONS.

WHAT is quality in broadcast reception? Where does it begin, and where does it end, in terms of frequency range? These are questions which are continually being raised and, as far as we can see, are likely to remain a topic of discussion for a long while to come. However scientifically we may endeavour to approach the question, the fact remains that, in considering questions of quality and endeavouring to arrive at a standard, we are dealing not, strictly speaking, with a science, but rather with an art, and the limits of our definition must depend to a considerable extent upon the tastes of the individual.

Conflicting Views

A contributor to our Correspondence columns last week put forward the proposal that a radio receiver might be regarded purely and simply as a musical instrument, and he observed that just as the piano does not cover all musical frequencies, so we must learn a new technique for the most modern of musical instruments—broadcasting; that the final criterion must be the sensation produced on the ear by certain sound combinations; and that the question as to whether broadcast reception covered the full musical range or not was a matter of little importance.

This week another contributor adopts an entirely different view, stating that those who consider that a cut-off frequency at 5,000 cycles is adequate to ensure first-class quality are either hopelessly bigoted or devoid of the ability to pick out the good from the bad.

It seems to us that we shall be obliged to compromise somewhere. According to investigations carried out at the Bell Laboratories in America recently, it is revealed that there are only two instruments which can be transmitted faithfully through a wireless system which cuts off at 5,000 cycles; all others suffer to a greater or lesser degree.

The present congestion of the ether on the broadcasting band in Europe appears to be the principal limiting factor in the range of frequencies which it is practical to broadcast, because already great difficulty is being experienced in endeavouring to extend the effective separation between stations beyond 9,000 cycles. The B.B.C. favours 10,000 or 11,000, and would further extend this if it were reasonably possible to do so, but it is recognised that, for the time being, this is as far as it is practical to go without first limiting the number of stations in Europe. On the receiving side, too, there are, we believe, comparatively few commercially produced receivers and loud speakers, as a unit, which could really reproduce faithfully if the frequency range of transmission were extended beyond the present limits.

Which Is It To Be?

As we stand to-day we have to face the fact that broadcast transmissions and gramophone reproduction are tending to swamp every other form of musical entertainment, so that the generation now growing up is likely to have little opportunity of hearing music direct, and will take as a standard the quality of electrical reproduction. All this brings us to the conclusion that we have either to try to copy the standard which direct musical performances provide, as far as practical limitations permit, or we must be content to adopt a new standard with a convenient arbitrary cut-off in the frequency range and cease to worry about striving to attain perfect reproduction of the original performance. Which is it to be?

More About The Diode

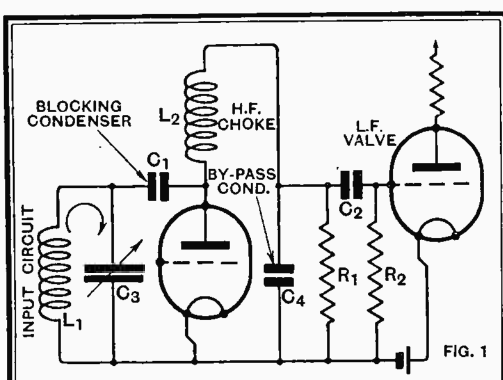
An outline of highly interesting experiments recently conducted with the new form of diode which was described in a previous article. The author now deals with some practical applications.

Interesting New Circuits.

By H. L. KIRKE.

SINCE the article on diodes was written[1] some further experiments have been made which may be of interest to readers. It has been found that when a diode is used, if the output impedance at modulation frequencies is less than the output impedance at D.C.—that is to say, the rectified carrier—the peak percentage modulation with which the detector can deal faithfully, is reduced.

In a diode the output impedance to modulation frequencies consists of all the impedances to earth which terminate at the anode of the diode. Fig. 1 shows a diode which is not directly coupled to the first L.F. valve. In this circuit, for the direct-current rectified component of the carrier frequency, the output impedance of the diode consists of R_1 only. At modulation frequencies R_2 in series with C_2 is in parallel with R_1. In other words, current flows through both these resistances, while the input circuit and input blocking condenser in series also form part of the diode output impedance; that is to say, a modulation frequency current will pass through C_1 and L_1, L_1 being a negligible impedance at audio frequencies compared with C_3. The condenser C_2 should have negligible impedance compared with R_2 at all audio frequencies, and therefore R_2, as far as modulation frequencies are concerned, is directly in parallel with R_1.



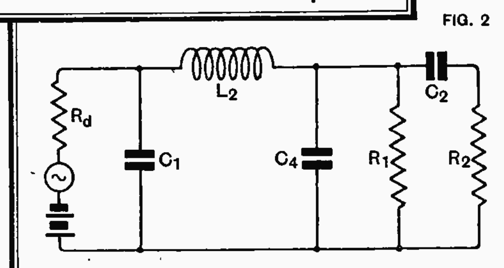


Fig. 1.—A diode circuit resistance capacity-coupled to the first L.F. valve. Fig. 2.—The equivalent circuit of Fig. 1 as regards modulation frequency.

We can redraw the circuit from the point of view of the output impedance of the diode as in Fig. 2, where the diode is now represented by a resistance R_d, a battery representing the rectified carrier, and a generator in series. We must remember that this resistance R_d is not a true resistance, and that in it current can only flow in one direction; in other words, the peak value of the alternating current cannot exceed the direct current. The direct current will be equal to $I_{DC} = E/R_d + R_1$. For 100 per cent. modulation the peak value of the alternating current would normally be equal to the direct current, but in the case shown we have an additional current flowing through R_2 which is in parallel with the alternating current flowing through R_1, so that the peak value of the total alternating current flowing through the rectifier would be greater than the direct current. This is not possible, and therefore distortion results. This is shown in Fig. 3. If the diode was so efficient that its impedance could be neglected in comparison with R_1 and R_2, then the maximum modulation which can be faithfully dealt with by the circuit will be proportional to the ratio of the D.C. to A.C. impedance. Other cases can, of course, be worked out. It is only proposed here, however, to point out that if indirect coupling is used between the diode and the L.F. valve, R_2 must be made very high compared with R_1. For instance, if R_1 is 0.5 megohm, R_2 should be at least 5 megohms, which is normally too high for a grid leak. From the above the advantage of the direct-coupled diode circuit will be apparent.

For higher modulation frequencies the condensers C_1 and C_4, *plus* any stray capacities to earth, also form part of the output impedance, and all these capacities should be kept as small as possible, although this factor is not of the first importance, because, first, the percentage modulation at high modulation frequencies is seldom very great, and, secondly, the current in the condenser is in quadrature with that in the resistance; therefore, all that would result from shunted capacity is a reduction of efficiency at the high modulation frequencies.

It might be thought that a circuit consisting of

[1] See *The Wireless World*, February 3rd, 1932.

More About the Diode.—

C_1, C_4, and L_2 might be made into a properly terminated filter circuit. In such a filter circuit the value of inductance would have to be $L=2Z/\omega$ where ω is the cut-off frequency, Z the output impedance, and C would be given by the formula $C=1/\omega Z$.

Supposing we wish to make our cut-off frequency 8,000 cycles per second, i.e., $\omega=50,000$ approximately, and make $Z=0.5$ megohm, C_1 and C_2 would have to be 40 $\mu\mu$F. each, and L would require to be 20 henrys (for $Z=10^5$, $L=4$ henrys, and $C=200$ $\mu\mu$F.). The capacity of a choke having an inductance of 20 henrys would be considerable, and would certainly be such that it would cease to act as a choke at high modulation frequencies. If we increase the cut-off frequency, then both L and C are decreased in proportion to the increase of frequency.

It is not, therefore, feasible to design a truly terminated filter circuit for such high impedances at such high frequencies. The best we can do is to use a choke having as high a self-inductance and as low a self-capacity as possible in order to keep back radio-frequencies and to make C_1 and C_4 as small as possible to avoid by-passing the higher audio frequencies.

It is now becoming the practice among many set designers to incorporate a low-pass filter circuit in the chain in order to remove the unpleasant heterodyne note caused by the beating of the received carrier with the carrier of the station on the adjacent channel. It is very desirable to place this filter as early as possible in the chain in order that it, and any sidebands from the interfering station, do not get rectified with the interfering carrier in any of the low-frequency valves. Such rectification would cause the interference to become audible as intelligible speech or music instead of the familiar grasshopper sounds which are the actual sidebands of the distant station heterodyning with the local carrier. It is not, as has been shown above, feasible to place this filter circuit before the first L.F. valve, but it is desirable to place this, or some other filter circuit, immediately following the first L.F. valve, where the impedance is relatively low, as, even if it is not desired to go to the complication of a complete low-pass filter, the best filter circuit which can be provided between the detector and the first L.F. valve is insufficient for the complete removal of high-frequency potentials from the L.F. circuits, particularly on the long waveband, and an additional radio-frequency filter after the first L.F. valve is desirable.

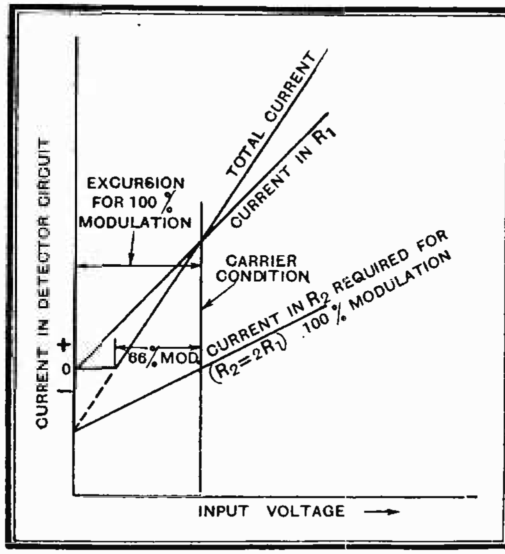


Fig. 3.—Showing the relation between input voltage and current in the detector circuit under various conditions.

A high-frequency choke in the anode of the valve, with a 0.0005 mf. condenser between anode and earth, will provide a reasonable filtration for the first L.F. anode circuit. The 0.0005 mfd. condenser may be split into two condensers of 0.00025 to 0.0003, one of which may be connected from anode to earth, and the other to earth from the end of the choke remote from the anode.

Care should be taken that the choke in the anode circuit and the choke in the grid circuit (anode circuit of diode) do not form part of long-wave resonant circuits which can cause the first L.F. valve to self-oscillate through the inter-electrode capacity or mutual coupling. This form of parasitic oscillation may cause serious distortion.

Next Week—

21st BIRTHDAY NUMBER

THE WIRELESS WORLD celebrates its 21st Birthday this month and the issue of next Wednesday, April 27th, will be a special Birthday and Progress Number recording the outstanding advances made in wireless from the early days to the present time. A special feature of the issue will be an

IDEAL STATION FINDING CHART

presented as a folding supplement in colour. This chart will be of interest to all readers as providing a really accurate calibration for any type of receiver.

The issue is one for which a big demand is anticipated so that we hope our regular readers will make sure of their copies in advance, in order to avoid any risk of disappointment.

NEW FIELD RECTIFIER.

By
W. STOCKMAN.

Field Winding Excitation Without a Mains Transformer.

AN interesting new mains rectifying valve with a high-voltage heater is now available. Dispensing with a transformer, this valve can be used to energise the field winding of a moving-coil loud speaker, thus effecting an economy of apparatus.

IN the series of valves with indirectly heated cathodes for direct connection across the mains—the so-called "high-voltage" valves—there have recently appeared two new examples. In the review of certain of these valves in this journal[1] it was suggested that they were especially useful as far as D.C. supplies are concerned, but in the case of A.C. supplies it is economical enough to step down the voltage of the mains by means of a transformer. This holds true, of course; but now that the high-voltage rectifying valves have appeared we have to make up our minds as to the best way in which these valves must be used.

The writer has come to the conclusion that the circuit of Fig. 1 is best. As can be seen, we are here concerned with half-wave rectification exclusively. The plate of the rectifier is connected to one pole of the mains, and the cathode through the load to the other. The heater is fed directly. Across the output is connected a large reservoir condenser C, and the complete circuit is undoubtedly an extremely simple one.

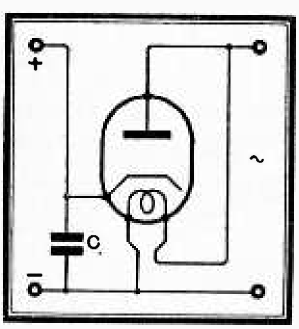


Fig. 1.—A satisfactory method of connection for a high-voltage rectifier. The heater is joined directly across the mains supply.

The rectifier shown in Fig. 1 is intended for feeding the field winding of a moving-coil loud speaker. Hitherto it has not been possible to dispense with the mains transformer if one wishes to use a valve rectifier.

High-voltage Heater.

This has now been made possible by the introduction of a rectifying valve with high-voltage heater. The cost of a complete field rectifier is accordingly equal to that of the rectifying valve with its holder and a condenser (8-mfd. electrolytic type was found to be satisfactory).

A moving-coil loud speaker with a field-current consumption of some 50 milliamps. at 220 volts was connected up to the rectifier, and, after switching on, the output voltage under load was measured to 215 volts. The hum caused by the field ripple was not so strong as to be the least detrimental to quality; in fact, the hum from the receiver—a commercial product—was very much stronger. In the test described above the mains voltage was 220.

In Fig. 2 can be seen some regulation curves of a similar high-voltage rectifying valve, the "Ostar" EG50. Two values of reservoir condenser have been shown, namely, 4 and 12 microfarads respectively. Apparently the heater voltage has a very large influence upon the output. Accordingly, to obtain the maximum possible rectified wattage, the A.C. input voltage should be maintained at the full rating of the valve, and at the same time the condenser shunted across the output terminals should be of high capacity.

High-voltage rectifying valves of the type under consideration have, of course, other spheres of usefulness, but it should be realised that, when they are used to supply anode current, there will be direct metallic connection between the mains and the receiver circuits. With the more conventional type of rectifying valve, isolation is provided by a double-wound transformer.

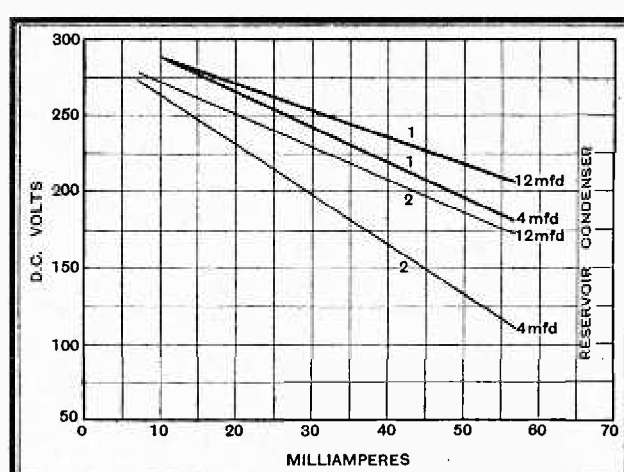
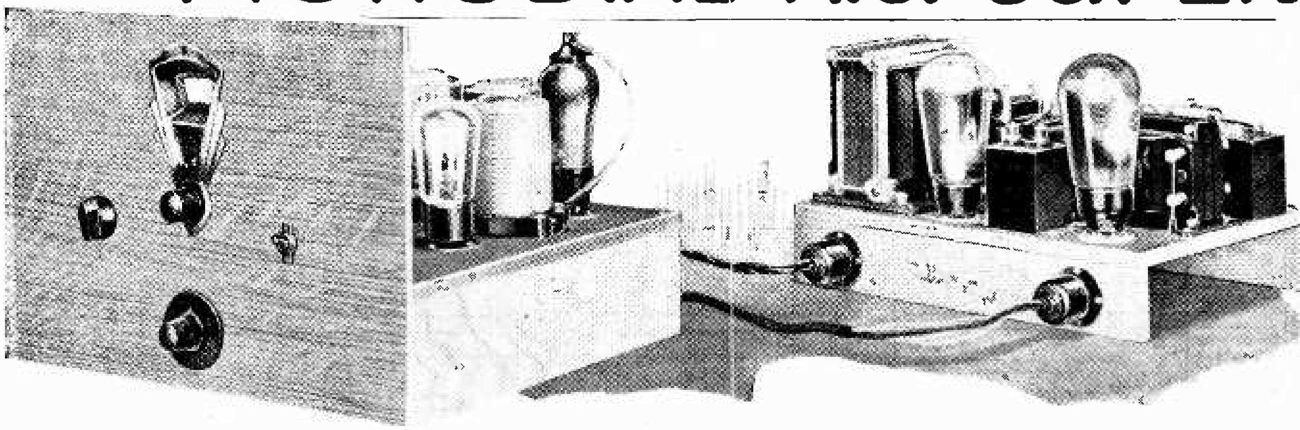


Fig. 2.—Characteristics of the "Ostar" EG50 rectifier. Curves 1 heater volts at 225. Curves 2 heater volts at 215. The heater current is about 32 mA.

[1] High-voltage Valves, December 23rd, 1931

MONODIAL A.C. SUPER



Constructing the New Highly Selective Superheterodyne.

By W. T. COCKING.

CONTINUING the description of the Monodial A.C. Super, it will be observed that there are two separate units—the receiver and power chassis. For this there are several reasons, of which the most important is that the constructional work is simplified owing to the reduction in size and weight of each individual unit. Where the superheterodyne is to be fitted to a cabinet of the radio-gramophone type, moreover, the two-unit construction lends itself to an economy of space, since the receiver can be placed on one shelf, with the power unit and loud speaker on the other. A further point is that the mains equipment and output stage are available for use with other receivers if desired, and any modifications to the output stage which might be necessary for abnormally large volume are more readily carried out.

WHY the building of the Monodial A.C. Super described theoretically last week is unusually easy is partly explained by the use of two separate units—the receiver and its power chassis. Full constructional details of this set of highly advanced design appear in this instalment.

The first six valves are all mounted on the receiver chassis, which is built of aluminium-covered ply-wood mounted on battens. This special wood is known as Venesta, and may be obtained with the large holes already cut. If undrilled material is obtained, however, these large holes, which have a diameter of one inch and are for the valve holders, can be readily cut with an ordinary brace and bit, since the aluminium covering is only thin. The first step in the construction is to mount the base on the battens, and then the valve holders, taking care that none of the valve legs come into contact with the metal covering of the wood. The components above the baseboard should next be mounted with the exception of the gang condenser, and it may be remarked, in passing, that the aluminium covering to the base is easily pierced with a pricker.

The under-base components are then screwed in position, and the wiring begun. With the exception of the three leads which run to the gang condenser, all the coil connections should be made first. No. 22-gauge tinned copper wire is used and run in small-diameter sleeving, and in most cases the leads are taken directly from point to point by the shortest path. Few soldered joints are necessary, and the metallised resistances are supported entirely by their connecting leads to other components; care should be taken, however, to see that the leads to these resistances do not come into contact with the metal cases of fixed condensers.

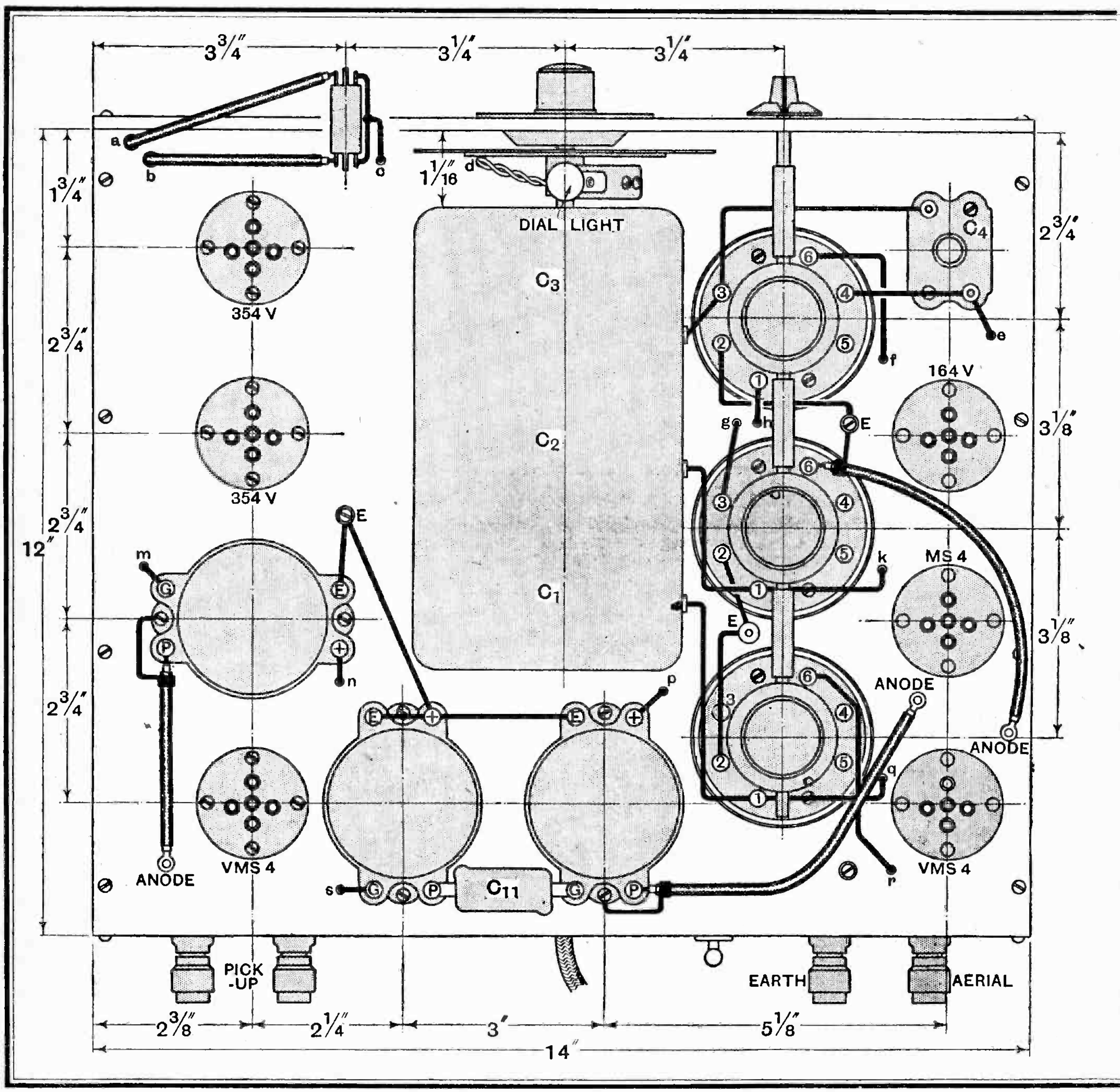
A separate pair of twisted leads must be run to each valve holder and the dial light for the heater wiring in order to avoid an excessive voltage drop; at one end the seven leads are twisted together and inserted into the junction block for connection to the inter-unit cable. Screened leads are used for the anode connections to the three screened-grid valves, and for two of the connections to the radio-gramophone switch. The type of screening recommended is that in which a piece of large-diameter sleeving is provided with a braided-metal covering. The material should be cut to the correct length, and the metal covering pushed back at each end so that about one-eighth of an inch of the sleeving projects. A few turns of tinned copper wire should then be wrapped round each end and soldered in position to prevent any possibility of the covering coming into contact with the internal wire. The screening should, of course, be earthed by joining one end to a convenient earth point on the chassis.

Having completed the wiring, three leads should be attached to the three terminals of the gang condenser, and this component secured to the chassis. The contact of the condenser with the metal-covered baseboard

Monodial A.C. Super.—provides a sufficient earth connection, but care should be taken to see that the holding-down screws are well tightened up. The three connections to the coils can now be completed, and the dial and front panel placed in position.

The Inter-unit Cable.

The receiver should now be complete with the exception of the inter-unit cable, which is terminated at one end by a five-pin plug and at the other by the junction block. The pins on the plug are arranged in the same way as on a valve base, and, in fact, it fits into an ordinary valve holder; it is convenient, therefore, to refer to them individually by the familiar valve-pin names. In connecting up the cable great care should be taken to avoid errors and short-circuits, and it will be a help in this respect if the colour code shown on the drawing is adhered to. The black and red wires should be used for joining the negative and positive

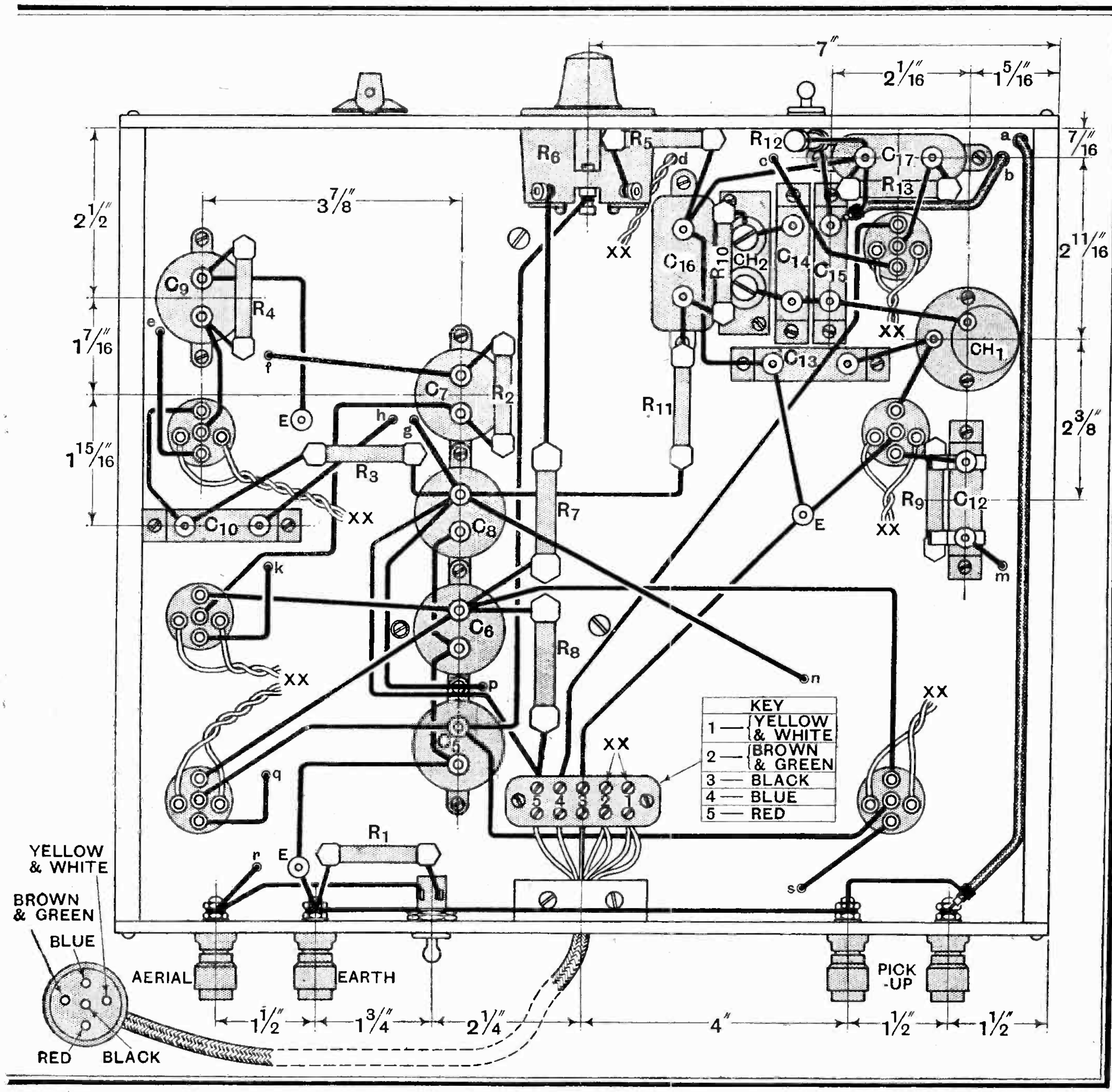


Dimensional data of the components above and beneath the baseboard

Monodial A.C. Super.—
H.T. lines to the cathode and anode pins respectively of the plug, while the blue wire must connect between the anode of the tone-corrector valve and the grid pin.

Since a seven-wire cable is used, and there are only five connections, four wires will remain. Of these, the white and the yellow wires are connected together at each end, and the two wires are then treated as a single lead and used for the connection between one side of the receiver heater wiring and one heater pin in the plug. Similarly, the green and brown wires are joined together at each end, and provide the other lead between the heater wiring and the other heater pin. Two wires in parallel are used for the heater connections in order to avoid an excessive voltage drop along the cable, and for the same reason it is important to note that a longer cable than that specified should not be employed.

The power unit is built upon a chassis of aluminium-covered ply-wood, and carries two valve holders for



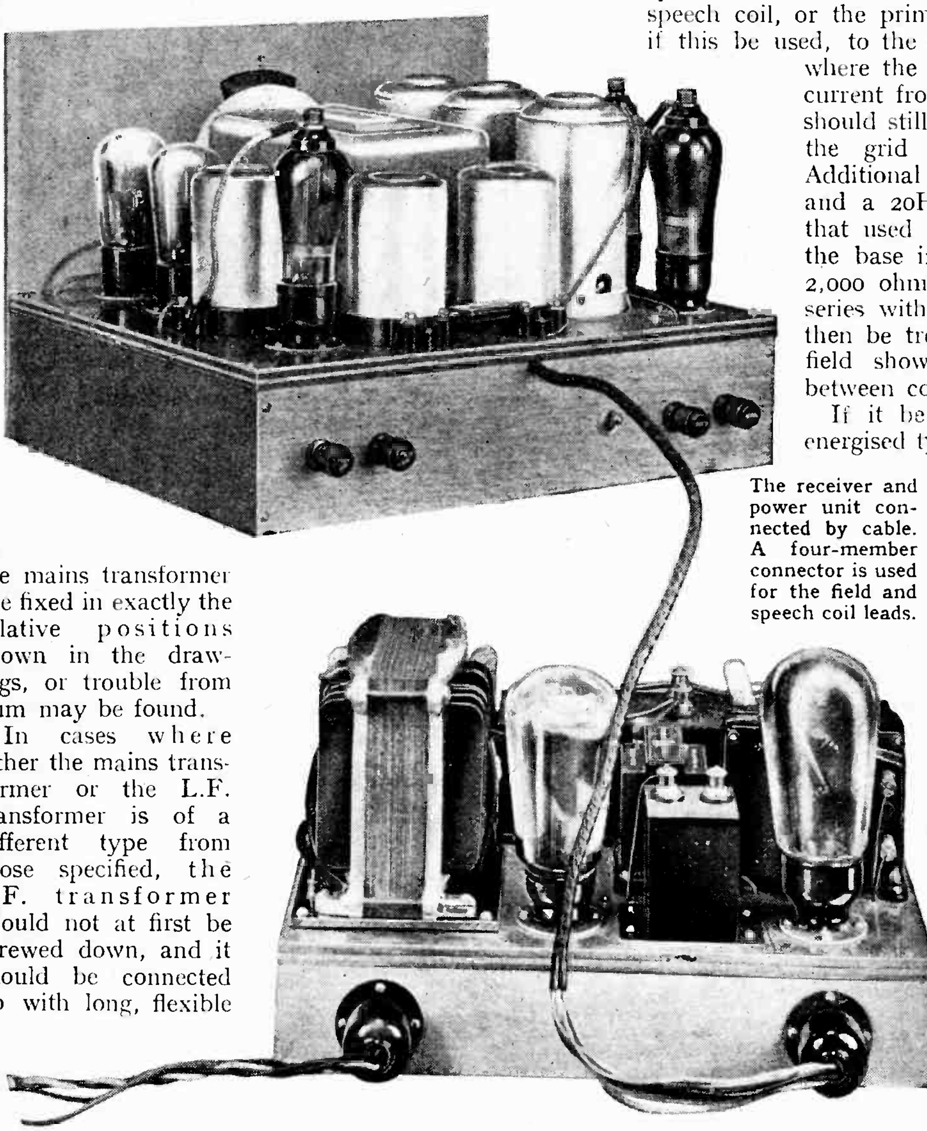
.ctically all the wiring is carried out on the underside.

Monodial A.C. Super.—

the output and rectifier valves. Two further valve holders are mounted on the rear supporting batten for the receiver and loud speaker plugs, and this vertical mounting is adopted in order to prevent confusion with the valve holders proper. Since the L.F. transformer is fitted with reversible feet, it can be mounted on its side in the correct position without difficulty, but care should be taken to see that both this component and the mains transformer are fixed in exactly the relative positions shown in the drawings, or trouble from hum may be found.

In cases where either the mains transformer or the L.F. transformer is of a different type from those specified, the L.F. transformer should not at first be screwed down, and it should be connected up with long, flexible leads. When the set is first tried out it can then be readily moved into the position of minimum hum, and once this is found it can be screwed down and permanently wired up. It should be emphasised that this procedure will be unnecessary if the specified components be employed.

The mains transformer is fitted with coloured leading-out wires instead of terminals for the various secondaries, and care should be taken to connect these up correctly in accordance with the colour code supplied with the transformer. The leads are of amply sufficient length to reach to the various connecting points without difficulty. The mains terminals are mounted on a strip carried by the transformer itself, and the mains connections are, therefore, taken directly from them.



The receiver and power unit connected by cable. A four-member connector is used for the field and speech coil leads.

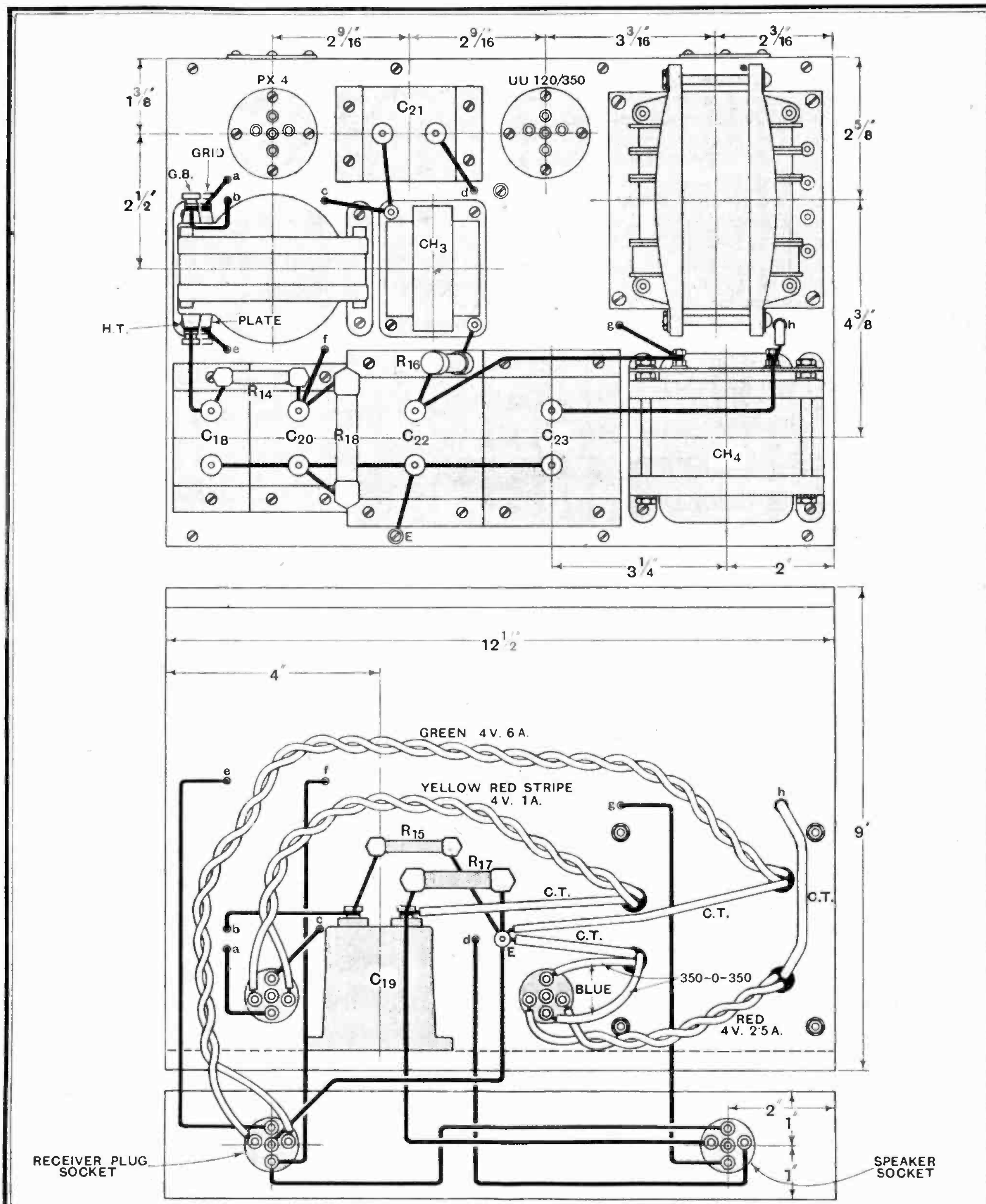
Only four of the sockets of the valve holder used for the speaker connections are employed, and in the plug which fits this socket the field winding of the speaker is wired to the grid and anode pins, and the speech coil, or the primary of the output transformer if this be used, to the two filament pins. In cases where the speaker does not require field current from the set the plug connections should still be retained, but the wiring to the grid and anode sockets omitted. Additional smoothing will be necessary, and a 20H. choke of a type similar to that used for the output choke, fixed to the base in the space left for it, and a 2,000 ohms 10 watts resistance wired in series with it. This combination should then be treated as if it were the speaker field shown in the circuit and wired between condensers C_{20} and C_{22}.

If it be desired at times to use an energised type of moving-coil speaker and at others to use a non-energised type, then the power-unit connections should all be made exactly to specification. The energised speaker should be connected in the normal way to its plug connector, but the non-energised speaker should be wired to the filament pins of another plug, to the grid and anode pins of which are connected the series combination of a 20H. choke and a 2,000 ohms 10 watts resistance. In this way the alterations required to the smoothing system for the different types of speakers will automatically be made on inserting the plugs.

Throughout the apparatus all nuts should be well tightened up so that secure connections are made, but care should be taken, in the case of the valve holders, not to apply too much force, or wires may be cut through. The coil and condenser covers should fit tightly, and screened leads should not be allowed to rub against metalwork, for, even if both be earthed, an intermittent contact may cause noisy reception.

The wiring should be carefully checked over before putting the set into operation, and it is a wise plan to check the continuity of the various circuits with the aid of a voltmeter and battery, for it is easy to overlook

THE ELIMINATOR DETAILS AT A GLANCE.



The power unit from above and below. It is important that the relative dispositions of the L.F. and mains transformers should be maintained.

Monodial A.C. Super.—one of the many earth connections. It is a safe plan, also, to test the various components before building the set, as it eliminates one possibility of trouble. Coils should be tested for continuity, and condensers to make sure that there is no internal short-circuit.

If desired, a switch of the quick-make-and-break type can be joined in series with one of the mains leads, and mounted on the power unit. The position of such a switch is in no way critical, but on no account should the mains leads be allowed to wander near the output valve or the L.F. transformer. When the receiver is first switched on hum will be found, and will persist for, say, thirty seconds, after which it will gradually die away as the early valves warm up.

The set will not function for half a minute or so after the hum has disappeared, for the oscillator valve takes the longest to warm up, and until it is working nothing at all will be receivable. Apart from its circuit constants, the exact frequency generated by the oscillator depends to some extent upon its anode voltage and heater temperature. As completely stable conditions are not reached for some time after the set is switched on, the oscillator frequency may wander slightly during the first quarter of an hour or so. Any station which is tuned in during this time, therefore, may require slight retuning when conditions have become completely stable, but thereafter stability should be maintained indefinitely.

Although results should be obtainable as soon as the construction has been completed, correct functioning cannot, of course, be expected until the various preliminary adjustments have been carried out. These adjustments are a matter of the first importance, for, if the receiver be correctly built, its success depends entirely upon the accuracy with which they are carried out. They will therefore be dealt with at length in the next instalment.

*For the convenience of readers constructing the **Monodial A.C. Super**, full sized blue prints of the complete layout and wiring diagrams on pages 392-3 and 395 are available from the publishers at 1s. 6d. post free.*

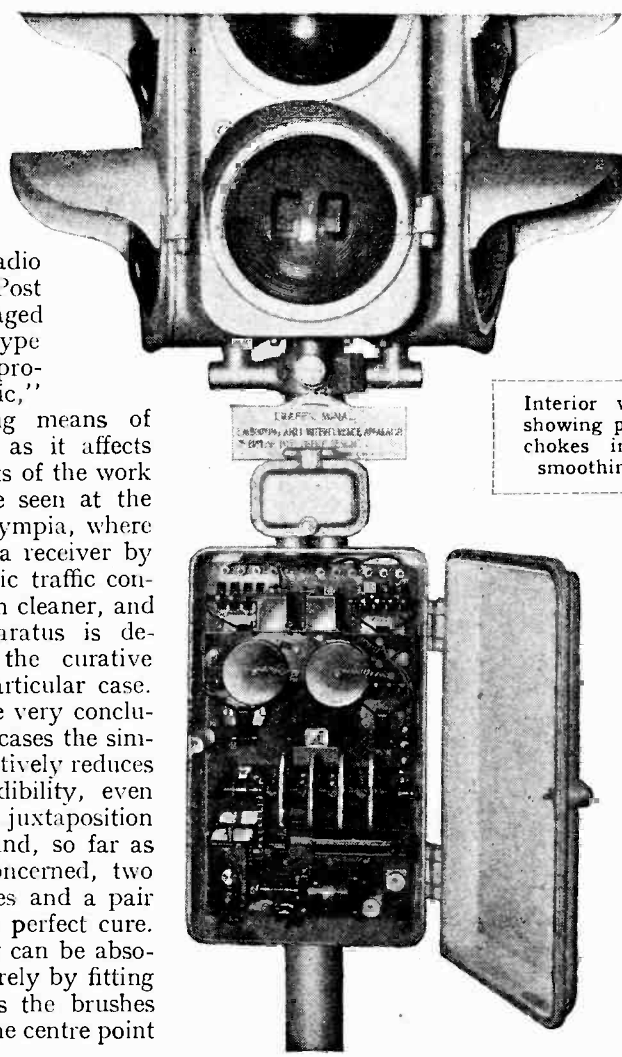
THE POST OFFICE TACKLES STATIC.

Investigation of Interference Problems.

FOR some time past the Radio Section of the General Post Office has been actively engaged in investigating that vexing type of interference described so appropriately as "man-made static," with the object of evolving means of ameliorating the evil so far as it affects wireless reception. The results of the work so far accomplished is to be seen at the Ideal Home Exhibition at Olympia, where the interference produced in a receiver by such offenders as an automatic traffic control signal, a domestic vacuum cleaner, and high-frequency medical apparatus is demonstrated, together with the curative measures evolved for each particular case.

These demonstrations prove very conclusively that in the majority of cases the simplest silencing equipment effectively reduces the background to bare audibility, even when the receiver is in close juxtaposition to the offending apparatus, and, so far as the traffic-control signal is concerned, two suitably designed H.F. chokes and a pair of 1-mfd. condensers effect a perfect cure.

A domestic vacuum cleaner can be absolutely silenced electrically merely by fitting two 2-mfd. condensers across the brushes of the motor and connecting the centre point to the frame of the machine.



Interior view of traffic-control signal showing position of the two special H.F. chokes in circular bobbins with the smoothing condenser mounted above.

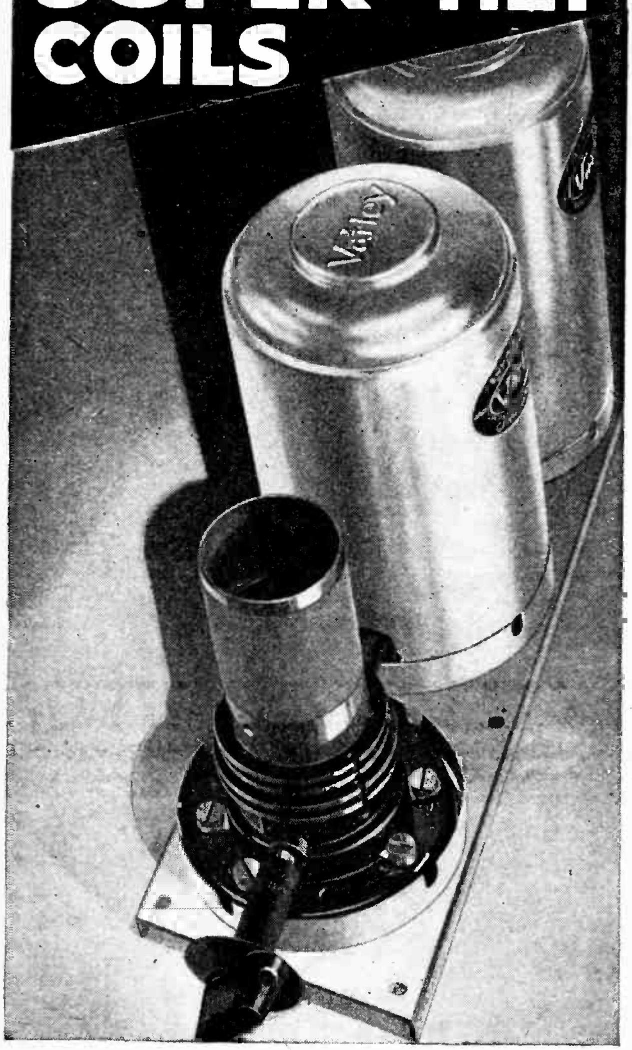
The treatment of high-frequency medical apparatus is not so straightforward as it has been found necessary to effect certain structural alterations in the apparatus. The work carried out so far in this direction has produced results such as to enable the Post Office engineers to indicate to manufacturers where quite definite improvements can be made, which, when adopted, will go far to ameliorate the interference arising from this source

Investigations have been extended to the surface trolley cars and a special heavy-duty H.F. choke developed, which, it is claimed, considerably reduces the interference produced by this type of electric traction.

H. B. D.

NEW 'SQUARE PEAK' SUPER-HET COILS

REGD TRADE MARK



With these coils **single knob control** is obtained without using any "padding" condensers on the medium waves, and with only one additional fixed condenser on the long waves. The intermediate frequency is 110 k.c.

Supplied as a complete unit comprising single control aerial, intervalve and oscillator coils. List No. BP19. 3-gang unit on aluminium base-plate - - - **30/-**

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Say Player's Please

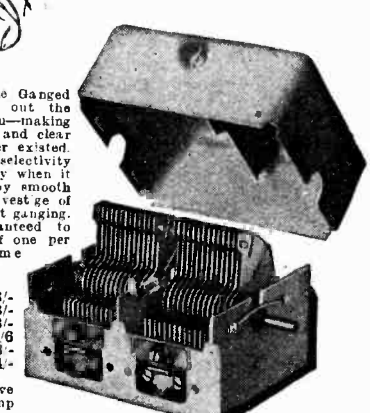
PLAYER'S NAVY CUT

They always do!

N.C.C.60

CLEAN and SHARP as *the Scissors' Clip*

British Radiophone Ganged Condensers pick out the stations for you—making each one as sharp and clear as though no other existed. This is the kind of selectivity you want especially when it is accompanied by smooth steady action, no vestige of slipping and perfect ganging. Accuracy is guaranteed to within one half of one per cent—a supreme achievement.



2-Gang Condenser	18/-
Dustproof Cover	3/-
3-Gang Condenser	28/-
Dustproof Cover	3/6
4-Gang Condenser	38/-
Dustproof Cover	4/-

Drum Drive 8/6.

Oxidised Silver Escutcheon and Drive Assembly complete with pilot lamp attachment, 5/-

RADIOPHONE GANGED CONDENSERS

THE BRITISH RADIOPHONE LTD., Aldwych House, Aldwych, W.C.2

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 presented, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Problems 35 to 37 have been previously given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

QUESTION 35.—**An unmodulated carrier wave of 1,000 kilocycles frequency has an amplitude of 0.8 volt at the grid of a detector valve. If it is now modulated 50 per cent. at audio frequency, what is the voltage amplitude of the L.F. modulating wave?**

Answer.—0.4 volt.

The "percentage modulation" of a high-frequency signal is defined as 100 times the ratio between the peak value of the modulating frequency wave and the peak value of the non-modulated carrier wave. In this case the latter, or H.F. carrier, is known to have an amplitude of 0.8 volt at the grid. The amplitude of the L.F. or modulating component is, however, unknown; let us call it x volts. Since from our definition,

$$50 = 100 \times \frac{\text{peak voltage of modulating wave}}{\text{peak voltage of carrier wave}}$$

we may write

$$50 = 100 \times \frac{x}{0.8}$$

Solving this equation for x, we readily find that

$$x = \frac{50}{100} \times 0.8 = 0.4.$$

QUESTION 36.—**What is the unmodulated R.M.S. input voltage to the grid in Question 35, and what will be the extreme values of R.M.S. voltage variation at the grid during the modulated signal?**

Answer.—0.566 volt R.M.S. Extreme values are 0.848 and 0.283 volt R.M.S.

The first part of this question is easily answered. We know that the voltage amplitude of the unmodulated carrier at the grid is 0.8 volt. Its R.M.S. or effective value will therefore be 0.707 of this amount, or 0.566 volt.

To answer the second part, we must remember that the amplitude of the modulated H.F. wave is itself changing periodically in a cycle of low frequency. At one part of this cycle the amplitude of the H.F. oscillations will be greater than the average, consisting of the *sum* of the high and low-frequency component voltages, *i.e.*, $0.8+0.4$ or 1.2 volt. At the opposite phase of the L.F. cycle the amplitude of the modulated oscillations is small, being the *difference* between the two component amplitudes, *i.e.*, $0.8-0.4$, or 0.4 volt.

We thus see that the amplitude of the modulated H.F. oscillations varies periodically between 1.2 and 0.4 volts. The R.M.S. values of the input voltage will therefore vary between values corresponding to 0.707 of these amounts; that is, between 0.848 and 0.283 volt.

QUESTION 37.—**Unsatisfactory reproduction is obtained from a set in which the 2,000-ohm loud speaker is connected directly in the anode circuit of a small power valve. The H.T. battery is found to have a P.D. of 155 volts on load, and the mean plate current of the power valve is 15 mA. What voltage is thus lost to the plate of the valve?**

Answer.—30 volts.

The voltage drop across the loud speaker is given, as always, by the product of the resistance and the current flowing through it, these being expressed in the fundamental units, ohms, and amperes. The formula $E=IR$ becomes here, $E=0.015 \times 2{,}000$, which equals 30 volts.

The actual voltage on the plate of the power valve is, therefore, less than the 155 volts of the H.T. battery by this amount—a very serious loss indeed for a power valve where adequate plate voltage is a primary consideration. The obvious remedy would be to adopt some form of coupled output, e.g., transformer or choke-feed coupling. By such means the steady component of plate current would be by-passed away from the loud speaker, so that no potential drop in the available H.T. supply can occur across its windings, while at the same time the L.F. oscillations can play their part in actuating the speaker mechanism. A further advantage, of course, is the possibility afforded of "matching" the speaker impedance to that of the valve in order to obtain the maximum A.C. power for distortionless working.

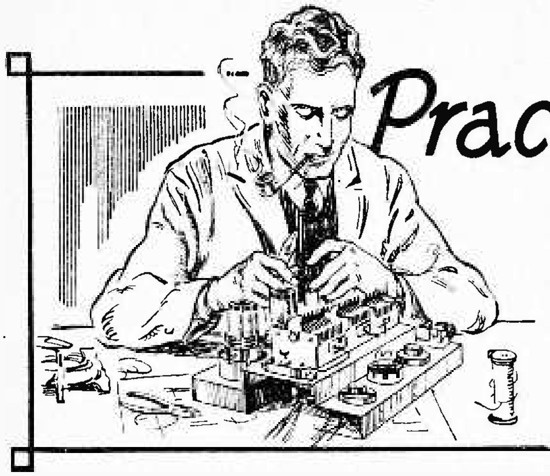
NEXT SERIES OF PROBLEMS.

QUESTION 38.—**The working grid bias of a certain amplifying valve is 5 volts negative. When the plate potential is 100 volts the steady anode current is 3.45 mA., but when the plate volts are increased to 120 the anode current is 6.25 mA. What numerical information can be drawn from these figures?**

QUESTION 39.—**A four-valve set is supplied with L.T. current from a 6-volt accumulator. The 2 H.F and detector valves each take 0.1 amp. at 2 volts, while the power valve takes 0.25 amp. at 6 volts. If the earlier valve filaments are arranged in parallel, what should be the value of the voltage limiting resistance employed, and what is the total current taken from the accumulator?**

QUESTION 40.—**Two stages of resistance amplification are arranged so that the external load resistances have each four times the value of the anode A.C. resistances of the valves. The magnification factor of each valve is 15. What is the overall voltage magnification of the amplifier?**

NUTCRACKER.



Practical Hints and Tips

Simplified Aids to Better Reception.

AN IMPROVED OHM-METER.

WHEN making systematic tests of a receiver, either in an effort to locate a fault or to assure oneself that the wiring is in order, it is often desirable to have something more than a mere indication of electrical conductivity. Accurate measurement of resistance is a somewhat laborious business, and in most cases is unnecessary, but it is an undoubted fact that a fault or an error in wiring can often be detected by employing a method of testing that will differentiate between, say, a resistance of 100 and 1,000 ohms; for this purpose a rough-and-ready "ohm-meter" is distinctly useful. An instrument of this sort can be improvised in half an hour or so from an ordinary low-tension moving-coil voltmeter—a piece of apparatus already in the possession of a large number of wireless amateurs.

It is not suggested for a moment that the meter should be interfered with internally; this is a task only for those who have great confidence in their manual dexterity. But by pasting a paper scale, calibrated in ohms, on the glass cover of the meter, and using the instrument in conjunction with a flash-lamp battery, it is possible to obtain resistance readings of sufficient accuracy to be useful for our present purpose. The addition of this scale to a typical 0-6 volt meter is shown in Fig. 1.

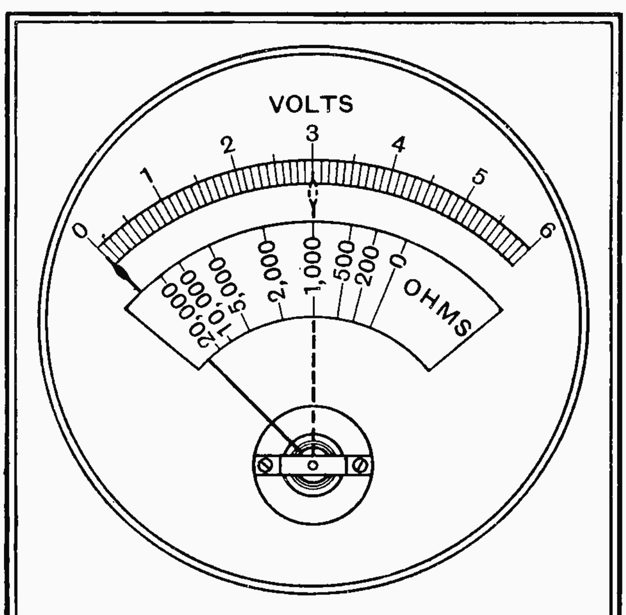


Fig. 1.—A calibrated resistance scale, pasted on the glass front of a typical moving-coil L.T. meter. The procedure for converting voltage readings into ohms is described in the text.

To convert the normal voltage indications of the meter into ohmic values, resort must be had to calculation, and as a start we must ascertain the internal resistance of the instrument. The following explanation should make clear the procedure of translating volts into ohms. For purposes of illustration we will assume that an external battery of $4\frac{1}{2}$ volts is used, that the meter reads 0-6 volts, and has an internal resistance of 2,000 ohms.

(1) For each of the resistance values to appear on the scale, ascertain the current that will be driven through the meter by dividing "volts applied" by "resistance" (in ohms). The answer will be given as fractions of an ampere. "Resistance," it must be remembered, is the internal resistance of the meter plus the value of external resistance to be measured or to be marked on the scale. An example:

The current flowing when the meter-battery combination is connected across an external resistance of 1,000 ohms will be $\frac{4.5}{1,000+2,000}$ =0.0015 amp., or 1.5 milliamps.

(2) Next, translate the current value found by the preceding calculation into voltage scale readings. The current (in amps) needed for full-scale deflection is first found by dividing "maximum voltage reading" by "internal resistance" (in ohms). Then, by simple proportion, the current values corresponding to any intermediate voltage readings are easily calculated. Example, conditions as before:

For full-scale deflection the meter requires $\frac{6}{2,000}$ =0.003 amp., or 3 milliamps. Therefore, a current of 1 milliamp represents a scale reading of 2 volts, and so on. We have already seen that when an external resistance of 1,000 ohms is connected in series with the meter and battery a current of 1.5 milliamp will flow. This corresponds to a voltage reading of 3 volts.

Naturally, the accuracy of an improvised ohm-meter of this kind will depend on the voltage of the battery. This point is checked by short-circuiting the connections for resistance measurements, and observing whether the voltage reading is that taken as a basis for calculation.

ELECTRIC SOLDERING IRONS.

UNLESS the experience of the present writer is particularly unfortunate, it is quite a common occurrence for a short-circuit to develop between the heating element of an electric soldering iron and the copper bit. This does not affect the normal functioning of the appliance, but it may be responsible for a more or less disastrous short-circuit if the iron be used to make a connection in a receiver that is already installed and connected to earth. A short-circuit arises, of course, through the fact that one side of the mains supply which feeds the iron is already "earthed."

Unless one can be quite sure that the short-circuit in question does not exist, it is a wise precaution to disconnect the earth lead from the set before using the iron on its internal wiring. In dealing with a D.C. set, the mains should be disconnected as well.

CURRENT FOR A PILOT LIGHT.

IN the average A.C. receiver the constructor has a choice of several sources of current for supplying a small lamp, which is often desirable, both for purposes of illuminating the tuning scale and for serving as an indication as to whether the set is "on."

If brilliant illumination is not required, it is often satisfactory to choose a 3.5-volt lamp and to wire it between one end and the centre tapping of the heater transformer secondary; when supplied with two volts the lamp will glow brightly enough for most purposes, and will have a long life. A lamp of higher voltage may, of course, be connected in parallel with the heaters, or in shunt with the filament of, say, a directly heated output valve. In some cases it is preferred to employ a lamp which demands quite a small current—100 milliamperes or less—and to connect it in series with the H.T. feed circuit; in this position an indication is given that the rectifier and anode circuits are operating normally. The lamp also acts as a safety fuse.

As a general rule, it is not to be recommended that a pilot lamp should be wired across the L.T. winding which supplies the filament of a rectifying valve. In this position the lamp and its associated wiring will be a high potential with respect to earth, and so the consequence of an accidental short-circuit may be serious; indeed, an unpleasant shock may result from this form of connection, as the exposed metal parts of most commercial "dial-light" holders are in direct metallic connection, with one pole of the lamp.

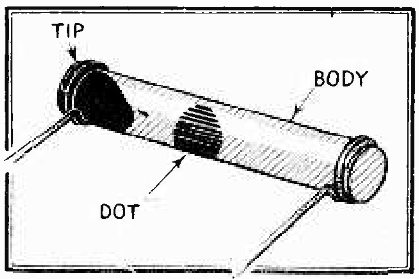


Fig. 3.—An Erie resistor with distinctive coloured markings to indicate its resistance value.

COLOUR CODED RESISTORS.

FOR some years past radio manufacturers in America and Canada have adopted a scheme of identification for resistors, whereby their ohmic values are indicated by distinctive colour markings. It now seems likely that the same "colour code" may be generally adopted in this country, and so the matter is likely to be one of interest to readers. We are indebted to Erie Resistors, Ltd., of Cricklewood, for details of the scheme.

The code is very simple to understand, and identifies resistors by means of three markings, referred to as "body," "tip," and "dot" colours. "Body" is the main colour of the resistor element, and represents the first figure of its ohmic value. The coloured tip represents the second figure, and the dot indicates the number of ciphers which follow the first two figures.

The following is the complete list of colours, with their corresponding values:—

1st Figure, "Body."	2nd Figure, "Tip."	Ciphers, "Dot."
0 = Black	0 = Black	None = Black
1 = Brown	1 = Brown	0 = Brown
2 = Red	2 = Red	00 = Red
3 = Orange	3 = Orange	000 = Orange
4 = Yellow	4 = Yellow	0000 = Yellow
5 = Green	5 = Green	00000 = Green
6 = Blue	6 = Blue	000000 = Blue
7 = Violet	7 = Violet	
8 = Grey	8 = Grey	
9 = White	9 = White	

For example, a resistor having a red body, green tip, and orange dot has a value of 25,000 ohms; similarly, one with a green body, black tip, and yellow dot is of 500,000 ohms.

The advantages of this standard colour code need hardly be stressed. From the manufacturer's point of view it affords an easy method of identifying the various values as they are assembled in a set, and eliminates the possibility of mistakes. The usual transfer or printed identification is always liable to be defaced.

BASS DRUM AND TYMPANI.

The 5,000-cycle Limit.

ADVERTISING claims to the contrary, very few radio receivers now on the market, or in the home, transmit faithfully up to 5,000 cycles. The majority of them are practically dead at this frequency, especially those equipped with tone controls. On the other hand, the broadcast stations have continually increased their audio-frequency range; wires between studios and cross country have been improved, so have repeaters and the other transmitting paraphernalia.

At the Bell Laboratories tests were made of all musical instruments to see when trained and untrained listeners could tell when certain high and low frequencies were cut out. It was observed that very little transmission below 60 cycles was necessary. But there were only two instruments that could be transmitted faithfully through a radio that cut off at 5,000 cycles—the tympani and the bass drum.—*Electronics*, U.S.A., March, 1932.

NEWS of the WEEK.

Current Events in Brief Review.

Call Me Early . . .

RUSSIA seems determined to surpass all other countries in broadcast power output. We learn that on May 1st next, in the presence of M. Stalin, the new Leningrad transmitter will be inaugurated with a power of 250 kW. Considering that the wavelength will be 351 metres, i.e., that used by the existing Leningrad transmitter of 1.2 kW., it seems probable that interference may be experienced by listeners to London and Stuttgart.

Several neighbouring countries have already registered protests, and it is reported that preliminary tests with only 15 kW. have troubled Stuttgart's Scandinavian listeners.

Broadcasting and the German Election.

A THREATENED listeners' strike in Germany during the Presidential Election failed to materialise. The aggrieved listeners—National Socialists—numbered 13 million, and their complaint was that Hitler was not allowed to broadcast. Throughout the election, writes our Berlin correspondent, only the Government were allowed to use the broadcast microphone. Certain of the broadcasting organisations appeared to object to the Government monopoly, and strange rumours spread concerning the real cause of the breakdown of one of the stations in the midst of a speech by Dr. Brüning in favour of Hindenburg.

New French Broadcasting Station.

BRITTANY, it seems almost certain, will soon have its own broadcasting station. Our Paris correspondent understands that the site chosen for the new transmitter is within the Commune of Thourie in the Vitry Arrondissement some 20 miles S.E. of Rennes.

A Broadcast Magazine.

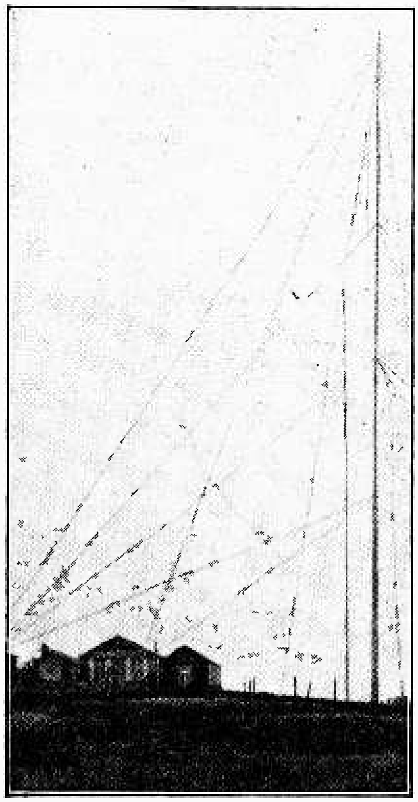
"POSTE PARISIEN," which will shortly inaugurate its high power transmitter, plans to include in its programmes a nightly "magazine" or journal which will be contributed to by leading literary personalities. The magazine will be broadcast every evening from 7 to 8 p.m.

An Example from Morocco.

PARIS listeners are suggesting that the local broadcasting authorities should go to Morocco to learn how a go-ahead broadcasting service should be conducted. It appears that "Radio Maroc" has outstripped all other French stations by its enterprising developments within the last year, particularly in the direction of educational transmissions. Every school in French Morocco now has its own receiver in addition to a cinematograph installation, radio lessons being illustrated by films forwarded in advance by the Public Education Department.

How They Listen in U.S.

NO fewer than 68,484,937.3 (sic) persons in the United States listen to broadcasting programmes, according to a "conservative estimate" issued by the *Broadcasting Magazine* of Washington in collaboration with *Radio Retailing* of New York. It seems that this precise figure must include the babies in the 16,679,253 homes which are known to be equipped with receiving sets. The figures represent an increase of 4,600,000 sets since the official census of two years ago. New York continues to lead all States in the number of wireless sets in use, with Pennsylvania second and Illinois third.



SURPRISES FROM FÉCAMP. A distant view of the Radio-Normandie station (219.9 metres) to which *Wireless World* readers should listen on Sunday next, April 24th.

Decibels Win.

"I OWN a house with brick and cavity walls and securely fitted windows with inside shutters; yet I cannot escape from the loud speaker in a neighbour's house 15 feet away."—Correspondent in the *Daily Mail*.

Pirates?

A CURIOUS state of affairs is revealed by the publication of figures showing the sale of valve sets in Germany during 1930. Nearly 800,000 sets were sold, whereas the licence increase for the same year was little over 400,000.

The German licence figures reached 4,168,440 on April 1st.

A Field for Invention.

THE lament against ugly wireless masts is an old one, but is being revived in different parts of the country, probably because the spring weather is bringing people into their back gardens and reminding them of the existence of long rows of unsightly aerial supports.

A Lancashire amateur suggests that a fortune awaits the inventor of a really graceful wireless mast, and we wonder whether this will appear at Olympia.

Amateur Radio Film.

THE Gaumont "Sound Mirror" No. 79, which includes talking pictures of Mr. H. L. O'Heffernan operating his station G5BY at Croydon, is on view during the next few days at eighteen cinemas in different parts of the country. The official list is as follows :—

April 25th..	Palace	Rushden	3 days
	St. George's .	Canterbury ...	3 days
	Cinema	Bermondsey ..	6 days
	Pavilion	Eastbourne....	6 days
	King's Hall .	Penge	6 days
	Broadway ..	Coventry......	3 days
	Cinema	Canning Town .	3 days
	Globe..	Bristol	3 days
	Lyceum.....	Dumfries......	3 days
	Coliseum ...	Leeds.........	6 days
	Empire	Maryport	3 days
April 28th..	Palace	Wellingborough	3 days
	Grand	Coventry......	3 days
	Queens	Bristol	3 days
	Empire	Cleethorpes....	3 days
	Jubilee	Scunthorpe ...	3 days
	Alhambra ..	Darlington	3 days
	Marine......	Seacombe	3 days

Denmark's Mystery Station.

A MYSTERY station is adding to the excitements of listening in Denmark, writes our Copenhagen correspondent. In the intervals between the transmissions by the official stations, the unknown station has been sending records and humorous talks, greatly to the delight of listeners in general. Private transmission being forbidden in Denmark, a special trained staff of wireless inspectors has started to scour Denmark in search of the pirate, who, nevertheless, continues to transmit.

Langenberg Leads.

SEVERAL European broadcasting stations transmit physical training instructions, but to Langenberg belongs the distinction of having started a daily gymnastic course for "ladies only." The innovation began as an experiment, but the widespread demand for more has led to the permanent inclusion of women's physical training talks each morning.

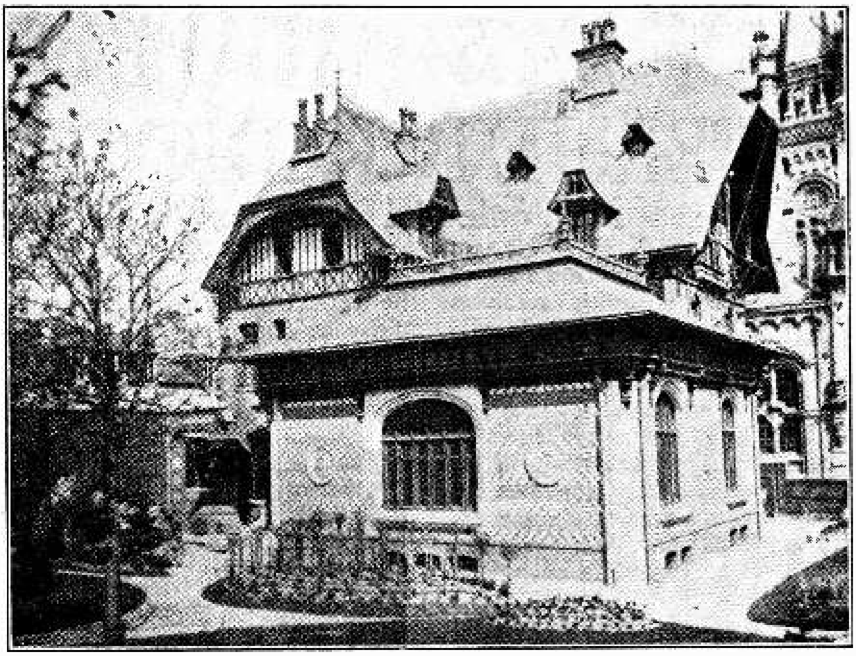
Denmark Buys British.

THE Danish Government has just placed an important order in this country for a new broadcasting station for Kalundborg. This broadcaster is to be one of the most powerful in Europe, having a carrier power of 60 kW. increased by modulation to 100 kW. The equipment will be manufactured in the London factories of Standard Telephones and Cables, Ltd., and will be put into service early next year. The station will operate in the 1,100-metre waveband.

A Snore Cure.

THE cure of snoring by radio methods is one more feather in the cap of wireless research. According to a French journal, a device has been perfected whereby the "tempestuous noises" created by sleepers can be instantly suppressed. Above the head of the slumberer a microphone is suspended, and upon the snores registering a sufficiently high level of sound, a minute electric shock is administered; the sleeper awakes only too glad to know that his dream of the electric chair was unfounded.

There would seem to be other applications for such a device. For instance, it could be made to operate a Klaxon horn when the neighbour's loud speaker became more than usual sonorous, while its use in counteracting the efforts of conversational bores would be invaluable.



BROADCASTING FROM A CHATEAU. The studio building at Fécamp. The International Broadcasting Company, who control the transmissions from Radio-Normandie, consider that the 21st birthday of *The Wireless World* is a fitting occasion for a special transmission commencing at 11 p.m. on Sunday next. We shall welcome reception reports from our readers.

Universal Time.

MANY wireless problems might be solved with the adoption of universal time, as suggested by a correspondent in the *Morning Post*.

"Now that wireless is a universal factor particularly on short wavelengths," he writes, "and that the matter of longitude makes timekeeping between transmitter and receiver end always one of difficulty, would it not be possible to adopt a Standard Universal Time what I might call 'Earth Time,' based on the diurnal 24 hours? There are so many systems of Standard Time that they are apt to be confusing.

"What I suggest is simply this: The World Standard Hour would start at Greenwich, and all wireless equipment would take its time from it, so that, say, one o'clock Earth Time at Greenwich would be one o'clock all over the world."

British listeners would certainly benefit by the new order of things, but it is doubtful whether America, for example, would submit to the confusion of sitting down to afternoon tea at 10 p.m. and tuning into the nightly dance music at 4 o'clock in the morning. And would Russians consent to go to bed at 7 o'clock in the evening?

Wireless and Earthquakes.

THE emergency corps organised by the New Zealand Amateur Radio Transmitters' Association to maintain communications in the event of earthquakes or similar disasters held an experimental field day recently to test apparatus and organisation. Each district, says our Wellington correspondent, has two portable combined transmitters and receivers, weighing about twenty pounds complete, and successful daylight communication was maintained throughout the day between sections at Auckland, Wellington, Ashburton, Christchurch, Gisborne and Dunedin.

Amateur transmitters maintained communications with the Hawke's Bay districts devastated by the last earthquake.

When Radio Beats the Wire.

AMERICAN broadcasting stations have received a sharp warning from the Federal Radio Commission not to transmit time signals received by telegraph wire even when announced as originating in the U.S. Naval Observatory in Washington. The Navy Department has informed the Commission that "the rebroadcasting of Naval Observatory time signals which are transmitted over a land wire is objectionable because of the inherent time lag in the system which creates an appreciable error in the signal." The Navy authorises stations to transmit the signals if they are intercepted by radio direct.

A French Tongue Twister.

"THE seething sea ceaseth and thus the seething sea sufficeth us," was the shibboleth recently employed by the American National Broadcasting Company to weed out 300 candidates for positions as announcers.

The French have now applied their ingenuity in devising a similar test for their own speakers. The best example seems to be: "Un chasseur sachant chasser chassa son chien de chasse dans un sachet séché."

Obituary.

WE regret to have to record the death on Friday, April 8th, of Mr. James Ward, a founder and director of the well-known wireless and electrical firm of Messrs. Ward and Goldstone, Ltd., Manchester.

Volume Level.

READERS will have noticed an obvious mistake in Figure 6 in the article "The Importance of Volume Level" in our issue of April 6th. The horizontal scale should, of course, show TIME, not Frequency.

Railway Radio in Scotland.

THE success of the new wireless listening facilities on the King's Cross and Leeds expresses of the L.N.E.R. has led to a decision to extend the installation of wireless reception to a Scottish express. The train is being equipped with a specially constructed duplicate set to enable the operator to tune in to another station without interference, should a variety of programmes be requested.

"Radio Excelsior."

BUENOS AIRES is to have a new and up-to-date broadcasting station, which will be constructed at the Marconi Works at Chelmsford. Incorporating all the latest developments in the design of broadcasting transmitters, including crystal and valve-frequency control and low-power modulation, the new station will operate on a power of 20 kilowatts, and will serve a large area around Buenos Aires.

It is to be operated by "Radio Excelsior," of Buenos Aires, and is expected to commence regular transmission early next year.

The HALFORD SUPERHET RADIOGRAMOPHONE

A Single-dial Receiver with Tone Control.

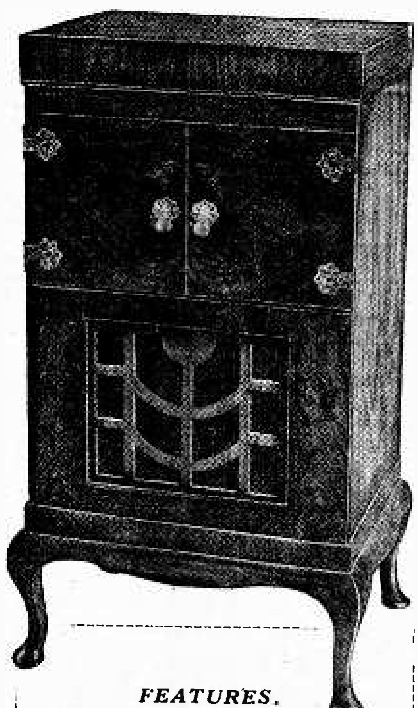
THE superheterodyne is unique among receivers in offering an infinite scope for an individuality in design which involves no departure from sound technical principles. Not only does the actual function which the various valves are called upon to perform vary from receiver to receiver, but even such standardised parts as the tuning circuits themselves are found in an infinite variety.

In the chassis under review a total of eight valves is employed as first detector, oscillator, two I.F. stages, second detector, push-pull output, and mains rectifier. As usual, the AC/SG first detector functions as an anode bend rectifier, and is self-biased by a resistance in its cathode lead. The input band-pass filter, however, is unusual in that mutual inductance coupling is used between the two sections, and completely separate coil assemblies are employed for the two wavebands. Two single pole change-over type switches are necessary, therefore, for the waveband switching of these input circuits.

The Oscillator Circuit.

The oscillator, for which a 164V. valve is used, is of a type rarely seen in this country, although common in America. An examination of the circuit diagram will show that the tuned circuit is connected only to earth, and that untuned coils in both the grid and anode circuits of the oscillator are coupled to it. The tuned winding itself, therefore, is coupled but loosely to the oscillator, and a high degree of frequency stability is maintained. A further untuned coil is coupled to the oscillator and included in the cathode lead of the first detector in order to transfer the oscillations to the first detector circuit. Completely separate coil assemblies are again used for the two wavebands, and as each assembly consists of four windings, the wavechange switch has a multiplicity of contacts.

A standard type of three gang condenser is employed, and two sections are used for tuning the pre-selector circuits. In order to maintain the accurate alignment of the oscillator circuit, therefore, it is necessary to employ the padding condenser circuit, and it is interesting to note that entirely separate trimmers are fitted for the two wavebands. The medium wave parallel trimmers are, as usual, fitted to the gang condenser, but an additional parallel trimmer is brought into circuit on the long waveband, and the two series trimmers each consist of a fixed condenser in parallel with a small capacity compression type adjustable condenser.



FEATURES.

General.—*Chassis-built eight valve superheterodyne with mains energised moving-coil loud speaker, and complete operation from A.C. mains.*

Circuit.—*Two variable-mu I.F. stages with band-pass tuning, anode bend first and second detectors, with separate oscillator to the frequency changer. Band-pass pre-selector with single dial tuning. Push-pull pentode output stage with adjustable tone control.*

Controls.—*(1) Calibrated single tuning control with illuminated drum dial. (2) Combined volume control and mains switch. (3) Single knob control of radio-gramophone and wave-range switches. (4) Tone control.*

Price.—*Chassis, moving-coil speaker and valves, 28 guineas, including royalties. Cabinet models complete from 31 guineas and radio-grams from 43 guineas.*

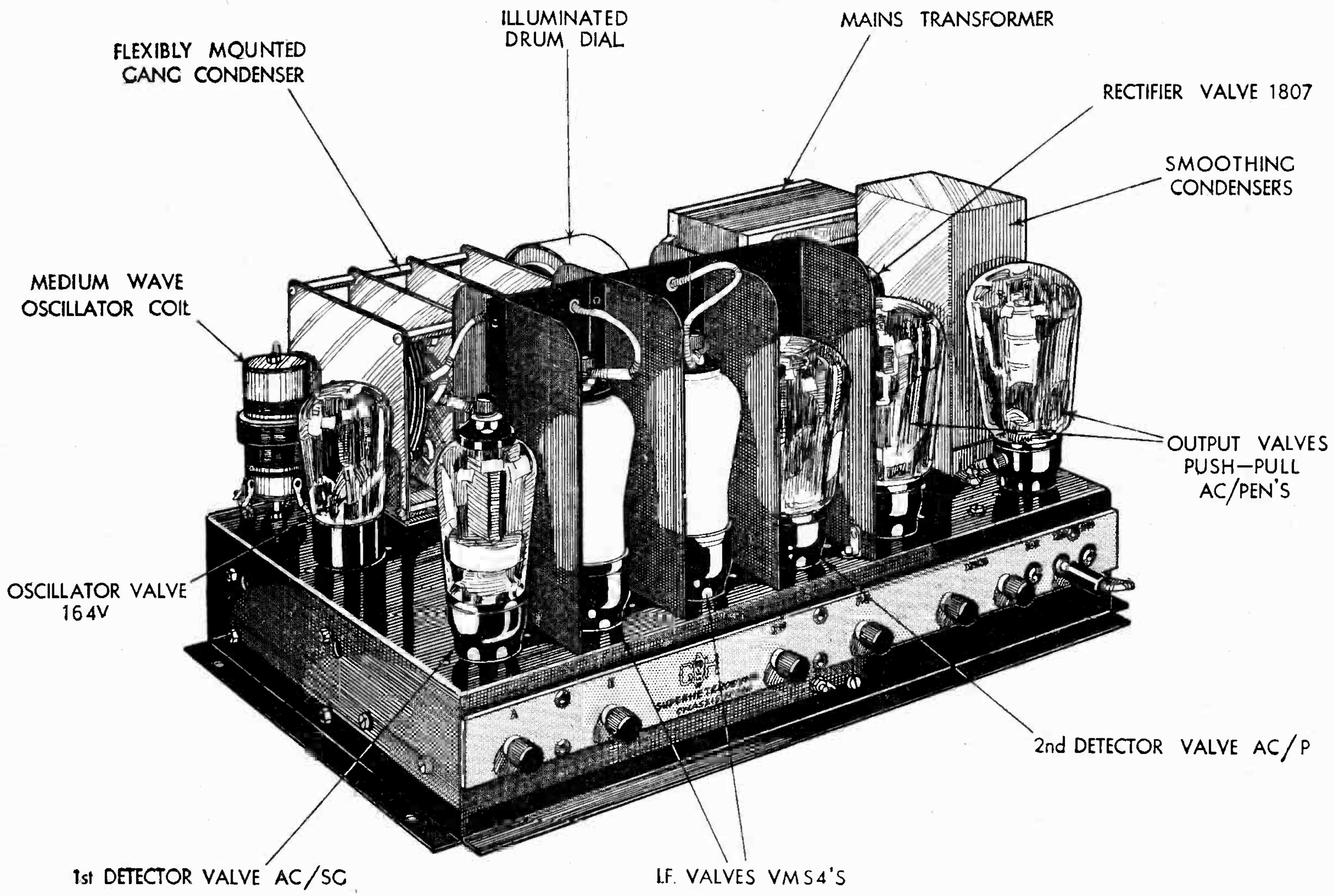
Sole Distributors.—*Halford & Co., 194, Bishopsgate, London, E.C.2.*

Special Refinements.

The gang condenser is fitted with an illuminated drum dial calibrated in wavelengths, and an unusual and very good point is the mounting of the condenser on soft rubber bushes, so that it is free to move. In this way a particularly insidious form of acoustic reaction, due to the vibration of the condenser vanes, is avoided.

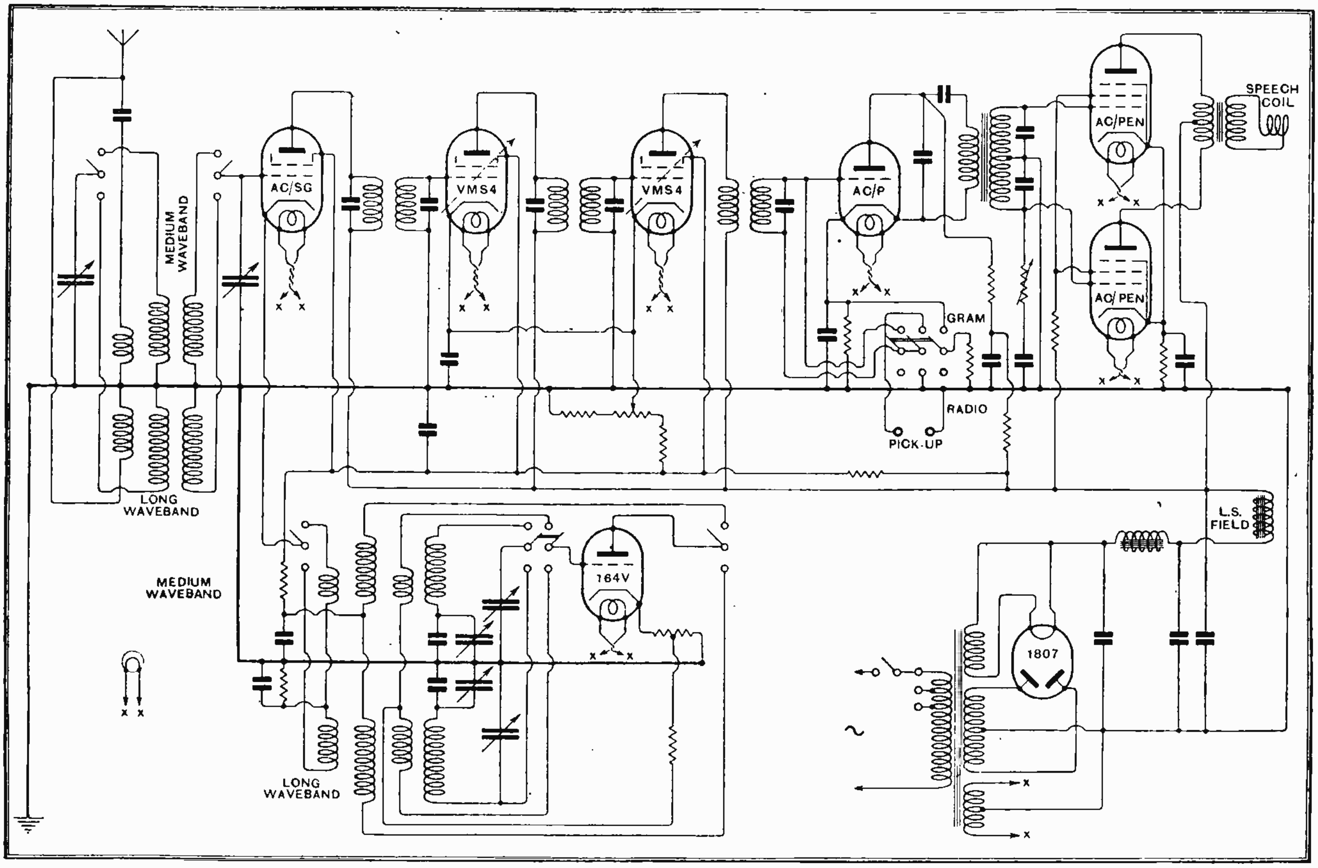
The circuit diagram shows that while the biasing arrangements throughout the set follow the usual practice, a departure has been made in the case of the oscillator. A 1,100-ohms resistance, tapped at 100 ohms from the cathode end, is included in the cathode lead, and the lower end of the oscillator grid coil is returned through a 1,000 ohms resistance to the tapping point. With the valve in the non-oscillating condition, only the voltage drop along the 100 ohms section of the resistance would be applied as grid bias. When the valve is oscillating, however, grid current must flow, with the result that the actual effective grid potential may be considerably modified. It is interesting to note that none of these resistances is shunted by any condenser, and, as a result, they will tend to equalise the oscillator output over the tuning range of the receiver.

ONE-DIAL CONTROL CALIBRATED IN WAVELENGTHS.



The chassis of the Halford Superheterodyne in which screening is particularly complete. The ganged condenser is flexibly mounted to avoid acoustic reaction.

The Halford Superhet Radio-Gram.—The intermediate frequency amplifier is of conventional design with V.M.S.4 variable-mu valves and a combination of band-pass filters and single circuit. There are five tuned circuits, and, as might be expected, the selectivity is of a high order, while the quality of reproduction shows that sideband cutting is kept at a minimum. An AC/P valve acts as an anode bend second detector, and the multi-contact switch, which is provided for connecting a gramophone pick-up, modifies the bias voltage for the two different functions of the valve.



Complete circuit diagram. Note the comprehensive tracking scheme for ganging the oscillator.

The Output Stage.

A resistance capacity fed transformer acts as the L.F. coupling to the two push-pull AC/Pen output valves, which should deliver some three watts undistorted power to the loud speaker. The tone control consists of a variable resistance in series with a condenser, and is connected across the L.F. transformer. The usual full-wave rectifier is used for the H.T. supply, and a single choke in conjunction with large capacity condensers provides the preliminary smoothing, which is completed by the field winding of the moving-coil speaker.

The volume control acts by varying the bias voltage on the two I.F. valves, and is combined with the mains switch in a single unit, so that when the control is fully rotated in an anti-clockwise direction the set is automatically switched off. The various switches are all linked together and operated by a single control knob, the rotation of which controls the radio-gramophone switch, while a sideways movement actuates the waverange switches.

On test the receiver proved to be highly selective, and at only nine miles from Brookman's Park it proved possible to receive Mühlacker without serious interference from the London Regional, and complete separation of more distant transmissions was readily achieved. Second channel interference from the two London stations was experienced at two points on the dial, but this is usual with superheterodynes, and a commendable absence of whistles showed that the input filter and screening were correctly fulfilling their purpose.

The quality of reproduction reached a high standard, and the high and low notes were well balanced. On radio the best tone was secured with the tone control set for full brilliance, but on gramophone it proved a useful accessory. Since the volume control acts upon the I.F. stages only, it is, of course, quite inadequate to deal with a powerful local station. As recommended by the makers in the booklet which accompanies the receiver, a very short aerial is necessary for local reception, and when this is used the control functions admirably. The sensitivity is ample for the reception of the weakest stations, and background noise is satisfactorily low.

WIRELESS ENCYCLOPEDIA

NO. 12

Brief Definitions with Expanded Explanations.

FREQUENCY CHANGER. ***The local oscillator and its associated circuits in a superheterodyne receiver. Its function is to derive from the received modulated high-frequency oscillations a lower but supersonic frequency which can be more efficiently amplified.***

THE salient feature of the superheterodyne receiver is the conversion of the received high-frequency oscillations to a lower radio frequency enabling a very high degree of amplification and selectivity to be obtained. For instance in receiving a station operating at a frequency of 1,000 kilocycles per second, the frequency may be changed to, say, 100 kilocycles per second in the receiver before any degree of high-frequency amplification is applied.

This conversion is effected by the frequency changer which, in conjunction with a detector valve, consists of a local oscillator producing a frequency removed from that of the received signal by a number of cycles per second just equal to the new frequency desired. The principle employed is that of the well known heterodyne method of producing a *beat frequency*; when two high-frequency currents flow in a single circuit they combine to produce a resultant current whose *amplitude* varies at a frequency just equal to the difference between the frequencies of the two original oscillations.

The frequency of this modulation or variation of amplitude represents the beat frequency referred to, and the latter is separated from the original high frequencies by means of a detector valve in the ordinary way. The curves of Fig. 1 show how two waves (*a*) and (*b*) of slightly different frequency combine to form a resultant modulated wave (*c*). By the action of the detector valve and its associated circuits, the modulation frequency is separated out as shown at (*d*). One-half of the wave is cut off.

In a superheterodyne receiver the beat frequency between the local oscillations and the carrier wave of the received signal is given a definite supersonic value, of the order of 100 kilocycles per second, being intermediate between the received high frequency and the low or speech frequencies. The actual choice of intermediate frequency is determined not only by theoretical considerations, but also by the conditions existing in the locality where the receiver is to be operated—interference has to be avoided between powerful long-wave stations and the intermediate frequency in the receiver.

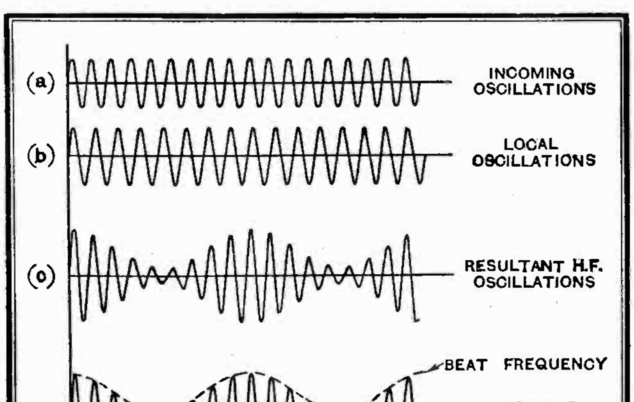


Fig. 1.—Diagram showing the action of a frequency changer.

The system can be satisfactorily applied to the reception of radio telephony because the low-frequency modulation of the received oscillations is passed on to the intermediate-frequency oscillations, subject only to the usual slight modification imposed by the tuned circuits and the detector valve. The reason for this retention of the low-frequency modulation follows from the fact that when two waves heterodyne each other, *the amplitude of the resulting beat frequency is proportional to the weaker of the two original waves*. Thus it is essential that the amplitude of the local oscillations in a superheterodyne receiver should be more powerful at the detector valve than the received oscillations.

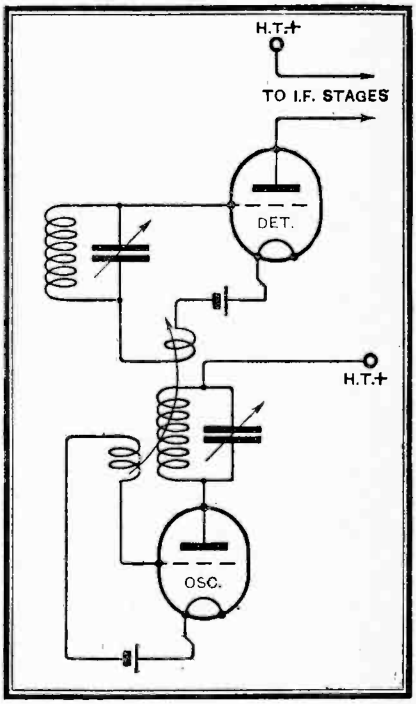


Fig. 2.—An early arrangement in which the oscillator was inductively coupled to the grid circuit of the first detector.

In most of the earlier types of superheterodyne receiver the frequency changer took the form of a separate local oscillator loosely coupled to the tuned grid circuit of the detector valve, in the manner shown by Fig. 2. In some forms the detector valve itself was made to generate oscillations and act as the

Wireless Encyclopedia.—frequency changer, but this arrangement, whilst economical in valves, had the disadvantage of generating numerous powerful harmonics which caused the same station to be obtainable at a number of different settings on the tuning dial and which heterodyned the carrier waves of unwanted stations, causing considerable interference.

In any design of supersonic receiver special precautions must be taken to prevent the oscillations of the frequency changer reaching the aerial and causing radiation likely to interfere with other receivers. For this reason it has until recently been found necessary to interpose a high-frequency amplifying valve between the aerial tuning coils and the frequency changer. This disadvantage, however, has now been eliminated by an entirely new system developed by *The Wireless World*: the first valve is of the screen-grid type, and is made to act as an anode detector, the oscillator valve being coupled to the *anode* circuit of this first detector instead of to the grid in the older way. The screen grid prevents the local oscillations from reaching the tuned grid circuit of the valve. There are several ways of doing this, one method being indicated by Fig. 3 where the oscillator is coupled inductively to the anode circuit of the detector.

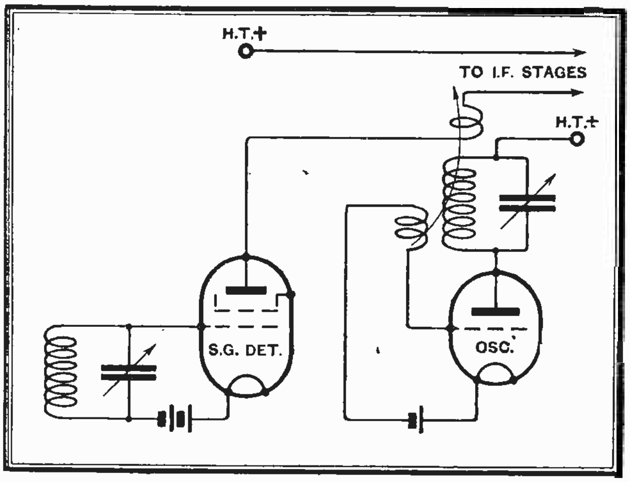
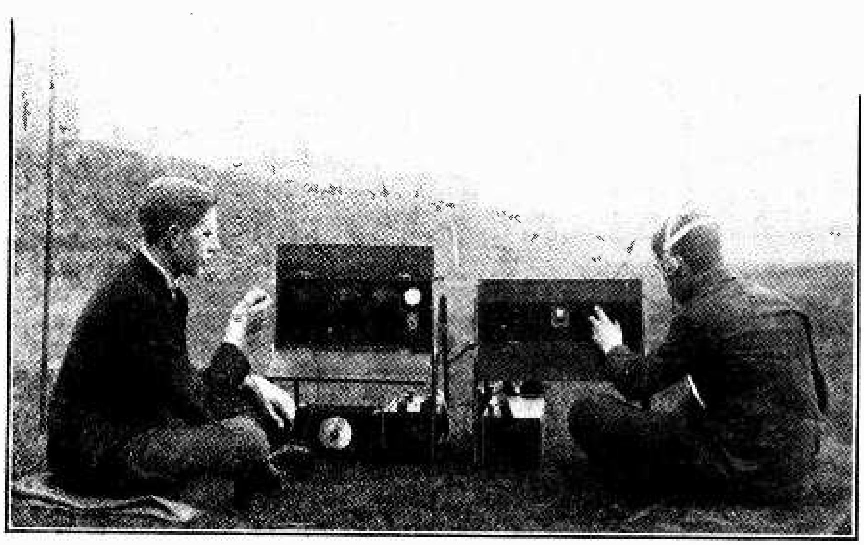


Fig. 3.—Illustrating the principle of a modern non-radiating frequency changer. The first detector is a screen-grid valve and the oscillator is coupled to its anode circuit.

TRANSMITTING ENTHUSIASTS IN ACTION.



Portable Station G 6 OJ designed by Capt. J. Timbrell, B.Sc., and built with the help of the boys of King Edward's School, Stourbridge.

TRANSMITTERS' NOTES.

New American Amateur Regulations.

The new regulations issued by the Federal Radio Commission for the control of American amateur stations came into force on February 1st. In general, they follow the procedure already adopted, with the following alterations: (1) The name of the person operating the transmitter must be logged at each transmission; (2) stations licensed for telephony may transmit music for short test purposes for *bona fide* experimental work, though the usual prohibition against the broadcasting of entertainment remains.

New Wavelengths Allowed.

On April 1st. 1932, the wavebands open for amateur telephony in U.S.A. were allotted as below :—

(*a*) Open to any amateur.—1,875 to 2,000 kc/s (160 to 150 metres); 56,000 to 60,000 kc/s (53.57 to 50 metres).

(*b*) Open only to amateurs specially licensed for unlimited radiotelephone operation.—3,900 to 4,000 kc/s (76.9 to 75 metres); 14,150 to 14,250 kc/s (21.20 to 21.05 metres).

Young Enthusiasts.

King Edward's School, Stourbridge, has two amateur transmitting stations, G6OI and G6OJ, which were designed and built by Capt. J. Timbrell with the help of twelve boys of the school, who, incidentally, are fully licensed to operate the stations. Most of the actual components, such as transformers, chokes, microphones, etc., were built in the school workshops. The fixed station, G6OI, comprises a 10-watt choke-controlled telephony transmitter and a three-valve receiver working on the 1.7 mc. band, and a 10-watt master-oscillator power-amplifier transmitter for telegraphy on the 7 and 14 mc. bands. Telephony can also be used by grid control on these bands. The transmitter is crystal-controlled. A four-valve receiver is used with this set.

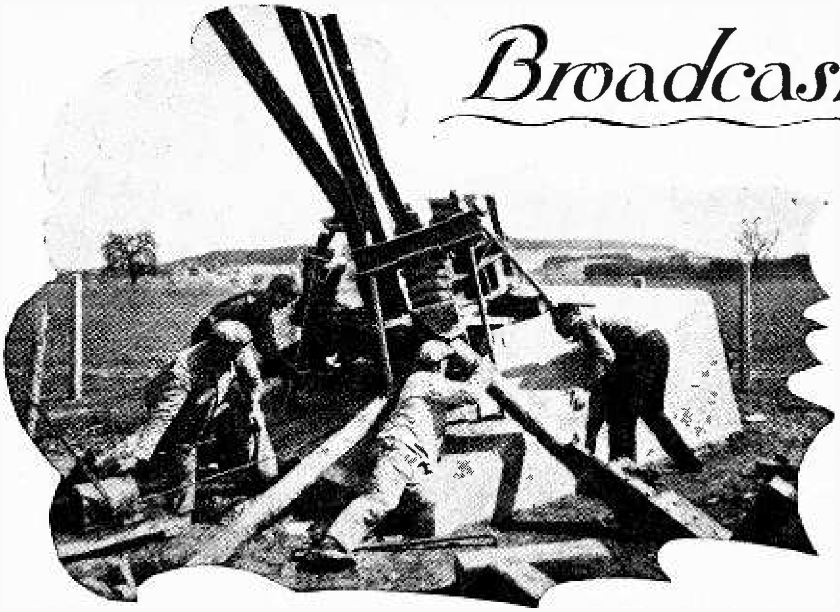
Other units comprise a two-valve modulation amplifier, heterodyne wavemeter, piezo-crystal oscillator, and two-valve rectifier units giving rectified and smoothed current at 500, 160, 6 and 4 volts, a switch panel controls these units, which are all mounted in one framework, making a most compact and useful set.

The portable station, G6OJ, of which we are able to give an illustration, consists of a 10-watt master-oscillator power-amplifier transmitter for the 1.7 mc. waveband, a three-valve receiver, motor generator, heterodyne wavemeter, portable masts, and earth mat. The complete installation can be transported over rough country by a party of eight.

General Notes.

Conditions on 7 megacycles have improved, according to reports received during the past few weeks, but 14 mc., in contrast to previous years' experience, has proved very quiet. A correspondent who is closely following the sun-spot cycle predicts that there should be a very bright wireless period during the end of April and the beginning of May.

Broadcast Brevities



A TENSE MOMENT. Repairs to one of the masts at Sottens (Switzerland) necessitated the use of an hydraulic jack. The photograph was taken at a critical stage in the proceedings.

By Our Special Correspondent.

B.B.C. and Luxembourg.

FEW European broadcasting matters, except, perhaps, the question of wavelengths, have provoked more concern among the B.B.C. officials than the recently announced plans of the new Luxembourg station.

I hear that this new scheme for collecting sponsored programmes from all over Europe and broadcasting them from a central high-power transmitter is putting all sorts of new notions into the heads at Savoy Hill.

Awkward Questions.

People of some influence within the B.B.C. ranks are suggesting that Luxembourg is simply pointing in the direction which all broadcasting concerns must pursue sooner or later.

The leading merchandise houses in this country are almost certain to "buy time" at the Luxembourg station, with the inevitable sequel that awkward questions will be asked.

Money Going Abroad.

"Why," John Citizen will exclaim, "should all this money go out of the country when we have under our own control the same kind of medium for the spread of publicity and improvement of British trade?"

So long as the B.B.C.'s licence continues to forbid microphone propaganda, no answer will be expected of the B.B.C. The problem will be one for the P.M.G. or Parliament to solve.

And Now Athlone.

Much as we may (some of us) object to the whole idea of trade-supported programmes, there is no gainsaying the fact that the practice is spreading to most European countries. In Italy, Rome and Turin are latest converts. Belgium and German stations also give sponsored programmes, while as for the Paris jumble sale . . . one hopes it will not be too closely copied by Athlone, which, I see, is to open with 100-kW. output in July next.

The Chancellor To-night.

IS it necessary to remind readers that Mr. Neville Chamberlain will to-night broadcast on the subject of the Budget?

The talk will go out from all National transmitters.

Next Saturday's Cup Final.

THE commentary on the Football Association Cup Final between Arsenal and Newcastle United at Wembley on Saturday next, April 23rd, will be given by Mr. George F. Allison.

Community singing, which precedes the commentary, will be conducted by T. P. Ratcliff, and accompanied by the band of the Welsh Guards, under the direction of Captain Andrew Harris.

Heard Scottish Regional ?

LISTENERS are being warned not to assume that the test transmissions now radiating on 376.4 metres from the Scottish Regional transmitter at Westerglen are representative of the ultimate performance of the station either as regards strength of reception or quality of reproduction.

I understand that an announcement is to be made very shortly concerning public reception tests to be started probably in the first week in May.

Birmingham's "No. 10."

BIRMINGHAM now has its "No 10" studio—equivalent to the Waterloo Bridge Warehouse—in the shape of a temporary studio lent by Wm. Bayliss and Co. When it was definitely decided to extend the Midland Regional studio facilities in Broad Street, steps had to be taken to find alternative accommodation before the workmen were let loose on the B.B.C. premises.

The firm mentioned have come to the rescue with a draped room in their factory buildings, capable of holding eighty persons. It contains a small organ, which should be useful for broadcasting purposes.

Regained Prestige.

When the new studios are completed and the Broad Street premises are linked with the new Midland Regional transmitter at Droitwich, Birmingham will have regained its old broadcasting prestige. Birmingham folk never looked kindly on the closing of their own transmitter in favour of 5GB, but it is felt that the city will have far greater control over the Droitwich station, and will, indeed, be the centre of broadcasting activity in the Midlands.

Do We Want Chatty Finance ?

THE financial Press is making overtures to the B.B.C. for brighter Stock Exchange Reports. It seems that, in the opinion of some people, these announcements could be made less wooden, mechanical, and uninforming than they are at present.

To my mind, the present announcements are at least brief and to the point. When a financier tries to be chatty, he makes use of jargon which would make even a wireless research worker envious.

When dealing with money matters, the B.B.C. should keep out the cackle and help us to forget the state of our pockets as quickly as possible.

Henry Hall.

HENRY HALL'S band is growing in popularity for the sound reason that its leader is very cleverly feeling the public pulse without making the mistake of trying to please everybody at once.

It was a good move to drop the vocal chorus in the signature tunes, but I am not sure that Mr. Hall has done right in introducing a woman vocalist. I hear that the lady who obliged the other evening was a celebrated broadcasting star who prefers, in this instance, to remain anonymous.

What Johnson Would Have Said.

In this she displayed good judgment. Women dance vocalists prompt remarks like that of Dr. Johnson concerning women preachers.

"Preaching by women," said the great Doctor, "is rather like a dog standing on its hind legs. It is not done well, and one wonders why it is done at all."

The Magnification of the Tuned Circuit.

Separating Stations Without High-note Loss.

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

(*Concluded from page 380 of previous issue.*)

AT the close of the preceding part of this article it was shown that if the magnification of a tuned circuit were held constant over the usual medium-wave range, from 200 to 550 metres, the selectivity would be greater at the higher wavelengths, while the dynamic resistance of the tuned circuit, and hence the amplification attained, would be less. The variation in dynamic resistance over the wave-range is shown in the curve marked "Constant Magnification" in Fig. 5.

Instead of holding the magnification unchanged over the tuning-range, we might lay down the condition that selectivity should be the same at all wavelengths. This implies that *m* must be lower at 550 metres than at 200, which will accentuate the drop in R and the falling off in amplification, as the curve marked "Constant Selectivity" clearly shows.

If, finally, we try the remaining alternative, and stipulate that amplification, and with it R, shall be held constant from one end of the wave-band to the other, the inevitable result is an accentuation of the variations in selectivity as between one end of the range and the other. This point is illustrated in Fig. 6, which gives tuning-curves for 200, 300, and 550 metres for a tuned circuit of dynamic resistance 125,000 ohms at all wavelengths, using a coil of inductance 200 microhenrys. The variation in selectivity is now very marked indeed.

Constant selectivity and constant amplification are thus mutually exclusive. The two cannot be attained in any set by adjustment of tuned-circuit values, though they could conceivably be had by skilful juggling with band-pass filters, and with the couplings between valve and tuned circuit.

In the table different values of R corresponding to a series of wavelengths obtained by tuning a constant inductance were given, *m* being constant throughout. A more interesting, because more practical, point arises in connection with a superheterodyne receiver, where the intermediate frequency is fixed, but may be reached by any desired combination of inductance and tuning capacity. If, for example, we happened to have a particular affection for the rather bad resonance curve given in Figs. 3 and 4 as applying to 3,000 metres (100 kc.), we could attain it in a number of different ways, each of which requires a different inductance, a different tuning capacity, and a different resistance, though in all cases the magnification could be held constant at 100. Fig. 7 gives the values of series resistance that it is necessary to obtain with each value of inductance, while the values of dynamic resistance R that correspond are also shown by the same curve on the right-hand scale. The tuning capacity required is given by the second curve; the scale, except for the number of noughts, is the same as those for r and R, but "landmarks" are inserted on the curve itself to prevent confusion.

These curves show that for such a case as this high

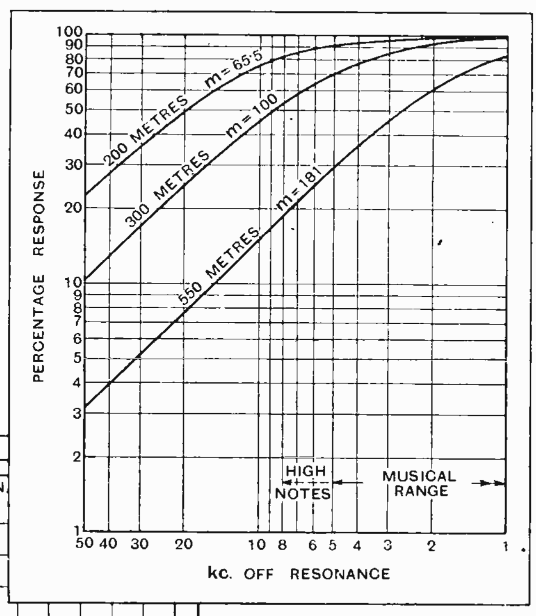


Fig. 6.—Tuning curves at three wavelengths of a tuned circuit which has the same dynamic resistance over the wave range covered. R = 125,000 ohms and L = 200 microhenrys. Compare with the corresponding curves of Fig. 4.

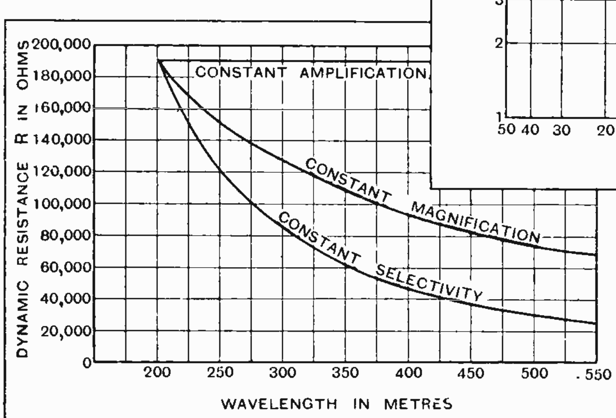


Fig. 5.—Variation of dynamic resistance (which controls stage gain) with wavelength for the following conditions: (1) Constant Amplification; (2) Constant Magnification; (3) Constant Selectivity.

The Magnification of the Tuned Circuit.—amplification (resulting from high R) does not necessarily involve higher, or lower, selectivity. By the aid of such curves as these, selectivity and amplification can be adjusted quite independently of one another to any required values that are within the range of practical possibility.

Much the same thing can be done, though within much narrower limits, in a tuned circuit designed to cover a whole range of wavelengths. If, for example, it is desired to increase the amplification of a receiver intended to tune from 200 to 550 metres without at the same time increasing the selectivity and incurring loss of side-bands, it can be done to a limited extent by raising the dynamic resistance of the tuned circuit by choosing a high inductance value. Suppose, for example, that coils of magnification 100 at 300 metres are regarded as satisfactory for a projected receiver; this figure can be attained by choosing circuit-constants as given in Table II.

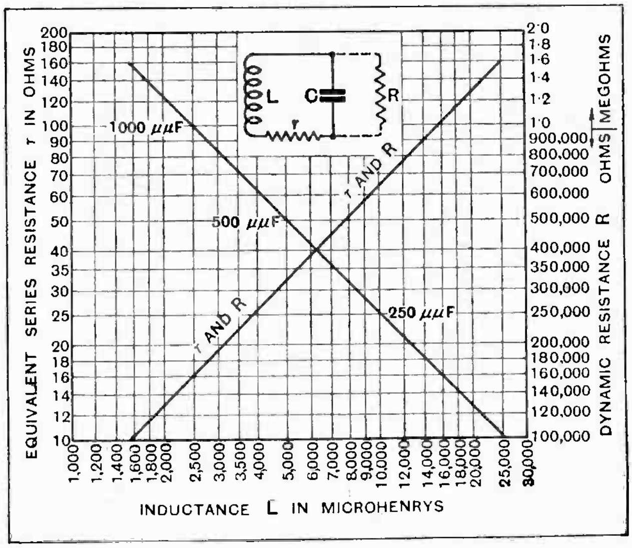


Fig. 7.—Values of *r* and C necessary for a tuned circuit of $m = 100$ at 100 k.c. Corresponding values of R can also be read off. R may be given in any value from 100,000 ohms to over a megohm, thus making wide variations in amplification, without any change being produced in the tuning curve of the circuit.

In the case of the superheterodyne, where one wavelength only has to be considered, one can accept almost any reasonable value of tuning capacity that one's calculations indicate as desirable. When dealing with a complete tuning range, on the other hand, greater difficulties arise owing to the fact that a high value of inductance, though desirable for the longer wavelengths, makes it impossible to tune down to the lowest wavelengths owing to the stray capacities inevitably present. The last two columns, in which are given the maximum and minimum capacities necessary to tune each coil from 200 to 550 metres, illustrate this point. In a receiver using screened coils, the lowest value of C_{min} can hardly be approached. Nevertheless, with proper precautions, R can be varied over a range of nearly two to one without altering the tuning curve of the circuit.

The magnification of the tuned circuit can be made the basis of other calculations, both more interesting and more complicated than those discussed. For example, one can find the number of tuned circuits required, and the magnification that each should have, to enable the finished set to fulfil certain prescribed conditions.

TABLE II.

L (μH.).	r (Ohms).	R (Ohms).	*Cmin.* (μμF.).	*Cmax.* (μμF.).
150	9.44	94,400	117.0	566
175	11.0	110,000	102.0	486
200	12.6	126,000	88.0	425
260	16.3	163,000	68.0	327
300	17.8	178,000	58.5	284
380	23.9	239,000	46.4	224

An interesting result is obtained if one calculates the requirements of a set which is to give reasonably good separation of Radio-Paris from 5XX, while at the same time giving acceptable quality. Let us suppose that signals from 5XX are ten times stronger, at the aerial, than those from Radio-Paris, and that it is desired to reduce the former till the strength at the detector valve is one-fiftieth of that of Radio-Paris. Let us further assume that we shall be content to lose three-quarters of the 5,000-cycle notes from the desired station, but that we will not tolerate a greater high-note loss than this.

Clearly, if we try to separate these two stations with only one tuned circuit, it will have to be made to tune so sharply that the side-bands of the desired station will be almost non-existent. Several tuned circuits, each of moderate selectivity, will be required. Calculation shows that if we use five tuned circuits, each of magnification 15.2, the desired separation of the two stations will be reached, but that 5,000-cycle notes from Radio-Paris will be reduced just a shade too much—actually, to 24.3 per cent. of their full value.

The following table shows the high-note loss incurred when the desired separation is achieved with fewer tuned circuits:—

TABLE III.

No. of Tuned Circuits.	Magnification of Each.	5,000-Cycle Notes Reduced to :
1	2,290.0	0.755%
2	102.1	2.84 %
3	36.0	8.05 %
4	20.7	16.9 %
5	15.2	24.3 %

The quality to be expected from the many receivers which have only two tuned circuits, and yet are guaranteed to separate Radio-Paris from Daventry, needs no further comment than these figures provide.

Turning to a similar problem on the medium-wave band, we find that the difficulties are much the same. To fulfil the same conditions in trying to separate Mühlacker from London Regional is impossible, for the separation between the two is only 9 kilocycles. Two million tuned

The Magnification of the Tuned Circuit.—
circuits of magnification 0.1 give the maximum permissible cut of side-bands, but still leave the signal from London Regional five times as loud as the prescribed conditions demand.

It is interesting to note that although two million tuned circuits of ordinary type are not adequate to separate these two stations without a prohibitive loss of side-bands, fourteen only, if arranged in pairs as filters, will perform the feat with a handsome margin to spare. Taking the resonance curves given in a previous article[1] we find that seven such filters in cascade will reduce the signals from London Regional to half the value suggested as adequate for separation, while leaving 34.4 per cent. of the 5,000-cycle notes from Mühlacker.

It is not suggested that seven band-pass filters would make a very practicable set; but such a set would at least be a little more compact than one containing two million single-tuned circuits.

[1] *The Wireless World*, April 9th, 1930, p. 386, Fig. 7.

If we leave the realms of absurdity, and consider the possibility of separating Algiers from London Regional (18 kc. apart, in place of the 19 kc. of the high-wave example) we find something a little more reasonable. To fulfil the numerical conditions suggested for the separation of Radio-Paris and 5XX, six tuned circuits, each of magnification 61.5, will be needed; 27.1 per cent. of 5,000-cycle notes will remain. Again, filters are preferable; keeping the six circuits and arranging them as three band-pass filters more than doubles the margin of safety in the separation of the two stations, while leaving over 60 per cent. of the 5,000-cycle notes carried by the outer side-bands.

The problems of receiver design for which a knowledge of the magnification of the proposed tuned circuits is required have not by any means been exhausted in this discussion, but enough has perhaps been said to convince the reader that the magnification of a circuit is as important a matter in its way as either the series or the dynamic resistance.

CLUB NEWS.

Ratepayers' Radio.

"THE History of Valves" was graphically shown in an illustrated lecture given by Mr. W. G. J. Nixon at a recent meeting of the Radio Section of the New Eltham Ratepayers' Association. At a subsequent meeting, Mr. C. A. Quarrington, of Messrs. A. C. Cossor, Ltd., demonstrated a seven-valve superheterodyne which gave impressive selectivity.

Membership of the section is free to all members of the Association; this may account for the high membership roll, which includes over one hundred names.

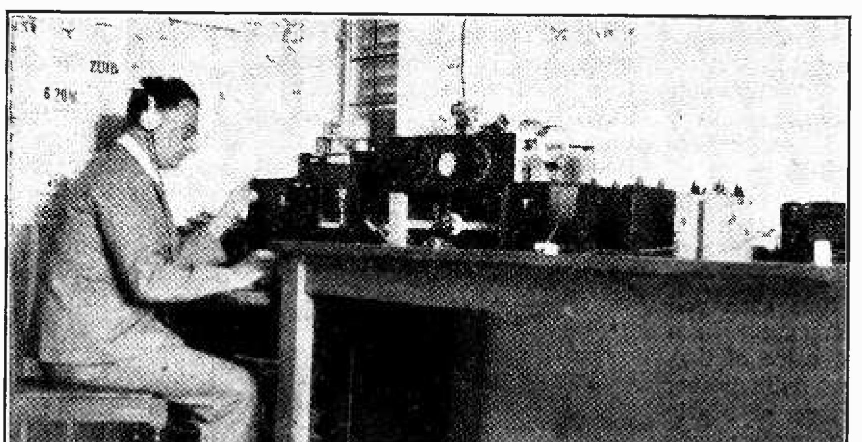
Some attractive outings are being arranged for the summer months.

Hon. Secretary: Mr. A. C. Knowling, 27, Felhampton Road, New Eltham, S.E.9.

An "Outside Broadcast."

FOR the first time in the history of the Sunbury and District Radio Society, an outside speaker occupied the rostrum on April 1st, Mr. Furner, of the Mullard Wireless Service Co., Ltd., giving a talk on "The Operation and Construction of Radio Valves."

Hon. Secretary: Mr. F. W. Diamond, Windy Croft, 21, Rooksmead Road, Sunbury.



A SOUTH AFRICAN AMATEUR. ZT1H, operated by Mr. E. W. Osborn at Klipheuval. The station is crystal-controlled and works chiefly on the 14 M.C. waveband with an input of 15 watts. Mr. Osborn, who is an engineer at the Klipheuval Beam Station, will welcome reports on his signals from British amateurs.

Talking Films.

"SOUND Reproduction from Films" was dealt with at a recent meeting of the Catford and District Radio and Television Society, held at the newly acquired laboratory at 21, Bromley Road, S.E.6. Mr. Ryland, the chairman, after an interesting talk, demonstrated a full-sized projector in conjunction with a 75-watt amplifier driving two R.K. cinema-model speakers.

Visitors are welcomed at any of the meetings, which are held fortnightly, on alternate Wednesdays and Thursdays.

Hon. Secretary: Mr. M. W. Jones, 42, Honley Road, Catford, S.E.6.

Rotary Transformers.

ONE of the most interesting lectures ever given before the Southend-on-Sea and District Radio Society was recently provided by Mr. R. H. Woodhall, A.M.I.E.E., of Messrs. Rotax, Ltd., who dealt with "The Use of Rotary Transformers and Motor Generator Sets for Radio Purposes." The lecturer demonstrated one or two of the models he had brought with him in conjunction with a McMichael moving-coil mains receiver, and the absence of mains hum and parasitic noises was very noticeable.

Hon. Secretary: Mr. Fred Waller, 49, Fermoy Road, Thorpe Bay, Essex.

"Autotone" for Belfast Club.

ONE of the most active transmitting stations in Ireland to-day is GI-6YM, the City of Belfast Y.M.C.A. Radio Club, Wellington Place, Belfast. The club has two transmitters, one for the 40-metre band and the other for the 20-metre band. The club was formed over eight years ago, and has been steadily advancing ever since. Morse practice classes have been held for the past five years, and other diversions include talks, demonstrations, and constructional work.

At present *The Wireless World* "Autotone" receiver is being built for club use, and its completion is eagerly awaited.

Amateurs visiting Belfast are warmly invited to call at GI-6YM and get acquainted with a most enthusiastic band of "radioists."

Hon. Secretary: Mr. J. J. Cowley, 4, St. Paul's Street, York Street, Belfast.

The Growth of the Gramophone.

"THE History of the Gramophone" was fascinatingly portrayed by Mr. E. M. Payne, of the Gramophone Co., Ltd., in a recent lecture before the Newcastle-upon-Tyne Radio Society. A most interesting exhibit was the model record track and model needles, which were illustrated some time ago in an article by Mr. Payne, published in *The Wireless World*. The meeting concluded with a recital of records of years ranging from 1895, 1900, 1914, 1920, 1925 (last of the old recordings) and the present day.

Hon. Secretary: Mr. William W. Pope, 9, Kimberley Gardens, Jesmond, Newcastle.

"Junk" Night at South Croydon.

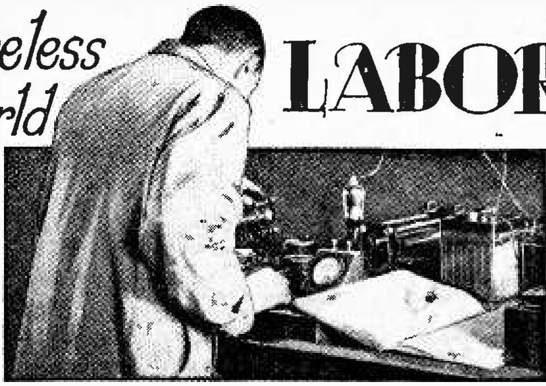
MYSTERIOUS and very ancient transformers and chokes rubbed shoulders with more sophisticated gear at the recent junk sale of the South Croydon and District Radio Society. Some enthusiastic home constructors had an obviously sentimental affection for their products, and in several cases would not dispose of them until assured that each would find a good home. The technical adviser was very particular on questions of diet, and recommended the correct current consumption and at what pressure it should be exercised. Goods which refused to "go" were gathered in groups, and members were asked to draw lots. The vice-chairman was unfortunate enough to draw the "booby" prize, which was an assortment of valve holders.

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

New Preston Society.

LANCASHIRE readers will be interested in the formation of the Preston and District Radio Research Society, full particulars of which can be obtained from the Hon. Secretary: Mr. J. E. Bradley, 89, Friargate, Preston, Lancs.

Wireless World LABORATORY TESTS



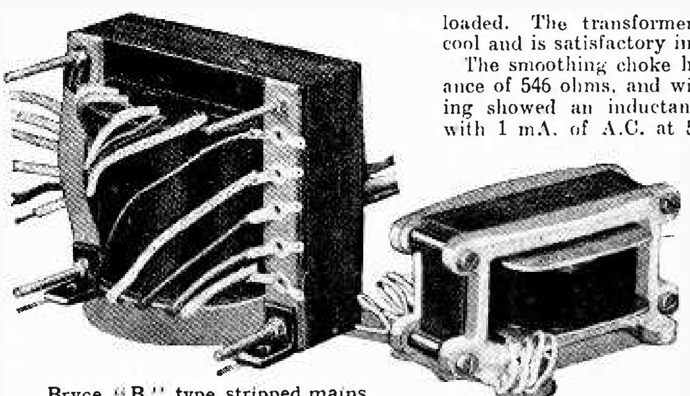
Review of New Radio Products.

BRYCE MAINS COMPONENTS.

The mains transformer and smoothing choke dealt with in this review fall within the category described as "stripped" or manufacturers' types; that is to say, they are not "finished" in the usual manner with terminals and other embellishments. With the exception of the primary winding on the mains transformer the ends and the tappings of all windings are brought out as loose leads, sleeving of various colours being employed as a means of identification.

The primary winding and its various tappings terminate in soldering tags riveted to a thin strip of fibre clamped under the bolts holding the core laminations together.

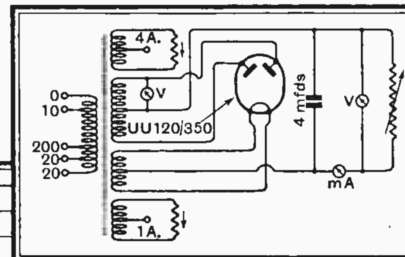
By omitting terminals a considerable saving in manufacturing costs is effected, and this is reflected in the price, which, for a "B" type transformer, as illustrated, is 30s. only. This model carries three L.T. windings, one rated at 4 volts 2.5 amps. for the rectifier, one giving up to 4 amps at 4 volts and another 4 volts at 1 amp. The H.T. winding is rated at 350-0-350 volts.

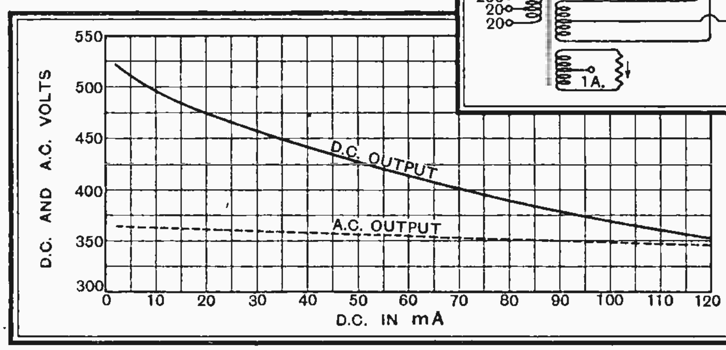


Bryce "B" type stripped mains transformer and L.F. choke.

For the purpose of ascertaining the D.C. regulation, which is shown on the graph as a full-line curve, all L.T. windings were fully loaded. The broken-line curve shows the A.C. voltage across one half of the 350-volt secondary measured during the test. The A.C. potential of this winding dropped 20 volts when 120 mA. of D.C. was drawn from the rectifier, or 5.5 per cent, which is very satisfactory indeed for a component of this type.

The L.T. windings are wound with very heavy gauge wire, and the output voltages are sensibly constant, irrespective of the load on the H.T. circuit. Furthermore, all voltages are correct; for example, the rectifier received a shade under 4 volts at 2.5 amps., while the 4-amp. and 1-amp. windings showed 3.97 volts and 4.02 volts, respectively, when fully loaded. The transformer runs perfectly cool and is satisfactory in every respect.





Regulation curves of Bryce "B" mains transformer

The smoothing choke has a D.C. resistance of 546 ohms, and with no D.C. flowing showed an inductance of 65 henrys with 1 mA. of A.C. at 50 cycles passing through the winding.

Its inductance when carrying D.C. is shown in the table below.

As in the case of the mains transformer, there are no terminals, two flex leads being provided. The price of the choke is 14s. 6d., and the makers are W. Andrew Bryce and Co., Woodfield Works, Tile Street, Bury, Lancs.

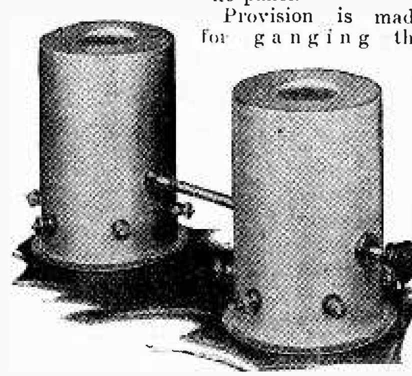
D.C. in mA.	Inductance in henrys.
0	65
10	60
20	55
30	44
40	33.5
50	25
60	19

CORDO DUAL-RANGE COIL.

This coil has been designed especially for use in a band-pass filter where the selectivity is maintained substantially constant by an inductive-capacity coupling. The principal feature of the design is that the coupling coils actually form part of each tuned circuit, an arrangement for which is claimed a minimum loss of energy. Another feature of the coil is that it can be used for intervalve H.F. coupling and provision is made for applying reaction, an extension of the coupling coil winding serving for this purpose.

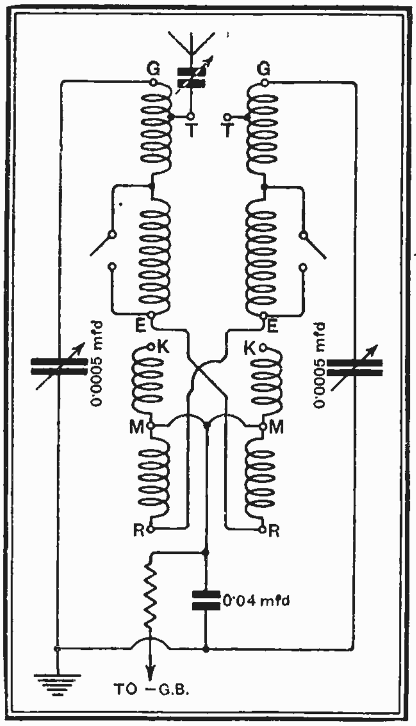
In common with present-day practice a small 1¼-inch former is used which is carefully centred in an aluminium screen measuring 2½in. in diameter. The wave-change switch is mounted between the medium- and long-wave windings, in which position it falls about one inch from the base, thus enabling the switch control to be mounted in a convenient position on the panel.

Provision is made for ganging the switches where two or more coils are used and extension rods are available



Cordo type "U" dual-range screened coils with wave-change switching.

so that the coils can be mounted well back from the panel if desired.



Theoretical arrangement of Cordo coils.

A band-pass filter circuit was assembled using two specimen coils with a coupling condenser of 0.04 mfd. They were found to be entirely satisfactory in every respect; indeed, the coils are remarkably efficient for their size and the selectivity is substantially constant over the whole range.

The makers are Cordo Electrical Products, Ltd., 68, Victoria Street, Westminster, S.W.1, and the price of the Cordo type "U" coil is 8/6d.

WAVEMASTER CONDENSERS.

The Webb Condenser Co., Ltd., 42, Hatton Garden, London, E.C.1, manufacturers of "Wavemaster" condensers, has introduced a new range of screened condensers in which is included two-, three- and four-gang-models. Aluminium is used throughout for the frame and the vanes, and each section is fitted with a small adjustable trimmer. All rotors are assembled on a common spindle, but a separate pig-tail connection is provided for each section.

Segmented end-vanes are used which, during the testing process, are adjusted so that all sections in a ganged condenser are matched at all parts of the scale to within one-half per cent.

Separate covers are fitted to each section, on which is a small terminal for the rotor connections, while the stator connection is mounted on the end of a projecting stud. This passes through a clearance hole and projects sufficiently to afford easy access. These condensers are extremely well made; the stators are perfectly rigid, and there is not the slightest trace of play in the bearings. A specimen three-gang was tested and the capacity of each section measured at various parts of the scale with the trimmers set to minimum capacity in each case.

Wavemaster Three-gang Condenser.

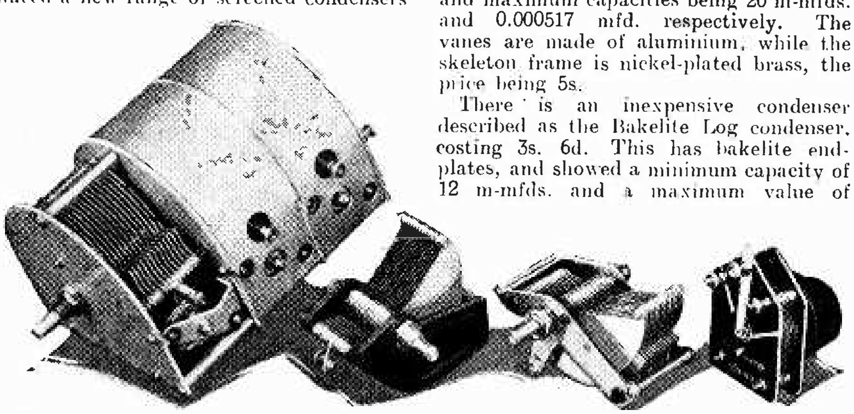
Scale.	Front section.	Centre section.	Back section.
	m-mfds.	m-mfds.	m-mfds.
0	33	30	32
20	44	42.5	43.5
40	63	62.5	63
60	91	91	91.5
80	127	127	127
100	176.5	176.5	176.5
120	236.5	237	236.5
140	317	317.5	316.5
160	414	415	413.5
180	533	535	532.5

In the above table the capacities are given to the nearest 0.5m-mfd. Only at the extreme lower end of the scale do the discrepancies exceed the maker's figure, and from 40 degrees onwards the matching is exceptionally good. The trimmers give a difference in capacity between minimum and maximum position of 58 m-mfds.

The price of this model is 27s. A two-gang costs 18s., a four-gang 36s., while a single screened unit costs 9s.

A 0.0005 mfd. sample of the Colonial Log condenser was tested, its minimum and maximum capacities being 20 m-mfds. and 0.000517 mfd. respectively. The vanes are made of aluminium, while the skeleton frame is nickel-plated brass, the price being 5s.

There is an inexpensive condenser described as the Bakelite Log condenser, costing 3s. 6d. This has bakelite end-plates, and showed a minimum capacity of 12 m-mfds. and a maximum value of 0.000512 mfd. Other sizes are available, also a range of bakelite-dielectric reaction and differential condensers at attractive prices.



Samples of Wavemaster screened and plain condensers.

THE 1932 MURPHY PORTABLE.

Original Chassis to be Continued in a Redesigned Cabinet.

WHEN first introduced nearly two years ago the Murphy type B4 receiver at once established for itself a position in the front rank of portable sets of the better class. The performance in the matter of range and selectivity was exceptionally good, and the arrangement of the controls on the top of the cabinet with a ledge upon which to rest the hands when tuning was an idea which earned universal approval.

We are glad to note that this feature is retained in the 1932 edition of the B4 portable. The only alteration to the cabinet takes the form of a new loud speaker grille of bold and original design. No alterations have been made to the chassis, as the original screen-grid H.F.-detector-2 L.F. circuit gives a performance which is still more than adequate for present-day reception conditions. It is a tribute to the intrinsic soundness of the design that this performance is being repeated consistently in current sets. This was proved by a recent test on a receiver drawn from stock. Upwards of twenty-five reliable programmes were available on the lower waveband after dark, while four or five medium-wave stations, including Brussels, Hilversum, and Langenberg, came through well in daylight. The efficiency on long-waves is equally good, and the selectivity on both wave-ranges is exceptionally good, even for a set employing a frame aerial.

The Murphy type B4 portable in its redesigned cabinet.

The price of the Murphy portable in its latest form is fifteen guineas, and the makers are Murphy Radio, Ltd., Welwyn Garden City, Herts.

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.

SURELY the most glaring example of economy of information in wireless advertising is the consistent failure of makers to state the power output of their receivers.

Does it not seem fantastic that "prospects" should be invited to part with large sums of money without being told how many loud-speaker watts they are buying?

This should be a fundamental consideration like the h.p. of a motor car. R. N. WATSON.

Southport.

The Importance of Volume Level.

MAY I suggest that your contributor, Mr. Raven-Hart, is possibly mistaken in his deduction that if "the listener in the studio hears every part of the scale of frequencies as equally loud, the energy curve in the studio must therefore be parallel to the threshold curve"?

It is fairly well established that the "contours" of equal loudness level are not necessarily parallel to the threshold sensitivity curve of the ear; indeed, for loudness levels of seventy or eighty decibels above the threshold value as judged by average ears, the level of intensity approximates remarkably to the horizontal. This circumstance explains in part the need for favouring the low (and high) notes in reducing volume.

This, of course, does not invalidate Mr. Raven-Hart's conclusions as to the necessity for more skilled *musical* control at the studio, with which every music lover will be in cordial agreement. W. A. BARCLAY.

Bieldside, N.B.

Is 5,000 Cycles Enough?

YOUR leader about the disappointing discussion on selectivity at the Institute of Electrical Engineers is very much to the point, and I think that an explanation of the disagreement between the technicians is not too difficult to supply.

There appear to be two schools of thought: those who affirm that a cut-off frequency of 5,000 cycles is adequate to ensure first-class quality and those who don't. Since we find eminent technicians belonging to both parties, one can only conclude that those who say "5,000 cycles and no more" are either hopelessly bigoted or are devoid of the ability to pick out the good from the bad. It is not a matter of opinion but of plain facts. If two radio receivers, with their associated equipment, be set up, one with a 5,000 cycle cut-off and the other with a 10,000 cycle cut-off, and *any* person whose hearing is not defective be invited to listen to one and then the other, even if some time elapse between the two auditions, that person will inevitably say that the apparatus with the 10,000 cycle cut-off afforded very much better reproduction of speech and music than was obtained from the other.

The utter nastiness of many early portable sets has cramped receiver design more than any other single factor. The public thinks that present-day receivers, in comparison, are as good as can be made, while certain technicians think that nothing better need be made, mainly because they are not musicians. When all is said and done, a radio receiver is a musical instrument, and it is just as reasonable to ask a technician without musical discrimination to design a set as to commission a cabinet maker to design a violin. Judging from the advertisements, radio manufacturers sincerely believe that they are offering musical instruments, but on what grounds do they make their bold statements? Almost every home has a piano, but can any set-maker honestly say to himself that a piano "reproduced" on his receiver is indistinguishable from the piano in his drawing-room, or that the announcer's voice has precisely the quality possessed by someone speaking to him? That is the amazing thing about commercial broadcast receiver design: not that the experts should disagree among themselves, but that the 5,000-cycle school should believe, or assume to believe, that their products are giving first-class reproduction. Let us offer up heartfelt thanks that Mr. Ashbridge and his B.B.C. colleagues *do* insist on something more than this.

Isleworth, Middlesex. H. A. HARTLEY.

Hearing Aids.

FROM a recent issue of *The Wireless World* we note that a reader is unable to find a satisfactory deaf-hearing aid. May we ask whether your reader has tried a Western Electric portable Audiphone?

A booklet is available describing and illustrating our 6033C and 6034B types, which are exceptionally efficient little instruments. They are simple to operate and inexpensive to maintain, and the compactness of their design enables them to be carried without discomfort to the wearer. They are, moreover, quite inconspicuous in use.

We have a 6034B model at Bush House, and should your reader require a demonstration at any time we shall be only too glad to arrange this for him by appointment.

WESTERN ELECTRIC CO., LTD.

Bush House, Aldwych, G. Jacques.
London, W.C.2.

Wireless Instructor Wanted.

WE are wanting to arrange a class here in the elements of wireless science, one afternoon a week, in connection with a scheme for providing free classes for unemployed men and women. Unfortunately we are entirely without funds for paying teachers. I am venturing to write to you in case any of your readers have both the leisure and the knowledge required to take such a class. So many young unemployed men are interested in wireless that it seems a fine opportunity to give them something they really care about to occupy their minds.

I should be most grateful for any help in this matter.

EVA M. HUBBACK,

Principal, Morley College for Working Men and Women.
61, Westminster Bridge Road, S.E.1.

Amplifiers and Tone Correction.

I HEARTILY support Mr Pohu in what I interpret to be a plea for quantitative treatment of amplifier circuits in his letter in to-day's issue, April 6th.

I say "interpret" because as it stands his exhortation to cease to regard an amplifier as an assemblage of valves, etc., and regard it instead as an electrical network of resistances and reactances, is like urging the world at large to cease regarding a train as an assemblage of rolling-stock, and to consider it as a system of masses and velocities. People who have to use the things will naturally just keep on regarding them as physical objects, and people who have to design them will keep on regarding them in their abstract terms. One cannot sell an abstract reactance, neither can one insert physical valves and condensers into equations. There is no question of abandoning one scheme of things in favour of another.

It is when Mr. Pohu predicts the revolutionary things that will happen when those engaged in the study of sound transmission make the same discovery as himself that I feel led to refer him broadly to any journal dealing with the subject, such as *The Wireless Engineer*, *The Journal of the Institution of Electrical Engineers*, *The Post Office Electrical Engineers' Journal*, etc.

A study of these journals will probably save him from much error into which he will otherwise fall in regarding the input impedance of a valve as infinite. That is more often than not a fatal simplification.

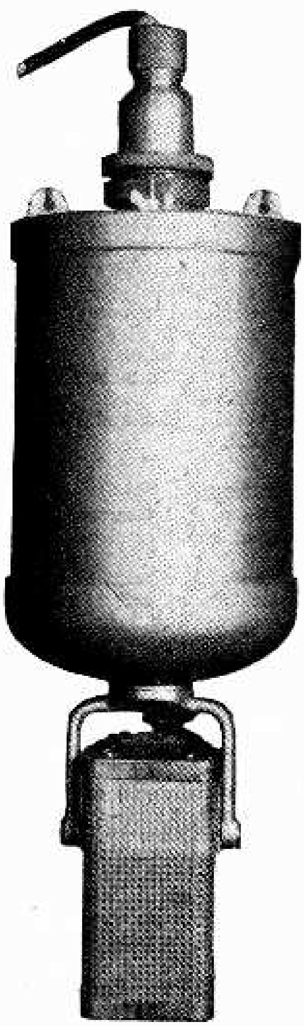
In describing *The Wireless World* views on tone correction as "recent," I think Mr. Pohu is overlooking an article by Mr. A. P. Castellain which appeared in *The Wireless World* of November 9th, 1927, explaining clearly the principles of tone correction as a comparison for side-band cut-off. The applications to pick-ups, microphones, etc., have, of course, been long familiar. Mr. Pohu might possibly be interested in my own contribution to the subject in *The Wireless Engineer* of January, 1932. In the annual index of the same journal references to the very extensive literature on this subject are conveniently set forth. M. G. SCROGGIE.

Upper Norwood. S.E.19.

A NEW ELECTRODYNAMIC MICROPHONE.

The R.C.A. Ribbon Pick-up and Amplifier.

OF late, a new microphone has made its appearance in a number of talking-film studios in this country. Known as the R.C.A. Ribbon microphone, it consists essentially of an electrodynamic transmitter or pick-up and an amplifier. The transmitter takes the form of a very light corrugated ribbon, about 2in. long, supported at its extremities in a magnetic field. The natural frequency of this ribbon as mounted is very low indeed—below the limits of audibility. As the sound waves strike the ribbon it vibrates in sympathy in the field, producing voltage variations, which are magnified by a three-stage amplifier. The frequency characteristic of the ribbon pick-up is such that the reproduction tends to fall off as the frequency is raised. To correct this, one of the amplifying stages is used as a tone-correcting stage, which results in the output being sensibly linear.



The R.C.A. Ribbon microphone consists of an electrodynamic transmitter and amplifier.

With regard to practical applications of this microphone, the outstanding characteristic seems to be its two-directional pick-up. That is, the sound can be picked up from each direction lying at right-angles to the plane of the ribbon. This characteristic can sometimes be useful, and at other times may be just the reverse. Consequently, the microphone should be used with discrimination. For instance, when used in a "set" constructed of plywood, the sound picked up might consist of the direct pick-up, combined with a second component, reflected from the "set" walls. This would happen if the ribbon were two or three feet from and nearly parallel to the wall. The advantage of this duo-directional property would show in the recording of dialogue taking place between two parties separated by a considerable distance. The use of two microphones, or of one "tracking" microphone, would be obviated by placing the ribbon in a central position, utilising the pick-up from both directions.

The chief advantage of this microphone is, perhaps, its sensitivity. It is considerably more sensitive than the condenser, and lacks one of the disadvantages of the latter—a defect known as "cavity resonance." For "long-shot" work the ribbon is ideal, as speech of perfect quality, with negligible background, may be obtained at twenty feet or more—indeed, sound picked up at this distance usually appears like "close-up" recording.

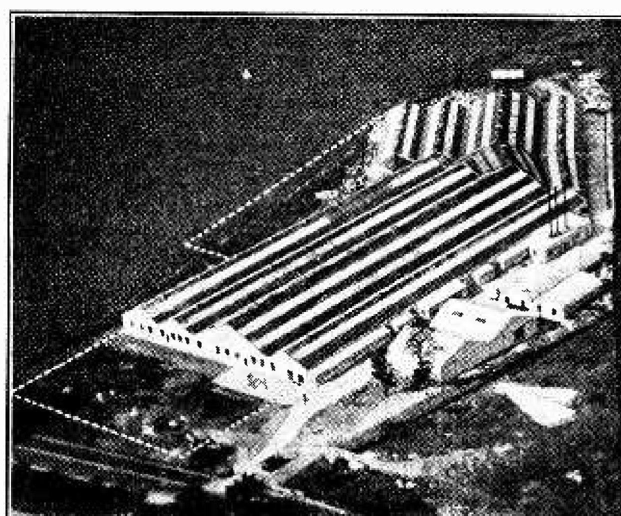
Another advantage of the ribbon microphone is that the transmitter, or electrodynamic portion, may be separated from the amplifier by quite a long lead, thus enabling it to be concealed in range of the camera, where the bulk of the amplifier would not ordinarily permit this to be done. The condenser microphone has been used in like manner, but here the difficulty arises in the providing of a suitable *low-capacity* connection between the transmitter and amplifier, and this difficulty has always seriously limited the practical separation, the high-note loss becoming an important factor.

W. H. O. S.

INNOVATION AT EKCO FACTORY.

THE popularity of bakelite, which has been used by Messrs. E. K. Cole, Ltd., in the manufacture of their receivers, has led to a decision by the firm to lay down their own plant for the production of bakelite mouldings at their Southend works.

This will consist of three 1,000-ton hydraulic high-speed presses which, we understand, are the largest yet used in this country. The actual moulding dies for the standard Ekco



A PRESSING QUESTION. Messrs. E. K. Cole, Ltd., intend to lay down their own pressing plant for bakelite radio cabinets. Special extensions to their Southend works, as indicated by the dotted line, will become necessary.

radio cabinets will weigh approximately five tons each, and will be electrically heated.

In addition to the new bakelite factory, the expansion of business has necessitated a new suite of offices and a further extension of the existing factory.

READERS' PROBLEMS.

Aerial Efficiency.

HIGH-EFFICIENCY aerials are no longer fashionable, but we still receive a number of questions with regard to the best form of aerial to use with receivers of various types.

There is a temptation nowadays to follow the path of least resistance, and to recommend the use of a short and relatively inefficient aerial in cases where interference is troublesome, and particularly where the receiver in question is lacking in real selectivity. But it always goes against the grain for us to do this; there is still no perfect substitute for a good aerial.

If it is found that an aerial is too effective, and that the receiver is insufficiently selective to cope with a heavy input from the local station, there always remains the possibility of reducing aerial coupling; this, of course, provides almost the precise equivalent of a less-effective collector. At the same time advantage can be taken of the greater collective power of a good aerial when conditions permit.

Band-pass Pentode Three Conversion.

IT is asked whether the "Band-Pass Pentode Three" could be operated satisfactorily with a variable-mu H.F. valve, and, if so, what alterations would be necessary.

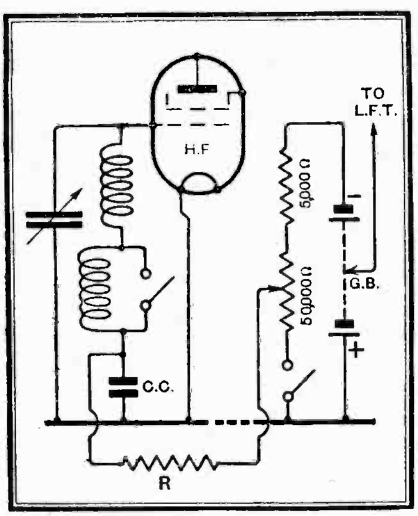


Fig. 1.—Fitting a variable-mu valve: grid bias modifications.

One of the new S.G. battery valves is quite suitable for inclusion in this set, and the necessary alterations are shown in Fig. 1. In addition, it will be necessary to short-circuit the 80 ohm resistance, across which a bias potential for the H.F. stage is developed. The resistance values given are suitable when a 16-volt bias battery is employed, and may be halved when one of 9 volts is substituted.

Magnets and Iron Filings.

APPARENTLY forgetting the intensely strong magnetic field in a permanent-magnet loud speaker, a reader has been filing off an iron screw-head in his loud-speaker cabinet, with the result that particles of metal have collected in the gap, and now prevent free movement of the speech coil. He states that a buzzing sound is produced, and asks for a suggestion as to how the "offending foreign matter" may be removed.

We fear this will prove a somewhat ticklish operation, and perhaps it would be wise to leave the task to the maker's service department. If our reader decides to do it himself, he will find it necessary first to remove the entire cone-moving-coil assembly before starting operations. The usual expedients of using a brush or a strip of stiff paper are effective enough for removing non-magnetic material, but in this case they will probably fail to clear away all the iron filings. It has been suggested that a thin strip of plasticine, suitably bent so that it may be inserted in the gap, is effective in such cases, and we advise that this should be tried. A "tacky" coating of rubber solution on stiff paper is likely to be even better, but care must be taken that no pieces of solidified solution are left in the gap.

"Music Magnet" on Ultra-short Waves.

THE latest "Osram Four" (Music Magnet) has two H.F. stages, and so to use this receiver for ultra-short-wave reception undoubtedly the best plan is to convert it into a superheterodyne by adding a frequency changer.

A reader who asks for information on this subject is referred to the "Superheterodyne Short-wave Adaptor" described fully in our issue for April 23rd, 1930, and also to a published description of several autodyne converter units which appeared in *The Wireless World* for August 26th and September 2nd, 1931.

Anode Bend Detector Current.

A USER of the "Super-Selective Six" has been checking the anode currents consumed by the various valves in his receiver, and is surprised to find that that taken by the first detector valve amounts to no more than a quarter-milliampere. In spite of this the set works well, but he asks whether this low current may be taken as an indication that matters could be improved.

When a screen-grid valve is used as an anode bend detector in the manner employed in the "Super-Selective Six," it is found that there is considerable variation between various specimens in the matter of current. The average valve takes about 0.5 milliamp; the value mentioned by our correspondent is certainly rather low, but it should not be low enough to affect results adversely.

To make a rough check as to whether the valve is in good condition, it would be worth while temporarily to short-circuit the bias resistor. This should result in a large increase of current—up to some 5 milliamperes. An abnormally low current is most likely to be due to a defective bias resistor, to a faulty valve, or to a defect in the screening grid potentiometer. Excessive bias is likely to be responsible for an appreciable decrease in sensitivity.

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 on the next page.

For Continental Readers.

IN the majority of Continental countries instrument wires are rated in terms of their diameter in millimetres (or fractions of a millimetre), and not in standard wire gauges, as in this country or America.

For the benefit of several continental readers who have asked for information as to the equivalents of wire gauges recently mentioned in constructional articles, we give below a list showing the metric diameters of most of the wires in common use in receiver construction:—

S.W.G.	mm.	S.W.G.	mm.
42	0.1016	28	0.3759
40	0.1219	26	0.4572
38	0.1524	24	0.5588
36	0.1930	22	0.7112
34	0.2337	20	0.9144
32	0.2743	18	1.2192
30	0.3150	16	1.6256

A Loud Speaker Change.

THE Magnavox Model 143 (L) loud speaker, as specified for the "Power Radio-Gram," is no longer available, and the question has been received as to whether the Model 142 instrument of the same make, with a field winding of similar resistance, would be suitable.

This loud speaker has a slightly smaller cone, but is, nevertheless, quite capable of handling the output of the "Power Radio-Gram." It may accordingly be regarded as a satisfactory alternative for the model originally recommended.

The Danger of Inductive Condensers.

A READER sends a list of rather out-of-date components which are in his possession, and asks whether these parts could be used in the construction of a "2 H.F." battery-operated set. A number of 1-mfd. paper condensers is included in the list.

It so happens that all the components mentioned are of good design, and although their modern counterparts have been improved in detail, we think that they are good enough to employ in a new set. But an exception exists with regard to the fixed condensers, which, it is presumably intended, shall be pressed into service for decoupling the various circuits of the H.F. valves. Unless we make a mistake, the condensers referred to are not non-inductively wound, and so there is a very real risk in using them.

Uncontrollable H.F. instability is always a trouble to be envisaged when considering a set with two high-frequency stages, and one can hardly afford to take risks in this direction. Probably our reader could use most of his 1-mfd. condensers, connected in parallel in pairs, for decoupling the L.F. feed circuits.

Direction of Rotation.

THE natural direction of rotation of a volume-control knob is in a right-handed or clockwise sense when intensity is to be increased. This, of course, is arbitrary, and unless one is using a special potentiometer with a graded track the actual direction makes no real difference to results.

A letter from a reader deals with this point; he states that clockwise rotation of his volume-control potentiometer has the effect of decreasing the signal strength, and asks how this may be changed.

All that is necessary in this case is to reverse the present connections to the end of the potentiometer winding, leaving everything else unchanged. Whatever method of control is adopted—and no information is given to us on this point—the desired effect will be attained in this way.

When wiring a new receiver it is perhaps worth while to give a little thought to this point, and to arrange matters so that full volume is obtained when the slider of the controlling potentiometer is set at the extreme limit of its travel in a clockwise direction. The accompanying diagram (Fig. 2) will help to make this matter clear. In it the grid potentiometer is drawn in "practical" form, as seen from the front; when its slider is in the upper position full signal voltage is applied to the first L.F. valve.

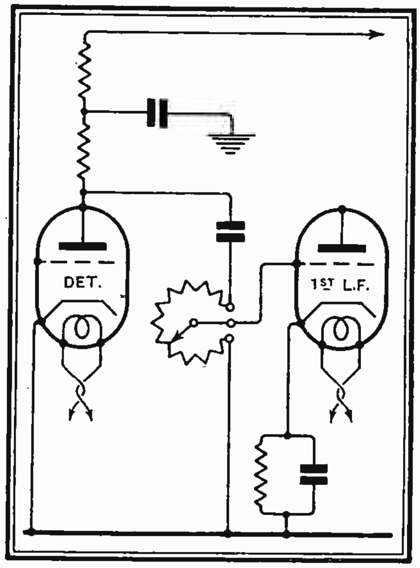


Fig. 2.—Correct potentiometer connections for "clockwise" increase of volume.

Is the Oscillator Oscillating?

IN spite of the relatively large number of tuned circuits in a superheterodyne, this type of receiver is singularly free of trouble. Experience goes to show that when a complete cessation of signals occurs the oscillator is more often than not to blame, and so this valve, or its associated circuits, should always be suspected in such cases.

This is in reply to a reader whose set, after working well for some time, has suddenly failed to produce any signals. Before going to the trouble of making systematic stage-by-stage and point-to-point tests, he asks if we can suggest the most probable cause. We advise him to make a test of the oscillator; this may be done conclusively by inserting a milliammeter in the anode circuit of this valve, and noting the current reading under normal conditions. A complete short-circuit is then introduced across the oscillator grid coil, and a further milliammeter reading is taken. If everything is in order there should be a distinct difference between the two readings; if there is not it can be concluded definitely that the valve is not in the necessary condition of self-oscillation.

Wavetrap Operating Procedure.

A READER who has built a wavetrap, described in this journal some time ago, does not, to judge from his letter, appear to be using this device to the best possible advantage. The instrument is employed to eliminate signals from the local station when receiving other transmissions on wavelengths differing from it by a small percentage. The procedure adopted is, first, to tune the receiver exactly to the local transmission, and then to reduce strength as much as possible by adjusting the wavetrap circuit. The trouble is that, on tuning to the wanted distant station, it is necessary to make a further adjustment of the wavetrap condenser in order to eliminate interference, and generally still another adjustment is needed for each station.

In all probability the wave trap and input circuits are closely coupled together, and so their tuning will be interdependent. Inconvenience due to this effect may often be avoided by setting the wavetrap to eliminate the local station when the receiver input circuit is detuned as widely as possible from its wavelength.

"THE WIRELESS WORLD"

Information Bureau.

CONDITIONS OF THE 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
(21st Year of Publication)

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TWENTY-ONE YEARS.

JUST twenty-one years ago the world's first wireless paper appeared; its name was *The Marconigraph*, and it was published in response to a growing demand for some medium for the exchange of information and views on wireless telegraphy, with special reference to the Marconi system, its early circulation being mainly amongst wireless engineers and operators at home and abroad.

After the paper had been running for two years, public interest in wireless had been so far stimulated that it was found that the greater demand justified a broadening of the policy of the paper and adapting it to meet the needs not only of those for whom it was first intended, but also the general public, and particularly the ever-increasing numbers of amateur enthusiasts who had taken up wireless experimenting as a hobby.

Widening the Appeal.

As the paper was no longer to be confined to the interests of the Marconi wireless system, the name was changed to the more comprehensive one of *The Wireless World* incorporating *The Marconigraph*. In discussing, in the first number, the objects of the journal, it is interesting to find that these were summarised with the statement, "This, then, is our policy, to be of use and interest to our readers and through them to be a factor for progress." It is on these lines that the paper has been conducted ever since.

For approximately half the period during which *The Wireless World* has been in existence its pages were devoted exclusively to the subject of wireless telegraphy, for neither broadcasting, nor even wireless telephony, had been developed. Even as far back as early 1914 future possibilities had been realised, and it is interesting to find from a study of back numbers that certain prophets had appreciated the ultimate possibilities of wireless almost to the point of predicting broadcasting. In a lecture given before the Wireless Society of London in January, 1914, the late Mr. Campbell Swinton is reported as saying that:—

"With a little imagination one could picture to oneself in the not very distant future wireless receiving stations, specially set up in connection with halls resembling picture palaces, where people would be able to go and hear *viva voce* all the prominent speakers of the day, although these might be speaking hundreds of miles away. Again, why, with improved apparatus requiring less attention and adjustment than what we at present use, should not a wirelessly operated column printing telegraph in every house tell the latest news to all the nation, as also to the newspapers, should any of these continue to survive this much more rapid method of disseminating intelligence?

"One thing seemed pretty certain; that if we were ever to have transatlantic telephony, it would be wireless."

Some eight years had to elapse before the fulfilment of these prophecies came about with broadcasting, and perhaps this development would have been much further delayed had not a remarkable stimulus been given to wireless development by the war as soon as it was recognised how essential an aid wireless communication was to modern warfare. Before those days wireless progress was retarded through lack of financial support, but with the outbreak of hostilities cost became of secondary consideration to the requirements of the Forces.

After the war amateur licences granted by the Post Office for experiments were not reissued readily; in fact, it was not until *The Wireless World* had conducted

Twenty-one Years.—

a strong agitation for the reinstatement of these pre-war privileges that they were regained.

Wireless telephony had by now been developed, and the number of licences grew rapidly as a result of the interest taken in listening to the experimental telephony transmission of amateurs in various parts of the country. The only other regular transmissions emanated from the Eiffel Tower and from a transmitter erected in Holland which achieved fame amongst British listeners under the name of the "Dutch concerts," and *The Wireless World* opened a subscription to obtain funds to help the organisers to maintain these transmissions. Later, authority was obtained from the Postmaster-General by the wireless amateurs for regular telephony transmissions of an experimental character, and the Marconi Company volunteered to conduct these as the agent of the amateur wireless societies.

So began the transmissions from Writtle, near Chelmsford, and from that small beginning broadcasting developed, being first conducted by an association of wireless firms under the name of the British Broadcasting Company, and later, as the importance of broadcasting grew, the company ceded its office to the British Broadcasting Corporation, under Government auspices.

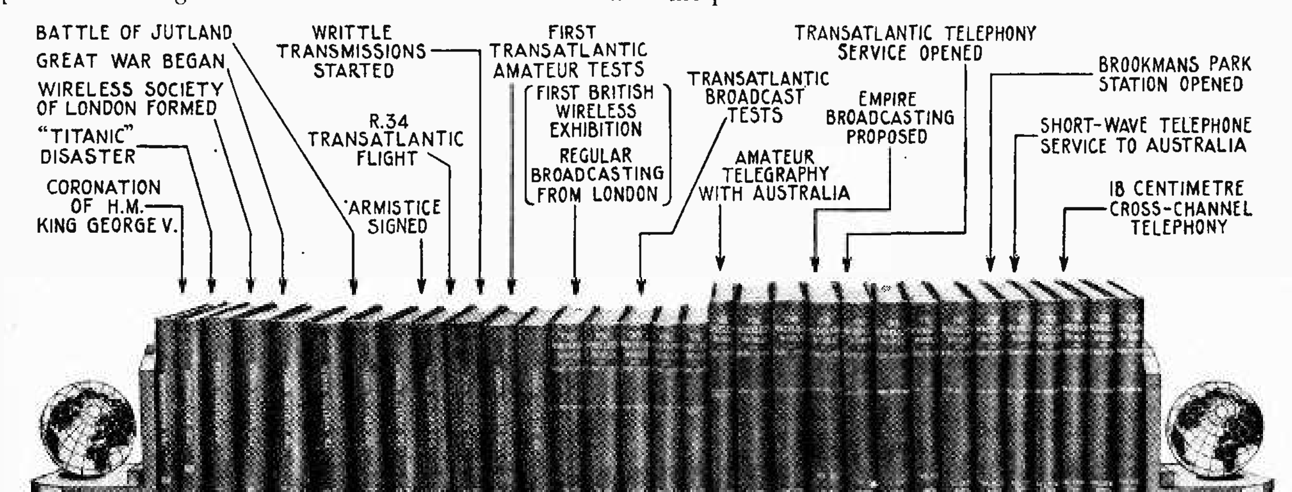
Back numbers of *The Wireless World* provide an amazing record of wireless progress, and the paper itself can claim to have been instrumental in the creation of wireless history in a number of directions. Shortly after the war it was *The Wireless World* which organised communication tests between amateurs here and in America, with the object of seeing whether it would be possible to bridge the Atlantic on short waves with low-power transmitters. The success of these tests was a revelation to wireless engineers throughout the world, and resulted in intensive research work and the realisation that waves of this order, hitherto regarded as unsuitable for distant communication, were, in fact, ideal for the purpose. Beam stations with world-wide range of communication were established as a sequel.

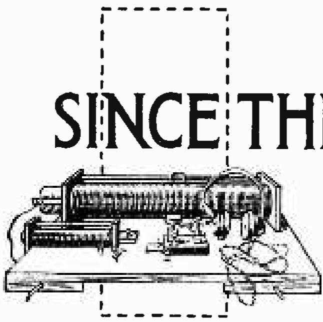
Reproduction of titles of No. 1 of *The Marconigraph*, April, 1911, and No. 1 of *The Wireless World*, April, 1913, incorporating *The Marconigraph*.

When broadcasting came a similar experiment to see if broadcast transmissions could be exchanged was conducted by *The Wireless World*, and paved the way for the transatlantic exchange of programmes, which is to-day becoming a feature of broadcasting.

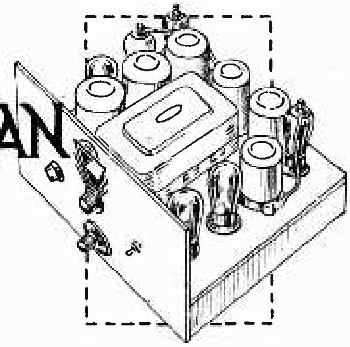
Although a familiar topic to many of our readers, it would be out of place to omit to mention the part which *The Wireless World* has played in connection with Empire Broadcasting. The proposals for an Empire Broadcasting station originated with the paper, and, in view of the opposition with which the scheme was met for several years, we doubt whether a service would as yet have been inaugurated but for these initial efforts.

Looking back over twenty-one years, one cannot fail to be astonished at the progress which wireless communication has made in all branches, and who knows what lies in store if progress continues at the present rate for twenty-one years to come? It seems likely that wireless will, in its many spheres, play an increasingly important part in human civilisation. Ideas which may have seemed only remotely possible in the early days of wireless are commonplace to-day, so that we can but look to the future as an unfolded book with every page more crowded with interest than the pages of the past.





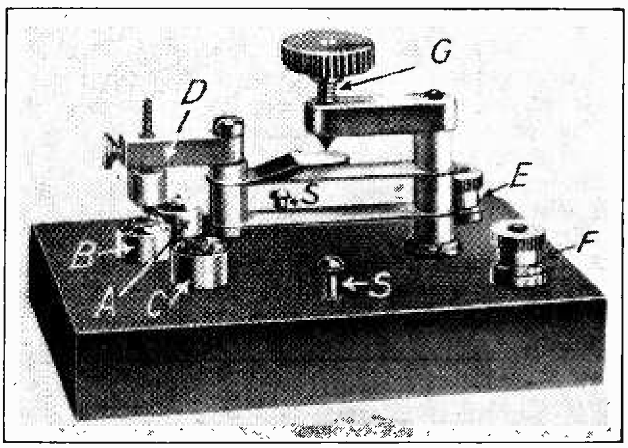
SINCE THE *WIRELESS WORLD* BEGAN



Radio in Retrospect: From Telegraphy to Telephony and Television

On the occasion of our twenty-first birthday we of *The Wireless World* would naturally like to claim that our journal is "as old as radio." But this cannot be: radio-telegraphy was established, albeit precariously, as a commercial means of communication before the first appearance of the journal, although telephony did not become practicable until several years afterwards.

Nowadays, few people seem to realise that the basic principles underlying radio communication were understood more than half a century ago. If they did, they would think twice before repeating the trite inaccuracy that "wireless is in its infancy," much to the annoyance of those of us who have grown grey—or, worse still, bald—in its service. As long ago as 1873 Clarke Maxwell proved mathematically that electromagnetic waves could be produced, while Hertz, in 1887, actually radiated and detected these waves, measuring their length and velocity. As a detector, he used a minute spark gap connected in series with an oscillatory circuit—obviously an extremely insensitive arrangement. The first great stride towards improved reception was made in 1892 by Branly, in France, who invented the coherer, an improved version of the cruder arrangement that was discovered some thirteen years before by Hughes in England. Sir Oliver Lodge, in 1894, repeated some of the Hertzian experiments with improved apparatus, and at about this time Admiral Jackson was doing important pioneer work for the ultimate benefit of our Navy.



From small beginnings: A Cossor crystal detector, described in Volume I of *The Wireless World*.

So far, wireless as a means of long-distance communication did not exist, and it remained for Guglielmo Marconi, in 1896, to improve the radiating properties of the simple Hertzian oscillator by earthing one side of it and elevating the other in the air as an aerial. With the help of the improved coherer detector, intelligible signals could now be exchanged over distances of miles. A year afterwards Sir Oliver Lodge took out what is known as the Syntonic patent, which provided for more persistent oscillations and less interference.

At about this time Marconi was in England, busy with practical experiments. Among his earliest achievements was the linking of the East Goodwin lightship with the land, and, in 1899, the spanning of the English Channel. In the same year a range of eighty-five miles was attained between ship stations, and wireless was used, though with small success, in the South African War.

An important practical development was made by Marconi in the first year of the present century; he patented the coupled-circuit transmitter, which allowed for sharper tuning and the radiation of infinitely more energy than had been possible with the simple "plain aerial" sets of the past. The first spectacular result of this development was the conquest of the Atlantic, which was spanned by radio-telegraphic signals in 1901. It is true to say that at this time the technique of reception had lagged behind that of transmission, but important developments were soon to come. The years between 1902 and 1906 saw the introduction of the magnetic detector, the Fleming two-electrode valve, and crystal rectifiers, all of which were responsible for a considerable increase in the distance over which signals could be interchanged. Range—and selectivity—were then, as now, the ideals after which everyone concerned in development work were always striving.

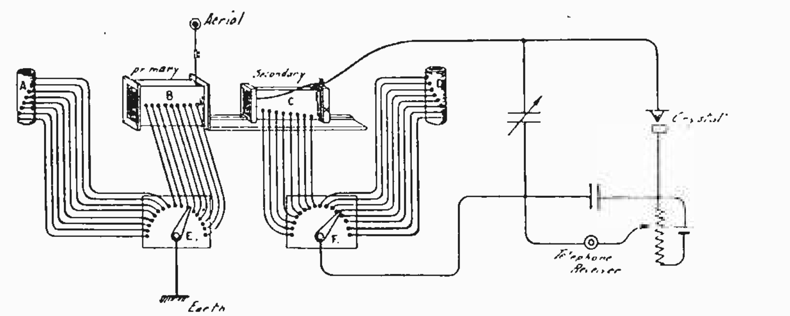
In the years immediately preceding the publication of the first number of *The Marconigraph*, from which *The Wireless World* evolved, several far-reaching discoveries were made. Lee De Forest, in America, put the third electrode into the Fleming valve; telephony was made possible, theoretically if not practically, by the invention of the arc transmitter and the high-frequency generating machine, and the

Since *The Wireless World* Began.—radiogoniometer, or wireless direction finder, was evolved by Bellini and Tosi.

When we began publication the position was that the number of land and ship stations—especially the latter—were steadily increasing, and throughout the world several thousand people were directly employed in some capacity or other in wireless communication. There was a regular telegraphic service across the Atlantic, and sets were being installed on aeroplanes and airships. This was the age of spark transmitters, and the high-powered station had already come into being. A wireless station *was* a wireless station then, giving both visual and audible evidence of its existence; aerial masts of 750 feet in height were soon to appear, and the sudden dissipation of many kilowatts of energy in a crashing and almost awe-inspiring spark discharge was a sound not to be easily forgotten.

The condenser which I describe is easily made, and can be produced by an amateur carpenter, without any special tools; on the other hand, the rotary condenser is difficult to make satisfactorily.

The following articles were bought: Receiver and blocking condenser. Carborundum crystal. Dry cell. A few binding screws.



An extract from one of our earliest constructional articles.

infallible stand-by of every amateur, as the transmissions were easily receivable. The test of a really good set was the ability to receive the German station at Norddeich; except in very favourable circumstances, the thin, piping signals from this station were so weak that one's own breathing seemed loud in comparison.

Wireless seems to thrive on adversity, or, at any rate, to derive benefit from the misfortunes of others, and a great impetus to its development was given by the "Titanic" disaster in 1912. This great liner struck an iceberg on her maiden voyage to America, and, although there was an appalling loss of life, more than 700 persons were saved, almost certainly by the intermediary of wireless. As a result, it was at last brought home to the public that radio was something more than a scientific novelty.

From now until the outbreak of the World War was a period of steady development, although time was hardly ripe for the commercial application of the three-electrode valve. This device was used in 1911, as an amplifier, by Von Lieben, and, as a generator of continuous oscillations, by Meissner in 1913. Franklin, of the Marconi Company, in the same year applied the principle of plate-grid reaction to the reduction of losses in tuned receiving circuits, and by doing so added enormously to the sensitivity of existing methods of reception.

Continuous waves, as produced by arc generators, had already been modulated in a crude sort of way by water-cooled microphones, or by banks of microphones in parallel, and so telephony had already come into being, but only experimentally, and there was no attempt to broadcast speech and music for general

Early Amateur Activities.

The amateur movement was already established, but the early enthusiast had to cope with many difficulties. His favourite receiver was a tuner consisting of inductances of gigantic size wound on cardboard tubes, with tappings for variation of inductance, and sometimes, by way of refinement, with a parallel-connected variable condenser of crude design for fine tuning. The title illustration of the present article shows a crystal set of the period made by Mr. Leslie McMichael, then a prominent figure in the amateur world, and now the Chairman of the Radio Manufacturers' Association.

Time signals from Eiffel Tower, with its high aerial, relatively great power, and the low-pitched croaking note of its spark transmitter, were then the

A successful amateur transmitting and receiving station of 1911. The owner, Mr. Leslie McMichael, is deeply absorbed in the reception of a message—seldom an easy task in those days.

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Since *The Wireless World* Began.—consumption. But time signals were being used by those who were not technically interested in wireless matters.

Wireless and the Great War.

In 1913 and 1914 amateur wireless clubs were flourishing, although apparatus was still crude; the triode valve was not yet for Mr. Everyman, or, indeed, for anyone except those engaged in important development work. Low-power amateur transmission was in full swing, quite often with the help of a discarded motor bicycle coil as a source of high voltage for the spark transmitter. Detection was still by crystal in most cases, although some of the more advanced amateurs used electrolytic detectors. The design of tuners was rather more refined, but large coils were still the vogue; it was not unusual to specify their inductance by the pound (of wire used in winding them).

Brutal as it may sound, it is a fact that the outbreak of war in 1914 was, like the "Titanic" disaster, a blessing in disguise for those interested in the practical development of the scientific innovations of the preceding years. All the fighting services of the belligerent nations were clamouring for better radio sets, and plenty of them, and it is probable that twenty years of normal advancement of technique was crammed into the war period.

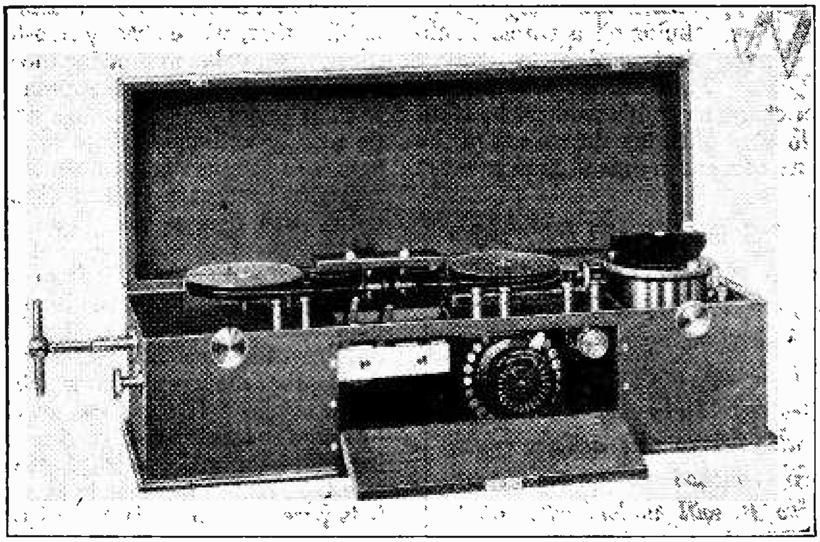
As all the German cables had been cut at the outbreak of war, that country depended almost entirely on wireless for communicating with the outside world, and especially with America. The activities of the Sayville (Long Island) station were responsible for a certain amount of diplomatic friction between Great Britain and the U.S.A.; proof of violation of neutrality was ultimately forthcoming through the ingenuity of an American amateur, who recorded high-speed messages on wax cylinders. As a result, the activities of the station were curbed, and *The Wireless World* scored a journalistic scoop in November, 1915, by publishing the amateur's own story of how he "took the say out of Sayville."

Amateur activities in this country were, of course, entirely stopped at the outbreak of war, and all apparatus had to be deposited with the Post Office authorities. At the time when spy-fever was at its height many who neglected to obey this order found themselves in serious trouble with the authorities, and, in some cases, received sharp sentences. The pirate listener—or even transmitter—who even then was not unknown—found himself in a quandary; to surrender his apparatus amounted to admitting an infringement of the law, while to retain it might mean a much more serious penalty under the Defence of the Realm Act. Even a morse buzzer was decided to be taboo, and it was seriously suggested in these pages that code practice should be carried out with the blade of a table knife between a pair of dinner plates! Most amateurs found their way into the wireless branches of one or other of the Services, and many of them attained positions of great importance.

Space forbids any attempt to deal, even sketchily, with war-time radio work; the valve amplifier, detector, and oscillator were developed apace, and telephony became practicable.

Immediately after the War came a period of intensive development of long-distance radio-telegraphic circuits, culminating in the building of directional beam stations, which entirely upset the preconceived idea of an Empire wireless chain.

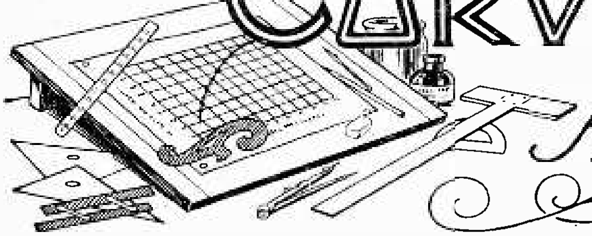
After a good deal of difficulty the amateur was able to recover his pre-War "rights," and again set to work in earnest. It was not too easy to acquire a valve—few aspired to more than one—and it is to be feared that most of them were obtained through subterranean channels from America, or, more often, through the Army "scrounger." Rapid progress was made, culminating in the transatlantic tests of 1921.



Marconi time-signal receiver, a "broadcast" set intended for the non-technical user before the advent of telephony.

Broadcasting, as we know it to-day, started towards the end of 1920 in America, where the Pittsburg station, KDKA, began a series of regular transmissions. Shortly afterwards preliminary steps were taken towards the establishment of a service in this country, and, with the help of the Marconi Company, transmissions were made from stations at Writtle and in London. The B.B.C. started operations at the end of 1922, the same year seeing the opening of the first All-British Wireless Exhibition.

From the inception of broadcasting technical improvements succeeded one another so rapidly that it would be impossible to chronicle them here in true perspective. Indeed, it would hardly serve any useful purpose to attempt to do so, as these developments are still fresh in the minds of many of our readers.



CURVES: A Simple Explanation

How They Are Built Up and What They Mean.

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

WHENEVER any contributor on a wireless subject wishes to convey information of a numerical character to his readers, he is inclined to offer his statements in the form of a curve drawn upon squared paper. It is understandable that he should do this, because the only effective alternative method of presentation is a table of figures. To all those who are accustomed to the use of curves their meaning, if only in general terms, can be grasped at a glance, whereas a table of figures requires at least a little conscious analysis before the full information can be extracted from it. For those to whom, from lack of familiarity with them, the meaning of curves is not always self-evident, it may be useful if we consider a few examples, discussing the connection between the curves and the figures upon which they are based, and showing how points that need to be extracted from the figures are shown directly to the eye upon the curve.

SO much useful information in radio is presented in the form of graphs that a clear understanding of how they are built up and read is almost essential. Special interest attaches to this article, which is couched in simple terms, as it will undoubtedly assist readers to complete the "Ideal Station Finder" Supplement in this issue.

As a first example we will choose a subject that, while strictly non-technical, has a value in showing the way in which curves must be approached if their underlying meanings are to be readily extracted. The table of figures in the next column shows the receiving licences in force at different dates, two figures being given for each year.

Even from Table I, it is at once clear, by comparing successive numbers with one another, that the number of licences has risen steadily during the whole period to which the Table applies. If, however, we want to find out further details, discovering, for example, which half-year saw the greatest increase in licences, it is necessary to subject the figures to analysis, the process obviously being to subtract each total from the one that follows it, thereby determining the increase for each individual half-year.

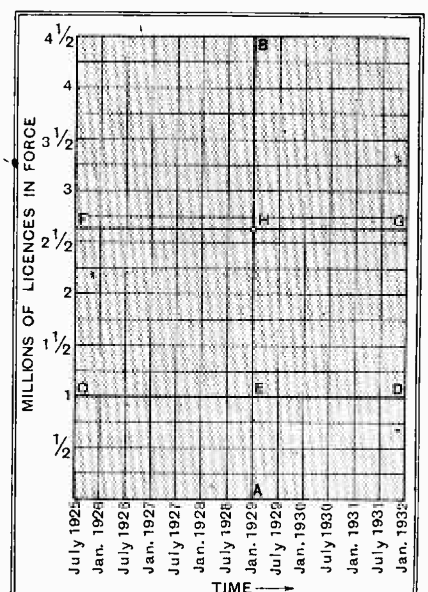


Fig. 1.—How a curve is constructed. Any point on AB means "Jan. 1929," and any point on CD means "One million licences."

Let us convert this table into a curve, drawn on squared paper in the usual manner. For this purpose

TABLE 1.

Date.	Licences in Force.
July 1st, 1925 ..	1,387,000
Jan. 1st, 1926 ..	1,644,325
July 1st, 1926 ..	2,076,000
Jan. 1st, 1927 ..	2,179,000
July 1st, 1927 ..	2,239,391
Jan. 1st, 1928 ..	2,395,176
July 1st, 1928 ..	2,519,072
Jan. 1st, 1929 ..	2,630,288
July 1st, 1929 ..	2,791,717
Jan. 1st, 1930 ..	2,956,736
July 1st, 1930 ..	3,147,298
Jan. 1st, 1931 ..	3,411,910
July 1st, 1931 ..	3,710,942
Jan. 1st, 1932 ..	4,329,754

time, expressed in years, is laid out along the horizontal scale, the number of squares to a year being chosen to make the space of time covered approximately fill the whole of the paper. A scale of numbers, running up to the highest number of licences indicated in the table, is marked out in a similar way in a vertical direction, as shown in Fig. 1. We must now think of the month "Jan., 1929," on the time scale as being indicated not merely by the point A, but by the whole of the line running vertically upwards from A to B, for every point on this line is the same distance from the left-hand edge of the paper as any other, and so has the same value on the time-scale. In just the same way the value "1" on the millions-of-licences scale marked vertically is represented not

Curves: A Simple Explanation -

only by C, but by the whole line CD, for all points on this line have the same height above the bottom of the diagram.

The point where these two lines intersect, shown at E, must therefore represent the statement that "January, 1929," coincides with "one million licences," and if we wished to make that statement we should do so by marking E firmly with a dot that would eventually be part of our curve. It will be evident, however, that we could have drawn a horizontal line across the diagram at any level we liked. All such lines would necessarily have cut across the line AB, and each of the intersections would have ascribed a different number of licences to the date January, 1929. Only one of the many possible points on the line AB can be the one that expresses the known fact that on that date there were 2,630,288 licences in force; that point is H, where the horizontal line FG, whose height represents the number of licences quoted, cuts across AB. This point H, then, is a true statement, and represents in graphical terms one of the lines of Table 1.

By repeating the process for each of the other dates of the table we finally arrive at a series of points, spaced apart horizontally by intervals of six months, each with a height standing for the number of licences in force on the date represented. This series of points is shown in Fig. 2, and it will at once be seen that they outline the irregular curve which has been made by drawing a straight line from each point to the next.

Information in Pictorial Form.

At the first glance it is evident that the number of licences has risen, half-year by half-year, throughout the whole period of time to which the curve refers. Moreover, it is instantly obvious that the rise is steepest for the first half of 1926 and the last half of 1931, thereby indicating without any analysis at all that these two half-years contributed the greatest increases in the number of licences. It is to be noted that this information is latent in Table 1—it must be, since the curve was made from the Table—but that it can only be extracted from the figures of the Table by performing the subtraction sums necessary to work out each half-yearly rise.

The curve, in short, presents to the eye in pictorial form the information that the Table offers to the mind in arithmetical figures. In most of us the eye, which is busily employed conveying impressions to the brain for the whole of our waking hours, is so perfectly trained that an appeal to it has become the most direct route to our minds. Whenever we wish to grasp the significance of a collection of figures the curve is therefore the easiest way of doing it.

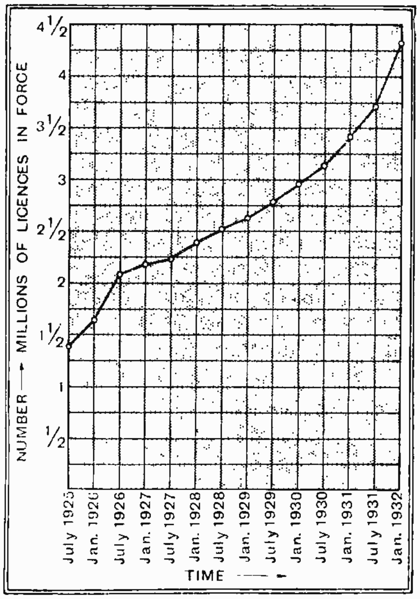


Fig. 2.—The finished curve, constructed from the data of Table 1. Observe how obviously the varying steepness of the curve stands out.

It will be appreciated from these remarks that the main purpose of a curve is not to exhibit numerical results as such, but rather to display the relations between them. If we wished to convey the number of licences in force on one date only, we should not produce one solitary dot solemnly marooned in the middle of a wilderness of squared paper. The eye would have no other dots with which to compare it, and could therefore make none of the instinctive and instantaneous deductions for the sake of which curves are drawn. In Fig. 2 the eye picks out the fact that the number of licences has always been rising, and that the rise has been rapid at some periods and slow at others. The outstanding feature of the curve is thus its *slope*,* which in the present case represents the increase in licences per half-year.

In the particular example chosen, the meaning of the curve is made exceptionally clear by the nature of the information that it presents. From left to right is a scale of time, and we are accustomed to regard time as flowing steadily onwards. The idea of "onwards" contains no underlying suggestion of "up" or "down," so that its representation as a horizontal line, drawn from left to right like a line of print, is almost instinctive. Do we not all tend, in laying out a wireless set, to have the aerial terminal on the left and the loudspeaker on the right?

The vertical scale, too, is a self-explanatory one. If the number of licences increases we speak at once of a "rise" in the number of listeners. We use, in ordinary parlance, metaphorical expressions which the curve we have been discussing exactly duplicates in pictorial form. We have only to turn Fig. 2 through a right-angle, so that the time-scale reads from above downwards and the numerical scale from left to right, to realise how utterly the curve loses its meaning when no longer expressed in terms of our unconscious prejudices.

Now that the reasons making this rather uninteresting curve so easy to grasp have been analysed, the attitude of mind that was almost instinctive in this particular case can be consciously applied to other and less self-evident curves. Let us glance at the data of Table 2, which gives the anode current of a valve at a fixed anode voltage, for each of a number of grid-bias values.

TABLE 2.

Grid Voltage.	Anode Current.
0	37.0 mA.
− 2	31.0
− 4	23.5
− 6	17.5
− 8	12.0
− 10	7.5
− 12	3.5
− 14	2.0
− 16	1.0

* In effect, the eye automatically differentiates the function corresponding to the curve. Those who have studied the calculus will grasp at once why this makes a curve so extraordinarily informative.

Curves : A Simple Explanation—

The Table shows that the anode current decreases with increasing negative grid-bias, but, unless they are subjected to analysis, the figures give no further information. We will therefore plot them on squared paper

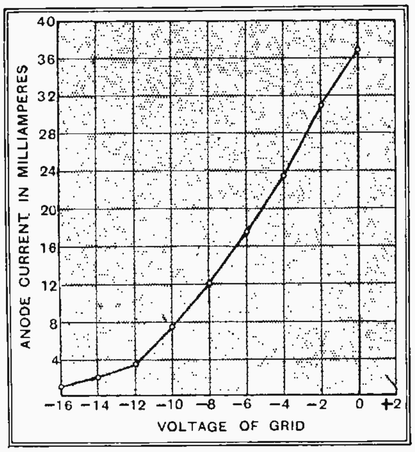


Fig. 3.—The data of Table 2 literally shown in graphical form by merely joining up the plotting points.

and see if the curve that will result is easier to grasp.

In plotting we can allot the horizontal scale either to grid-voltage or to anode current—which is preferable? In the case of Fig. 2 we drew the time-scale horizontally, and we regarded time rather in the light of cause, while number of licences was looked upon to some extent as effect. The tendency, therefore, is to regard it as natural to plot cause horizontally, reserving the vertical scale for the effect.

"Cause" and "Effect."

In making the measurements that provide data, such as those in Table 2, we can only arrive at a given anode current by suitable manipulation of grid-bias. This, therefore, is "cause," and will be plotted horizontally, leaving anode current to take the vertical "effect" scale. Arranging the squared paper in this way, and putting in dots to represent the data of the Table, we arrive at Fig. 3, in which each dot is, as before, joined to its neighbours by straight lines.

The first point to notice is that the dots do not mark out a perfectly smooth curve, but one in which there are one or two rather sudden changes in direction. This was also true in the curve of licences, but in that case we did not raise the point. There is no necessary relationship between licences and time; if a million licences had expired in August and had not been renewed till December in any year the data for July and January would have been unaffected, but there would have been a tremendous dip in the curve between those two dates. We cannot say that this did not happen, but we do not know that it did; we therefore put in a straight line and hope for the best. We can only guess at the number of licences in force in September; the value of the curve is quite a likely one, but is certainly not known.

In the case of the valve curve we have information as to what is happening *between the dots*. The information is only general, but we do know for certain that successive quarter-volt changes in bias will evoke anode-current changes which will either be identical or will slowly increase or decrease from one end of the series to the other. In graphical terms we know that the curve will be a smooth one, devoid of *sudden* changes in direction, and free from any suspicion of a kink.

We are consequently entitled to look upon Fig. 3 with the eye of contempt, for it shows changes of direction that are known to be impossible. We deduce that the data must be inexact, and we must either check them by repeating the measurements, adding one or two extra points for bias values near those which are under suspicion, or, if further data cannot be had, we must make the most of what we have by drawing a curve, as in Fig. 4, which seems most fairly to represent the data as a whole. This "smoothed curve" will then be the most probable curve that can be derived from the available information, and, since each point acts as a check on its neighbours by virtue of the fact that the curve is known to be smooth, the probability of accuracy in the final smoothed curve is very high. More important still, it is perfectly legitimate to read off values from parts of the curve intermediate between the dots, and these values will have an accuracy exactly as great as that of the dots themselves; in the case of a smoothed curve the accuracy will be greater than that of a dot, for the latter may have a high individual error, while the curve has only the mean error of all the original points.

Interpreting the Curve.

Finally, the interpretation of the curve. Its fundamental significance can most readily be grasped if we replace the scale of grid-voltage by an imaginary time-scale, thus making use of our instinctive tendency to regard movement from left to right as symbolising the passage of time. Imagine the grid-voltage at −16, and that it is made more positive at the rate of 1 volt per second by turning the knob of a potentiometer slowly and evenly in a clockwise direction. The meter in the anode circuit will indicate a current rising exactly as the curve shows; slowly at first, but gaining in speed all the

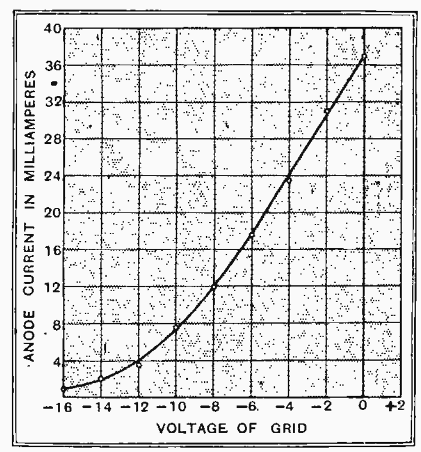


Fig. 4.—The "smoothed curve" which best represents the data of Table 2.

time, until after six or seven seconds (e.g., about −9) it settles down to a steady, rapid rise at the rate symbolised by the steeper slope of the curve. Over this range it will increase at 3.25 milliamps. per second—or 3.25 milliamps. per grid volt, which is the mutual conductance of the valve.

But now we are beginning to leave the study of curves, replacing it by the study of valves. Articles in plenty have been published on that topic; to these the reader is now referred in the hope that he will find application in reading them for some of the points we have been discussing.

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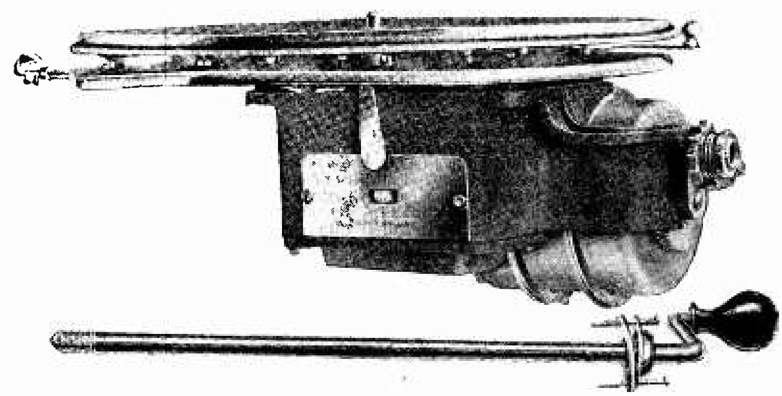

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NEWS of the WEEK.

Current Events in Brief Review.

The First British Broadcast?

WHEN was telephony reception first available to amateurs in Great Britain? The celebration of *The Wireless World's* 21st Birthday has prompted a reader to record his first experience, in 1913, of listening to wireless telephony tests carried out at the Crystal Palace. He remembers hearing a gramophone record and also a reading from a newspaper by a man in the North Tower, the transmitting apparatus being installed at the Penge entrance.

Reports from readers who heard this or any previous telephony tests should make interesting reading.

The New Poste Parisien.

BY the time these lines are read the powerful new transmitter of Poste Parisien, 329 metres, will have been inaugurated, the ceremony having been fixed for Monday, April 25th.

Luxembourg Developments.

THE "Internationaler Radiodienst," or International Radio Service, has been granted the sole rights for selling "time on the air" in connection with the sponsored programmes of the new Luxembourg transmitter. This organisation will collect publicity material from all parts of Europe.

Although regular transmissions are not to start until the end of July, we understand that a small 100-watt transmitter is testing daily on the allotted wavelength of 1,250 metres.

An International Radio Forum.

AN interesting visitor in Berlin is Mr. Morris, former U.S. Ambassador in Stockholm, who has founded an International Radio Forum, prominent members of which are the German broadcast Commissioner, Herr Bredow, Prof. Einstein, and Gerhart Hauptmann. The aim of the Forum is to foster international relations through the medium of broadcasting. Prominent Germans are to speak to the American people in English, while American celebrities will respond in German. A branch of the Society has been founded in France, and our Berlin correspondent understands that Scandinavia is also to join in the movement. It is emphasised that the Forum has no business background.

Calling Up the Doctor.

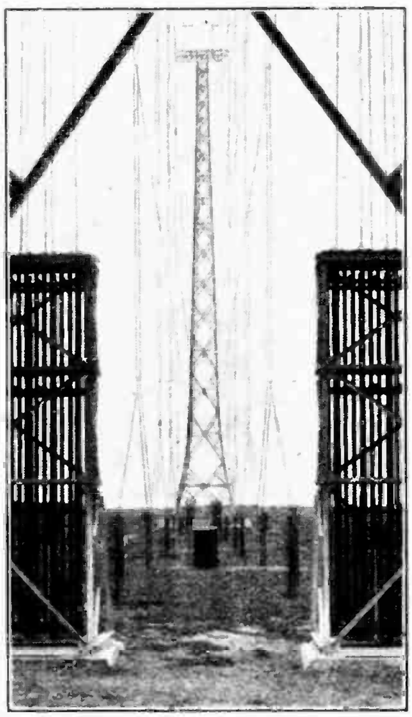
A CZECHOSLOVAKIAN doctor, who likes, if possible, to avoid rising from his bed in the early morning hours to attend to patients, has fitted up a two-way microphone and loud speaker system between his bedside and the front door. Patients or their representatives can now obtain the medico's advice with a minimum of inconvenience to both, and we commend this simple plan to the practitioners of Britain.

Fifth Million in Sight?

BRITISH wireless licence figures passed the four and a half million mark in March, and the total is now approximately 4,600,000. This is nearly a million in excess of the figure a year ago.

The Photocell Again.

PARIS has found another use for this ubiquitous instrument. Fixed to a lamp-post outside one of the boulevard subways is a photo-electric cell by means of which groups of lights in the passage are switched on or off depending upon the amount of daylight or artificial illumination in the street above. The object of the contrivance is to maintain in the subway an intensity of illumination roughly corresponding to the light outside, so that motorists are not confused by great variations in light on entering or leaving the tunnel.



SHORT-WAVE AERIALS at Nauen, near Berlin, are here seen from an unusual angle. The frames on the right and left contain the weights for adjusting the tension of the reflector wires.

Composing for the Microphone.

THE National *Conservatoire de Musique*, Paris, has formed a "microphone class" for the purpose of instructing composers in the present limitations of broadcast transmission.

Sit Down and Listen.

SEATS in "L'Orangerie," the municipal gardens of Strasbourg, have been fitted with headphones connected to a central broadcast receiver, and passers-by are invited to enjoy free concerts at their leisure

Ragchewers and Bed Haters.

AMERICA is not alone in the possession of unusual amateur transmitting clubs, such as the Barnyard Club, recently mentioned in these columns. Great interest has been shown among European amateurs (writes a correspondent) in what is known as the Ragchewers' Club, which is composed of those who can transmit and receive at 16 words per minute. Members of the club "meet" at specified times on each amateur band, the time-tables being circulated by means of a novel little magazine entitled "Ragchewing."

One sub-division of the club is the "B.H.S." or Bed Haters' Section, members of which are never happier than when conversing with each other between 3 and 4 o'clock in the morning.

Excelsior!

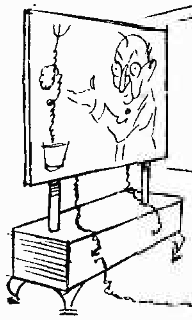
PERSPIRING amateurs toiling up the mansion stairs of Paris may soon be a familiar sight in consequence of the "battle" which has developed between radio enthusiasts and the manufacturers of lifts on the question of man-made static. Apparently, with surprising unanimity, the lift-makers refuse to fit anti-static devices, and the only practical form of protest at present available to amateurs seems to be that of walking upstairs, thus making their appeal to the hearts rather than to the minds of their enemies.

A Plea for Help.

A COMPETENT wireless engineer in Morocco is sought for by Overseas Receivers, Ltd., 18, Ganton Street, Regent Street, London, W.1. Recently the company shipped to Morocco and Algiers fourteen portable sets; reports go to show that these are not working, and it is believed that the batteries may have run down and minor adjustments may be necessary which are not understood by the natives. It is felt that a reliable radio engineer could rectify the trouble in a few moments.

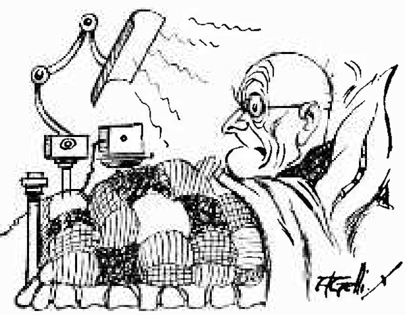
Verb. Sap.

RECENT experience suggests that the coupons appearing in our advertisement pages are not always completely filled in by enquirers, with the result that the advertisers, lacking necessary information, are unable to respond. Occasionally a coupon is despatched which bears neither name nor address!



TWENTY-ONE YEARS HENCE

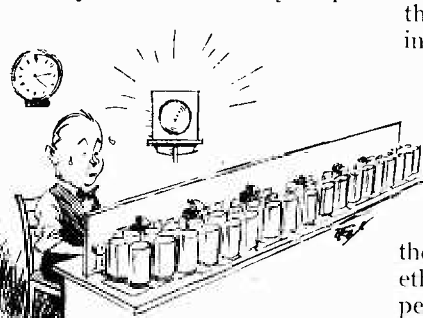
By "FREE GRID."



Reflections on the Morning After.

AWAKENED by the gentle influence of the radio sunbath broadcast direct from the Italian Riviera by the International Sunray Diffusion Co. Inc. I opened my eyes. Stretching myself luxuriously, I pressed one of the remote control buttons of the latest W.W. Radiogramoscope to see what had come in and recorded itself while I slept, and immediately the stern and familiar face of the rate collector stood out in bold relief on the stereoscopic screen situated on the opposite wall. "Unless we receive a cheque in settlement," he began, but I had pressed the rejector button, and he faded away.

After listening for a while to a newspaper's financial Editor and to its turf advisor vying with each other in telling me the quickest way to lose my money, I chanced to glance at my Greenwich-driven radio-calendar-clock. It indicated that to-day was Wednesday, April 1st, 1953—the day on which a special issue of "W.W." was to be published celebrating the passing of twenty-one years since the paper attained its majority. I speedily "rejected" the remainder of the morning dailies and tuned in to the exclusive wavelength of 25 micro-angstrom units—or microstroms as they are popularly called—reserved by "W.W."



A race with time.

On the screen there appeared the smiling features of the Editor. "We propose," he began, "to give a brief summary of the developments which have been made since our birthday number of April 27th, 1932."

Far be it from me to attempt a verbatim account of his eloquent remarks, but in my own halting language I will give you a picture of the glowing period of progress which came under review.

Yesterday To-morrow.

Old enthusiasts will remember that in 1932 radio was in such a crude state that we were compelled to listen to any programme at the moment at which it was sent out, this, of course, preventing us enjoying both programmes when, as so often happened, two stations were simultaneously radiating different items to both of which we desired to listen. This state of affairs persisted until 1937, when one of "W.W.'s" most distinguished contributors made the epoch-making discovery that etheric disturbances, once created, persisted for ever, and any programme, therefore, which had been emitted could always be picked up and amplified.

It is true that something of this sort had been suggested previously, but it remained for the genius of this contributor to prove it mathematically. It may be remembered that his calculations were promptly contradicted by other mathematicians who contributed profusely to the Correspondence pages of the journal, and the whole state of affairs was rather reminiscent of the earlier polemics which had raged round the question of the existence of side bands. (That controversy was subsequently ended by a member of the Radio Research Board, his clever mathematical analysis showing that, since carrier waves were but a figment of the imagination, their satellites, the side bands, were in like degree non-existent. It is true that he went even farther and proved that radio communication also was non-existent, and that the sounds we heard from our loud speaker actually emanated from our subconscious minds.)

Central heating for –

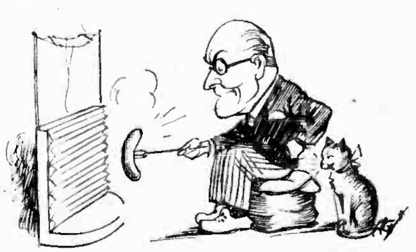
Being a practical sort of person the contributor constructed a receiver for bringing in programmes of the past. Now when it is realised that radio waves commence to decrease in amplitude as soon as they are emitted it will be obvious that after quite a short space of time the amplitude is exceedingly small; consequently, in order to recapture a

Twenty-one Years Hence.—programme which was but a quarter-of-an-hour old, he found it necessary to use no fewer than thirty-seven stages of radio-frequency amplification. This worked out at rather more than one valve per minute of age, and valve prices being what they were at that period, it was not unnatural that readers of *The Wireless World* began to complain of the growing expense of radio as a hobby.

Short and Sweet.

The next epoch-making event occurred several years later when a "W.W." man, following the general tendency to design apparatus capable of working on shorter and shorter wavelengths, inadvertently tuned in to that portion of the etheric spectrum occupied by heat waves, perishing miserably in the ensuing holocaust. His work did not finish with him, however, as it led the U.S. Government to devise an entirely new method of executing prisoners, namely, by connecting them across the tuned circuit of a receiver designed to operate on such a wavelength. This method had the advantage that execution and cremation were carried out in one operation, thus saving much time and labour.

Later research work led to the universal adoption of this novel



—all purposes.

method of heating in all our homes. Naturally, this innovation immediately suggested to one of our most skilled laboratricians the construction of a set capable of being tuned to a still shorter wavelength so that light might be received. The result of this, as you all know, is that all other forms of lighting have now been superseded. Possibly the most important result, however, has been the development of sun bathing by which all of you are enabled to tune in to the health-giving radiations emanating from various parts of the world.

It will be remembered that in 1940, after all the countries of the

Denuded of all hair.

world had been off the gold standard for a number of years, it was eventually decided to adopt an international radium standard, this being the most valuable substance then known. By 1947, however, short-wave fever had grown to such an intensity that an amateur succeeded in producing a wireless receiver and transmitter capable of working on a wavelength of $\frac{1}{10,000,000,000}$ of a metre, or in other words, a frequency of 3,000,000,000,000,000,000 cycles per second, thus producing synthetically the radiations of radium. This had a very far-reaching effect in the money markets of the world, bringing the whole structure of international credit crashing to the ground, and eventually led to the system of barter by which we now live.

Permanent Shaves.

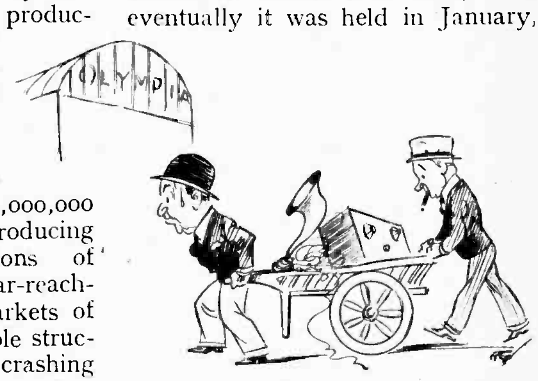
The good work still went on, however, and eventually an enthusiastic member of *The Wireless World* staff, in the course of his researches into the possibilities of still shorter wavelengths, had the misfortune to denude himself of all hair, this being the peculiar effect brought about by radiations in the neighbourhood of 900 microstroms. This startling discovery, of course, led directly to the invention of the permanent shave which is such a boon to us to-day.

I remember that as the Editor's voice drifted off into his usual charming peroration I pressed my rejector button again, and soon had the handsome, debonair features of Mr. B. smiling at me from the screen as he plunged into a graphic description of the building of his latest receiver.

Behind the Times.

I was intensely interested in following the maze of moving drawings through which he so skilfully piloted me, and was interested to learn that the receiver was designed for a wavelength so short that it was less than the diameter of a couple of electrons placed side by side.

The next article dealt with the Exhibition itself, and it was interesting to be reminded how the Radio Manufacturers' Association in 1932 advanced the Exhibition from September to August so that manufacturers might be able to fulfil their orders by Christmas. This proving unsuccessful, the date of the Exhibition was in subsequent years advanced a month at a time, until eventually it was held in January,

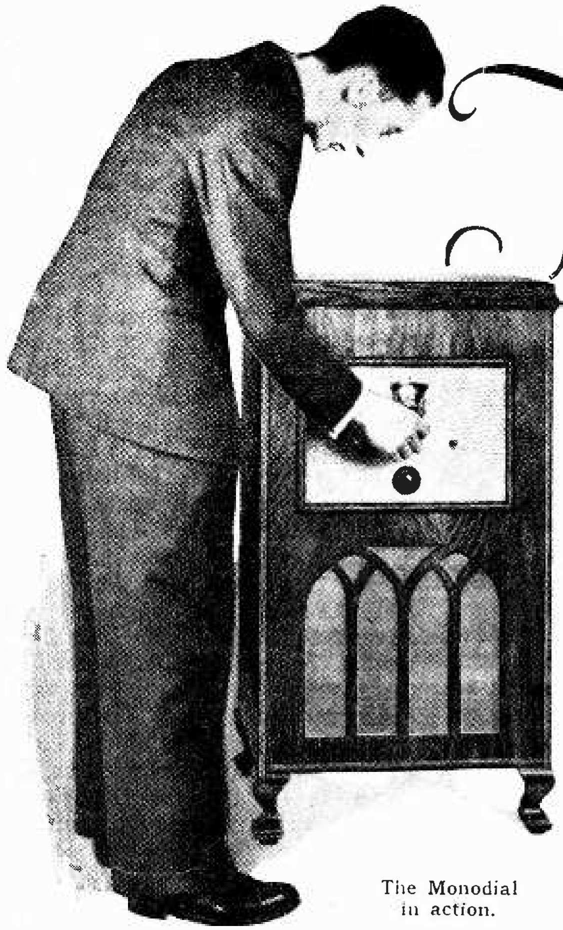


Three and a half Christmases behind.

but still the manufacturers failed to deliver their goods by Christmas. Further advancement of the date had taken place from time to time, until at present the manufacturers were three and a half Christmases behind, but still trying to catch up.

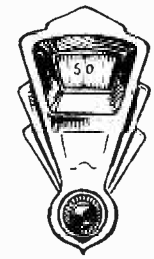
Coming at length to the final portion of the journal, which was still devoted to "Readers' Problems," I saw a sturdy son of Lancashire appearing on the screen. He was beginning, "I've just built the Monodial Super——"

[We hope that "Free Grid" will soon recover sufficiently to continue his contributions.—ED. "W.W."]



The Monodial in action.

Tuning up the MONODIAL



Obtaining a Balance Between Selectivity and Quality.

By W. T. COCKING.

THE salient features and construction of the Monodial A.C. Super have been fully dealt with in the last three issues of this journal,[1] and it now remains to describe those initial adjustments which are so essential for the correct operation of the receiver. As completely stable conditions are not reached for a short time after the set is switched on, some quarter of an hour should be allowed to elapse before starting the adjustments, and this interval may well be occupied by making a rough check on the operating voltages and currents. These should be measured with the volume control at maximum, with the wave-range switch set for the medium waveband, and with the aerial disconnected so that no signal is audible.

The values obtained should agree fairly closely with the figures given in the table, but complete agreement cannot be expected, since individual valves and components vary somewhat, and the mains themselves may not have their rated voltage at the time of testing. Provided, therefore, that the various voltages and currents are of the same order as those obtained with the original receiver, it may safely be assumed that the mains equipment, feed-circuits, and valves are functioning, and the initial adjustments can be proceeded with.

These initial adjustments fall into three categories, and must be carried out in the order named: first, the tuning of the I.F. circuits; secondly, the ganging; and, lastly, the balancing of the selectivity and quality. The two earlier processes are carried out by tuning for the maximum signal strength, and, if care be taken, the ear is a sufficiently accurate indicator. If a milliammeter be available, however, the adjustments are made much easier by connecting it in the second detector anode circuit, and using the change of anode current with a signal as a precise indicator of signal

TABLE OF VALVE VOLTAGES.

	Volts anode	Volts screen	Volts bias	Current mA
H.F.; V.M.S.4	200	84	2.6	8.4
1st detector: M.S.4 ..	200	80	— 6	0.7
I.F.; V.M.S.4	200	84	— 2.6	8.4
Oscillator: 164v.	76	—	— 3.8	4.8
2nd detector: 354v. ..	96	—	—	5.2
Tone Corrector: 354v. ..	164	—	— 3	3.7
Output: P.X.4	240	—	35	50
Across C20 ..	200	—	—	—
Across C22 ..	340	—	—	—
Across C23 ..	357	—	—	—

Volume control at maximum for all the foregoing.

Speaker Field Current.	
Volume control at maximum	54
Volume control at minimum	42

[1] Readers who have not had the opportunity of seeing the last three issues describing this set can obtain them from the publishers. Full-sized blue prints are also available, 1/6 post free.

Tuning Up the Monodial.—

strength. A convenient point at which to connect a meter, which should have a full-scale reading of about 10 milliamperes, is in series with R_{11} shown in Fig. 1 of *The Wireless World* for April 13th, 1932.

HERE is a complete guide to the operation of the Monodial A.C. Super, which is recognised as representing the most advanced superheterodyne technique of to-day. The constructional details of this receiver were given last week, and this article shows how no fewer than 120 different stations can be logged if the initial adjustments—simple in themselves—are carried out with care.

The I.F. Tuning.

The coils in all three I.F. transformers should be set at nearly their maximum distance apart, and a station tuned in as accurately as possible. The strength of this station should be adjusted to a conveniently low level, at which changes of strength are readily detectable, by means of the volume control. Each of the six levers projecting from the bases of the I.F. transformers must then be adjusted in turn for the maximum response, and when this has been done it should be found that a movement of any lever in either direction results in a reduction of signal strength. If it be found that maximum strength occurs with any lever pushed over to the full extent of its travel, then all the other levers should be moved slightly in the opposite direction and the station retuned by the gang condenser. This changes the intermediate frequency slightly, and a readjustment of all the levers should now allow of the correct conditions being obtained.

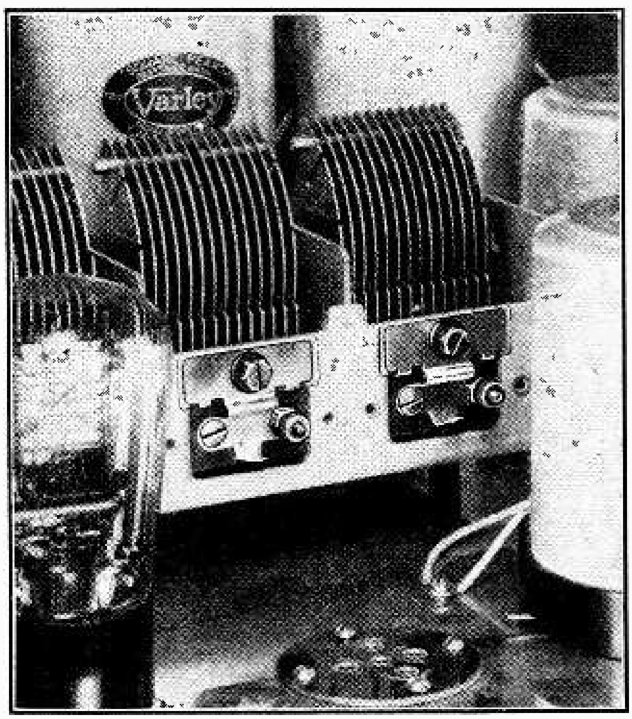
During this process it will probably be found necessary to lower the setting of the volume control as the circuits come into tune, so that the increased signal strength does not lead to overloading of the second detector. This point should be carefully watched, for it is hopeless to attempt to adjust the circuits on a signal so strong that the valves are overloaded.

When the I.F. tuning has been completed it should be found that, although the input circuits are not correctly ganged, a number of stations are receivable, and the setting of the tuning dial should be critical. A station on a low wavelength should be chosen so that the ganging adjustments can be carried out. This station should preferably tune-in within the first ten degrees on the dial, and it should not be one greatly subject to fading. If it be found, however, that the circuits are so badly out of tune that no very low wavelength station can be heard, a somewhat higher-wavelength station, such as the London National, should be used to get the circuits approximately in tune.

Before tuning-in this low-wave station, the trimmer on the oscillator section of the gang condenser should have been slacked off by one or two turns, and the other two trimmers nearly fully unscrewed.

The Ganging.

The station is tuned-in as accurately as possible by the main tuning control, and the two trimmers on the first two sections of the gang condenser each adjusted for maximum response. The trimmer on the oscillator section should not be touched unless it be found that either of the other trimmers has reached the full extent of its capacity range. If, for instance, it be found that one of the preselector trimmers is fully unscrewed, then the oscillator trimmer should be screwed up slightly and the station retuned at a slightly lower setting of the main dial. By proceeding on these lines it will readily be possible to arrive at settings such that any further alteration to the preselector trimmers gives a reduction in signal strength.



The layout is so arranged that there is easy access to the trimmers on the ganged condenser members. The oscillator trimmer is behind the valve in the foreground.

The circuits are now accurately ganged at the high-frequency end of the tuning range, and it should be found that stations can be tuned-in over the whole of the medium waveband. Unless the stray circuit capacities have their correct relative values, however, the ganging may be slightly out at high dial readings, and so the next step is to correct for this. A station working with a frequency of about 550 to 600 kc. (550 to 500 metres) should be tuned-in, and the trimmer on the oscillator section of the gang condenser adjusted while rocking the tuning dial backwards and forwards over a few degrees until the optimum combination of settings is found. On no account should the preselector trimmers be adjusted at this wavelength.

When this adjustment is completed, a return should be made to the high-frequency (low-wavelength)

Tuning Up the Monodial.—

station, and the preselector trimmers readjusted. This completes the medium waveband ganging, and the next step is to perform the same operation on the long waveband. This is considerably easier, since there is only one adjustment, and it is far less critical. Either Huizen or Radio-Paris should be tuned-in with the padding condenser C_4 set at about one-half its capacity.

This completes the ganging, and it should be found that stations are receivable, and tune-in very sharply, at all points over the dial, but both the sensitivity and the quality of reproduction will be below normal. Before proceeding to discuss the quality adjustments, however, it is as well to repeat that, while carrying out the ganging on the medium waveband, the preselector trimmers must be adjusted only at a low wavelength,

CONDENSER DIAL READINGS FOR 120 STATIONS.

Kc's.	Station.	Dial Reading.
	LONG WAVE BAND.	
155	Kaunas	90
160	Huizen	86
167	Lahti	80
174	Radio-Paris	74
183.5	Koenigswusterhausen	67
193	Daventry National	60.5
202.6	Moscow	56
207.5	Eiffel Tower	51.5
212.5	Warsaw	48.6
222.5	Motala	45.5
230.1	Moscow	40
238.1	Novosibirsk	36
260	Kalundborg	28.5
268.5	Moscow	26
277	Oslo	23
300	Leningrad	20
320	Kharkov	17
353.5	Rostov-Don	12.5
	MEDIUM WAVE BAND.	
530	Hanover	98
533	Wilno	97
536	Common Wave	94.6 (?)
545	Buda-Pesth	92.8
554	Sundsvall	90
563	Munich	88
572	Riga (or Palermo)	86.3
581	Vienna	84.5
590	Brussels, No. 1	82.5
599	Florence	80.1
614	Prague	77.5
625	North Regional	75.1
635	Langenberg	73.5
644	Lyons	71.8
653	Schweizerischer Landessender	70
622	Common Wave	68.8
671	Paris, P.T.T.	67
680	Rome	65.5
689	Stockholm	64
697	Belgrade	63
707	Madrid	61
715	Berlin	59.9
721.1	Rabat	59
725	Dublin	58.1
734	Katowice	57
743	Radio Suisse Romande (Sottens)	55.9
752	Midland Regional	54.5
761	Bucharest	53
770	Frankfurt	52
779	Toulouse	50.8
788	Lwow	49.5
797	Glasgow	48.5
806	Hamburg	47.2
810	Radio L.L.	46.5
815	Common Wave	46.1
824	Bergen	45.2
825.3	Algiers	45
832	Mühlacker	44
843	London Regional	43
852	Graz	42
860	Barcelona	41
869	Strasbourg	40
878	Brno	39
887	Brussels No. 2	38
896	Cadiz (or Poznan)	37 (?)
905	Milan	36.1
914	Grenoble	35.3
923	Breslau	34.5
932	Göteborg	33.5
941	Naples	32.5
950	Marseilles	32 (?)
959	Genoa	31 (?)
968	Cardiff	30.5
977	Zagreb	29.5 (?)
986	Bordeaux-Lafayette	29
995	North National	28
1,006.2	Hilversum	27
1,013	Tallinn	26.6 (?)
1,022	Limoges (or Kosice)	26 (?)
1,031	Common Wave	25
1,040	British Relays	24.4
1,043	Lyons	24
1,049	Montpellier	23.9 (?)
1,058	German Relays	23
1,067	Copenhagen	22.5
1,076	Bratislava	22
1,085	Heilsberg	21
1,096	Turin	20.3
1,103	Rennes	20
1,112	Bremen	19.2
1,121	Spanish Relays	18.8
1,130	Lille	18.2 (?)
1,137	Moravska-Ostrava	17.8
1,147	London National	17
1,157	Leipzig	16.5
1,166	Hörby	16
1,175	Toulouse	15.5
1,184	Gleiwitz	15 (?)
1,193	Spanish Relay	14.5
1,211	Trieste	13.5
1,220	Common Wave	13
1,229	Basle	12.5
1,238	Belfast	12
1,250	Radio Beziers	11.6 (?)
1,256	Nürnberg	11.1 (?)
1,265	Common Wave	10.8
1,274	Christiansand	10.5 (?)
1,283	Lodz	10 (?)
1,292	Kiel	9.2 (?)
1,301	Malmo	8 (?)
1,310	Common Wave	7.9 (?)
1,337	Cork	7.5 (?)
1,364	Radio Normandie (Fécamp)	7
1,373	Common Wave	6.8
1,382	Common Wave	6.4
1,391	Common Wave	6
1,400	Warsaw	5.6 (?)
1,460	Ornskoldsvik	3.5 (?)
1,470	Gavle	3 (?)
1,530	Karlskrona	1.5 (?)

A query against the dial reading indicates that a station was received but not definitely identified.

It may be found that a few of the stations of low power have undergone a slight change in wavelength since the above were logged. The latest list of transmissions will be found in the supplementary Ideal Station Finder accompanying this issue.

If any difficulty be experienced in finding one of these stations, the tuning dial should be set for it in accordance with the list of dial settings given herewith, and the adjustment carried out by means of C_4 alone. When the station has been found, C_4 is adjusted while rocking the tuning dial backwards and forwards until the optimum combination of settings has been found.

and never at a high, and the oscillator trimmer only at a high, and while rocking the gang condenser. *On no account must any of the three trimmers on the gang condenser be adjusted on the long waveband, otherwise the medium wave ganging will be seriously wrong.*

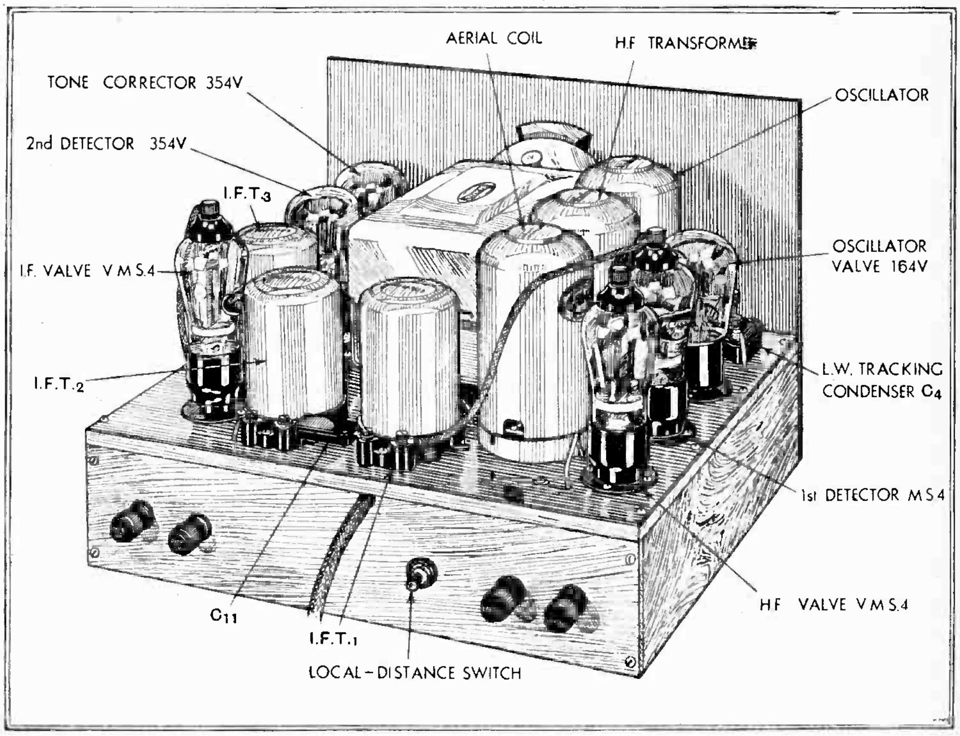
The final points to receive attention are the coil positions of the I.F. transformers, and these should be adjusted for the best quality of reproduction. In

Tuning Up the Monodial.—general, the coils in the first transformer should be set with 29/32in. between the adjacent faces of the formers, and the coils in the third transformer with 1/4in. between adjacent faces. The second transformer coupling can then be regulated to suit the characteristics of the particular loud speaker which is being used. With the particular speaker used during testing this distance was found to be 1/2in. When carrying out this adjustment care should be taken to select a station which is known to be transmitting with good quality, for certain foreign stations are sometimes defective in this respect.

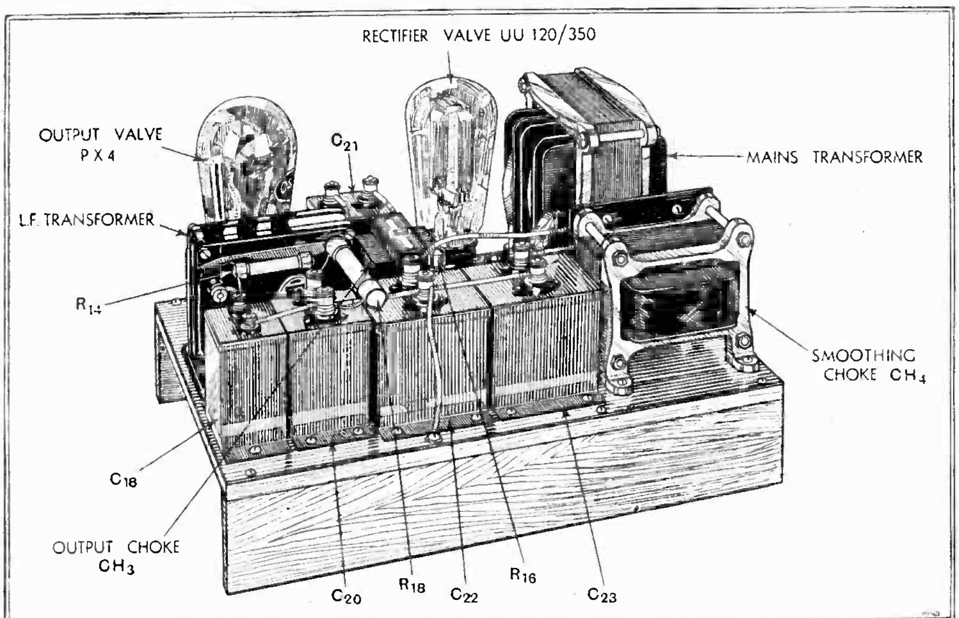
A general test should now show that the sensitivity has increased considerably, and it should be possible to tune-in stations over the whole of the dial, with each transmission quite separate and distinct from its neighbours in cases where their separation is not less than 9 kc. An efficient aerial and earth should be used in most cases, but where the set is to be worked at a very short distance from a powerful local station it may be found that better results are had with a small aerial.

On test, the 120 stations given in the accompanying list were logged in a single evening, and while the Brookmans Park stations were working, the receiver being located some nine miles away. Prague and Breslau both suffered somewhat from second-channel interference due to the two London transmitters, which were also responsible for a considerable amount of interference on Graz, Leipzig, and Moravska-Ostrava. Mühlacker, which is spaced 11 kc. from the London Regional and is a stronger signal, could normally be received without serious interference. Any interference, of course, took the form of sideband heterodyning, and was at its worst during deep modulation of the London transmitter, being particularly bad during the reading of the News Bulletin.

On the remainder of the more powerful Continental stations no interference was experienced other than occasional chirps due to sideband heterodyning. Except where the transmission itself was distorted, the



The receiver unit with principal components identified.



The output stage and eliminator are built together as a separate unit.

Tuning Up the Monodial.—

quality on all stations was equally good, and reached a standard which would satisfy the most critical. The sensitivity proved ample for the reception of the weakest stations, and at no time had the volume control to be set at maximum, even although the aerial was of only a moderately efficient type.

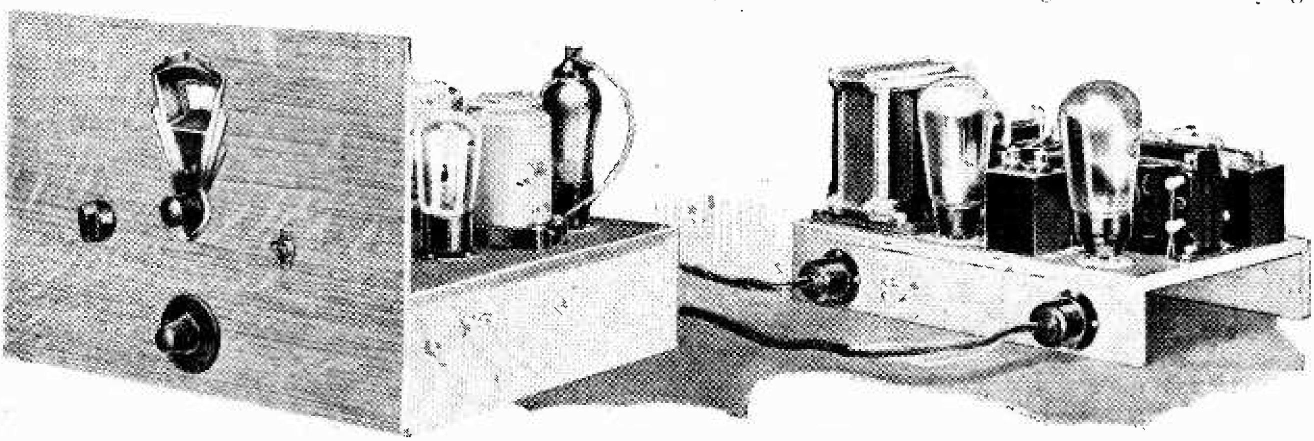
Of the 120 stations which can be received, some forty to fifty are at times available sufficiently free from interference for their programmes to be of entertainment value, and on any given night a choice of about twenty stations is obtainable. During the summer months, of course, atmospheric conditions make reception poorer, but a reasonable number of alternatives to the local should be available. Even when conditions are poor the receiver is sufficiently sensitive to bring in distant stations, and it is the background produced by atmospherics, rather than a lack of amplification, which is likely to prove the limiting factor. Background noises introduced by the set itself are at a minimum, and, in the case of the stronger stations, are inaudible.

Before concluding, some general remarks on the receiver may be of interest. The quality of reproduction is very largely dependent upon the loud speaker employed, and as good a type as possible should be used. If advantage be taken of the provision for free field current, the speaker should be a model requiring some four to six watts for field excitation, since these figures represent the maximum and minimum powers obtainable at the maximum and minimum settings of the volume control. Unless it is already of the correct impedance, the speaker should be fitted with a transformer of such ratio that its average primary impedance is 4,000 ohms, but the output choke must be retained whether a transformer is used or not.

In perhaps the majority of cases the "local-distance" switch will prove an unnecessary refinement. Where the set is used close to a local station it may prove advantageous in avoiding distortion with that station. Furthermore, under such conditions it may be necessary to avoid cross-modulation when receiving stations within about 20 kc. of the local. For general reception, however, it should be kept in the "distance" position.

When tuning, the volume control should be kept at a low setting to avoid valve overloading. The circuit conditions are so adjusted that it is impossible greatly to overload the output valve, and if the volume control be turned up too far it will be found that the second detector overloads and reduces the output. As a result, greatly excessive volume when tuning through a strong station is avoided.

The dial settings given in the accompanying list of stations should be found fairly accurate, although one cannot expect that they will be reproduced exactly. They will, however, serve as a guide when first trying out the set, and if the actual dial settings for a few widely spaced stations are noted it should prove possible to obtain a reasonably accurate estimate of the settings for any particular receiver.



A view of the completed receiver, with its associated amplifier. The Monodial can be confidently regarded as embodying the most advanced practice in modern superheterodyne technique.

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

NEW BOOKS.

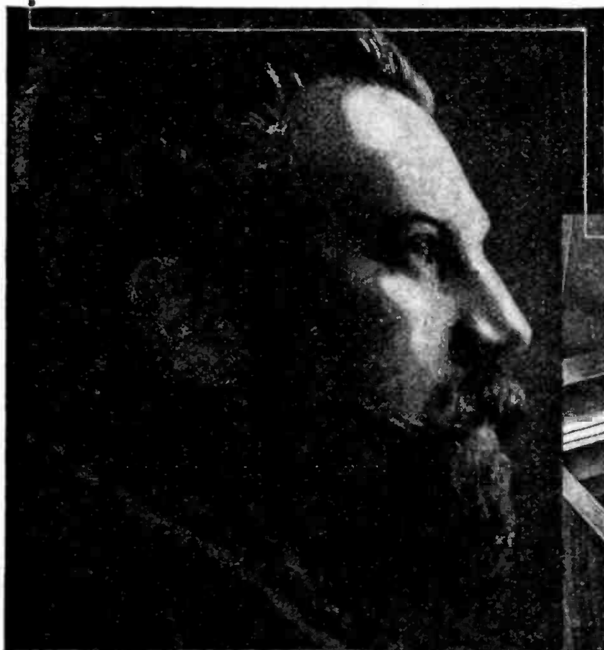
The Mathematics of Wireless, by Ralph Stranger. A simple textbook covering the various excursions into the realm of mathematics usually undertaken by the wireless engineer, including the necessary arithmetic, algebra, geometry, trigonometry, calculus, graphs, and the use of the slide-rule. Pp. 193, with 113 illustrations and diagrams. Published by George Newnes, Ltd., London, price 5s.

This is Jack Payne, by Himself. An autobiography of this favourite conductor of dance music with two chapters of appreciation by his wife. Pp. 148, with numerous illustrations. Published by Sampson Low, Marston and Co., Ltd., London. 5s.

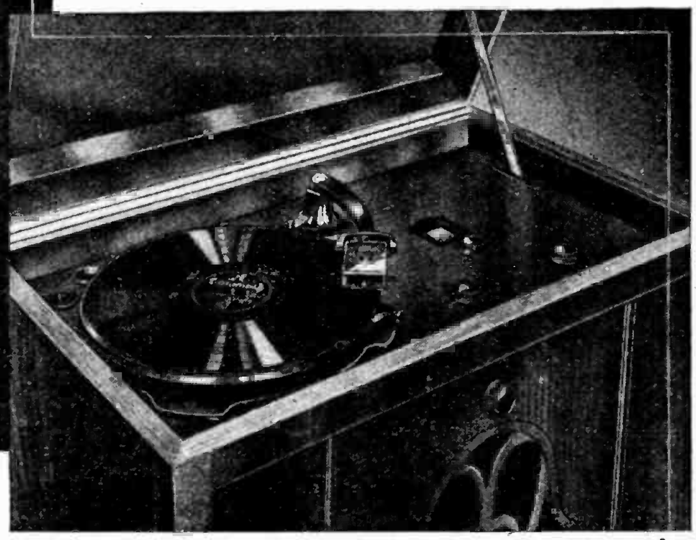
Radio Inductive Interference (Bulletin No. 2), by H. O. Merriman. Investigations by the Radio Branch of the Canadian Department of Marine into the sources of interference from power lines and other causes. The test employed and the means adopted or suggested for elimination of such interference. Pp. 104, with 29 illustrations and diagrams. Issued by the Department of Marine, Radio Branch, Ottawa, Canada, price 35 cents.

Lautsprecher für Tonfilmwiedergabe, by E. Schwandt. A description of various loud speakers used in "Talkies," public address systems, etc. Pp. 36, with 34 illustrations and diagrams. Published by Wilhelm Knapp, Halle (Saale), price R.M.1.20.

Sir HENRY J. WOOD says



"Your latest Radio-Graphophone is a splendid instrument. Its standard represents the highest achievement in musical performance to-day, and I should like to see one IN EVERY HOME. Indeed, this is not an unreasonable wish, judging by its very modest price."



"In every home"
—*made possible by the*

Columbia

MAGIC NOTES
TRADE MARK

RADIO-GRAPHOPHONE

The opinion of Sir Henry J. Wood is significant; this instrument indeed "represents the highest achievement in musical performance to-day." This is the greatest tribute yet paid to any radio-gramophone.

Never before has such a wealth of home entertainment been offered at such a low price. This instrument provides the pick of European music—some 40 radio programmes, powerful and distinct, from a set which incorporates two screen grid valves and band-pass tuning. And then—your own programme on the electric gramophone, chosen when you wish, music of superb fidelity, and tonal purity . . . "the highest achievement in musical performance to-day."

For 40 gns. (Model 603) you may obtain the outstanding radio-gramophone of the year possessed of remarkable power and selectivity. For only 7 gns. extra it may be had with the last word in convenience, an automatic record changer (Model 604).

Model 602

£2. 14s.

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deposit £3 . 9 . 6 and 12 payments of £2. 14s.

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FREE CATALOGUE OR HOME TRIAL.

(a)★ I should like to hear Model .... playing in my home without cost or obligation to myself.

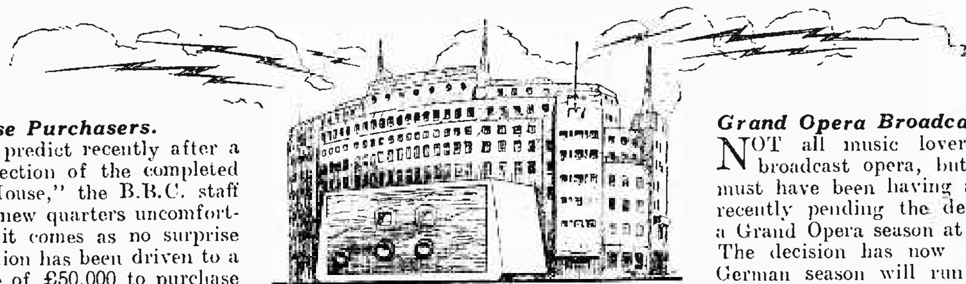
(b)★ I should like a Catalogue of Columbia Radio-Graphophones and/or Columbia Radio.

★ *Cross out if not required.*

NAME ....

ADDRESS ....

Cut this out and post it in an unsealed envelope bearing ½d. stamp to Columbia, 102E, Clerkenwell Road, London, E.C.1.



BROADCAST BREVITIES

By Our Special Correspondent.

B.B.C. as House Purchasers.

AS I dared to predict recently after a hurried inspection of the completed "Broadcasting House," the B.B.C. staff are finding their new quarters uncomfortably small, and it comes as no surprise that the Corporation has been driven to a fresh expenditure of £50,000 to purchase the freehold of the two neighbouring houses.

This Year, Next Year . . .

Unhappily for the people now labouring in cubicles measuring 7 ft.×5 ft. the new purchase does not permit of immediate expansion. "We may build an annexe in ten months' time," a B.B.C. official told me. "On the other hand, it may be ten years. It all depends upon certain events connected with the sitting tenants."

A Round Million.

While this cryptic remark may leave us guessing, there need be little guessing over the total amount of money spent on the new headquarters. The original budget allowed for £650,000 for the purchase of the premises, £200,000 for furniture and equipment, besides the sum already stated for the purchase, if necessary, of neighbouring properties. I understand that this total of £900,000 has been exceeded by at least £100,000, bringing the grand sum to over £1,000,000.

I hope we shall all, as licence holders, get good value for our money.

A Consecration Difficulty.

The suggested consecration of the religious studio cannot take place, and for a curious reason. As I understand the question, consecration of a site or building involves the ground beneath as well as the structure itself. Now it happens that underneath the "chapel" is the vaudeville studio. . . .

Henry Hall's Postbag.

LETTERS in appreciation of Henry Hall's tea-time broadcasts still arrive to the tune of about fifty per day. I am told that Jack Payne's post used to average twenty-two, though, in fairness to Jack, it should be remembered that his successor still exerts a novelty appeal. Whether Henry Hall will maintain the present level—whether, in fact, "songs that are getting older will last for ever"—is beyond the realms of phophecy.

Sir Henry Wood.

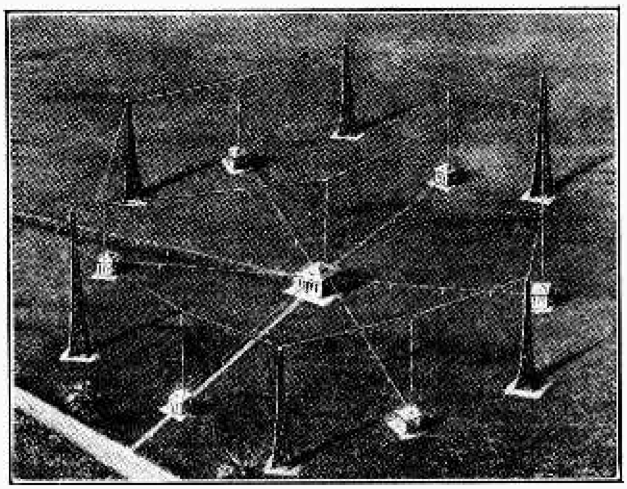
THE usual rumours are being raised that the forthcoming Promenade Concert season will be Sir Henry Wood's last. The prophets were declaring the same sort of thing five years ago. I can state categorically that Sir Henry, who is in the best of health, has no intention of turning his thirty-eighth season into a swan song.

The Next "Prom" Season.

The Promenade Concerts will open at the Queen's Hall on Saturday, August 6th, continuing for eight weeks. This will be the sixth season under the auspices of the B.B.C. and the third in which the B.B.C. Symphony Orchestra takes part.

We need not expect any change in the usual arrangements this year. I understand that Mondays will continue to be Wagner nights, Wednesdays being dedicated to Bach or Brahms, Friday to Beethoven, and so on.

This scheme seems to suit everybody except the ultra modernists, who would probably like Klaxon horns on one day and tin cans on the next.



LEIPZIG'S NEW AERIAL.—Germany's most powerful broadcasting station, which will shortly be operating at Leipzig with a power of 150 kilowatts, will have a new type of aerial system. Designed by the famous Lorenz firm, the aerial will concentrate most of the power in the horizontal wave.

Grand Opera Broadcasts.

NOT all music lovers are fond of broadcast opera, but those who are must have been having an anxious time recently pending the decision regarding a Grand Opera season at Covent Garden. The decision has now been made; a German season will run from May 9th to June 3rd, and a goodly number of excerpts will be provided by the B.B.C. from the National and Regional transmitters alternately.

"O.B." from the Zoo.

THE Zoo provided some valuable hints on the technique of the most difficult of outside broadcasts when the B.B.C. engineers first turned their attention to it seven years ago. Several thrilling broadcasts have come from the famous gardens since then; and now another, one of the most elaborate yet staged, is in prospect. On May 3rd the Children's Hour will have a Zoo programme with Mr. Will Owen introducing the animals. The "studio" is to be in the Reptile House, and microphones will be fixed in the Bird House, the Wolves' Den, the Lion House, the Monkey House and the Mappin Terraces. The rattlesnake and the talking cockatoo will also be heard—if they are in the right mood.

Sousa: In Memoriam.

TUNES that are famous wherever military band music is played will be given in the National programme on May 8th, when the Band of the Grenadier Guards gives a selection of Sousa's music. The great American composer of march music died in March last, and this programme is in memoriam. It includes the Memorial March: The Golden Star; Three Marches — El Capitan, King Cotton and The Washington Post; Patrol—Rose, Shamrock and Thistle; and the Stars and Stripes march.

Play on a Motor Race.

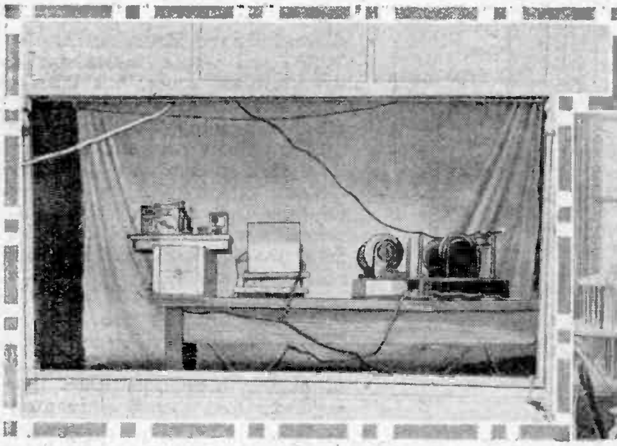
THE first play to be broadcast from Belfast dealing with the subject of the great Ulster Motor Race will be heard by listeners on May 13th. It is called "Bed o' Roses," and it tells an amusing story of how the great sporting event very seriously interferes with the life-long ambition of an old gardener, whose house is on the side of the course.

Why the Soup was Burnt ?

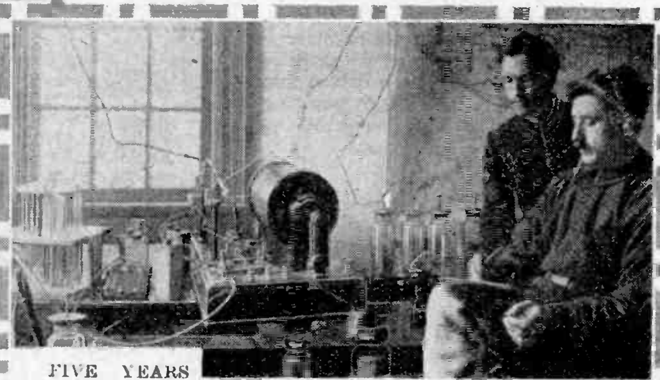
"SIR HAMILTON HARTY, who doesn't like broadcasting, has presented his wireless set to his cook."—*Daily Sketch.*

PICTURES FROM THE PAST.

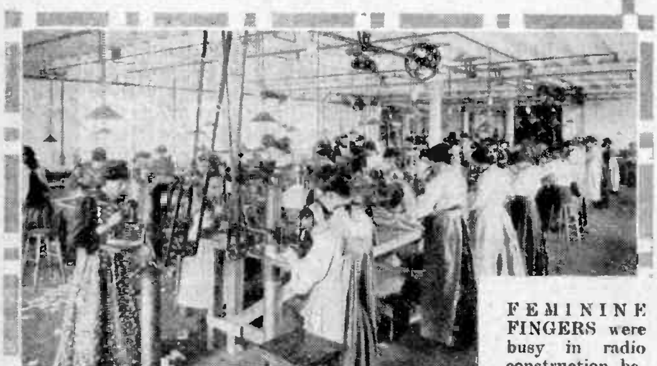
Vivid Glimpses which will Recall Many Memories to Early Readers of "The Wireless World."



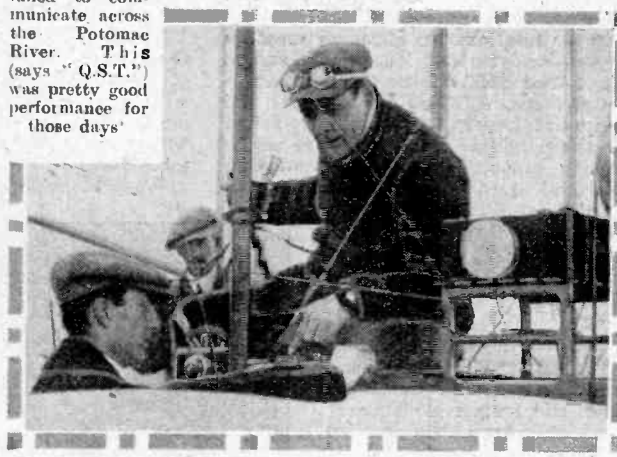
IN THE GAY 'NINETIES.—This Marconi spark transmitter was used in the world's first commercial wireless station at Poole Harbour, Dorset, in 1898.



FIVE YEARS LATER this U.S. Army gear failed to communicate across the Potomac River. This (says "Q.S.T.") was pretty good performance for those days.



FEMININE FINGERS were busy in radio construction before 1910. This photo was taken in the condenser shop of the early Marconi Works at Dalston.

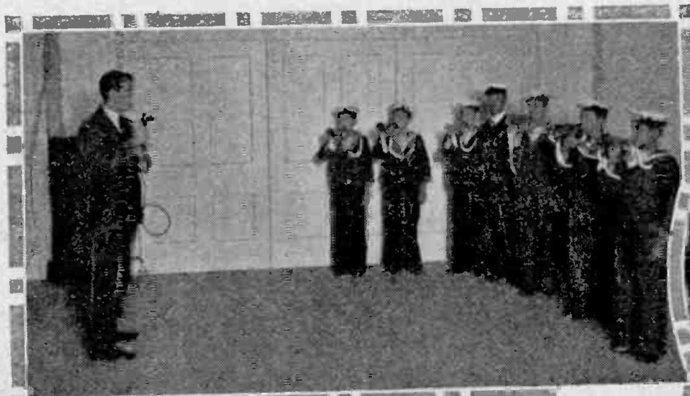


ROBERT LORAINE, the celebrated actor, collaborating with Mr. Thorne Baker, showed that aeroplane wireless was practicable in 1911.

MYSTERY RADIO VANS were unknown when this picturesque vehicle was parading the streets of New York in 1918.

WAR-TIME RECRUITS to the wireless operating profession learnt the mysteries of $1\frac{1}{2}$ kW. ship sets in the basement of Marconi House.

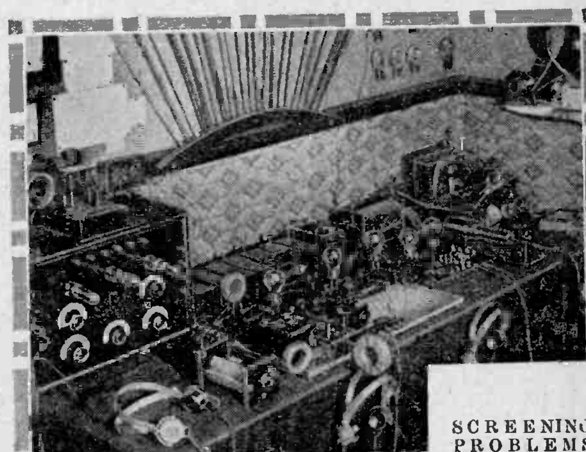
HOW BROADCASTING GREW.



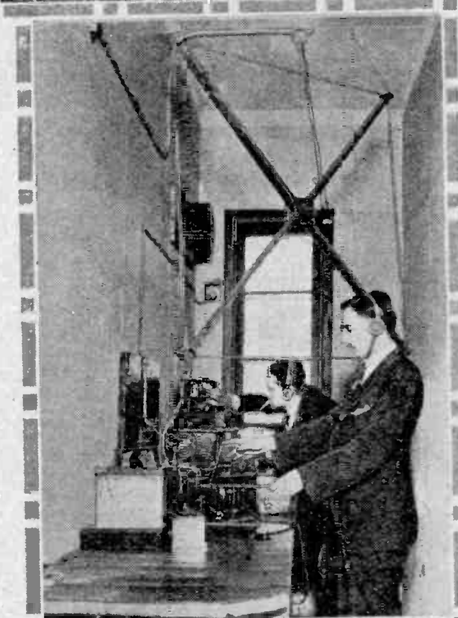
HENRY HALL'S predecessors — the boys of the *Exmouth*—giving the first broadcast from "2LO, London," in June, 1922.

GEORGE ROBEY became very closely acquainted with the carbon microphone in the same year.

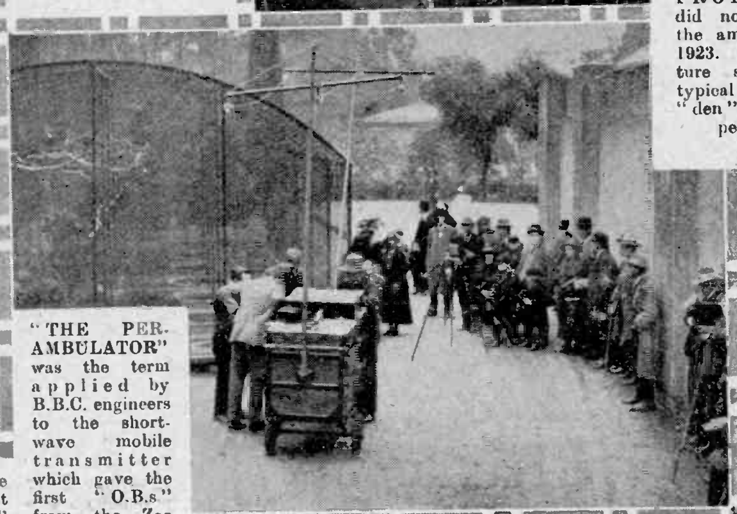
A TOP BACK ROOM in Marconi House served as the first B.B.C. studio in 1922. (Left to right) Miss Cecil Dixon, Mr. Stanton Jeffries, Mr. Rex Palmer, Mr. A. R. Burrows and Mr. Cecil Lewis.



SCREENING PROBLEMS did not worry the amateur of 1923. The picture shows a typical amateur "den" of the period.



DELICIOUS UNCERTAINTY characterised the B.B.C. relays from America in 1924. Captain West is here seen operating a thirteen-valve "superhet." at Biggin Hill



"THE PERAMBULATOR" was the term applied by B.B.C. engineers to the short-wave mobile transmitter which gave the first "O.B.s" from the Zoo in 1925.

PRACTICAL HINTS AND TIPS.

Simplified Aids to Better Reception.

"When we were very young" there were no amplifying valves, and the aerial was the most important part of the receiving equipment. Anything less efficient than that shown above was hardly worth while considering.

THIS is our twenty-first birthday issue, and so we may be forgiven for pondering retrospectively over long-forgotten "hints and tips" that have been offered to readers of an earlier age.

Many of the suggestions made when amateur radio began are so entirely out of date that they would now appear to be almost ludicrous. For instance, when tuning coils with sliding contacts were popular, it was advised that the user should assure himself that his set was really capable of being accurately tuned to the desired wavelength by observing whether signal strength was weakened to a perceptible extent by moving the slider in *either* direction!

"OLD-FASHIONED, BUT CHOICELY GOOD."

But there is one piece of advice, consistently given by *The Wireless World* writers since Volume I, that still holds good with almost unabated force—in some respects with even greater force, since the number of transmitters has increased so greatly. It is: "Use a two-circuit aerial tuner to diminish interference." To be rather more up to date, this might be modified and elaborated to read: "Use a band-pass input filter, or, unless you have a set of properly matched coils and a good ganged condenser, a two-circuit tuner."

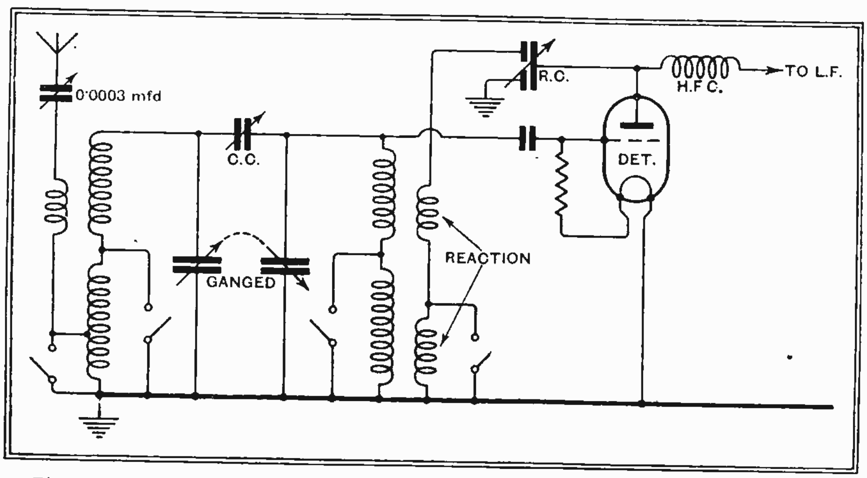
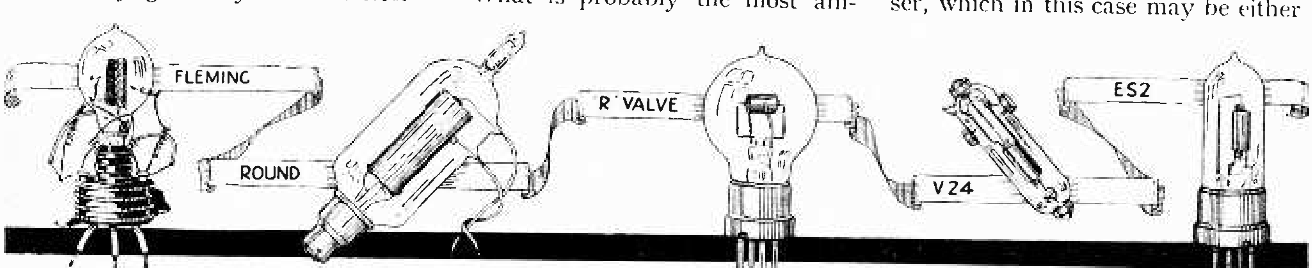


Fig. 1.—Still an invaluable aid to selectivity: the two-circuit tuner has been consistently advocated, and is here shown in its latest form.

What is probably the most ambitious form of tuning equipment of this type to be described in this journal was included in the "Autotone" receiver. Special components were necessary in order to ensure the maintenance of accurate ganging, and almost perfect single-knob tuning was attained. But there are many who are willing to content themselves with something less easy to operate, and who may be interested in a brief description of a simplified version of the "Autotone" tuner which proves on test to be eminently satisfactory. Admittedly, almost constant readjustment of the subsidiary controls—trimming, inter-circuit coupling, and reaction—are necessary, but one soon acquires the necessary knack, and quite a fair section of the waveband can be explored by means of the ganged condenser knob.

The tuner circuit, illustrated in Fig. 1, is intended to precede a simple detector-L.F. set, but, by omitting the reaction connections, is equally applicable to a receiver with an H.F. amplifier. Reasonably well-matched coils and a good ganged condenser are still desirable; the better they are, the less need there will be to make compensating adjustments of the trimming condenser, which in this case may be either



FROM 1904 TO 1932. Valve history really begins with the——

Practical Hints and Tips.—in series with the aerial, as shown, or in parallel with the input section of the tuning condenser.

For controlling coupling, a small variable condenser (C.C.) is suggested. This should have a minimum capacity of not more than 2 or 3 micro-microfarads. An Ormond "Midget" condenser, with its elements connected in series, is suitable for this purpose. Thorough screening of the coils with regard to each other is necessary.

CHECKING GANGING.

THERE seems to be an impression that, in order to check the adjustment of a ganged tuning system, it is necessary to employ elaborate apparatus, and to bring to bear an extensive knowledge of the technique of tuned circuits. Actually, the process is simple enough. Having tuned in a signal of maximum intensity by means of the external control, each of the trimmers which are shunted across the various elements of the ganged condenser should be manipulated in turn, and if any of these adjustments is found to bring about an increase in signal strength we have proof positive that there is a certain amount of misalignment in the tuning of the associated circuit. While making this test, no change beyond adjustment of the trimmers should be made.

When one considers the matter this sounds almost like a statement of the obvious; it should be evident that if signal strength can be increased by altering the capacity across any one circuit that circuit was originally out of alignment with the others.

Where there are no accessible trimming condensers, it is not so easy to make a test, but as a rule the tuning of the various circuits may be checked by connecting temporarily a very small variable condenser with a low minimum capacity across each circuit in turn. If this addition does not result in a *decrease of strength* in every case, again we have definite proof that the tuning system is susceptible to improvement.

RECTIFIED CURRENT MEASUREMENTS.

MANY of us have become accustomed to using a meter in the anode circuits of our detectors—whether of the grid, power grid, or anode-bend type. When trying the latest form of diode rectification, as described in this journal, readers may have felt the need for some visual indication as to what is happening in the rectifier. In many cases, the usual anode meter is clearly impracticable for the very good reason that the anode terminal of the diode may be entirely disconnected, and so the only possible place for an instrument that will indicate rectified current is in series with the output grid circuit, as shown in Fig. 2. It will be observed that both meter and resistance are shunted by the small H.F. by-pass condenser which is usually employed in these circuits.

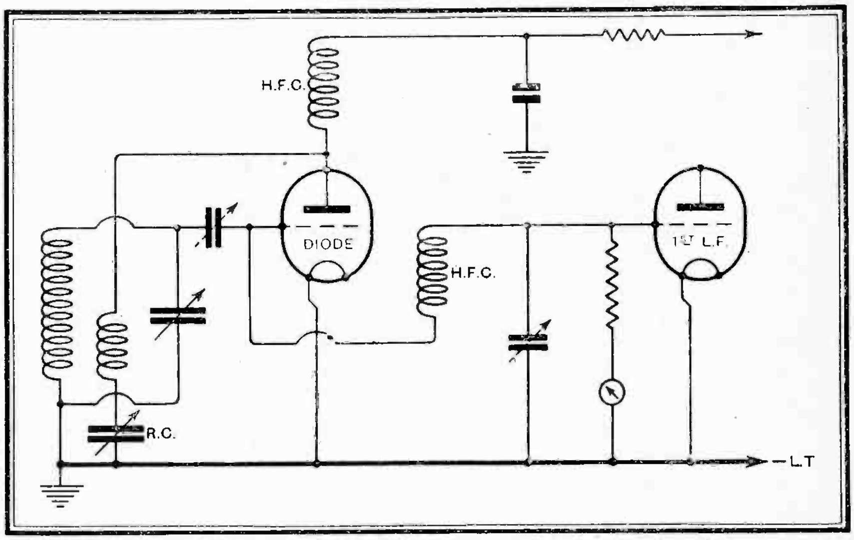
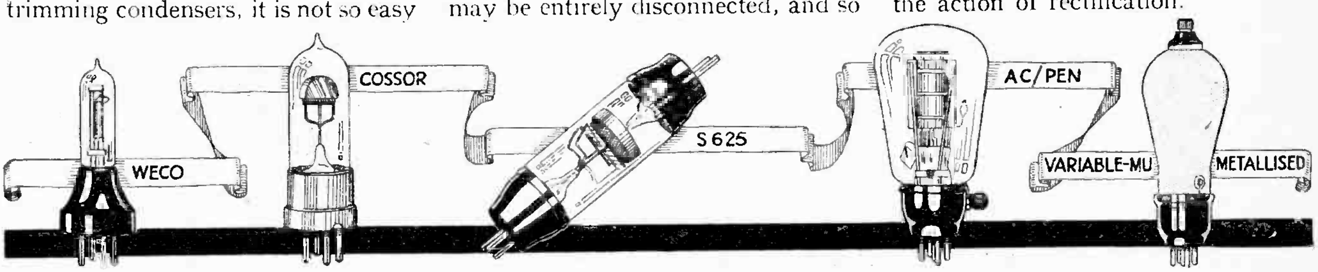


Fig. 2.—For indicating the rectified current for a diode detector; correct position for a microammeter.

So far, everything is simple enough, but there is the very real difficulty of choosing a suitable meter. With the circuit values commonly specified the rectified current will have a very small value; indeed, it is seldom that it will exceed some 20 or 30 microamps. Even if this current were doubled, a clear reading would not be given on a meter reading even as low as 0-1 milliamp. What is needed is a fairly sensitive microammeter.

When a reacting diode is employed, as in the accompanying diagram, a milliammeter may be inserted in the anode circuit in the ordinary way, but, although it will show the effects of tuning, etc., it will not give a direct indication of the action of rectification.



——*Fleming valve. In no branch of radio has progress been more continuous.*

Letters to the Editor.

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.

A Birthday Message.

IT would be remiss of us to let the celebrations of the coming of age of *The Wireless World* pass without a word of congratulation.

We have always believed, and still believe, your excellent publication has an appeal of immense value to those within the industry as well as to the great general public.

Although it is only five years since we entered the field of electrical reproduction and thus became allied to you, our associations reach back to the first issue of *The Wireless World*, for our ultimate aim, the perfection of reproduced sound, has been common to us both.

The only difference between us has been that for thirty-two years *we* have been striving to build commercially the ideal instrument for reproducing home entertainment, whilst for twenty-one years *you* have been guiding the public in choosing the best of these instruments. In addition to keeping people in touch with the march of progress you have also shown them how to put the latest developments of radio into practice for themselves

We must also congratulate you on your policy of unbiased criticism, a policy of real assistance to the industry and one which we are confident is largely responsible for the position *The Wireless World* holds in the minds of its readers.

I feel sure that in years to come, when we can send you congratulations on the bi-centenary of your paper, the pleasure given to "His Master's Voice" then will not be greater than the pleasure that is being given to us now.

London, W.1. THE GRAMOPHONE CO., LTD.,
Richard Haigh,
Manager, English Branch.

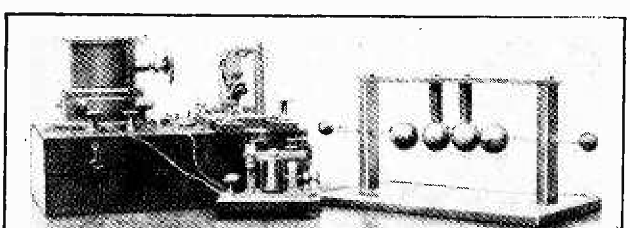
The First Amateur ?

WITH reference to "Free Grid's" paragraph, "Were You First?" in *The Wireless World* of March 23rd.

In 1898 I built a coherer, receiver, and spark transmitter, of which I enclose a photo. Unfortunately, the original Siemens relay was not available, and I substituted another of later date for purposes of the photo.

This "set" was worked without aerial or earth from a 4in. spark coil, and signals were received on the Morse sounder over a distance of about 70 yards!

The coherer was home-made, and the de-coherer was made from an old electric bell, the dry batteries being contained in the base.



The coherer-operated receiver and spark transmitter built by Col. Dennis in 1898.

I made this "set" after attending a lecture given in the Royal Dublin Society Theatre in Dublin by Professor Molloy, young Marconi being on the stage with the lecturer and operating the experimental apparatus, with which Morse signals were sent from the stage and received on a Morse printer in the balcony.

At sixty-seven I am still an active amateur!

Baltinglass, Co. Wicklow. M. C. J. DENNIS, Colonel.

Is 5,000 Cycles Enough?

I WISH in haste to protest against the gross Philistinism of your correspondent F. R. Merdler and the shallow sophistry by which he contends that we should sacrifice the higher musical frequencies "in the best interests for the future progress and popularity of the radio instrument."

He suggests that we should "cut off the top" and leave the poor truncated body of music, from which the soul has fled.

There is no doubt that to a sensitive person silence, reading or conversation are infinitely preferable to mutilated music; but music with the song of the violin and the ring of the piano and the full glory of each instrument of the orchestra is a never-ending joy.

I am not theorising; I am speaking from experience of both kinds of reproduction.

It is now practically impossible to buy a commercial receiver which does not alternate the higher musical frequencies to a degree which robs music of its joy and beauty; and most published circuits are infected with the some plague. If the pestilence spreads to the transmitting end, wireless will cease to be a way of receiving music.

Rugby. S. B. BAILEY.

Regional Scheme and National Broadcasting Service.

I READ with interest your correspondent's remarks upon the Regional Scheme under "Broadcast Brevities" in your issue of March 16th, and would like, with your permission, to recall my recent letters concerning a National Broadcasting Service.

It has for many years been my opinion that the ultimate solution to the national broadcasting problem lies not in the multiplication of high-power transmitting stations, but rather in the development of super-selective, high-quality receiving apparatus. This order has, unfortunately, been prevented because hitherto the reception of programmes has been in the hands of the public, and, as a consequence, the development of high-grade receiving apparatus has been restricted by the limits imposed by the public as to size, price, and ease of manipulation. Thus the broadcasting authorities have had no alternative but to erect their transmitting stations where the public demand has required them. It is rapidly becoming evident, however, that a halt must be called if it be desired to stay European broadcasting from making rapid strides towards a state of chaos similar to that which existed in the United States a few years ago before the advent of the Federal Radio Commission.

The time has come, I think, when serious attention should be given to the reception side of the problem, since the Regional Scheme in its present form is unable to provide 100 per cent. reception to all listeners or to provide satisfactory alternative programmes, and I have recently had the opportunity of advancing, through the courtesy of your columns, a scheme which will, I hope, assist in preventing the impending state of stagnation, and which will prove to be of material advantage to both the authorities and public alike from the point of view of revenue and of service. Under this scheme, good quality, interference-free reception would be possible to every listener, since the actual reception would rest in the hands of a technical staff equipped with sufficient apparatus to enable them to supply the listener with broadcast matter at a predetermined volume level. Not only this, but any alternative programme, either British or Continental, could also be supplied at the same standard volume level.

I appreciate that a few isolated dealers and private companies have, in fact, been operating such a service for some time past, but it is my opinion that, in order to prevent the Regional Scheme from "eating its own head off," the authorities would do well to adopt the scheme universally.

Goodmayes, Essex. THOS. L. STANTON.