The Wireless World

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Another Point of View

WE commented recently on the advantages of two receivers being used in the home so that all the members of the family were not placed in the position of having no alternative except to listen to whatever programme happened to be switched on at the time. In this issue a writer puts forward another although quite different argument in favour of a second set, for he advocates that one set should be ordinarily used for standard listening to the local B.B.C. programmes, whilst a second set should be one capable of a high standard of performance in the matter of sensitivity and selectivity, and should be used by those members of the family who are interested in fishing for distant stations and whose interests are not confined to the mere enjoyment of the programmes from the local station of the B.B.C.

There is, of course, another aspect of this matter, which is that when all that is required is the local station which can be obtained on a two-or three-valve set it seems, to say the least of it, wasteful to employ perhaps a ten-valve set switched on hour after hour, day after day, for local-station listening. Quite a simple set is all that is necessary for the local station, but the specialist wants to feel that he is in touch with the world with a receiver of high performance.

The Relay Position

The Next Step

THE fact that the Southampton Borough Council, as recently reported, decided to take no further action in the matter of providing facilities for the Post Office to instal a relay system in the town, does not necessarily mean that the Post Office must abandon the scheme as far as Southampton is concerned. Whilst the co-operation of the Borough Council would have facilitated matters for the Post Office, it is not, we understand, essential for the Postmaster General to have this permission before proceeding with the work.

It is to be hoped that the view taken by Southampton, and the arguments put forward by the Borough Council in defence of their attitude of non-co-operation, will not have the effect of stiffening Post Office determination to proceed, but rather that it may serve as a hint that the whole question of the undertaking of this enterprise by the Post Office should be reconsidered. A proper understanding of what was intended in the recommendations of the Ullswater Committee and their adoption by the Government should be arrived at before the country is committed to a vast expenditure to provide an alternative method of distributing broadcasting to a public already quite well served with the existing system.

We have previously suggested that the interest shown by the Post Office in developing relay services may be bound up with questions of national defence and the desirability of being able, if necessity should arise, to close down the wireless broadcasting stations and yet, by maintaining a relay service, provide a substitute means of keeping the public informed on occasions of national emergency.

If the relay system is to be developed for this purpose there can surely be no harm in disclosing the fact. Sooner or later it would become evident that it was a national defence scheme and it will be better to have the facts now and an opportunity to give them proper consideration before commitments are entered into.

Why Not Two Sets?

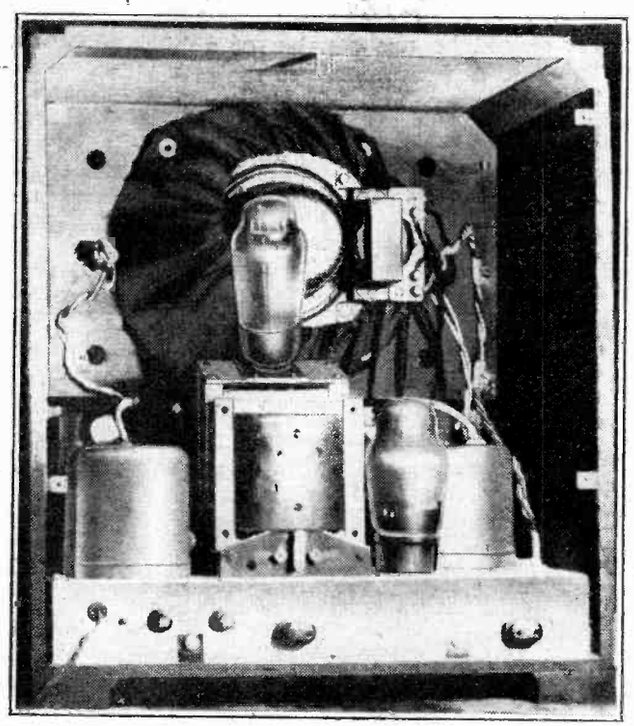
THE CASE FOR SPECIALISATION

AFTER describing some of the advantages of having one set designed exclusively for local-station reception and another for long-distance work, the author gives suggestions for converting a standard TRF receiver for high-quality reproduction at short range.

By R. H. WALLACE

THE first reaction to the above title on the part of many readers must be that this article is written for those who are distinctly well-to-do, and that it will have little interest for the wireless user who has to consider his budget carefully. This is not so, and, in fact, the present article is intended to show how the use of two sets may actually be cheaper than that of a single set of equivalent performance, to say nothing of the additional advantages that the ownership of two separate sets confers.

The average small superheterodyne now on the market is, of necessity, a compromise between the conflicting factors of selectivity and quality of reproduction; as such its performance is worse in quality on the local stations than it otherwise need be, while its selectivity is hardly sufficient for the interference-free reception of all those stations its sensitivity enables it to receive. The action of the AVC system generally fitted renders it liable to certain forms of distortion, even on the local station, and the size of the cabinet and of the speaker usually fitted limit still further the response; it is a fact that many of the "straight three" sets in vogue three and four years ago gave better quality in general than the present superhet of equal price, though their standard of selectivity was not sufficient for the reception of distant stations.



A typical set of the type suggested as being suitable for conversion to a local-station receiver.

Most of us probably do quite 75 per cent. of our listening on the local stations, yet, owing to the present policy of the B.B.C., we often require to receive items which are on the programme of another region, or to listen to special features to be heard from the Continental stations. The use of AVC is desirable for all but the local station, especially as the regional stations are at a more critical distance for fading than most of the more distant ones, and we are prepared to sacrifice the quality of reception in order to receive these.

There are many people who live in the black spots of British broadcasting who cannot regard any station as the local, and for these the use of a really high-quality set is out of the question. Fortunately, however, the majority of the population do live within about 25 miles of their regional transmitters, and this is quite near enough to permit really good quality to be obtained on a suitable set.

The high-quality local station set has not, up to the present, been attractive to the big maker, since as long as most people run only one set he could not hope to sell this type in any quantity, although a pre-tuned set of this sort with an output of three to five watts could be cheap to produce if a sufficient demand were created. A set like this requires little radio-frequency amplification, practically no screening and no expensive ganged condensers nor special dial systems.

Variable selectivity has been hailed by some as a complete solution of the problem, but, unfortunately, its proper application is both costly and complicated, and, if the amplifier is a really wide-response one, the valve noises arising in the early stages will be troublesome on distant stations unless low-pass filters are inserted in the circuit. Almost the only type of set catering fully in this way for these varied conditions of reception is the "luxury set," and this is available only at a luxury price beyond the means of many enthusiastic listeners; also, this type is usually only made in the form of a radiogram, which does not suit everyone.

There are several ways of obtaining the desired performance for these sets; sometimes the problem is solved by variable selectivity applied to the tuned circuits by electrical or mechanical means—this does not mean that the user will always remember to adjust the response to a value suited to the conditions, and it is also only capable of broadening response to a limited extent; it is, therefore, the practice of some designers to arrange matters so that the set works as a superhet for distant reception and as a straight set for local stations. Both of these methods need very careful design and either expensive switches or costly IF transformers, together with a greater assembly cost, hence it is sometimes considered better to provide separate tuning units, each coupled to the same amplifier; this necessitates extra mains transformers, unless both units are to be on all the time, since switching of filament current is not advisable; and the high-tension supply must be removed from the unit not in use or all the decoupling condensers on the plate side of the valves will be continually subjected to the full voltage, as there is no drop in their feed resistances when the valves are cold.

Avoiding Compromise

It will be seen, therefore, that the use of two entirely separate sets solves most of these problems more easily and more simply, and at the same time permits greater flexibility; the valves are only working when they are actually in use, and a much higher standard of performance can be obtained from each, since there is no need to make any compromise between quality and selectivity.

Ideally the selective set would be one of the so-called "communications" type, or at least a superhet with the highest usable sensitivity, say one microvolt or less, and selectivity adjustable from a top cut-off of 6,000 cycles to one of 2,500 cycles, and with a built-in speaker. The quality set could be something like the Pre-tuned Quality Receiver described in *The Wireless World* some time ago, or an amplifier with a more modest output such as the Small Quality Amplifier, coupled to a suitable tuning unit, would suit many people; either of these would be equipped with a

Why Not Two Sets?—

good-quality speaker on a separate baffle, or fitted in a substantial console or radiogram cabinet.

This ideal solution will not suit all readers, as they probably at present own a set of one type or the other; very likely this is a modern superhet of sufficiently good range and selectivity to give them all that they wish in the way of foreign listening, but which does not give them nearly as good reproduction of the nearby stations as they would like. If such people as these do not feel justified in constructing a high-quality set and amplifier there are various second-hand straight sets two or three years old available in the shops at a low price. These sets if of a good make are generally in solid, well-built cabinets, have comparatively good speakers, and can be modified to give very acceptable quality for local listening. Possibly, however, a receiver of this type is already in the reader's possession; in this case when a new set is to be bought, instead of trading the old receiver in at a nominal figure, it should be kept and adapted for use as the quality set, while the new one can be considered solely on its merits for long-distance work.

There are several methods which can be used to make a set give a wider response than before, and most of them involve some sacrifice of sensitivity, which in this case is not objectionable, since the set is only required to work on the comparatively large signal provided by the local station. These alterations will be described in the order in which they will generally be advisable and can be tried in turn until the sensitivity has fallen to as low a figure as will give sufficient volume for all occasions.

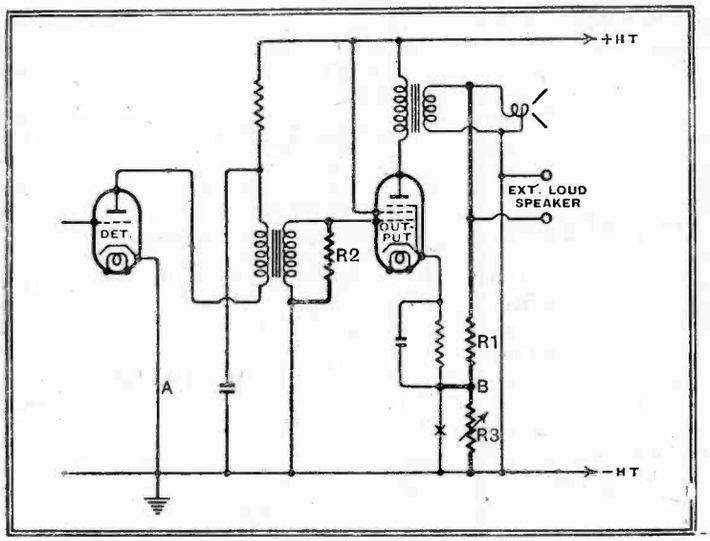
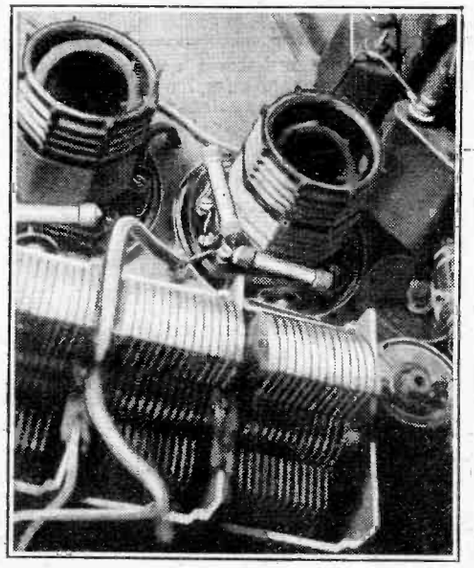


Fig. 1.—Introducing negative feed-back into a pentode output stage. The feed-back resistance R3 can be inserted either at A or B; at A the same value would give much greater feed-back. Additional wiring is shown in heavy lines; lead to be taken off marked X. Resistances depend entirely on output transformer ratio; suggested values: R1, 250 to 50 ohms; R2, 500,000 to 100,000 ohms; R3, 0/5 or 0/30 ohms variable.

First of all is the question of whether the existing speaker is of sufficiently good response; this is a matter of individual taste, but if it can be considered, the use of a separate speaker will be preferable, and if this is of an extra sensitive type the increase of volume can be quite as great as if an output valve of double the capacity had been fitted. A separate baffle would be the best form of mounting for this new speaker.

Next, if the set is fitted with a pentode output valve, the quality can be considerably improved by applying negative feed-back, either to the output stage alone, or to both the detector and output stages; if feed-back is taken from the secondary of the output transformer then any defects this component may have will also be partially corrected, and the speaker will perform better owing to the output valve having its impedance lowered and thus affording better damping. These points have already been dealt with in *The Wireless World* in considerable detail, so it is only necessary to say that this effect may be obtained very simply by breaking the earthed end of the cathode circuit of the valve concerned and inserting a small variable resistance, to the slider of which is taken a lead from the high-potential end of the output transformer secondary; these alterations are shown in Fig. 1. The feed-back can be applied either at A or B, and it will be best to find by experiment which gives the most satisfactory results. It may be necessary to reverse the connections of the secondary of the output transformer to secure feed-back in the right sense, and the use of a resistance across the secondary of the intervalve transformer as shown may be advisable if this stage is included in the arrangement. Strictly speaking the ratio of the speaker transformer should be changed, as the effective impedance of the valve will be reduced, and if other tappings are available these may be tried; this may not be needful, however, though if several speakers are to be used at once it would be wise to obtain a transformer of a lower ratio.



Improving high-note response; damping resistances across the tuning coils should be mounted inside the screening cans.

The distortion arising when several speakers are used from a pentode output is much reduced when negative feed-back is in use.

Should the output valve be a triode, or if for any other reason negative feed-back is unattractive the next alteration to consider on the low-frequency side is the changing of the intervalve transformer from direct to parallel-fed operation. For this only a resistance and a condenser are needed; Fig. 2 gives the details.

The above modifications having been made, if there yet remains more than sufficient reserve of sensitivity the response of the tuned circuits can be broadened by connecting damping resistances across the coils as shown in Fig. 3; here again the values will depend on the sacrifice of volume that can be made, and selectivity

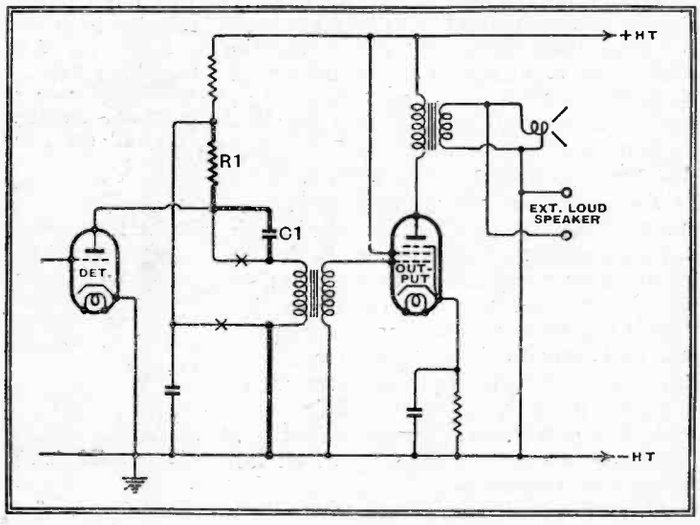


Fig. 2.—Method of connecting an intervalve transformer so as to work under parallel-fed conditions. Suitable values: C1, 0.1 mfd. to 1 mfd.; the larger value gives better response to low notes. R1, 25,000 to 100,000 ohms; as this alters the detector plate voltage the set should be retrimmed.

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must obviously not be reduced to the point where the two local stations interfere with each other. These damping resistances should be mounted on the coil terminals inside the cans and be non-inductive; by choosing suitable values the volume may be nearly equal on both wavebands.

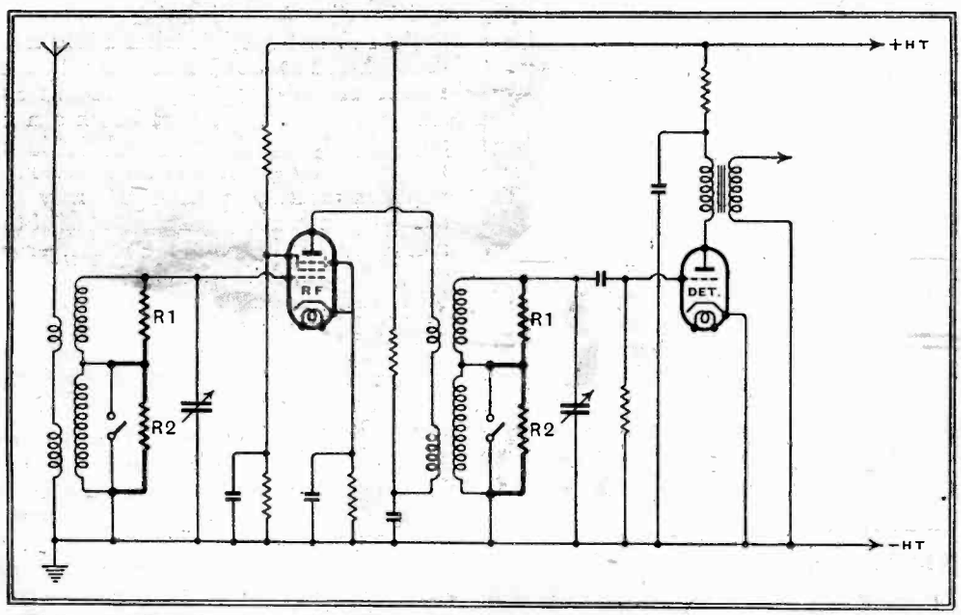


Fig. 3.—Illustrating the way in which to connect damping resistances across the tuned circuits of a receiver, to improve high-note response. Suitable values for R1 (medium wave) 10,000 to 2,000 ohms; R2 (long wave) 50,000 to 10,000 ohms.

The provision of aerial connections for the two sets need not be a difficult matter; undoubtedly the best solution is to use one of the excellent anti-interference aerials now obtainable, with a matching transformer for each set. This enables a really good aerial to be used for both sets and hence a high signal-to-noise ratio to be maintained on each. Alternatively, if the local station is sufficiently strong and the interference level low, an inside aerial may be used for the quality receiver and a good outside one for the more sensitive set.

Most of the remarks in this article apply primarily to the user who has a mains electrical supply, since there is usually more reserve of sensitivity in the mains receiver than in its battery counterpart, and more opportunity of making improvements. Nevertheless, much may be done for a battery set on the same lines.

The use of two sets in this manner provides most of the advantages of the luxury model, together with the greater flexibility of separate reception in two rooms; so that if different members of the family wish to listen to varied programmes they are at liberty to do so; thus a common source of discord in the home is removed. The cost of upkeep need be little more than that of a single, more ambitious set, since the two are not likely to be on for long periods together.

It is impossible to give other than average values of components for the alterations suggested, since the conditions will vary widely in sets of different makes, but it is hoped that enough has been said to indicate the lines on which the suggested improvements may be made, and that this article may help some readers to realise that the use of two sets is both practicable and possible for them.

On the Short Waves

FOR no apparent reason sunspot activity has still remained high, short-wave conditions having been excellent for at least ten days now, the 28 Mc/s amateurs in the U.S.A. being audible as late as 9 p.m. on some occasions.

Sunspot activity from about February 10th was more diffused, though equal in total activity, than that of the January 10th-23rd period. In the earlier period the spots were bunched into a large group and not distributed as small spots over the sun's surface, which is the form it took on the second occasion mentioned.

From the short-wave point of view it would appear the large compact spot is detrimental to good signals, and a fairly large number—though, perhaps, not too large—of small spots distributed over the sun's surface is beneficial.

Among the more interesting news items of the week is the report that the U.S. Federal Communications Commission has at last decided to re-allot the so-called Pan-American Union short-wave frequencies which were reserved by the U.S. Navy, in some cases as long ago as 1929, for a Latin-American broadcasting service from Washington.

These frequencies are:—6.12 Mc/s, 9.55 Mc/s, 11.73 Mc/s, 15.13 Mc/s, and 21.50 Mc/s.

The 15 Mc/s channel was notified in 1931 and the 11 and 21 Mc/s channels in 1932.

Of these, the 21.50 and 9.55 Mc/s frequencies have been allotted to the General Electric Co. at Schenectady, and the W2XAD transmitter has presumably been modified to work on them, starting on March 2nd according to the schedule published on page 171 of last week's issue.

The 11.73 Mc/s channel has been allotted to W1XAL, Boston, and this station has already been heard working on this frequency in the early hours.

So far no information is available regarding the disposal of the 6 and 15 Mc/s allocations.

It is worth noting at this point that the 11.73 Mc/s frequency is already being used by PHI, the 15.13 and 9.55 Mc/s frequencies by TPB Paris and the 9.55 Mc/s also by Podebrady OLR5.

Other newcomers are Bombay and Delhi in the late afternoons on 3.31 Mc/s and 3.47 Mc/s respectively.

In the morning, at 2.30 a.m. G.M.T., Delhi recommences transmissions on 9.59 Mc/s, this frequency at present being used for day transmissions, the daylight frequency (in India, of course) for Bombay appears to be 6.125 Mc/s.

The transmitters at Delhi and Bombay were supplied by the Philips Company, the Delhi transmitter having a power of 10 kW in the aerial. In order to accommodate the short-wave aerials—a fairly large one is required for the 90-metre (3 Mc/s) wave—an additional mast has been erected close to the medium-wave aerial at Delhi.

Perhaps rather contrary to my expectation, the new rhombic aerial at W8XK appears to have been successful, at least on 15.21 Mc/s, and an excellent signal has been available from this transmitter until approximately midnight recently.

In fact, W2XAD will shortly have to look to its laurels.

On the other hand, one was pleased to see that the two new rhombic aerials, one for Europe and one for South America, at Pittsburg, are erected on 80ft. poles, i.e., the rhombics are just over a wavelength high on 15.21 Mc/s. (15.21 Mc/s = 19.72 m. = 3.28 × 19.72 = 65ft.).

Whether these aerials will perform so well on 11 and 6 Mc/s remains to be seen; the study will be an interesting one; they would probably give excellent results on 21 Mc/s!

Finally, it will be most interesting to hear what type of aerial will be adopted by W2XAD for its new frequencies.

The South African stations have also recently come into the limelight, and the details of the various transmitters are as follows:—

Klip Leuval, Capetown: ZRK, day frequency, 9.606 Mc/s; night frequency, 6.097 Mc/s.

Johannesburg: ZRJ, day frequency, 6.097 Mc/s; night frequency, none.

Roberts Heights: ZRH, day frequency unknown, but use of 9.23 Mc/s is contemplated; night frequency, 6.006 Mc/s.

The Roberts Heights station also tests on 17.39 Mc/s and 8.695 Mc/s occasionally, and has been well heard on both these frequencies, especially the former.

ETHACOMBER.

KB All-wave Battery Receiver

THE new KB710, which was released on March 1st, is a three-valve receiver with pentode RF amplifier, detector and pentode output valve. There are three wave-ranges with band-pass tuning on medium and long, and the short-wave range is from 18 to 52 metres.

The provision of sockets for a gramophone pick-up in a set of this type is noteworthy, and there is also an HT fuse. An 8in. permanent-magnet loud speaker completes the specification and the price of the set, without batteries, is £7 17s. 6d.

American Facsimile

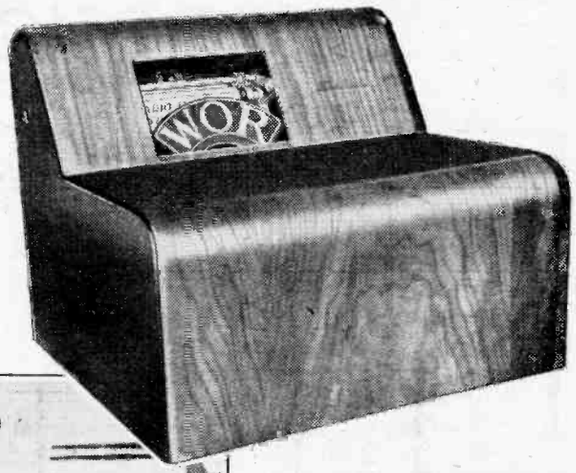
NEWSPAPER REPRODUCTION IN THE HOME

EXPERIMENTAL transmissions of facsimile are commencing from a number of American broadcasting stations. At present the hours of transmission are outside those devoted to the ordinary broadcasting programmes, being from midnight to 6 a.m. The apparatus is, however, provided with a time switch so that it will function without attention, switching itself on at midnight and off again when the transmission has ceased.

It is envisaged that the matter of the transmissions will take the form of a newspaper, and owners of the necessary gear will consequently come down in the morning to find a facsimile-reproduced newspaper awaiting them.

An ordinary broadcast set is employed, and the facsimile apparatus is connected to its output instead of the loud speaker. In this respect it is similar to the well-known Fultograph transmissions which took place in this country some ten years ago. The actual mechanism, however, is rather different.

At the transmitter, the material to be transmitted is scanned by a light beam, the reflected light falling upon a photo-cell and so producing variations in an electric current. The scanning speed is about 100 lines a minute, corresponding to one inch in depth; the width of the line of type is some four inches. In six hours of transmission 30ft. of material can be dealt with.



A view of a complete recorder used in facsimile.


WOR

RADIO PRINT

WEATHER
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FACSIMILE
Home Edition

Newark, N. J., Thursday, Feb. 10, 1938

RADIO OPENS VISUAL ERA

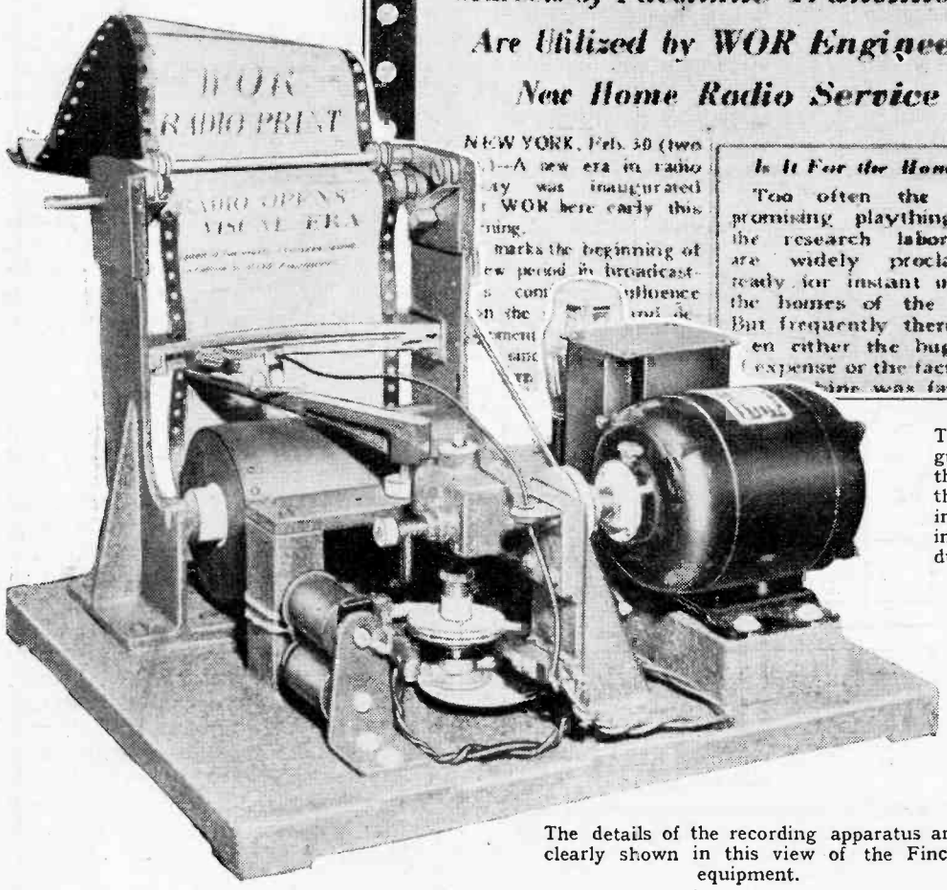
Marvels of Facsimile Transmission Are Utilized by WOR Engineers' New Home Radio Service

NEW YORK, Feb. 10 (two ...)—A new era in radio ... was inaugurated ... WOR here early this ... ring. ... marks the beginning of ... ew period in broadcast- ... s com... influence ... on the ... and ...

Is It For the Home?

Too often the most promising playthings of the research laboratory are widely proclaimed ready for instant use in the homes of the land. But frequently there has ... en either the bugaboo ... expense or the fact that ... was far too

This photograph shows the clarity of the "printing" obtained in the reproduced images.



The details of the recording apparatus are clearly shown in this view of the Finch equipment.

Audio-Frequency Carrier

The carrier of the transmitter is not modulated directly by the "picture" currents, but by a 3,000 c/s current which acts as a carrier for the "picture." In the receiver an output at 3,000 c/s, modulated by the "picture" signals, is obtained and applied to the facsimile apparatus. This varies in detail with different makes of apparatus. In general, however, a roll of paper is provided and a recording stylus moves across it in synchronism with the mechanism of the transmitter scanner.

With the Finch system 200ft. rolls of sensitised paper are used, and the paper is obtainable with various coloured surfaces. It is the coloured surface which is broken down by the "picture" currents to form the reproduction of the transmitted subject. In the R.C.A. equipment a different system of recording is used. In the products of this firm a carbon paper travels between the recording paper and the stylus.

The present transmissions are experimental, and it remains to be seen whether or not facsimile will achieve any great measure of popularity. The present price of equipment is 125 dollars, but mass production would probably halve this figure. Some fourteen stations are licensed for facsimile transmission, and among these are several owned by newspapers.

Magnetic Tuning Devices

A PRACTICAL REMOTE CONTROL SYSTEM

By L. de KRAMOLIN

(Concluded from page 162 of last week's issue)

IT was shown in last week's article that the principle of inductance variation by the magnetic biasing of ferromagnetic cores could, by the use of a suitable arrangement, be employed at radio-frequency. Further, various possible applications for such "magnetic variometers" were pointed out.

One of the most obvious of these applications is in the construction of remotely tuned apparatus, the remote tuning being accomplished by regulating the biasing current of such a variometer. In the simplest cases the apparatus would take a form more or less like that shown in Fig. 11. Here M is the "tuning" magnet carrying the "tuning" winding W. The variable resistance R regulates the magnetising current, and consequently the magnetic bias of the RF core H, carrying the winding L. The inductance of L is thus regulated, and with it the tuning of the oscillatory circuit LC. The magnet winding W is in this particular case supplied from the filament-heating battery B. The switch S cuts in and out the current from this battery and thus puts the whole apparatus in and out of action. If the apparatus has satisfactory insulation there is no need for a special switch in the anode-current circuit.

If the remote-tuning device is intended merely to control a receiver in the same room—so as to prevent one from having to get up from one's seat whenever the tuning has to be altered—the loud speaker can be mounted in the set itself and the remote control connected to the receiver by some suitable cable such as a flat "under-carpet" conductor. But such an arrangement, though frequently used nowadays, does not take full advantage of the possibilities of remote tuning.

For, whenever possible, the actual receiver should be kept out of the sitting room. In the first place a broadcast receiver cabinet is as a rule no ornament, in spite of the best intentions and efforts on the part of its designer; even if, in itself, it actually is a thing of beauty, it seldom fits in perfectly with the style or period of the room.

Secondly, remote control offers us the opportunity to install the receiver in just the position where it ought to be—as close as possible to the active portion of the receiving aerial. In most cases this position is directly below the roof of the house. Since the interference level is here at its weakest it is often possible to dispense entirely with a screened down-lead; in any case the latter can be limited to a few yards, thus greatly simplifying its installation. Such a layout involves no appreciable extra cost, since the longer screened down-lead is replaced by an audio-frequency lead and the remote-control lead, neither of which requires anything like the careful laying necessary for the down-lead.

The extra cost of the remote-control device, not very great in itself, is partly balanced by the fact that the receiver can now be protected by a simple sheet-iron box, for example. How great such a saving may be is realised when one remembers that in many ordinary receivers the cabinet may represent anything up to 30 per cent. of the total cost. Of course, part of the saving may be lost because of the necessity for a loud speaker cabinet. With a little imagination, however, one can usually find another way of dealing with the loud speaker; for instance, it can often be installed in a small hole in the wall between two rooms, with the added advantages of reception in two rooms with a single loud speaker chassis and freedom from cabinet resonance. The aperture can be covered with a picture or something of the kind, without appreciable loss in quality, so that nothing remains to be seen of the whole radio installation except one small control device. The latter, provided with a flexible lead and plug, can be plugged-in in any room, so that such an installation provides a high degree of "receiving comfort."

THE advantages of a magnetic tuning circuit for remote control are obvious, for it functions just as well at a distant point as at the receiver itself and so removes at one stroke all the normal difficulties of remote control. In this article a practical system is described.

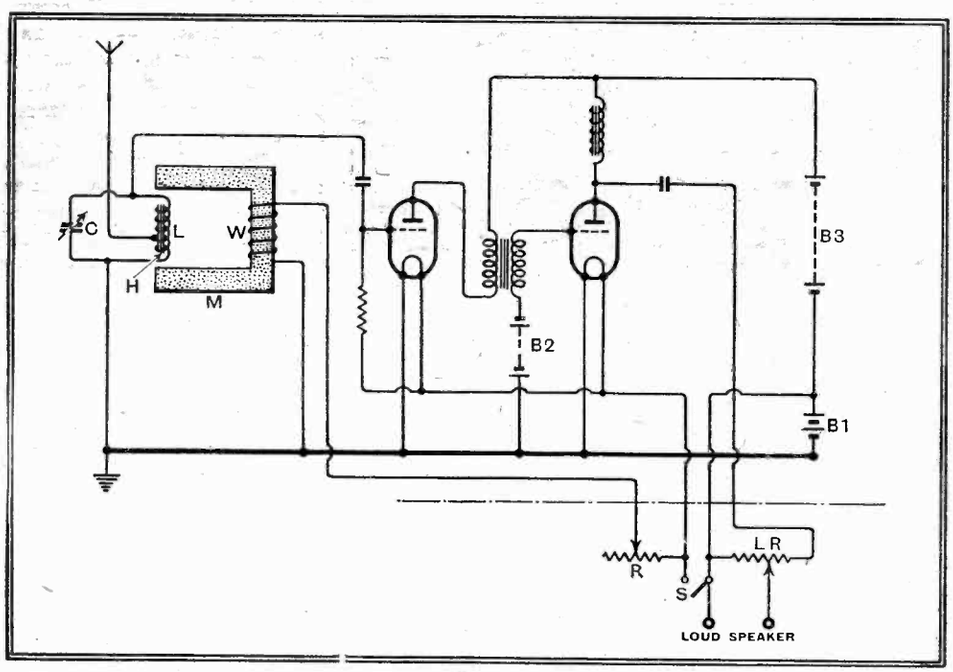


Fig. 11.—The circuit of a simple detector-AF set with magnetic tuning arranged for remote control is shown here.

Volume Control

In Fig. 11 a horizontal dotted line divides those components which are included in the receiver itself from those which have their place in the listening room. Even in a simple installation it is usually undesirable to do without a volume control. The simplest way of providing this is shown in Fig. 11, where the energy fed to the loud speaker is controlled by a potentiometer LR. Although this method of volume control is hardly ideal, it answers the simplest requirements and involves the smallest expenditure in components and connecting leads. If rather more expenditure is allowable, a theoretically perfect volume control may be obtained by the use of "Urdox"

Magnetic Tuning Devices—

resistances, as made by the Osram Company; the assembly is shown in Fig. 12. A glass bulb G contains a small tube U of uranium dioxide, which forms the actual resistance. This tube can be heated by the filament H inside it, with the result that its resistance, amounting to about 1 megohm when it is cold, falls gradually as the temperature is raised more and more, until it becomes only about 10,000 ohms. Thus, by regulating the filament-heating current the resistance of U can be varied between these two limits.

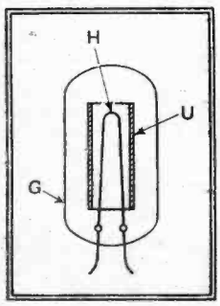


Fig. 12—The electrode assembly of the Urdox resistance.

By arranging such an Urdox resistance in a suitable place in the LF or AF circuits of the receiver, remote control is provided, since the filament-current regulator can be situated in the remote control unit together with the tuning regulator R of Fig. 11. Another method of volume control is by the use of "regulating" (variable-mu) valves for detector or LF stage, their bias voltage being regulated from the control unit. The use of this type of volume control in the audio-frequency channel is only to be recommended if push-pull circuits are employed.

The Tuning Indicator

Either Urdox resistances or variable-mu valves can be made to provide a remote control of coupling and feedback, or one can employ inductance variation, by means of a magnetic variometer (as described above) for this purpose.

For wave-band switching almost any type of relay can be used, but perhaps the most satisfactory is the simple mercury-tube relay.

The construction of a suitable station scale presents some difficulties. For many purposes the apparatus shown in Figs. 7-10 can be used, but when employed in conjunction with a remote-control receiver of the type shown in Fig. 11, the objection arises that neither the position of the slider of the control resistance R, nor the value of the magnetising current in the magnet coil W, as shown by an ammeter, gives a reliable indication of the corresponding inductance of the winding L, and, therefore, of the wavelength to which the circuit is tuned. Thus, if R is provided with a scale, any particular point on this will correspond to two different wavelengths, the one occurring if the slider has reached the point by movement in one direction (e.g., giving an *increase* of magnetising current) and the other if it has moved in the opposite direction. This behaviour is caused by the remanence phenomena in the iron cores M and H, and although not a serious difficulty in the simplest type of single-circuit receiver seen in Fig. 11, may be very troublesome in the multi-circuit apparatus such as will be considered later on. It may be suggested that this "backlash" difficulty could be overcome by an ingenious mechanical device for the indicator of R, but such a plan would be too complicated.

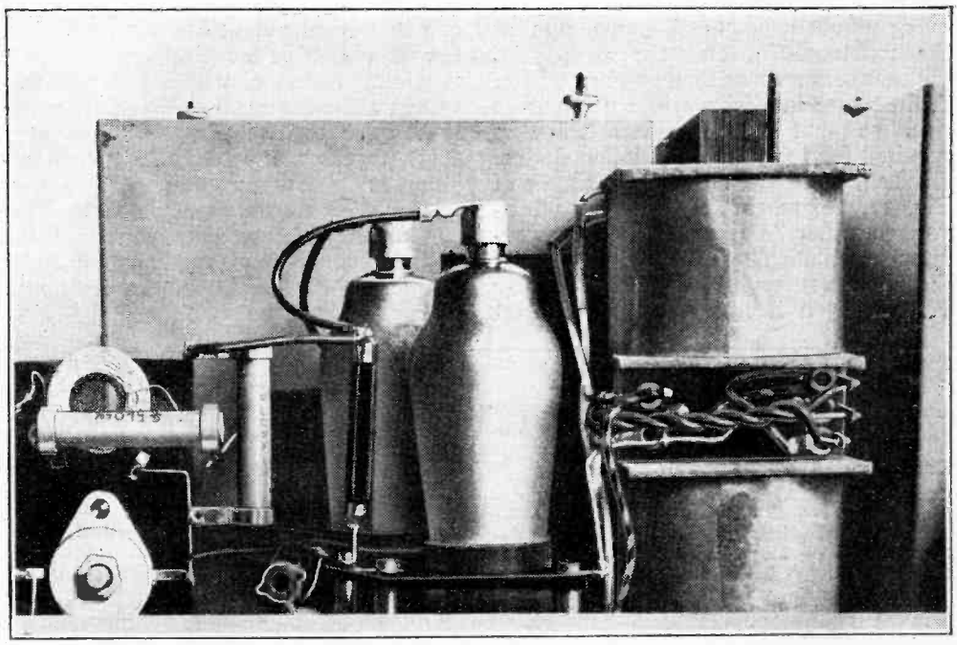
Another possibility is to make the tuning-scale indication completely independent of the position of the slider; for instance, by introducing at some point of the magnetic circuit M-H a component which will allow the magnetic field strength to be read directly. Such a device might be of magnetrom, cathode-ray tube, or bismuth-resistance type.

Further experiments, however, have shown that it is not necessary to have recourse to such methods, since it has been found possible, by the use of special magnetic material, to make the backlash error so small as to be negligible in practice. There are certain ferromagnetic materials which have an exceptionally small coercive force. In particular, nickel-iron alloys have been developed in which the remanence is so small that, even when the whole frequency range 150-1,500 kc/s is covered, the discrepancy between the actual wavelength and the wavelength as indicated by the magnetising-current value corresponds to a frequency difference of at most 7 kc/s—of no importance in a channel of 9 kc/s width.

The use of these special materials does, it is true, increase the cost of the magnetic variometer not inconsiderably; also, their employment involves a rather larger expenditure of regulating energy. In the most popular type of receiver to-day, however, namely the superheterodyne, the use of such special variometers is not necessary. For in these receivers the frequency of the oscillations in the local oscillator circuit is a definite measure of the received wavelength, so that any instrument showing this oscillator frequency will serve as a tuning indicator. Thus, if a part of the oscillator energy is led to a diode, an ohmic resistance (or, better, an inductance) being included in the connecting lead, this arrangement will constitute a frequency-dependent link, thanks to the self-capacity of the diode; and the effective voltage at the diode gap will be about inversely proportional to the oscillator frequency applied to it. The DC component from the diode can, therefore, be used directly to actuate a voltmeter, whose reading will then give the wavelength indication; or the diode can be made to act on the grid of an amplifier valve whose anode circuit contains a milliammeter. The latter plan is the better, since it allows the indicating instrument to be much less sensitive, and consequently cheaper and more robust.

The Tuning Scale in the Superhet

If valves with high internal resistance are used, so that the resistance of the indicating instrument is small compared with the valve resistance, the advantage is obtained that the reading is to a large extent independent of the resistance of the connecting leads, so that no errors of reading are caused by longer or shorter remote-control lines; further, with this arrangement it is possible to connect a varying number of indicating instruments in series, as desired, without upsetting the scale accuracy. Fig. 13 gives a diagrammatic view of such a station tuning indicator; V1 is the local oscillator valve, to which the oscillatory circuit LC is joined in the "three-point" connection. The L of this circuit is a winding on the powder-core H lying between the poles of the tuning magnet M. The condensers C2, C3, are merely to block the direct current. Part of the oscillator energy is led through the choke D to the anode of the diode



A view of an experimental receiver operating on the single-span principle. The magnet for tuning control can be seen to the right.

Magnetic Tuning Devices—

V3, which combines with D and its own self-capacity to form a frequency-dependent link. The DC voltage resulting from rectification is tapped off the resistance W. The magnitude of this voltage, on the assumption of a constant oscillator amplitude, is a measure of the received wavelength to which the receiver is tuned, which can, therefore, be read on the meter I. In practice, the assumption of a constant oscillator amplitude is generally fulfilled to a sufficient extent; if this is not the case, some form of stabilisation can be introduced.

Since the valve V2 is merely used for DC amplification (so far as its duties for remote indication are concerned) it can serve as well as a reflex-circuit valve or for any other purpose in the IF or AF channel, provided only that it is not over-controlled by the DC voltages at the resistance W and the added AC voltages arising from its secondary duties. A little care in design will easily ensure this, so that no additional valve is required for the remote-indication device.

When, as in the case of the circuit of Fig. 11, the magnet is fed from a low-voltage source (filament-heating accumulator), the difficulty is likely to occur that the regulating resistance for such a low voltage, even if it is of sliding-contact type, may not give a sufficiently smooth regulation; the difference of resistance from turn to turn of the winding may represent too great a jump for the purposes of fine tuning. Carbon-compression resistances, which can be adjusted to give a perfectly continuous variation, are inclined to be inconveniently inconstant. In such cases it is advisable to connect a second considerably higher-resistance variable resistance in parallel with the first, so as to act as a fine adjustment to the rough control given by the latter.

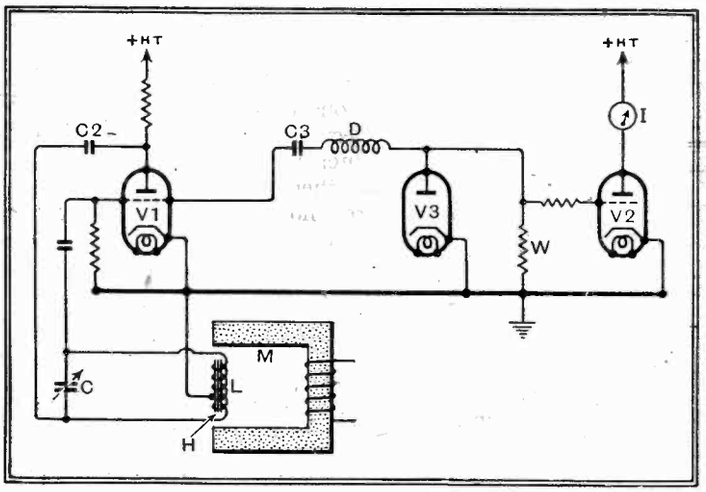


Fig. 13.—The circuit of a tuning indicator system is shown here

With such an arrangement the tuning can be carried out with ease, even when the adjustment is a critical one. Since a regulating resistance with a linear characteristic will compress the channels near the short-wave end of a wave range very much together, it is desirable to use resistances or potentiometers with logarithmic or similar adjustment characteristics.

Various problems encountered in the design of multi-circuit receivers, and their solutions, will, it is hoped, be dealt with in later articles.

News from the Clubs

Brentwood Amateur Radio Society

Hon. Sec.: Mr. J. R. D. Sainsbury, "Brunook," Crossways, Shenfield.

Mr. B. A. Pettit gave a very interesting demonstration of his short-wave receiver at a recent meeting. This receiver is a modified version of the well-known *Wireless World* "Everyman Four." A welcome visitor at this meeting was Mr. R. C. Beardow, Hon. Sec. of the Chadwell Heath Amateur Radio Society, with which the Brentwood Amateur Radio Society is now co-operating. The society will soon be on the air under their call sign G8HV. The P.M.G. has consented to Mr. A. H. S. Scott acting as a second operator. The journal of the society has now been reorganised and is being published quarterly under the honorary editorship of Mr. S. D. Jones. The following programme has been arranged for the remainder of the season:—

Mar. 11.—Demonstration by the M.P.R. Electrical Co. of their 7-watt amplifier and double button microphone.

Mar. 25.—Lecture. Details to be announced later.

Apr. 8.—Lecture and demonstration by Mr. S. R. Walker, of the Automatic Coil Winder and Electrical Co.

Apr. 22.—"The Equation of $x-x=0$." Cinematograph film showing in a practical form the construction of Harmonics.

Dates of lectures and demonstrations to be given by the Mullard Wireless Service Co. and the Milnes Radio Co. will be announced later.

Thames Valley Amateur Radio and Television Society

Headquarters: The Albany Hotel, Twickenham.
Meetings: Wednesday evenings at 8.15 p.m.
Hon. Sec.: Mr. J. N. Roe, 19a, The Barons, St. Margarets-on-Thames.

This society has a special section working on 5-metre experiments under the direction of Mr. W. G. Pyke. Morse classes are being held under the direction of Mr. L. Cooper. The annual subscription to the society is 3s. 6d., dating from the day of election to membership. The following programme has been arranged:—

Mar. 16.—Talk: "More About Transmitting Aerials," by Mr. F. Charman.

Apr. 2.—Annual dinner at the Albany Hotel, Twickenham. Full details to be announced later.

Apr. 6.—Talk by Mr. E. A. Dedman, of the Quartz Crystal Co.

Apr. 27.—Talk: "The Progress of Amateur Radio," by Mr. J. Clarricoats.

May 11.—Talk (subject to be announced later) by Mr. H. E. Stoakes.

May 22.—1.7 Mc/s Field Day. Fully licensed members may enter stations.

June.—R.S.G.B. National Field Day. Full programme and exact date to be announced later.

June 22.—Talk (and possible demonstration) on Television. Full details to be announced later.

Radio, Physical and Television Society

Headquarters: 72a, North End Road, London, W.14.
Meetings: Fridays at 8 p.m.
Hon. Sec.: Mr. C. W. Edmans, 72a, North End Road, London, W.14.

"The Generation of Alternating and Direct Current" was the title of a recent lecture delivered by Mr. C. W. Edmans. By the liberal use of vector diagrams the lecturer was very successful in explaining the subject in a manner which could be easily grasped. Special thanks are due to Messrs. Joseph Sankey and Sons, Ltd., for the loan of a collection of dynamo stampings, and to Dr. C. G. Lemon for a number of machines, over fourteen of which were shown to the members present.

Croydon Radio Society

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

At a recent meeting Mr. H. J. Walters, of Belling & Lee, lectured on "Electrical Interference Suppression as Applied to Broadcast Reception." The lecturer went into great detail in the course of his talk and gave a very convincing demonstration. At this meeting members of the Short-wave Radio and Television Society of Thornton Heath were guests.

At another meeting at which members of the British Sound Recording Association were guests, Mr. P. K. Turner demonstrated his new "B" type negative feed-back amplifier. The lecturer explained why he was using tetrode output valves in a negative feed-back circuit in place of the triode push-pull arrangement which he had employed for many years.

Dollis Hill Radio Communication Society

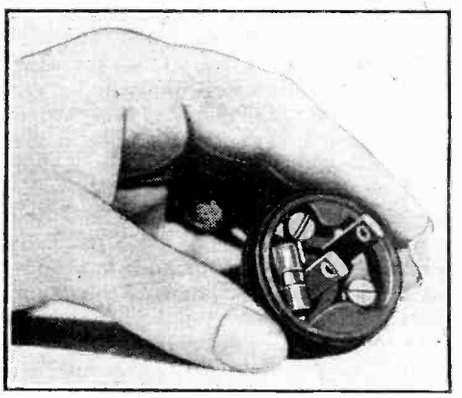
Headquarters: Braincroft Schools, Warren Road, London, N.W.2.
Meetings: Alternate Tuesdays at 8 p.m.
Hon. Sec.: Mr. J. R. Hodgkyns, 102, Crest Road, Cricklewood, N.W.2.

At the last meeting a lecture and demonstration was given by Mr. S. R. Wilkins, of the Automatic Coil Winder Co. On March 8th Mr. H. G. Menage, of Rothermel's, will give a lecture and demonstration entitled "Piezo Crystals and their Application."

South London and District Radio Transmitters' Society

Headquarters: Brotherhood Hall, West Norwood.
Meetings: The first Wednesday in each month.
Hon. Sec.: Mr. H. D. Cullen, 164, West Hill, London, S.W.15.

A successful year's work was concluded with the annual dinner at the Half Moon Hotel, at which the guest of honour was Mr. H. Bevan Swift. An interesting summer programme, including outings and field days, has been arranged. Anyone interested in short-wave amateur radio will be welcomed at the Society's meetings.



SAFETY PLUG: a renewable fuse is built into this American plug, which is used for connecting radio sets and other domestic appliances.

Television Topics

One VF Stage and the DC Component

WHEN a single VF stage only is used and the CR tube HT supply is arranged so that its negative side can be earthed, it is possible to use a direct connection between the grid of the tube and the anode of the vision-frequency amplifier. This is shown in Fig. 1 and the potentiometer R2 is provided so that the bias on the tube can be conveniently adjusted. With this

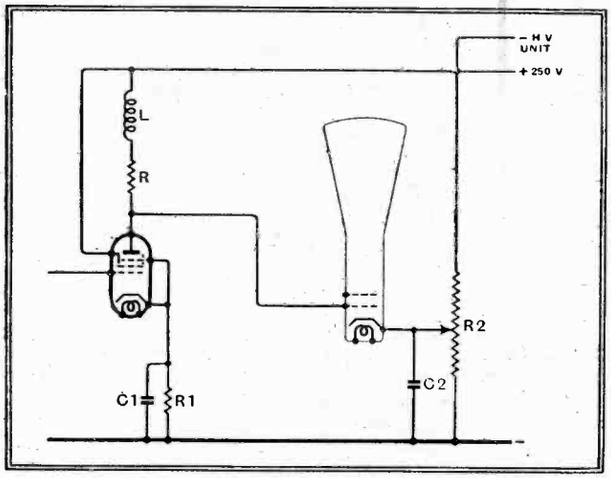


Fig. 1.— A cathode-ray tube can be fed directly from the anode of a VF stage by adopting the connections shown here.

circuit the negative of the high-voltage should be joined to the *positive* of the receiver supply.

At first sight this circuit would appear to give perfect results in retaining the DC component. In practice, however, the DC component is amplified to a lesser degree than higher frequencies. This is partly due to the bias components R1, C1, for the condenser cannot by-pass R1 at zero frequency and there is negative feed-back which reduces the stage gain to the DC component. This frequency discrimination can be avoided at the expense of stage gain by omitting C1. Feed-back will then be equally present at all frequencies.

Even if C1 is omitted, however, the DC component is amplified to a lesser degree than the AC components of the signal. This is partly because of the condenser C2, but chiefly because of the impedance of the HT supply system. At all but very low frequencies this impedance is negligible, for it consists merely of the reactance of the last smoothing condenser. For direct current the impedance consists of the resistance of the smoothing chokes, rectifier and mains transformer, while for very low frequencies there are resonance phenomena in the smoothing circuit which makes the impedance quite high at certain frequencies.

In general, these resonance phenomena are unimportant, for very low frequencies, as distinct from zero frequency, are not common in television. It is the relative amplification at zero frequency and at frequencies higher than, say, 50 c/s that is important. The precise effect of the impedance of the HT supply is rather a complicated matter and depends to some degree upon the point to which the CR tube cathode is returned. As far as the anode circuit is concerned the effect can be reduced somewhat with alternative tube connections. Even this would not remove all trouble, however, for the impedance of the HT supply would give rise to a species of negative feed-back to the screen grid.

As far as picture quality is concerned, however, these effects are of rather academic interest, for it is doubtful whether the imperfections are noticeable. In any case, they are unlikely to be any greater than with the well-known DC restoration circuit. The main advantage of the arrangement of Fig. 1 is that it is cheaper than DC restoring, because a diode is saved. The fewer components used also means a reduction in the stray circuit capacities and a consequent increase in VF gain for the same picture quality.

One word of warning should be given with regard to this circuit. If for any reason the VF valve fails to pass anode current, but the receiver HT supply is maintained, the grid of the CR tube will become positive with respect to its cathode —a condition highly detrimental to the life of a CR tube. Such a state will occur if the VF valve fails, or is driven beyond current cut-off by a strong signal. When the circuit is used, therefore, care must be taken to see that the anode current never fails to flow.

This case is a drawback in experimental work, and it is then advisable in the interests of tube life to use the DC restoration circuit of Fig. 2. Here the conventional arrangement of components is used, and tube bias is still obtained from the receiver HT supply. The negative terminal of the high-voltage unit is now returned to the negative of the receiver HT supply, however. It should be emphasised that although the arrangement of Fig. 1 may be entirely suitable for use in a finished receiver, it is safer to adopt the DC restoration system of Fig. 2 for experimental work, for it is then all too easy to drive the VF valve beyond current cut-off through applying an excessive signal to it.

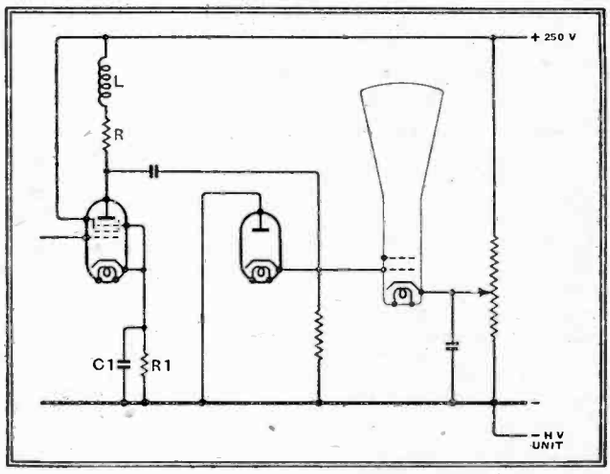


Fig. 2.—In experimental work it is often safer to adopt DC restoration as in this circuit.

AIRCRAFT WIRELESS

A Propeller Problem

IN the Lorenz system of guiding an aeroplane in fog, a machine approaching the aerodrome picks up a short-wave beam, which is modulated to port and starboard with "complementary" morse signals, such as a dot and a dash. These merge into one continuous note along the centre-line of the beam, thus charting out a course along which the machine noses its way to the landing point.

If the craft is fitted with a metal propeller, a rather curious problem arises, because, as they rotate, the blades periodically "screen" the surrounding high-frequency field, and so produce intermittent amplitude variations, which are liable to be mistaken for transmitted signals. This may confuse the pilot, either by leading him to think he is "off" the course when in fact he is on the centre line of the beam, or by giving him a false impression in other ways.

To safeguard the pilot from any such risk, the Lorenz firm propose, in Patent No. 477808, to use a considerably higher keying-frequency for the beam transmitter than is customary—say of the order of 100 cycles a second instead of 18—and to insert a band-pass filter between the RF amplifier on the aeroplane and the DF indicating instrument. The cut-off frequency of the filter is such as to suppress the "false" note produced by the propeller, though it will pass freely the modulation notes designed to give the pilot his sense of direction.

TRANSMITTER-RECEIVERS FOR GLIDERS

New German Equipment

EXPERIMENTS, with ordinary commercial apparatus, carried out some years ago on the Rhone gliding fields, were described in *The Wireless World* at the time, and showed the great advantages of wireless for gliding instruction and for soaring flight.

The German Research Institute for Soaring Flight, in Darmstadt, now publishes details of the special apparatus which it has developed for use in gliders and sail-planes. Midget valves were adapted for this purpose, and the weight of the short-wave transmitter-receiver is but 3¾ lb. The total weight with batteries is 9¼ lb.

As most gliding and sail-plane pilots do not learn morse, telephony was necessary, and no provision has, therefore, been made for telegraphy. Distances up to 50 miles have already been covered from ground to plane, and two-way conversation between planes remains clear up to distances of 30 miles. Two aerials are employed, a trailing wire and a dipole at the tail of the plane.

The new apparatus is invaluable for transmitting latest weather reports to long-distance flyers, and greatly helps the instructor during early training of the pilots. Formation flying also becomes much easier now that means of inter-plane communication is provided.

RADIO-TELEPHONE equipment developed in Germany for use in gliders and sail-planes. The complete equipment, which weighs only 9¼ lb., and measures but 12in. overall, is shown above with phones and midget microphone. On the left, it is being used as a ground station.

B.B.C.—PRESS AGREEMENT

No News Before 6 p.m.

THE ten-year-old agreement between the B.B.C. and the Newspaper Proprietors' Association, which, among other items, covers the broadcasting of news, is to be terminated, and the necessary three months' notice has been given by the B.B.C. According to *The Newspaper World*, the most important alteration in the new agreement, the completion of which has awaited the return of Sir John Reith from the West Indies, is that the Corporation will be free to take news from various sources, including their own correspondents, instead of being limited, as at present, to the services of the four agencies whose names are announced at the commencement of news bulletins. This change is in accordance with the recommendation of the Ullswater Committee's Report of 1935.

The Newspaper World categorically denies the rumour that the new agreement will permit the B.B.C. to broadcast news bulletins before 6 o'clock in the evening.

24 HOURS-A-DAY PROGRAMMES

STATISTICS just published show that the German Short-Wave Station very nearly reaches maximum possible programme time by broadcasting for 23 hours and 45 minutes a day. As many as six programmes are sometimes broadcast simultaneously on different wavelengths; if these were added together the Short-Wave Station's programme time would reach 100 hours a day. On the medium waves, Germany's thirteen stations and relays transmit on an average 16 hours a day.

NEWS OF

THE B.B.C. IN 1937

Governors' Report

THE eleventh annual report of the Governors of the B.B.C. to the Postmaster-General was issued last week, and is obtainable from His Majesty's Stationery Office, price 6d.

To quote from the closing paragraph, the Governors state that "Experience . . . has shown that the 75 per cent. (the B.B.C.'s portion of the net licence receipts) is required for sound broadcasting alone if the present standard is to be maintained." It is interesting, however, to note from the revenue account which is appended to the Report, that only 51.54 per cent. of the total income of £3,356,074 was expended on actual programmes (including programme staff salaries).

In the section devoted to television the Governors state that "Financial uncertainty complicated the framing of new plans; but this was relieved towards the end of the year by the Treasury's acceptance of the view that the costs involved should be met by a grant from the balance of net licence revenue retained by the Treasury."

LATE NIGHT LISTENERS

THE third interim report on the result of the B.B.C. questionnaire issued to 2,000 listeners in November shows that between 10 and 10.30 p.m. on weekdays a mass switching-off of receivers takes place. Roughly half the number of listeners at 9.30 have switched off by 10.30, and by 11 o'clock the figure has dropped to a quarter. After 11.30 there are but 3 per cent. listening. On the strength of the latter result those who suffer from insomnia because of their neighbours' nocturnal listening will hasten to ask why, if there are so few listeners at 11.30, cannot the transmitters close down at that hour?

These figures do not apply to Saturdays, when nearly 80 per cent. are still listening at 10.30, and even after 11.30 the number remains at about 17 per cent.

STILL MORE POWER

DURING last week, the German Press gave prominence to quotations from papers of Alsace and Lorraine complaining of the policy adopted in Strasbourg's German language news bulletins, which are also radiated from Lyons-la-Doua in the late evening. These bulletins often contain information which is withheld from listeners and newspapers in Germany, and which is officially termed incorrect or exaggerated by German officials.

Rumours regarding the erection of a super-power broadcasting station at Mühlacker to counteract the effects of Strasbourg, would appear to be substantiated in view of this Press campaign, although official information of this is lacking.

It is also rumoured that the new German long-wave station, the erection of which was announced at the Lucerne Conference in 1933, and which is supposed to have been under construction since the end of 1935, will shortly be completed. Here again there is official silence, but reports that the transmitter will have an aerial power of 300 kW have not been officially denied.

PORTABLE SHORT-WAVE transmitter-receivers were recently tested by Ski-ing Rescue Brigades and the Swiss Army to gauge the effectiveness of wireless in the location and relief of casualties in the Swiss mountains.

THE WEEK

BROADCAST BUCCANEER

Undiscovered Clandestine Transmitter

THE activities of a German short-wave station which has defied all efforts on the part of the authorities to trace it have created a romantic subject for conjecture. Transmitting at 10 o'clock in the evening on a wavelength of 23.8 metres, it has startled the German people with anti-government propaganda, and stories of its dashes over the countryside before the advance of search parties have provided thrilling gossip. If it is a mobile transmitter it could hardly have eluded the intensive searching campaign for so long, and it is now presumed that the station must be located outside the frontiers of the Reich.

RECORDING VAN AT SEA

A B.B.C. recording squad has just had its first sea trip, picking up and "bottling" the sounds associated with the trial run of the new 25,000-ton P. & O. liner *Stratheden*, built at Vickers Armstrong's Barrow yard for the Australian service.

A total of fifty-nine wax recordings were taken, many of them under difficulties, as the weather conditions were bad, particularly on the measured-mile run. These records will be incorporated in a feature programme, "A Ship on Trial," devised by Richard North for the Regional programmes next Monday and Wednesday, March 7th and 9th.

The van came ashore at Greenock, none the worse for its pioneer sea trip. The officials are now wondering whether a 'plane trip could be recorded in more or less the same way, the sounds being transmitted by ultra-short-waves to the van on the ground.

TELEVISING THE BOAT RACE

THE finish of the Oxford and Cambridge Boat Race on April 2nd will be televised from the Middlesex bank at Mortlake, one camera, fitted with telephoto lenses, being installed beside the winning post. Two other cameras will be operated in the enclosures of the Quintin and Ibis Rowing Clubs respectively to show close-ups as the crews bring in their boats. During the first part of the race viewers will be able to follow the progress of the boats on an animated chart which will be thrown on the screen.

The commentary given for National listeners will accompany the television broadcast until the finish at Mortlake, when a special television commentary will be given by Howard Marshall.

STAFF TALENT HUNT

A NEW B.B.C. regime for promotion from the ranks is suggested by the latest decision that staff on a weekly wage shall be admitted in limited numbers to the Staff Training School.

This means that clerks, messengers and secretaries will be escorted to Droitwich, Daventry, the London Television station, and other places of technical interest to receive general instruction in the whole technique of broadcasting. It is believed that the scheme will reveal much hidden talent.

It is emphasised that a course at the College does not guarantee promotion, but the inference is that those lucky enough to be chosen as pupils will be earmarked for better jobs; otherwise the work of the instructors would have been largely wasted.

WHERE SHORT-WAVE SETS ARE "INDISPENSABLE"

THE B.B.C.'s Empire Department works in the dark to a greater extent than the home service, as its contact with listeners must necessarily be less intimate. Sometimes, however, the hard-worked officials are rewarded with a sincere tribute from the other side of the world such as the following, which appeared in a recent issue of *The Broadcaster*, Perth, Australia, when discussing the recent changes in Daventry's schedule: "It is obvious . . . that the very able people who run the B.B.C. have the interests of all Empire listeners very much at heart. Once again we have to thank Daventry for its progressive spirit and for the rich variety of Empire programmes; programmes which make a short-wave set an almost indispensable adjunct to every up-to-date Westralian home."

TELEVISION RECORDS AT LOS ANGELES?

"LIVE" television begins at Los Angeles within the next month, the Don Lee Broadcasting System having been licensed to transmit daily from its television station, W6XAO. If extreme optimism can guarantee success, W6XAO should break world records, for Mr. Harry R. Lubche, the station television director, predicts a range of forty-five miles with an aerial power of one kilowatt. (The London television station has a peak output of 17 kilowatts.) According to the *Hollywood Reporter*, Mr. Lubche believes that there are more than 100 television receivers in Los Angeles. More than 3,000 requests have been received for instructions on how to build a television set.

AMERICAN RADIO INDUSTRY

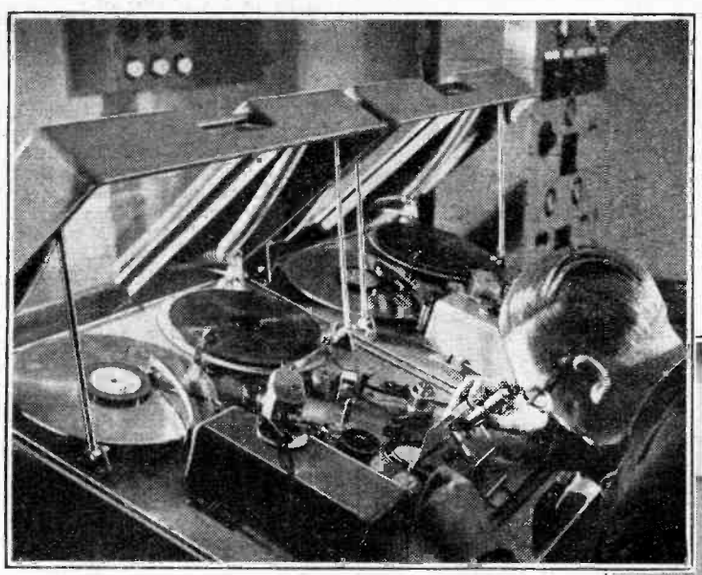
INTERESTING figures of wireless sales in U.S.A. during the past year are given by our American contemporary, *Radio Retailing*.

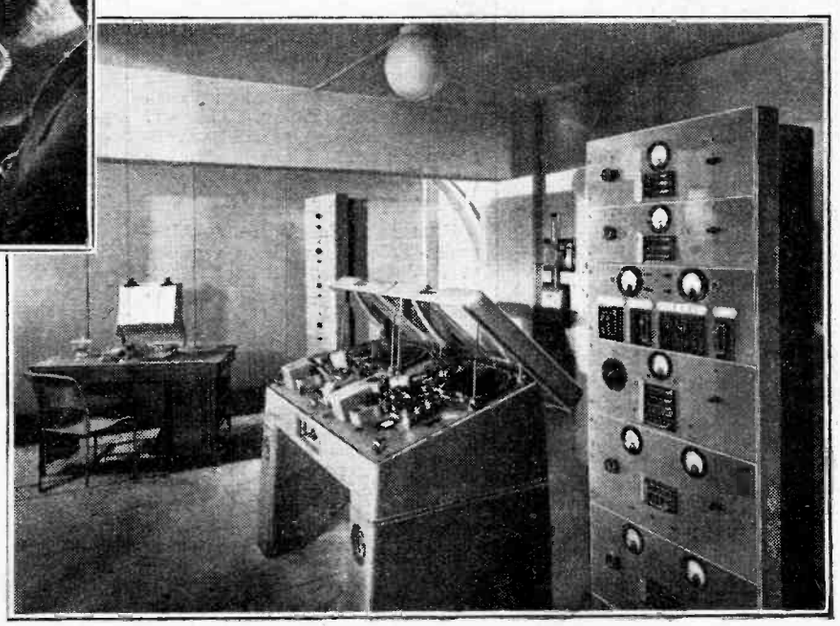
Nearly every section shows a decline in business in 1937 over 1936. The number of receivers retailed was 6,300,000 against 6,750,000, and their value 350,000,000 dollars against 395,000,000 dollars. Although all-wave sets are said to predominate in U.S.A., 33 per cent. of those sold did not fall into this class.

Valve sales reached 103,000,000, yet in spite of all these astronomical figures, only 13 of America's 48 States are within 90 per cent. of saturation point.

R.E. REUNION

OVER a hundred members attended the fifth annual reunion dinner of the R.E. Wireless Signals (1914-1919) Associa-





B.B.C. RECORDS. Philips-Miller recording apparatus is installed at the B.B.C. Maida Vale Studios. The general view shows the double turntable recording and reproducing machine, with its amplifiers in the foreground and on the left the editing desk. The engineer, seen above, is microscopically examining the film sound-track.

News of the Week

tion held in Birmingham on Saturday, February 19th. Colonel A. Handley presided, and the occasion once more provided the opportunity for old comrades to meet.

It has been suggested that the next reunion dinner should be held in Worcester, the former headquarters.

It is hoped that any R.E. Wireless veterans who are not already members of the Association will get in touch with the Hon. Secretary, Mr. C. R. Johnson, 288, St. Paul's Road, Smethwick, Staffs.

FROM ALL QUARTERS

For Empire Day

NEW ZEALAND broadcasting officials are now busily recording a feature programme which will shortly be shipped to England for transmission from the B.B.C. stations on Empire Day, May 24.

More Transatlantic Relays

AMERICA aims at providing more Transatlantic relays to foreign countries during 1938. At least 500 C.B.S. programmes will have international appeal, according to Mr. William S. Paley, President of the Columbia Broadcasting System, and more than thirty countries have been approached.

Bee't It !

LISTENERS to a network of American stations were recently horrified when the programme was interrupted by wild cries and an ominous buzzing followed by prolonged silence. What had happened? A family of bees who had been signed up by the authorities escaped from their box and filled the studio. Only ignoble flight saved the occupants.

American U.I.R.

IT has been decided, as a result of the first Inter-American Conference held in Havana at the end of last year, to open an Inter-American Radio-Communications office, which will be a similar organisation to the U.I.R. at Geneva. It will be stationed at Havana under the control of the Cuban Government. The erection of checking stations in various parts of America is contemplated by this organisation, the budgeted annual expenditure of which is $25,000.

New Austrian Station

CLOSE to the medium-wave 100-kW Vienna transmitter on the Bisamberg Mountain a site has been acquired for the erection of a new short-wave station, the power of which will be at least 50 kW.

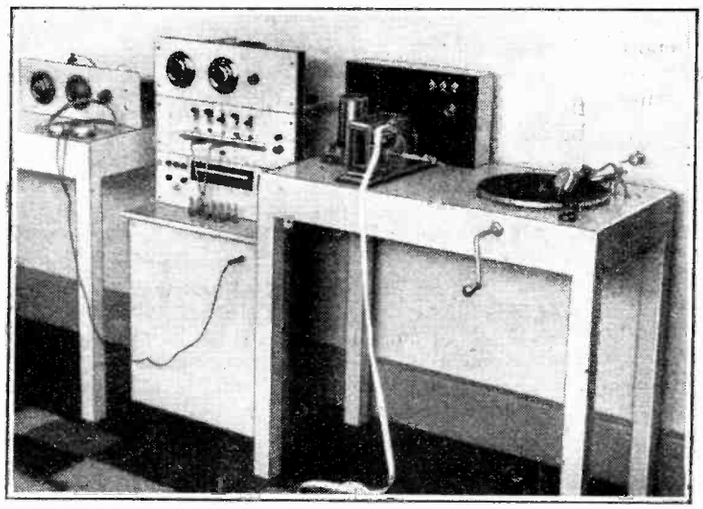
Bombay's New Station

Two of the ten proposed transmitters in the programme of All-India Radio have been in use for some time. They are the Philips 10-kW short-wave station, VUD, at Delhi and the Marconi 5-kW medium-wave station, VUL, at Lahore. Recently the Governor of Bombay, His Excellency Sir Roger Lumley, inaugurated the new 10-kW station at Bombay. This station, the call sign of which is VUD, will transmit on 90.8 metres after dark and on 49.3 metres during daylight.

The daylight wavelength of Delhi was given as 49.3 metres in last week's issue, but this should have been 31.3 metres.

Persia in the Short-Wave Market

CONSTRUCTION of a short-wave station of about 30 kW has been commenced at Teheran, the capital of Iran, by the firm Telefunken. Aerial installation will be directional on N. America and Australia, but the transmissions will be primarily directed towards Europe.



AMATEUR TATSFIELD STATION. Mr. C. H. Bulman of Higher Sutton, near Macclesfield, Cheshire, is building an amateur station in the open country and equipping it for the express purpose of assisting amateurs throughout the country by sending them detailed reports of reception. The station, which will cover all amateur and commercial frequencies, will be completed by the autumn, and its equipment will include telegraphy and disc recorders and frequency measuring apparatus.

Afraid of Television

IT is almost certain that the B.B.C. application for permission to televise the Cup Final, will be rejected by the Football Association Final Tie Committee, when the question is considered at its next meeting.

Popularising Television-Telephones

A SPECIAL television-telephone booth has been erected in one of the halls used for the Berlin Motor Show for communication with Leipzig and Nürnberg. This will be left in position and will be available for all exhibitions held in the same hall.

Television in Hastings

RELIABLE signals from Alexandra Palace have been received at Hydneye House School, Hastings, on a year-old Baird television set.

School Wireless

NEW schools are entitled to a grant from the Board of Education for wireless equipment, and the Durham County Education Committee has decided to avail itself of this provision in its new projects.

Eliminating Extraneous Noise

PROGRAMMES printed on thin sheets of cork to prevent rustling were distributed to an audience of 1,400 people in the New York studios of the National Broadcasting Company of America during a Toscanini symphony concert in January. To cut down extraneous noises, the engineers are also experimenting with microphone scripts composed of thick porous paper and also of artificial silk.

Canadian Arabs are Listening

THE B.B.C.'s Arab broadcasts are meeting with success in unexpected quarters. The Corporation has just learnt that the programmes are in demand by an Arab colony in Calgary, Alberta. Apparently the news bulletins make an enjoyable accompaniment to lunch.

Propaganda

SIR JOHN SIMON stated in the House of Commons that the suggestion of compiling a White Paper publishing examples of anti-British wireless propaganda had been rejected owing to the attendant difficulties of time and expense.

Police Wireless

FLYING-SQUAD cars in Hove have recently been fitted with wireless; they receive their instructions from the police transmitter GTN on the roof of the Town Hall, Brighton.

Horseback Wireless

MOUNTED police in Lancashire have been equipped with 6 lb. transmitter-receivers which have a service area of five miles.

An Indispensable Adjunct

A DECLARATION that the daily use of a wireless set is a necessity to a man of this twentieth century has just been made in a judgment of the Budapest Court of First Instance in a case concerning the seizure of a wireless set for debt. The Court found that a wireless set cannot be legally seized, as it is an indispensable adjunct in every home. No one, added the magistrate, ought to be hindered from participating in broadcasting development.

Press v. Radio

ACCORDING to an article in the *Eclaireur de Nice*, it would seem that the French Press is weakening in its efforts to impose limitations on broadcast news from State stations. The article asserts that radio is useful to the newspapers by sharpening the appetite of the public for more details in print.

Marconi Medal

THE wireless engineer of the Byrd Antarctic Expedition, Lieutenant Carl O. Petersen, was presented with the Marconi Medal at the Veteran Wireless Operators' Dinner in New York.

Broadcast Morse Lessons

THE biggest difficulty when learning morse is to get somebody to send a message for the learner to read. This difficulty does not arise in Czechoslovakia, where the broadcasting organisation has just completed a six months' course in broadcast lessons in the morse code.

Rural Broadcasting

THE Government of India has sanctioned Rs.100,000 to finance a three-year plan of rural broadcasting in Delhi Province. For the purpose of the scheme the Delhi Province is divided into five zones each with 25, of the specially designed, rural broadcast sets installed. Villages having at least 600 inhabitants will be chosen for installation of the sets. Each zone will be in the charge of a supervisor, who will be responsible for the maintenance of the sets.

Japan Tells the World

DRASTIC enlargement of its world broadcasting plans is promised by the Japanese Broadcasting Corporation. In the meantime there are four sets of transmissions on 25.42 metres, the zones served being Europe, Eastern Districts of America, Canada and U.S. Pacific Coast, and the South Seas and Straits Settlements.

The European and Eastern America services are sometimes transmitted on 31.46 metres.

Paris Wants a Broadcasting House

THE PTT Radio Pavilion of the 1937 Paris Exhibition is being demolished. Until a few days ago it had been suggested that the building might house a new television service. Its demolition has reminded the French Press to once again agitate for a Paris Broadcasting House to bring the scattered branches of broadcasting together

"Handley's Pages"

THIS is the title given to the reminiscences of Tommy Handley, the well-known stage and radio comedian. The book is written in that easy style which has made the author so popular as a radio artiste, and includes many amusing sidelights on his rise to fame. It has 157 pp. and 10 illustrations, and is published by Stanley Paul and Co., of Paternoster House, London, E.C.4 at 3s. 6d.

UNBIASED

By

FREE GRID

Memories of Vine Street

A RECENT item of news concerning an inmate of the Tegel prison at Berlin who was hauled up before the Bench for illegally operating a wireless set in prison has reminded me of a somewhat similar incident in my young days. In the Berlin case the prisoner had smuggled headphones into his cell, and, so the report said, was able to hear programmes without any other wireless apparatus owing to the high power of the Berlin transmitter, which practically adjoins the prison.

Even granting the high power and proximity of the station, I myself greatly doubt if signals could be heard without a rectifier, and I expect that if the prison authorities had been a little more technically minded they would have investigated further and found that the prisoner wore a denture having one of the well-known "permanent" crystal detectors mounted in one of the teeth, an old dodge well known to prison officials in America, where people take radio reception really seriously.

In my case the incident that has been recalled to memory dates back more years than I care to remember, namely, to 1912, when, as some of my older readers may recollect, both boats sank on the occasion of the University Boat Race. Owing to the umpire ruling that the race was to be rerowed on the following Monday the crews were unjustly prevented from taking part in the customary rejoicings on Boat Race Night, and, consequently, a few others, including myself, were appointed to deputise for them in this respect.

Being a believer in the old and now, alas! discredited maxim that what is worth doing at all is worth doing well we made very careful preparations.

Consequently, when we found ourselves in the harsh confines of Vine Street we did not

. . . listening to the Eiffel Tower time signals . . .

lack the entertainment of our hobby of listening to the Eiffel Tower time signals, for, in spite of the rigorous search to which, as nowadays, they subject prisoners before incarcerating them, we were able to smuggle by a complete wireless receiving set, headphones and all.

The scheme was really quite a simple one, and there is no real reason why something of the sort should not be attempted by our modern counterparts. We merely equipped ourselves with deaf-aid outfits, which were almost as readily obtainable in 1912 as they are to-day except that in those days, as there were no valves, the apparatus employed a very simple type of "microphone" amplifier. Naturally, these were passed by the authorities, as they would no more have dreamt of confiscating them than they would of taking away a prisoner's spectacles. As for an aerial, in these degenerate days prisoners, with their luxurious spring mattresses, are in clover, and no longer have to rely on the relatively small energy pick-up of the window bars as we pioneers did. I can strongly recommend the scheme, and shall be interested to hear of any of you who have successfully utilised it in modernised form.

Machiavelli a Back Number

THE suggestion has often been made in this journal and elsewhere that the B.B.C. should start showing us what real high fidelity is like by relaying the ordinary programmes on the ultra-short waves from the roof of Broadcasting House. The B.B.C.'s usual excuse for not doing it is that Broadcasting House is not a suitable site for the successful propagation of ultra-short waves, and strangely enough unlike some of their excuses there seems to be good evidence to support this one.

However, with the exception of its brief periods of television programmes each day, the Alexandra Palace sound transmitter is quite free to relay the ordinary programmes by means of a concentric cable link from Broadcasting House. I have, in fact, myself suggested this more than once to an official of the B.B.C., but in every case have received such feeble excuses that I have long suspected that there was some dark and subtle reason against it, and by pure chance I believe I stumbled across it only the other evening.

It so happened that I was on my way to Liverpool Street station en route for Southend, where I had an important engagement, and for some reason or other I lost my way, and chancing to find myself outside the local tavern I naturally

. . . he disclosed a plan . . .

popped inside to seek directions. I immediately spotted a broken-down ex-B.B.C. announcer who had been flung out of Broadcasting House for inadvertently forgetting his synthetic Oxford accent in a moment of anger and slipping into his native Cambridge dialect.

It need hardly be said that I lost no time in endeavouring to extract from him some details of the mysterious and esoteric underworld of Portland Place. Among the things he told me, some of which I could not, of course, possibly repeat, was the reason why the B.B.C. do not adopt this suggestion of relaying the ordinary programmes on ultra-short waves either from the Alexandra Palace, or from a transmitter at Broadcasting House, but in addition to this he disclosed a plan which, in its ingenuity, is fully worthy of Machiavelli himself.

My newly found acquaintance stated, quite rightly, that whereas nowadays the man who listens to the television sound programme cannot hear it on any other wavelength, things would be quite different if the ordinary programmes were relayed because listeners would be able, by the flick of a switch, to make a rapid comparison between the quality of reproduction of the same programme transmitted on ultra-short waves and on ordinary wavelengths. Furthermore, he alleged that the superiority of the ultra-short wave version would be so marked if this comparison were carried out that listeners would no longer tolerate programmes on ordinary wavelengths, and there would arise a great clamour for the erection of ultra-short wave transmitters all over the country. All the B.B.C. stations would, in effect, become obsolete in one night.

But it is at this juncture that the great diplomatic gifts of those in charge of affairs at Broadcasting House comes in, for my companion told me, under vow of secrecy, that plans are being made for the experimental relaying of the ordinary programmes on ultra-short waves, but with a deliberately restricted frequency band so that listeners will say that there is nothing in this so-called ultra-short wave fidelity after all, and the B.B.C.'s bacon and also their obsolete stations will be saved.

Random Radiations

By "DIALLIST"

The Radio Exhibition

THIS year's Exhibition dates, Wednesday, August 24th to Saturday, September 3rd, are almost the same as last year's, when Radiolympia opened on August 25th and closed on September 4th. I must say I am rather surprised that the organisers of the Exhibition still cling so firmly to an August opening date, particularly in view of last year's falling off in attendance. In many ways August is one of the least desirable months for an exhibition of this kind. Heaps of people are away for their holidays, and those who aren't are inclined to seek outdoor rather than indoor attractions. Of late years, too, August has tended to become the month of heat waves, and Olympia, with several thousand people inside its doors isn't exactly the coolest spot in the world. Another objection to August is that it hardly gives manufacturers time in anything like a boom year to get their wares into full production before the big demand comes in November and December.

Preliminary Canters

What has frequently happened in the past is that this firm or that, having evolved a new model and not feeling quite sure whether it will catch on, has decided to test the feeling of the public by making up just a few of these particular sets and showing them at the Exhibition. If they don't then find favour they can just be dropped; but if they do, much high pressure work may be needed ere production can be started and maintained. Personally, I should like to see not one but two radio exhibitions. The first, in May or June, would be designed to cater for those interested in the technical side of wireless and for radio dealers. In October would come the second exhibition, completely untechnical and as much of a fun fair as you like, intended for the man in the street and his wife and family. The first show would enable manufacturers to gauge the probable success or otherwise of projected models; at the second the models actually in production would be shown.

Sham-Omatic Tuning

IT'S good to see that *The Wireless Trader* has taken a strong line over some of the cheaper press-button receivers that are making their appearance on the market. In a leading article it divides button-tuned sets into three classes: Automatic, semi-automatic and sham-omatic. Wireless manufacturers as a body have a curious fondness for hitting themselves hefty blows below the belt. Once let the public form an idea from the performances of cheap press-button sets that *all* press-button sets are finicky and unreliable things, requiring constant adjustment, and the success of this new kind of receiver which has so much to recommend it may be seriously prejudiced. Something of the kind happened, if you remember, soon after the "all-wave" set had appeared in this country. There was a flood of cheap "all-wave" sets of the "thrown-together" kind and any amount of people became convinced, after experiences with them, that tuning on the short waves was much too fiddling a business and that anyhow there wasn't much worth hearing.

A Golden Opportunity

In the press-button set there was a magnificent opportunity of educating the public up to the better receiving set. I don't mean that press-button systems should have been applied only to sets costing £20 or more—you can market perfectly good fully automatic receivers for less than £20. But I do think that it is folly to try to apply the new system of tuning in clumsy or makeshift forms to low-priced sets, which are naturally without such features essential for satisfactory working as automatic frequency control. A good automatic press-button set is a most fascinating thing to use; the cheap sham-omatic receiver will acquire adjectives of its own, but I don't think that fascinating will be one of them.

A Way They Have in Switzerland

WHEN I lived in Switzerland some years ago I was much impressed by the efficiency and thoroughness of the administration of that small country. You couldn't, for example, obtain a licence to drive a car or even a motor cycle until you had passed a practical test proving (a) that you were capable of driving safely, and (b) that you could deal with any minor breakdown. The Swiss have dealt with the problem of wireless servicing in a similarly enlightened manner. If you want to sell wireless sets over there you must first obtain a Government licence to do so. And you can't get that licence without proving, by passing a comprehensive test, that you know a good deal about the theoretical and the practical side of wireless, that you can locate the trouble when a receiving set goes out of action, that you can use testing instruments as they should be used and that you can effect all reasonable repairs. That seems to me a pretty sound scheme from every point of view. Would that we had something of the kind here. The good service-man would welcome it, for he would pass with flying colours and have a certificate to show. The bungler would fail and be automatically barred from further bungling.

What a Difference!

Our service-men are steadily improving, but there are still far too many about who should really be called disservice men. I was in the service department of one manufacturing firm a while ago and a set was

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, MARCH 3rd.

Nat., 7.20, The London Film Symphony Orchestra. 8, Variety from the Holborn Empire. 9.20, "Rhythm Express," with Benny Frankel and his Orchestra.

Reg., 7.30, Horner's Corners; another Canadian village episode. 7.55, "Beware of the Gods": a sea fantasy. 8.35, History of the Comic Song.

Abroad.

Rome I, 8, "La Bohème": opera (Puccini).

Brussels II, 8, "Tosca": opera (Puccini).

FRIDAY, MARCH 4th.

Nat., 8, "Eight Bells": the first of a series of visits to the Empire's Naval Stations. 9.20, Discussion on Efficiency and Liberty in Great Britain. 9.50, B.B.C. Concert of Contemporary Music.

Reg., 7.30, Eugene Pini and his Orchestra. 8, Discussion on Control of the Growth of Towns and Industries. 9.10, Peter Yorke and his Orchestra.

Abroad.

Prague, 6.30, "Christopher Columbus": opera (Milhaud).

Vienna, 6.35, "The St. Matthew Passion." Mengelberg conducting Vienna Symphony Orchestra.

SATURDAY, MARCH 5th.

Nat., 8, Palace of Varieties. 9.20, American Commentary. 10.15, Dramatic readings from Victor Hugo.

Reg., 6, "What it is to be Young": a comedy. 7.30, Leicester Brass Band Festival.

Abroad.

Vienna, 6.10, "The Geisha": light opera (Jones).

Bordeaux-Lafayette, 8.30, "The Golden Cockerel": opera (Rimski-Korsakov).

SUNDAY, MARCH 6th.

Nat., 6, The Fortnight's Films. 7.15, Edwin Fischer, pianoforte.

Reg., 5, Transatlantic Spelling Bee. 6.40, All about the incomparable Cheeses of England. 9.5, Sunday Orchestral Concert—XXI, conducted by Sir Henry Wood.

Abroad.

Berlin, 7, "Faust": opera (Gounod).

Strasbourg, 8.30, "Lilac Time"; operetta (Schubert).

MONDAY, MARCH 7th.

Nat., 7, "Monday at Seven." 8, Talk on Running a Cinema. 9.20, World Affairs.

Reg., 6.30, Swift Serenade. 7.30, A Ship on Trial—recorded on board P. and O liner *Stratheden* during her trials. 8, Eddie Carroll and his Band. 9.25, Strange to Relate.

Abroad.

Leipzig, 7, Leipzig Symphony Orchestra, conducted by Weisbach.

Brussels I, 9, "A Musical Trip through the Walloon Country."

TUESDAY, MARCH 8th.

Nat., 6.25, Cuban Cabaret. 7.30, Talk by Sir Richard Livingstone on the Meaning of Civilisation. 9.20, America Speaks. 9.40, Ice Hockey Commentary.

Reg., 7.55, "Lucia di Lammermoor," Act I of Donizetti's opera from La Scala. 8.40, The Microphone at Large with S. P. B. Mais.

Abroad.

Stuttgart, 8, Concert from Heidelberg.

Paris PTT, 8.30, "The School for Husbands": comic opera.

WEDNESDAY, MARCH 9th.

Nat., 6.40, From the London Theatre. 7, Band Waggon. 8 & 9.20, The B.B.C. Symphony Orchestra conducted by Sir Adrian Boult, from Nottingham.

Reg., 7.30, The World Goes By. 8, Dance Music relayed from Hawaii. 9, Northern Music Hall. 9.30, "Three Tools of Death," a Father Brown mystery by G. K. Chesterton.

Abroad.

Bucharest, 6.35, From the Royal Romanian opera.

brought in which had been sent all the way down from Scotland because the local man could not discover what was wrong with it. For some reason I asked if it could be run over whilst I was there. The work was put in hand and it didn't take many minutes to locate *that* fault. Just a broken loudspeaker lead, that was all. I could mention scores of instances of equally futile doings on the part of those who style themselves experts, and so, no doubt, could many readers.

Nobody Pleased

The worst of this kind of thing is that it creates no small amount of ill feeling. Take a typical case. A couple of months after he has bought a new wireless set a man finds that it is not working as it should. He may call in the dealer right away or he may write to the makers. But if he takes the latter course the makers will nearly always tell him that the dealer from whom he bought the set is the man who should be consulted. To the latter's hands, then, the set returns for attention. If he finds that the trouble is beyond him he returns it to the makers, who may find some trifling defect that anyone with half an eye should have spotted. And now comes the rub. The odds are that the guarantee contains a clause stipulating that if the set is returned to the works with no fault that could not have been remedied locally, a charge will be made. The customer naturally kicks because he regards the makers as responsible for their agent, to whom they referred him. He doesn't see why he should have to pay carriage both ways plus a charge for work done. A lengthy correspondence may ensue and in the end nobody is pleased.

The Voice of Southampton

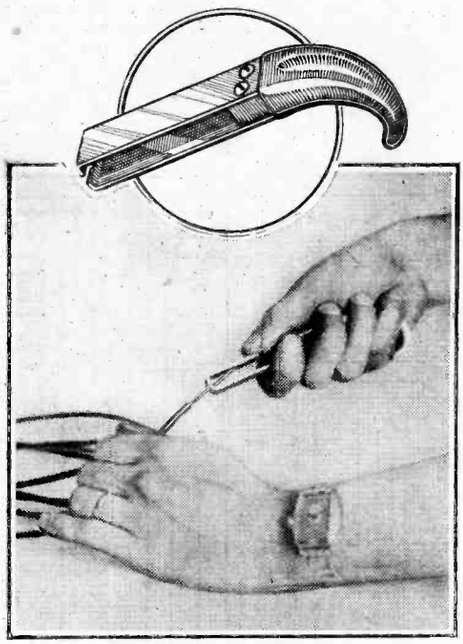
SOUTHAMPTON has rejected the Post Office relay scheme in no uncertain manner and one hopes that in view of this decision future schemes may be considerably modified. The only places, so far as one can see, where relay services are wanted are those in which the B.B.C.'s stations are unable to give a good and reliable direct service. With the modern receiving set these must be comparatively few and far between nowadays. Had the Southampton scheme gone through unopposed it might have been the thin end of the wedge. In no very long time the Post Office might have strangled, for all its good intentions, initiative, research and development in the technique of wireless reception.

A Cry from Tanganyika

FROM Tabora, in the Tanganyika Territory, come illuminating instances of the way in which some of our radio firms do their bit towards fostering overseas trade. In April last year my correspondent ordered the necessary parts for a gramophone amplifier. So many errors were made over these that it was December before the apparatus could be assembled. Also, in April, 1937, he ordered a good many pounds' worth of radio components, but not being sure of the exact cost asked for them to be sent C.O.D. This firm replied—and here one can't blame them—that they didn't send goods C.O.D. to places overseas. A cheque was sent for the amount quoted, and the receipt came to hand in July. The goods, however, had not turned up on February 3rd, when the letter to me was written. Nor have there been replies to queries, one of which was a cable. After giving some other examples, my correspondent concludes with the surprising information that some British firms use 2½d. stamps for their letters to Tanganyika, whilst others adorn the envelopes with air-mail labels and 6d. stamps!

During the Gales

IF you happened to turn to the 600-metre shipping wavelength during the recent great gales you must have realised what a vast factor for good wireless is for those who man the multitude of ships, from trawlers to great ocean liners, that are at any moment moving hither and thither over the seas. If you could read Morse you may have picked up more than one tragic SOS, with tales of steering gear broken down, flooded holds or engine trouble. Casualties there were, but thanks to wireless not a few ships which would otherwise have to fight their own grim battles with no outside aid, received the help that they had called for, with the happiest results. And how many, I wonder, were saved from disaster by the fact that though leaden skies made the finding of positions by sun or stars impossible, the radio DF stations and beacons enabled them to mark upon the chart the point at which they were.



THIS WIRE STRIPPER—or "wire skinner" as it is called in America, its country of origin—is designed so that just enough pressure to cut through the insulation may be applied without risk of damaging the wire. The groove in the back of the handle is used for straightening kinked wire.

Radio Upkeep and Repairs for Amateurs. By Alfred T. Witts, A.M.I.E.E. Third Edition. 196 pages + ix. Published by Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 5s.

THE purpose of this book is to give the reader an insight into the principles of set testing, with a view not only to the tracing of a defect, but to maintaining the receiver in good working condition. The author commences by a chapter describing the simplest testing equipment and then goes on to deal with the aerial and earth system. He then turns to the receiver and explains the use of meters and how to locate and cure the commoner defects. Battery sets are chiefly considered and mains operated is represented largely by battery sets used with an HT eliminator. All-mains receivers are not treated to any great extent. This is doubtless due to the time which has elapsed since the book first made its appearance (1933). At that time mains sets were by no means as common as they are now and the book is much more representative of practice then than of up-to-date apparatus.

It is unfortunate that in preparing this new edition the author has not made a more complete revision, for however useful the material may be when dealing with a battery set of five years or more ago, it is not nearly as helpful to anyone confronted with a breakdown in a modern AC set.

W. T. C.

Television Programmes

Vision	Sound
45 Mc/s	41.5 Mc/s

THURSDAY, MARCH 3rd.

3, "Not Really?"—Variety with Nan Kenway and Douglas Young and Elizabeth Pollock. **3.20,** British Movietonews. **3.30,** 125th edition of Picture Page.

9, Repetition of 3 p.m. programme. **9.10,** Gaumont-British News. **9.30,** 126th edition of Picture Page.

FRIDAY, MARCH 4th.

3, Irene Prador. **3.10,** Gaumont-British News. **3.20,** "Rosencrantz and Guildenstern," a play by W. S. Gilbert. **3.45,** Cartoon film. **3.50,** Preview.

9, Speaking Personally—XI, Cyril Maude. **9.10,** Jam Session: a programme of swing music. **9.25,** British Movietonews. **9.35,** "On the High Road," a play by Anton Chekhov. **9.55,** Preview.

SATURDAY, MARCH 5th.

2.45, O.B. from Kennington Oval, of Women's International Hockey—England v. Wales. **3,** Comedy Cabaret, including George Robey, Charles Heslop, and the Music Hall Boys. **3.30,** Women's International Hockey, continued.

9, Gillie Potter. **9.10,** Lina Menova in songs. **9.20,** Gaumont-British News. **9.30,** A Peplar Masque of "The Pardoner's Tale" by Chaucer.

MONDAY, MARCH 7th.

3, A Programme of Swing Music. **3.15,** Cartoon Film. **3.20,** Leonard Henry. **3.30,** British Movietonews. **3.40,** "C'est la Guerre"—an incident in the Great War, by Morland Graham.

9, Doris Hare, in impressions. **9.10,** Demonstration of garden planning by C. Tunnard and J. E. Richards. **9.25,** Gaumont-British News. **9.35,** Have you Brought your Music?—a play devised by Quinton Tod, written by Eleanor Farjeon.

TUESDAY, MARCH 8th.

3, Fashion Forecast. **3.15,** Gaumont-British News. **3.25,** Theatre Parade.

9, Speaking Personally—XII. **9.10,** Fashion Forecast. **9.25,** British Movietonews. **9.35,** Intimate Cabaret, including Joe Young and Co. and the Desardo Duo-skaters.

WEDNESDAY, MARCH 9th.

3, Richard Hearne, Lily Palmer and George Nelson in "Moving Furniture." **3.10,** Craftsmen at Work—IV. **3.20,** British Movietonews. **3.30,** "The Pardoner's Tale" (as on Saturday at 9.30 p.m.).

9, Starlight. **9.10,** Repetition of 3.10 programme. **9.20,** Gaumont-British News. **9.35,** "Have You Brought Your Music?" (as on Monday at 9.35 p.m.).

Murphy A40C

OUTSTANDING RADIO AND ACOUSTIC PERFORMANCE UNDER EFFICIENT CONTROL

IN this receiver are to be found all the qualities which have put the name of Murphy in the front rank of radio manufacturers. Originality of cabinet design, clean mechanical workmanship with ample evidence of the emphasis placed on reliability, quality of reproduction much above the standard usually accepted in mass-produced sets—all these are present in full measure as a background to the more intriguing technical refinements of automatic tuning, double superheterodyne reception on short-wave stations, AVC free from modulation distortion, efficient inter-station noise suppression and variable selectivity of a type that really works according to the book.

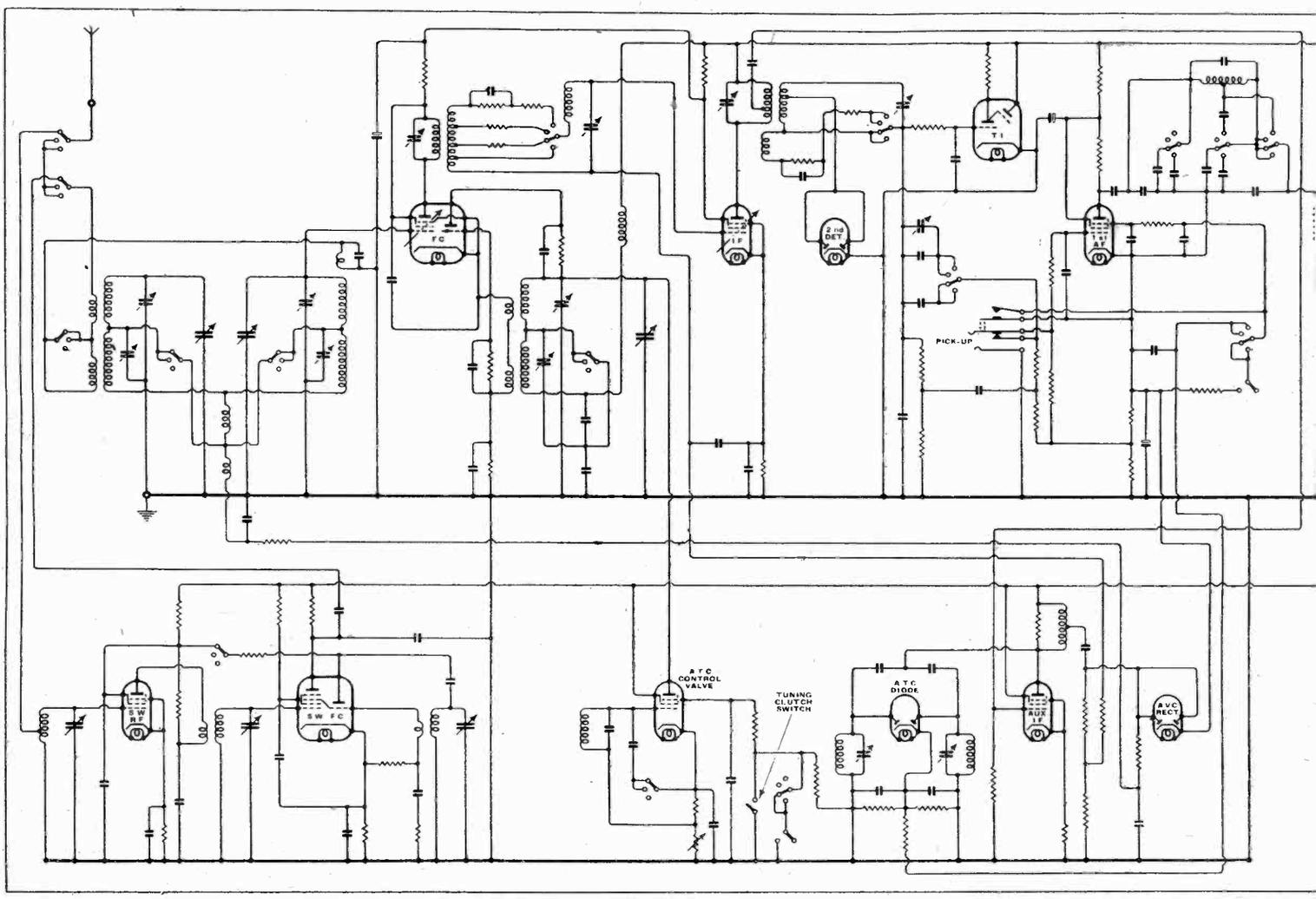
Most people will agree that quality of reproduction comes first when allocating the points that make up a figure of merit for any receiver. In the A40C special attention has been given to the acoustic aspects of the cabinet design, and a special loud speaker of unusually wide frequency range and smooth response has been developed. But the makers wisely appreciate that these are but first steps towards the achievement of usable good quality, and they have pursued the problem to its logical conclusion by designing the electrical circuits in such a way that those extraneous noises and sources of distortion which are exaggerated by a wide frequency response shall in no circumstances appear even in the hands of the non-technical listener.

The use of a separate "side chain" IF amplifier not only gives such a wide range of automatic volume control that mishandling of the manual volume control cannot produce serious overload distortion even on the local station, but it also removes that prevalent source of distortion on weak stations which is experienced when the AVC diode is fed from the same IF transformer as the signal diode.

Another point, when the receiver is adjusted to give the best possible quality of reproduction the designers insist that both the automatic tuning control and the noise suppression circuits shall be permanently in use, and contacts on the variable selectivity switch have been arranged accordingly. On the two positions of high selectivity the listener has the option of cutting out ATC and noise suppression.

Variable Selectivity Circuits

The variable selectivity control is a four-position switch giving simultaneous adjustment of the IF band width and the AF response after rectification. The first IF transformer consists of two separate iron-cored coils, each in its own screening can. A coupling coil wound over the primary is connected in series with the secondary, and tappings on this coil, in



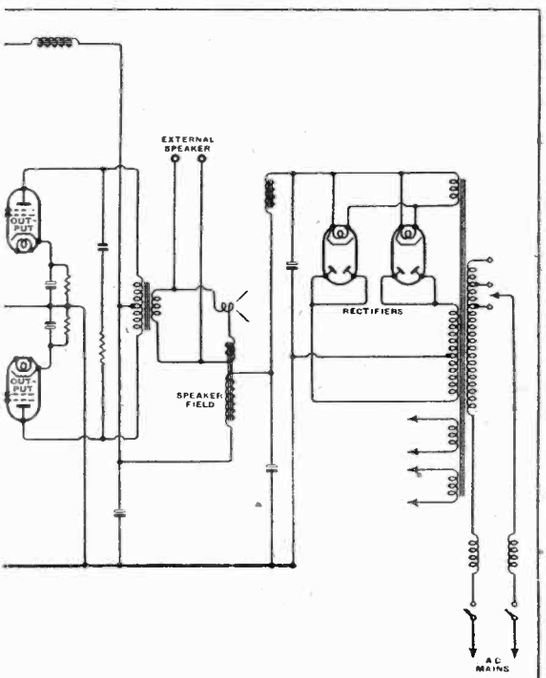
conjunction with a series condenser and resistances, are adjusted to give four symmetrical curves of different band-width. The selectivity of the second IF transformer is adjusted in two stages only, the band-width being increased by additional coupling provided by a coil wound over the primary. The increase of secondary inductance is compensated for by a series condenser and by-pass resistance.

The associated variations in audio-frequency response are effected in the following way. The main body of the rectified AF output is fed through the usual resistance-capacity filters for the removal of the IF component to the grid of the pentode first AF amplifier. An additional high-frequency boost is provided through either of two condensers connected to the top of the diode load. One of these gives a rising characteristic, and the amplified output appearing in the anode circuit of the AF valve is then controlled by a filter with a variable top cut-off.

Although the loud speaker is capable of a much wider response, the maximum frequency range in the position of highest quality is limited to 9,000 c/s, as it is found

FEATURES. ***Waveranges.—Short Waves:—****13.9—50 metres.* ***Medium Waves:—****200—550 metres.* ***Long Waves.—****900—2,000 metres.* ***Circuit.—Main Receiver:—****Triode-pentode frequency-changer—pentode IF amplifier—diode second detector—pentode first AF and noise-suppression valve—push-pull tetrode output valves.—****Short-wave Converter:—****Pentode RF amplifier—triode-hexode frequency-changer.* ***Auxiliary Services:—****Pentode IF amplifier—double-diode ATC rectifier—pentode ATC control valve—diode AVC rectifier.* ***Power Supply:—****Two valves arranged for full-wave rectification.* ***Controls.—****(1) Tuning. (2) Volume and on-off switch. (3) Waverange. (4) Short-wave tuning band selector. (5) Variable selectivity. (6) Noise suppression and ATC on-off switch.* ***Price.—****£35.* ***Makers.—****Murphy Radio Ltd., Welwyn Garden City, Herts.*

The tuning scale and electron indicator are viewed through apertures in the silvering of a bevelled mirror on the top panel.



The circuit divides itself naturally into four sections, the medium- and long-wave receiver (top left), auxiliary IF supplying AVC and ATC circuits (bottom right), short-wave converter (bottom left) and power pack (top right).

that by so doing little is lost from the quality point of view and much is gained by the elimination of the majority of heterodyne whistles between stations. In the second position the response—still level—is reduced to 7,000 c/s to take care of those heterodyne whistles due to stations working slightly off their allocated wavelengths. The third position gives a cut-off at 4,500 c/s and introduces, in conjunction with the rising input to the amplifying valve, a hump at 2,500 c/s. This has been done deliberately to give the impression of high-note response, and certainly improves the apparent quality from stations which require a drastic top cut and increased selectivity for their satisfactory reception, and which would sound dull and lifeless without the judicious over-emphasis of the treble response which remains.

The fourth position gives the highest selectivity and cuts off at 2,000 c/s.

One's first favourable impressions of the firm body of bass response, clarity in the middle and upper registers and the excellent balance under all conditions of reception, are supported by more specific tests, such as changing from music to speech and finding that there is no need for a tone control to take the boom out of male speech, good attack as shown by the reproduction of pianoforte playing.

The loud speaker which the Acoustic Section of the Murphy Laboratories has produced is approximately 12in. in diameter, and consequently has the area necessary to produce an adequate bass response. The single cone is of the curve-sided type and is a one-piece moulding of bakelised material. The magnet system has been carefully designed to avoid amplitude distortion, and special attention has been given to the suspension in order to keep the bass resonance below the audible range. The response published by the makers shows an output level within ±6 db. from 20 to 12,000 c/s.

The main dimensions of the cabinet have been governed by considerations of its function as a baffle, and in particular the depth from back to front is small compared with the other two dimensions. Consequently, the magnet of the loud speaker projects a short distance from the back, but this is no disadvantage, as it prevents the console from being pushed too close against the wall. The cabinet is exceptionally heavily stiffened from side to side by wooden struts, and the top is reinforced by an iron angle-piece under the back edge. Attached to the top of the back cover, which is well ventilated both thermally and acoustically, are two metal scoops to deflect the heat rising from the push-pull beam tetrode output valves.

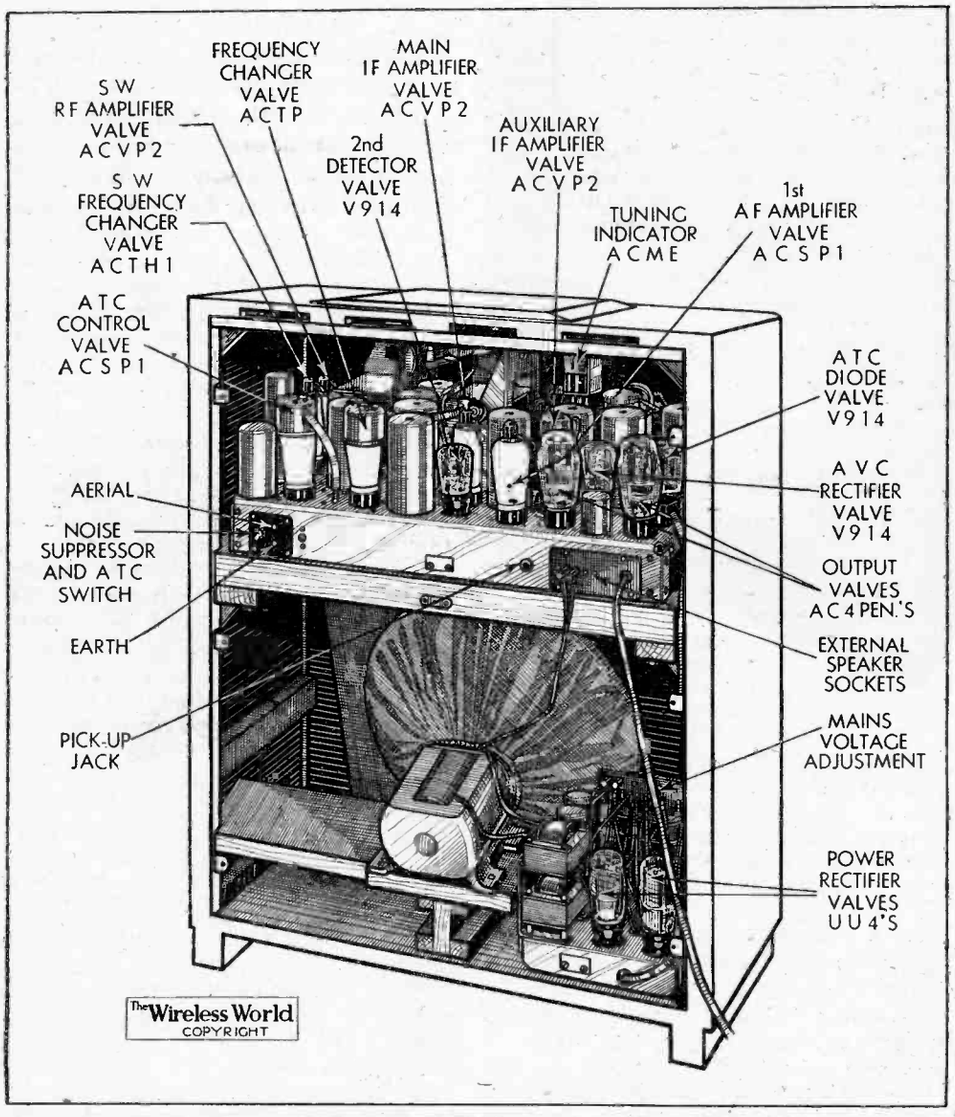
Noise Suppression

Not the least attractive feature of this receiver is the efficient noise suppression between stations—a very necessary precaution in view of the wide frequency response of the loud speaker. The method of operation is as follows. The suppressor grid of the pentode first AF amplifier, which should be normally connected to the cathode, is returned to the chassis through a chain of three resistances, one of which forms the load for one of the ATC diodes. With no signal there is no current in this resistance, and the suppressor is, therefore, at chassis potential. The cathode, on the other hand, is biased to about 16 volts positive, so that under these conditions the valve is inoperative. A signal develops a voltage on the ATC diode load, and when this is sufficient to overcome the difference between suppressor and cathode potentials the valve functions normally as an amplifier.

In general principle the automatic tuning control circuits follow those of the A28C, previously reviewed in this journal. The potential developed across the choke load in the anode of the auxiliary IF valve is applied to the ATC diodes, to which are connected discriminating circuits tuned 1½ kc/s above and below the normal

Murphy A40C—

IF of 119 kc/s. When a station is exactly in tune—that is, when the beat frequency is 119 kc/s—equal voltages are developed across both diode resistances. These voltages are in opposition, and are applied to cathode and suppressor grid of the pentode control valve. A reactance in the grid circuit is reflected in the anode



Heavy cross-bracing is provided to ensure rigidity in the cabinet. The loud speaker is of Murphy design and makes use of a bakelised curved-sided cone 12in. in diameter.

circuits, and is then used to modify the tuning of the oscillator in the main frequency-changer valve. The effective value of this reflected inductance depends upon the relative potentials of suppressor and cathode, and the circuit is so arranged that the alteration of tuning always tends to bring the IF towards 119 kc/s. Stability is reached at a frequency as close to this figure as makes no matter from the quality point of view.

In our opinion, one of the most important advantages of this receiver is that the automatic tuning control works on short as well as on medium and long waves. The use of the double superheterodyne method of short-wave reception makes this possible, and as a result there is never any trouble from progressive frequency drift.

The performance on short waves is, in fact, from every point of view outstanding, and tuning is no more critical than for medium-wave stations. The appropriate band-width is selected on an auxiliary dial provided with notches at 13, 16, 19 metres, etc. Each band is then extended to cover the whole of the main tuning range, and stations may be logged by reference to an auxiliary scale at the top of the main "alphabetical" tuning drum.

The electron tuning indicator is very sensitive on the short-wave range, and clearly shows the action of the automatic tuning circuits.

Conditions over the Atlantic were much better than usual, and really excellent programmes were obtained from W3XAD and W3XAL. Incidentally, these stations appeared at the same settings of the main dial within the limits of the automatic tuning action, and to change from one programme to the other it was only necessary to move the short-wave dial from 19- to the 16-metre notch.

With noise suppression and automatic tuning control in operation the short waves lose their character of communication channels and become effectively an extension of the broadcasting service provided on the medium and long waves.

On these ranges the performance is about as good as it can be made in the present state of the art. There are no irritating self-generated whistles, the sensitivity is high and uniform, giving much better reception of those useful stations in the vicinity of 500 metres than we have been accustomed to expect, and selectivity which is capable of losing the London Regional transmission within one channel on either side of its normal setting when using the set at a distance of 15 miles on a full-sized outdoor aerial.

On long waves an exceptional performance was obtained from the Deutschlandsender, the reception of which constitutes our usual test for the usable selectivity on this range. The automatic tuning control holds this station firmly and shows no signs of wishing to wander to the more powerful transmissions on each side. Reception from this station from the point of view of programme value is better than we remember having obtained before, and as with all other technical qualities of this receiver, it carries that hallmark of all outstanding performances in appearing to be quite effortless.

There is also a radiogramophone, the A40RG, which makes use of the same receiver chassis as that used in the A40C. It is, however, something more than a radiogramophone version of the console radio receiver, for it incorporates an acoustic system which has been developed as the result of a good deal of thought.

Through the courtesy of the makers we were enabled to judge the radio console and the radiogramophone side by side, and good as is the performance of the console, the radiogramophone distinctly shows up to advantage in orchestral and other transmissions which do not emanate from a "point source."

The spatial qualities of the radiogramophone reproduction are due in part to the employment of twin loud speakers and partly to the manner in which the frequency response of the two units has been combined. Associated with the twin loud speakers is a heavily lagged acoustic tunnel leading to the back of the set. The function of this is rather different from that of the usual acoustic labyrinth as it does not reinforce the bass by resonance. Its main function is to keep the area of the outlet from the back approximately equal in area to that of the twin diaphragms and thus to overcome the horn effect which would otherwise be present, due to the large area at the back of the cabinet as a whole.

On the gramophone side a Garrard record-changer is used with a standard piezo-electric pick-up corrected for its falling characteristic. Tone control is effected by the filter circuits associated with the selectivity control.

The radiogramophones are not being made on a mass-production basis and the price is high—£85; but many will, no doubt, agree that the quality of reproduction, particularly on the radio side, is worth the extra cost.

Letters to the Editor

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

An Alternative Programme

I HAVE been both interested and delighted to read your recent editorial on the above subject, and I may add that I heartily agree with every word in it.

I have been an enthusiastic follower of broadcasting since its early days, and a constructor since the days of the "Neutrodyne circuit"; also, I believe that I was one of the first amateurs in India to possess one of the original "sausage-shaped" screen-grid valves.

When I finally came home in 1931 I determined that "*quality*" should be my motto, but I never got anywhere near it till the introduction of your "Push-Pull Quality Amplifier." Subsequently I built your "QA Receiver,' and later still your "QA Super," both of which continue to give excellent results.

Concurrently, however—and somewhat to my own surprise—I found myself taking less and less interest in the B.B.C. programmes, until *now* I scarcely ever use the radio side of my equipment except for the News Bulletins and the Queen's Hall Concerts. Recorded music claimed me more and more for its own, so that with a Garrard turntable, a Piezo-Electric pick-up, your amplifier and a Magnavox Duode speaker, I thought I had reached perfection.

Not so, however! But at last, since adding to my circuit your "Contrast-Expansion Unit," I believe the final word *has* been said on the subject of faithful reproduction from the "disc." That is why I can support without reservation your contention that "the modern record is able to give, with a high-grade pick-up, quality of reproduction better than that available even from the local broadcast station."

This morning, for instance, I gave myself a two hours' concert, including Mozart's Symphony in G Minor, Schubert's "Unfinished," the Fourth Movement of Beethoven's "Seventh," and Brahms' First Symphony in C Minor. And so pleased was I with the quality of the last-mentioned that I decided against going to hear it this afternoon at Covent Garden!

February 13th. J. H. MOORE.
Streatham Hill, S.W.2.

Volume (Range) and Quality

WE notice in a letter by Mr. E. R. Robbins, in a recent issue, a comment that feeding a speaker designed for 15 or 20 watts with only 200 milliwatts will cause the reproduction to be "backward, leaden, and of inadequate volume."

This may have been perfectly correct in the early days when many loud speakers relied to a considerable extent on amplitude distortion for some of their effect. We would like to point out, however, that in the case of a loud speaker intended to be free from distortion, amplitude distortion should not exist, and in that case the output will be just as faithful when the input is 1 milliwatt as when it is 10 watts, the only difference being the volume level.

If Mr. Robbins cares to consider for the moment and imagine his 15-watt loud speaker dealing with the crescendo passage of a symphony orchestra, followed immediately by a pianissimo solo passage, he will realise that if the contrast is 30 db., the power in the fortissimo passage might be 15 watts, and in the pianissimo passage 15 milliwatts. If the full 15-watt level is not required (and with an efficient loud speaker this should not be necessary under domestic conditions) a turn of the volume control so that the fortissimo passage takes 1.5 watts and the pianissimo passage 1.5 milliwatts should not introduce any distortion or change other than the desired reduction in volume.

P. G. A. H. VOIGT,
Director, Voigt Patents, Ltd.
London, S.E.26.

Condenser Breakdowns

CAN any of your reader experts—manufacturers or otherwise—inform me whether it is beyond the power of manufacturers to make main condenser-packs capable of withstanding the voltage surges which occur on switching on one's set? My reason for enquiring will be clear from the following:

Being desirous of having first-class reproduction, I purchased in September, 1935, a British 15-valve AC mains radiogram. The instrument was said to be the last word in perfection.

The purchase of such an expensive instrument meant denying myself many other comforts, such as motoring, and I imagined, in my innocence, that my only maintenance costs would be for occasional valve replacements or small running repairs. The instrument was guaranteed for twelve months.

Within a few days of the expiry of the guarantee the main condenser-pack broke down and caused a direct short, blowing the house-wiring fuse. The servicing department of the firm in question replaced the condenser-pack, and charged me £1 17s. 6d. for doing so. This new condenser-pack was a little more obliging; it lasted for a further sixteen months before giving out. It was again replaced by the same service department, and this time I was charged £3 12s. 3d. for the job, including a test of the valves, all of which were found to be O.K.

I wrote to the firm, protesting against the fitting of condenser-packs with an inadequate factor of safety, and was informed in reply that ". . . our engineer's examination of the condenser did not reveal any direct evidence that its replacement was necessitated by there being an inherent fault in manufacture, but rather to it having reached the end of its normal working life." I can only interpret this somewhat cryptic utterance as meaning that the normal working life of the condensers fitted by this firm is from 12 to 16 months. If this is so, then I am afraid that I and other purchasers of this particular instrument are going to find "quality" listening a somewhat expensive entertainment. I am a discriminating listener, and use the set very sparingly. The life of these condenser-packs, therefore, measured in actual working hours has been ridiculously short.

I am not a technical expert, but I feel sure that condenser-packs *can* be made which will not break down in this fashion. May I please have opinions on this point? If robust and long-lifed condensers *can* be made, then surely one is entitled to expect

Letters to the Editor—

to get them in an instrument for which such a high price is charged.

I may say that I have no reason whatever to suppose that the electric supply pressure in this district fluctuates unduly. I have had no trouble with valves or with light bulbs, and enquiries amongst my neighbours reveal the same absence of cause for complant on this score. C. F. N. LEAHY.

London, W.4.

"Electrical Interference"

IT does seem to me that manufacturers of domestic electrical appliances might help us by producing articles which are definitely non-radio interfering. Pending legislation, which is undoubtedly overdue, much would be achieved if, for instance, makers would use induction or other similar AC motors instead of those awful racket-making universal (series commutator) contraptions. Some of the biggest offenders are electric fans, sewing machine motors, hair dryers, refrigerators and vacuum cleaners. Electric fans are fortunately readily available with AC induction motors, and recently I have been able to purchase a Giplex Hair Dryer, which I should imagine is the first hair dryer fitted with an AC induction motor. The refrigerator people also seem to be moving forward as I noticed at an exhibition a little while back that quite a number of machines incorporated AC motors. There seems, however, a lot to be done before a decent vacuum cleaner becomes available—and similar remarks apply to sewing machine motors. I know that some kind friends will be anxious to point out that commutator motors can be suppressed to a fair extent, but I do not consider this at all the right way to go about the job. Surely the only correct method is to generate *no* interference and then no palliatives are required. In other words, make and use induction type motors whenever they can be used, and only employ commutator types where it is absolutely impossible to use induction. Incidently, properly designed AC motors for small jobs are often cheaper than commutator motors.

Who is going to be the first to produce a vacuum cleaner with an induction type motor? T. L. FRANKLIN.

Broxbourne.

Scottish National

I FEEL that remarks on the reception of the B.B.C. programmes in Dundee and district call for some comment, as the case has hardly been fully stated.

The difficulties of reception on Scottish National wavelength are due partly to faults in synchronisation, but a great deal of the trouble is caused by the fact that signal strengths of both Scottish National and Daventry are inadequate, particularly for reception in the city itself.

In Dundee the staple industries, which are scattered throughout the city, use mostly electrically driven machinery, and the noise level of electrical interference is high. The result of this state of affairs is that the long-wave station is received on ordinary aerials with a background of interference which completely spoils reception, and this can only be cured by the erection of a good anti-static aerial equipment in conjunction with mains suppressors.

Unfortunately, even with anti-static aerial equipment, although reception is greatly improved, after nightfall fading often occurs on both Scottish National and Daventry wavelengths, which makes reception very unsatisfactory.

Although there are a large number of poor aerial installations in the district many listeners have gone to a great deal of trouble and expense to improve their equipments, and it is very disappointing for these people to have to tolerate conditions of signal strengths and reception as they are at present. WAC.

Dundee.

New Apparatus Reviewed

Recent Products of the Manufacturers

MULTIPLIER UNITS FOR MAKING A UNIVERSAL TEST METER

THE main difficulty usually encountered when constructing a multi-range test meter is the correct adjustment of the various shunt and series resistances. In order to simplify this work L. A. MacLachlan, Balvaig, Strathyre, Perthshire, has introduced a series of units consisting of accurately adjusted resistances which can be connected, by suitable switching, to an existing milliammeter and thus convert it into a universal testing meter.

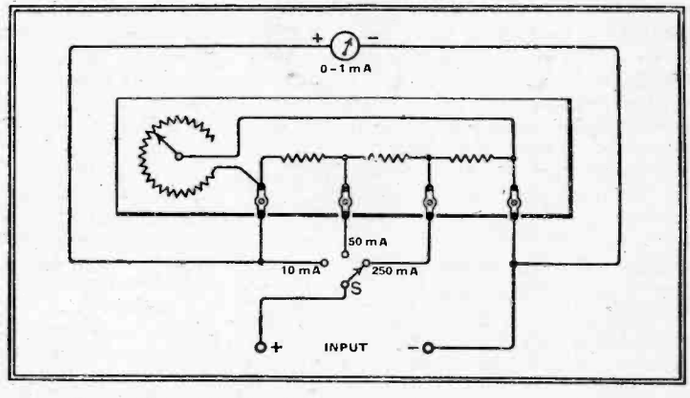
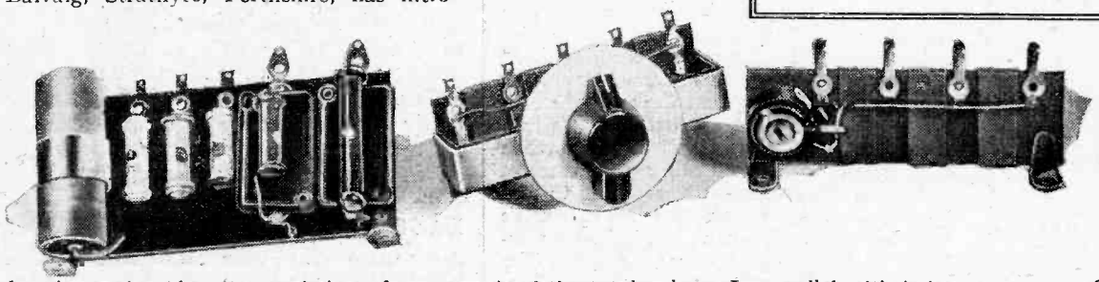


Fig. 1.—Method of connecting MacLachlan No. 1 Shunt to convert a milliameter into a three-range instrument.



Current shunts and voltage multipliers made by MacLachlan for the assembly of a multi-range test meter.

The No. 1 Adjustable Universal Shunt consists of a strip of insulating material on which is wound a resistance tapped at $\frac{1}{5}$ and $\frac{1}{25}$ of the total value. In parallel with it is a variable resistance, the purpose of which is to fix the actual shunt resistance needed for the required full-scale reading on the meter at the lowest current range.

The simplest method of connecting this shunt to a meter is shown diagrammatically in Fig. 1.

For our tests a Ferranti 0-1 milliammeter was used and by means of the variable resistance the lowest range was adjusted to read 0-10 mA. The two other ranges available then gave full-scale readings of 0-25 mA and 0-250 mA respectively. The accuracy was of as high a order as is usually obtained with most general-purpose multi-range instruments. Any three combinations bearing the same multiplication ratios, i.e., 1, 5 and 25, can be chosen, such as, for example, 0-3, 0-15 and 0-75 mA, or 0-5, 0-25 and 0-125 mA.

The No. 2 shunt is similar in principle, but provides four ranges with ratios of 1, 5, 25 and 50 respectively. This has a centrally-mounted variable shunt, which can be fitted with a blank ivorine disc and so used as a separate unit for two or more meters, the setting for each being marked on the disc.

The standard tolerance allowed in the resistance values is 1 per cent., and these shunts cost 2s. 6d. per range, the three-range model consequently being priced at 7s. 6d. Shunts giving up to 10 ranges can be supplied.

To adapt the meter for voltage measurements series resistances are supplied and the specimen unit sent in is designed for both AC and DC measurements using a 0-1 mA meter. An instrument rectifier has, of course, to be used for the AC ranges. It provides ranges of 0-10, 0-50, 0-250 and 0-1,000 volts. To enable the same scale to be employed for both AC and DC, the 250- and 1,000-volt series resistances are shunted by suitable values of capacity.

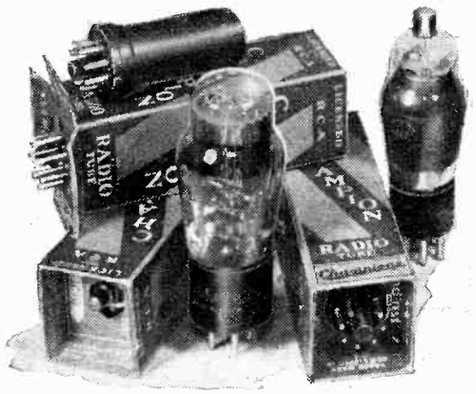
The reason for this cannot be dealt with here, but it was fully explained in an article in *The Wireless World* of July 19th, 1935, when a universal test meter was described.

The price of series multipliers for ranges up to 500 volts is 1s. 9d. per range, mounted as shown in the illustration, and above 500 volts the cost is 2s. 3d. per range. Capacity correctors for AC measurements cost 1s. 6d. each if assembled on the unit, or 1s. 3d. each unmounted.

CHAMPION VALVES

A COMPLETE range of American-type valves is being marketed by the Champion Radio Valve Corporation, Ltd., of Champion House, 39-41, Clifton Street, London, E.C.2. The range of valves not only includes the older standard glass types, but also the newer glass valves with

octal bases. In addition, a wide selection of line-resistance tubes is listed; these, of course, perform the function of a barretter.



A group of Champion Octal-base glass valves.

QUADRANT LITTLEFUSES

SO much damage can be done in a few minutes by a fault in a wireless set, amplifier or a measuring instrument that it is now the recognised practice to fit protecting fuses wherever possible. The design and manufacture of these fuses is actually quite an involved business and has required a very careful study of the before and after effects when the fuse "blows."

The Quadrant Carbon and Metal Products, Ltd., Quadrant Works, Cumberland Road, Stanmore, Middlesex, are now manufacturing a long range of fuses which follow the design of those made in the U.S. by the Littlefuse Laboratories and the range includes fuses suitable for protecting almost every piece of apparatus used in wireless and kindred electrical work.

Cartridge-type Littlefuse made by Quadrant to R.C.M.F. standard sizes.

Instrument protecting fuses rated at 5 mA are available, but those of most interest to the wireless listener and experimenter probably fall within the range of 100 mA to 5 amps.

Some samples of these have been sent in for test, the lowest current type being rated at $\frac{1}{8}$ A. Two of this rating were tested and both "blew" at 150 mA within two minutes of reaching this current value. Two 0.5 amp. fuses were also tested and these broke down at 0.66 and 0.67 amp. respectively. The fact that the breakdown current was in one case the same and in the other virtually the same for both specimens tested indicates a high order of consistency in manufacture and this is an important feature of these fuses.

Fuses above 60 mA rating cost 6d. each and instrument fuses, i.e., below 60 mA rating, cost 9d. each.

The Wireless Industry

THE Lowther-Voigt series of radio-gramophones, chassis and units, which include many interesting technical features, are designed essentially as high quality reproducers. Voigt loud speakers are fitted to these sets, which are fully described in a booklet issued by the makers, the Lowther Mfg. Company, Lowther House, St. Mark's Road, Bromley, Kent.

A new edition of the EDC converter leaflet has been issued by the Electro Dynamic Construction Company, Ltd., of St. Mary Cray, Kent. In it are shown the appropriate converters to use for supplying various makes of set, and the publication has been brought up to date by the addition of various newly introduced models.

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Change of Address: Reslo Sound Equipment, Ltd., formerly of 97, Hampstead Road, London, N.W.1, has now moved to new and larger premises at 359, City Road, London, E.C.1. Telephone: Terminus 1649.

Radio Receiver Circuits Handbook.—By E. M. Squire. Pp. 88+vii. Published by Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 4s. 6d.

THIS book is of an elementary nature and gives a description of the mode of operation of many commonly used circuits in quite simple language. It is, therefore, likely to prove useful to the beginner who would lose himself in the complexities of a complete explanation.

No attempt is made to deal with circuit theory from the mathematical viewpoint, with the result that it is not possible for the reader to choose circuit values with the assurance that they will be correct. Commonly used values of components are indicated in the text, however, and provided he sticks to orthodox practice the reader can consequently obtain an idea of suitable values.

The scope of the book is admirably suited to beginners, but there are, unfortunately, a number of errors. On page 5 the author states that "A serious defect in the HF choke is its high-frequency resistance. If this is high, it is equivalent to injecting a series resistance in the tuned grid circuit. . . ." If he refers to the series resistance of the choke this is incorrect, because the series resistance does not affect the tuned circuit. If he refers to the effective parallel resistance, it is also incorrect, because a high value of resistance means that the tuned circuit has its series resistance increased by a *small* amount, and vice-versa. Actually, the most important factor in the choice of an RF choke is the avoidance of series resonance effects in the working range of frequencies.

The circuit diagram of Fig. 4 shows an open grid circuit for the RF valve and the type of coupling described as tuned-anode is more usually called transformer coupling with a tuned primary.

The statement is made on page 23 that the highest frequencies transmitted by broadcasting stations on medium and long waves cannot be greater than 4,500 c/s, whereas frequencies up to at least 10,000 c/s are radiated by the London transmitters.

The circuit of Fig. 17 is incorrect in that the bias of the triode appears as a positive bias on the AVC line. It could not be used, therefore, unless the controlled valves are initially overbiased negatively by an equal amount.

On page 77 it is stated that the hum due to the field from heater wiring is 100 c/s. This is incorrect; it is at the same frequency as the supply mains.

On page 81 a reservoir condenser is stated to be essential. It is not, for equipment is commonly used with no reservoir condenser. Then on page 82 the author states that the HT voltage will increase with an increase in capacity of the smoothing condenser. This is also incorrect, for it has no effect on the HT voltage; it is the reservoir condenser which affects it.

W. T. C.

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Frequency and Wavelength

(Stations with an Aerial Power of 50 kW. and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Ankara (Turkey)	152		1973.5	5
Kaunas (Lithuania)	153		1961	7
Radio Romania (Brasov) Romania	160		1875	150
Hilversum, No. 1 (Holland) (10 *kW.* till 1440)	160		1875	150
Lahti (Finland)	166		1807	150
Moscow, No. 1 (Komintern) (U.S.S.R.)	172		1744	500
Paris (Radio Paris) (France)	182		1648	80
Istanbul (Turkey)	185		1622	5
Irkutsk (U.S.S.R.)	187.5		1600	20
Deutschlandsender (Germany)	191		1571	60
National (Droitwich)	200		1500	140
Minsk (U.S.S.R.)	208		1442	35
Reykjavik (Iceland)	208		1442	16
Motala (Sweden)	216		1389	150
Novosibirsk (U.S.S.R.)	217.5		1379	100
Warsaw, No. 1 (Poland)	224		1339	120
Luxembourg	232		1293	150
Moscow, No. 2 (U.S.S.R.)	232		1293	100
Kalundborg (Denmark)	240		1250	60
Vienna, No. 2 (Austria)	240		1250	0.5
Kiev, No. 1 (U.S.S.R.)	248		1209.6	100
Vigra (Aalesund) (Norway)	253		1186	10
Tashkent (U.S.S.R.)	256.4		1170	25
Oslo (Norway)	260		1153.8	60
Leningrad, No. 1 (U.S.S.R.)	271		1107	100
Tromsö (Norway)	282		1065	10
Tiflis (U.S.S.R.)	283		1060	35
Saratov (U.S.S.R.)	340		882.3	20
Finmark (Norway)	347		864	10
Archangel (U.S.S.R.)	350		857.1	10
Rostov-on-Don (U.S.S.R.)	355		845.1	20
Budapest, No. 2 (Hungary)	359.5		834.5	18
Sverdlovsk (U.S.S.R.)	375		800	40
Voroneje (U.S.S.R.)	390		769	10
Boden (Sweden)	392		765	0.6
Banska Bystrica (Czechoslovakia) (15 *kW.* after 1700)	392		765	30
Geneva (Switzerland)	401		748	1.3
Moscow, No. 3 (U.S.S.R.)	413.5		726	100
Ostersund (Sweden)	413.5		726	0.6
Oulu (Finland)	431		696	10
Tartu (Estonia)	518		579	0.5
Hamar (Norway)	519		578	0.7
Innsbruck (Austria)	519		578	1
Ljubljana (Yugoslavia)	527		569.3	6.3
Viipuri (Finland)	527		569.3	10
Bolzano (Italy)	536		559.7	10
Wilno (Poland)	536		559.7	50
Budapest, No. 1 (Hungary)	546		549.5	120
Beromünster (Switzerland)	556		539.6	100
Athlone (Ireland)	565		531	100
Klaipeda (Lithuania)	565		531	15
Palermo (Italy)	565		531	3
Stuttgart (Germany)	574		522.6	100
Alpes-Grenoble, P.T.T. (France)	583		514.6	20
Madona (Latvia)	583		514.6	50
Vienna, No. 1 (Austria)	592		506.8	100
Athens (Greece)	601		499.2	15
Rabat (Morocco)	601		499.2	25
Sundsvall (Sweden)	601		499.2	10
Florence, No. 1 (Italy)	610		491.8	20
Brussels, No. 1 (Belgium)	620		483.9	15
Cairo, No. 1 (Egypt)	620		483.9	20
Christiansand (Norway)	629		476.9	20
Lisbon (Portugal)	629		476.9	15
Tröndelag (Norway)	629		476.9	20
Prague, No. 1 (Czechoslovakia)	638		470.2	120
Lyons, P.T.T. (France)	648		463	100
Petrozavodsk (U.S.S.R.)	648		463	10
Cologne (Germany)	658		455.9	100
Jerusalem (Palestine)	668		449.1	20
North Regional (Slaithwaite)	668		449.1	70
Sottens (Switzerland)	677		443.1	100
Belgrade (Yugoslavia)	686		437.3	20
Paris, P.T.T. (France)	695		431.7	120
Stockholm (Sweden)	704		426.1	55
Rome, No. 1 (Italy)	713		420.8	50
Hilversum, No. 3 (Holland)	722		15.4	17
Kharkov, No. 1 (U.S.S.R.)	722		415.4	10
Fredrikstad (Norway)	731		410.4	1
Madrid, EAJ2 (Spain)	731		410.4	3
Seville (Spain)	731		410.4	5.5
Tallinn (Estonia)	731		410.4	20
Munich (Germany)	740		405.4	100
Marseilles, P.T.T. (France)	749		400.5	100
Pori (Finland)	749		400.5	1
Katowice (Poland)	758		395.8	12
Scottish Regional (Burghead)	767		391.1	60
Scottish Regional (Westerglen)	767		391.1	70
Stalino (U.S.S.R.)	776		386.6	10
Toulouse, P.T.T. (France)	776		386.6	120
Leipzig (Germany)	785		382.2	120
Barcelona, EAJ1 (Spain)	795		377.4	7.5
Lwow (Poland)	795		377.4	50
Welsh Regional (Penmon) (Anglesey)	804		373.1	5
Welsh Regional (Washford)	804		373.1	70
Milan, No. 1 (Italy)	814		368.6	50
Bucharest (Romania)	823		364.5	12
Agen (France)	832		360.6	1.5
Kiev, No. 2 (U.S.S.R.)	832		360.6	40
Berlin (Germany)	841		356.7	100
Sofia (Bulgaria)	850		352.9	100
Norwegian Relay Stations	850		352.9	—
Valencia (Spain)	850		352.9	3
Simferopol (U.S.S.R.)	859		349.2	10
Strasbourg (France)	859		349.2	100
Poznan (Poland)	868		345.6	16
London Regional (Brookmans Park)	877		342.1	70
Linz (Austria)	886		338.6	15
Graz (Austria)	886		338.6	15
Helsinki (Finland)	895		335.2	10
Limoges, P.T.T. (France)	895		335.2	1.5
Hamburg (Germany)	904		331.9	100
Dniepropetrovsk (U.S.S.R.)	913		328.6	10
Toulouse (Radio Toulouse) (France)	913		328.6	60
Brno (Czechoslovakia)	922		325.4	32
Brussels, No. 2 (Belgium)	932		321.9	15
Algiers (Algeria)	941		318.8	12
Göteborg (Sweden)	941		318.8	10
Breslau (Germany)	950		315.8	100
Paris (Poste Parisien) (France)	959		312.8	60
Bordeaux-Sud-Ouest (France)	968		309.9	30
Odessa (U.S.S.R.)	968		309.9	10
Northern Ireland Regional (Lisnagarvey)	977		307.1	100
Bologna (Radio Marconi) (Italy)	986		304.3	50
Torun (Poland)	986		304.3	24
Hilversum No. 2 (Holland) (15 *kW.* till 1810)	995		301.5	60
Bratislava (Czechoslovakia)	1004		298.8	13.5
Chernigov (U.S.S.R.)	1013		296.2	4
Midland Regional (Droitwich)	1013		296.2	70
Barcelona, EAJ15 (Spain)	1022		293.5	3
Cracow (Poland)	1022		293.5	2
Oviedo (Spain)	1022		293.5	0.7
Königsberg, No. 1 (Heilsberg) (Germany)	1031		291	100
Parede (Portugal)	1031		291	5
Leningrad, No. 2. RW70 (U.S.S.R.)	1040		288.5	10
Rennes-Bretagne (France)	1040		288.5	120
West of England Regional (Washford)	1050		285.7	50
Bari No. 1 (Italy)	1059		283.3	20
Paris (Radio Cité) (France)	1068		280.9	0.8
Tiraspol, RW57 (U.S.S.R.)	1068		280.9	10
Bordeaux-Lafayette (France)	1077		278.6	35
Falun (Sweden)	1086		276.2	2
Zagreb (Yugoslavia)	1086		276.2	0.7
Madrid, EAJ7 (Spain)	1095		274	5
Vinnitsa (U.S.S.R.)	1095		274	10
Kuldiga (Latvia)	1104		271.7	10
Naples No. 1 (Italy)	1104		271.7	10
Moravska-Ostrava (Czechoslovakia)	1113		269.5	11.2
Radio Normandie (Fécamp) (France)	1113		269.5	15
Alexandria, No. 1 (Egypt)	1122		267.4	0.5
North-East Regional (Stagshaw)	1122		267.4	60
Nyiregyhaza (Hungary)	1122		267.4	6.25
Hörby (Sweden)	1131		265.3	100
Turin, No. 1 (Italy)	1140		263.2	7
Genoa, No. 1 (Italy)	1140		263.2	10
Trieste (Italy)	1140		263.2	10
London National (Brookmans Park)	1149		261.1	20
North National (Slaithwaite)	1149		261.1	20
Scottish National (Westerglen)	1149		261.1	50
Kosice (Czechoslovakia)	1158		259.1	10
Monte Ceneri (Switzerland)	1167		257.1	15
Copenhagen (Denmark)	1176		255.1	10
Nice-Corse (France)	1185		253.2	60
Frankfurt (*and Relays*) (Germany)	1195		251	25
Prague, No. 2 (Czechoslovakia)	1204		249.2	5
Lille, P.T.T. (France)	1213		247.3	60
Rome, No. 2 (Italy)	1222		245.5	60
Gleiwitz (Germany)	1231		243.7	5
Cork (Ireland)	1235		242.9	1
Saarbrücken (Germany)	1249		240.2	17
Bilbao, EAJ8 (Spain)	1258		238.5	1
Riga (Latvia)	1258		238.5	15
Florence, No. 2 (Italy)	1258		238.5	1
Nürnberg (Germany)	1267		236.8	2
Radio Mediterranée (Juan-les-Pins) (France)	1276		235.1	27
Aberdeen	1285		233.5	1
Dresden (Germany)	1285		233.5	0.25
Klagenfurt (Austria)	1294		231.8	5
Vorarlberg (Austria)	1294		231.8	5
Danzig	1303		230.2	0.5
Swedish Relay Stations	1312		228.7	—

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Magyarovar (Hungary)	1321		227.1	1.25
German Relay Stations	1330		225.6	—
Lodz (Poland)	1339		224	2
Montpellier, P.T.T. (France)	1339		224	1.5
Dublin (Ireland)	1348		222.6	0.5
Königsberg, No. 2 (Germany)	1348		222.6	2
Rjukan (Norway)	1348		222.6	0.15
Salzburg (Austria)	1348		222.6	2
Tampere (Finland)	1348		222.6	0.7
Nottoden (Norway)	1357		221.1	0.3
Italian Relay Stations	1357		221.1	—
L'Ile de France (France)	1366		219.6	2
Basle (Switzerland)	1375		218.2	0.5
Berne (Switzerland)	1375		218.2	0.5
Warsaw, No. 2 (Poland)	1384		216.8	7
Lyons (Radio Lyons) (France)	1393		215.4	25
Stara-Zagora (Bulgaria)	1402		214	2
Vaasa-Vasa (Finland)	1420		211.3	10
Alexandria, No. 2 (Egypt)	1429		209.9	0.5
Turku (Finland)	1429		209.9	0.5
Miskole (Hungary)	1438		208.6	1.25
Paris (Eiffel Tower) (France)	1456		206	7
Pecs (Hungary)	1465		204.8	1.25
Belgian Relay Stations	1465		204.8	0.1
Bournemouth	1474		203.5	1
Plymouth	1474		203.5	0.3
Binche (Belgium)	1487		201.7	0.1
Belgian Relay Stations	1492		201.1	0.1
Nimes (France)	1492		201.1	0.7
Albacete (Spain)	1492		201.1	0.2
Santiago (Spain)	1492		201.1	0.5
Belgian Relay Stations	1500		200	0.1
Pietarsaari (Finland)	1500		200	0.25
Radio Alcalá (Spain)	1500		200	0.2
Karlskrona (Sweden)	1530		196	0.2
Liepàja (Latvia)	1734		173	0.1

SHORT-WAVE STATIONS OF THE WORLD

Station.	Call Sign.	kc/s.	Tuning Positions.	Metres.	kW.
Bandoeng (Java)	PMY	5,150		58.30	1
Caracas (Venezuela)	YV5RC	5,800		51.72	1
Vatican City (Vatican State)	HVJ	5,970		50.23	15
Moscow (U.S.S.R.)	RW59	6,000		50.00	20
Mexico City (Mexico)	XEBT	6,000		50.00	1
Montreal (Canada)	CFCX	6,000		50.00	0.1
Pretoria (South Africa)	ZRH	6,000		50.00	5
Havana (Cuba)	COCO	6,010		49.92	2.5
Prague (Podebrady) (Czechoslovakia)	OLR2A	6,010		49.92	30
Zeesen (Germany)	**DJC**	6,020		49.83	5-40
Boston (U.S.A.)	W1XAL	6,040		49.67	10
Miami (U.S.A.)	W4XB	6,040		49.67	5
Daventry (Gt. Britain)	**GSA**	6,050		49.59	10-50
Cincinnati (U.S.A.)	W8XAL	6,060		49.50	10
Philadelphia (U.S.A.)	W3XAU	6,060		49.50	10
Motala (Sweden)	SBO	6,060		49.50	0.75
Vienna (Austria)	OER2	6,080		49.34	1.5
Lima (Peru)	OAX4Z	6,080		49.34	15
Chicago (U.S.A.)	W9XAA	6,080		49.34	0.5
Nairobi (Kenya)	VQ7LO	6,080		49.34	0.5
Delhi (India)	VUD	6,080		49.30	—
Toronto (Bowmanville) (Canada)	CFRX	6,090		49.26	0.5
Hong Kong (China)	ZBW2	6,090		49.26	2.5
Capetown (South Africa)	ZRK	6,100		49.20	5
Johannesburg (South Africa)	ZRJ	6,100		49.20	0.2
Bound Brook (U.S.A.)	W3XAL	6,100		49.18	15-35
Chicago (U.S.A.)	W9XF	6,100		49.18	10
Belgrade (Yugoslavia)	YUA	6,100		49.18	1
Daventry (Gt. Britain)	**GSL**	6,110		49.10	10-50
Calcutta (India)	VUC	6,110		49.10	0.5
Pittsburg (U.S.A.)	W8XK	6,140		48.83	30
Winnipeg (Canada)	CJRO	6,150		48.78	2
San Jose (Costa Rica)	TIPG	6,410		46.80	1
Amateurs		7,000 to 7,300		42.86 to 41.10	0.01
Moscow (U.S.S.R.)	RKI	7,540		39.79	25
Prangins (Radio-Nations) (Switz'l'd)	HBP	7,780		38.48	20
Budapest (Hungary)	HAT4	9,125		32.88	6
Prangins (Radio Nations) (Switz'l'd)	HBL	9,340		32.10	20
Havana (Cuba)	COCH	9,430		31.80	10
Madrid (Spain)	EAR	9,480		31.65	10
Rio de Janeiro (Brazil)	PRF5	9,500		31.58	12
Melbourne (Australia)	VK3ME	9,510		31.55	2
Bangkok (Siam)	HS8PJ	9,510		31.55	10
Daventry (Gt. Britain)	**GSB**	9,510		31.55	10-50
Skamlebaek (Denmark)	OZF	9,520		1.51	6
Pretoria (South Africa)	ZRH	9,520		31.5	5
Hongkong (China)	ZBW3	9,520		31.49	2,6
Jelöy (Norway)	LKC	9,520		31.49	1
Schenectady (U.S.A.)	W2XAF	9,530		31.48	25
Suva (Fiji)	VPD2	9,540		31.45	2
Tokio (Japan)	**JZI**	9,540		31.45	50
Zeesen (Germany)	**DJN**	9,540		31.45	5-40
Prague (Podebrady) (Czechoslovakia)	OLR3A	9,550		31.41	30
Zeesen (Germany)	**DJA**	9,560		31.38	5-40
Lima (Peru)	OAX4T	9,560		1.38	10
Bombay (India)	VUB	9,565		31.36	4.5
Millis (U.S.A.)	W1XK	9,570		31.35	10
Manila (Philippine Isles)	KZRM	9,570		31.35	6
Daventry (Gt. Britain)	**GSC**	9,580		31.32	10-50
Lyndhurst (Australia)	VLR	9,580		31.32	1
Philadelphia (U.S.A.)	W3XAU	9,590		31.28	10
Sydney (Australia)	VK2ME	9,590		31.28	20
Perth (Australia)	VK6ME	9,590		31.28	2
Huizen (Holland)	**PCJ**	9,590		31.28	60
Prangins (Radio-Nations) (Switz'l'd)	HBL	9,595		31.27	20
Moscow (U.S.S.R.)	RAN	9,600		31.25	20
Capetown (South Africa)	ZRK	9,600		31.23	5
Sourabaya (Java)	YDB	9,610		31.20	1
Rome (Italy)	12RO3	9,635		31.13	25
Lisbon (Portugal)	CS2WA	9,655		31.09	2
Buenos Aires (Argentina)	LRX	9,660		31.06	10
Madrid (Spain)	EAQ1	9,860		30.52	10
Lisbon (Portugal)	CSW	9,940		30.18	5
Ruysselede (Belgium)	ORK	10,330		29.04	9
Buenos Aires (Argentina)	LSX	10,350		28.99	12
Teneriffe (Canary Isles)	EAJ43	10,360		28.94	4
Lisbon (Portugal)	CSW	11,040		27.17	5
Prangins (Radio-Nations) (Switz'l'd)	HBO	11,400		26.31	20
Winnipeg (Canada)	CJRX	11,720		25.60	2
Paris (Radio-Colonial) (France)	TPA4	11,720		25.60	12
Warsaw (Poland)	SPD	11,530		26.01	10
Huizen (Holland)	PHI	11,730		25.5	25
Daventry (Gt. Britain)	**GSD**	11,750		25.53	10-50
Zeesen (Germany)	**DJD**	11,770		25.49	5-40
Boston (U.S.A.)	W1XAL	11,790		25.45	10
Tokio (Japan)	**JZJ**	11,800		25.42	50
Vienna (Austria)	OER3	11,800		25.42	1.5
Rome (Italy)	12RO4	11,810		25.40	25
Daventry (Gt. Britain)	**GSN**	11,820		25.38	10-50
Wayne (U.S.A.)	W2XE	11,830		25.36	10
Lisbon (Portugal)	CWS4	11,840		25.34	5
Prague (Podebrady) (Czechoslovakia)	OLR4A	11,840		25.34	30
Zeesen (Germany)	**DJP**	11,850		25.31	5.40
Daventry (Gt. Britain)	**GSE**	11,860		25.29	10-50
Pittsburgh (U.S.A.)	W8XK	11,870		25.27	24
Paris (Radio Colonial) (France)	TPA3	11,890		25.24	12
Moscow (U.S.S.R.)	RNE	12,000		25.00	20
Reykjavik (Iceland)	TFJ	12,235		24.52	7.5
Warsaw (Poland)	SPW	13,635		22.00	10
Amateurs		14,000 to 14,400		21.42 to 20.84	0.01
Sofia (Bulgaria)	LZA	14,970		20.04	1.5
Zeesen (Germany)	**DJL**	15,111		19.85	5.40
Vatican City (Vatican State)	HVJ	15,123		19.84	10
Daventry (Gt. Britain)	**GSF**	15,140		19.82	10-50
Bandoeng (Java)	YDC	15,160		19.80	1.5
Daventry (Gt. Britain)	GSO	15,180		19.76	10-50
Hongkong (China)	ZBW4	15,190		19.75	2.6
Zeesen (Germany)	**DJB**	15,200		19.74	5-40
Pittsburgh (U.S.A.)	W8XK	15,210		19.72	20
Huizen (Holland)	**PCJ**	15,220		19.71	60
Prague (Podebrady) (Czechoslovakia)	OLR5A	15,230		19.70	30
Paris (Radio-Colonial) (France)	TPA2	15,243		19.68	12
Boston (U.S.A.)	W1XAL	15,250		19.67	10
Daventry (Gt. Britain)	**GSI**	15,260		19.66	10-50
Wayne (U.S.A.)	W2XE	15,270		19.65	10
Zeesen (Germany)	**DJQ**	15,280		19.63	5-40
Buenos Aires (Argentina)	LRU	15,290		19.62	7
Daventry (Gt. Britain)	**GSP**	15,310		19.60	10-50
Schenectady (U.S.A.)	W2XAD	15,330		19.57	18
Zeesen (Germany)	**DJR**	15,340		19.56	5-40
Budapest (Szekesfehervar) (Hungary)	HAS3	15,370		19.52	6
Zeesen (Germany)	**DJE**	17,760		16.89	5-40
Wayne (U.S.A.)	W2XE	17,760		16.89	10
Huizen (Holland)	PHI	17,770		16.88	25
Bound Brook (U.S.A.)	W3XAL	17,780		16.87	15-35
Daventry (Gt. Britain)	**GSG**	17,790		16.86	10-50
Bangkok (Siam)	HS8PJ	19,020		15.77	5
Daventry (Gt. Britain)	**GSH**	21,470		13.97	10-50
Wayne (U.S.A.)	W2XE	21,520		13.94	10
Daventry (Gt. Britain)	**GSJ**	21,530		13.93	10-50
Pittsburgh (U.S.A.)	W8XK	21,540		13.93	6
Daventry (Gt. Britain)	**GST**	21,550		13.92	10-50

Recent Inventions

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

TELEVISION SYSTEMS

THE "framing" signal used in television scanning is transmitted as a two-part impulse, the first part serving to "prepare" the corresponding saw-toothed oscillator, whilst the second part serves to discharge it.

The "line" impulses are represented at L in Fig. 1, whilst the two-part "framing" impulse is shown at A, B. Both sets of signals are applied to the pair of discharge valves V, V1 shown in Fig. 2. The line impulses trigger the valve V in the ordinary way, and at the same time build up a voltage

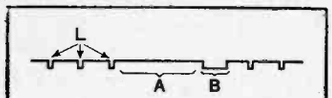


Fig. 1

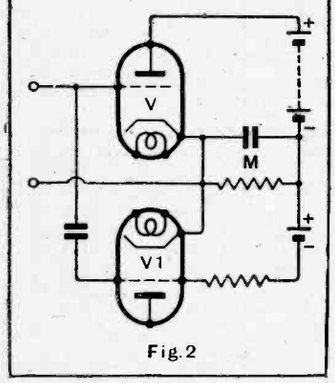


Fig. 2

The transmitted frame and line sync pulses taking the form shown in Fig. 1, are applied to a pair of valves in the receiver arranged as in Fig. 2.

across the circuit M which biases the grid of the valve V1 so that it does not respond to them.

The arrival of the first part A of the framing signal allows this blocking bias to discharge, so that the valve V1 is made ready to be triggered by the arrival of the second part B of the framing signal. The arrangement ensures an exact synchronisation of the line and frame scanning operations.

Telefunken Ges fur drahtlose Telegraphie m.b.h. Convention date (Germany) May 15th, 1935. No. 475189.

o o o o

AIRCRAFT WIRELESS

FOR direction-finding in the air it is usual to mount one or more frame aerials inside the fuselage of an aeroplane constructed mainly of wood and other insulating materials. In the case of an all-metal plane, however, a frame aerial located inside the casing would be screened off from the signals, so that it is customary then to mount it outside the fuselage. Here, however, it gives rise to undesirable air-friction and so constitutes a drag on the machine.

The inventors have discovered that it is possible to mount the aerial in a recess formed in the metal casing so that it only projects a small distance beyond the line of the fuselage. In this position it causes practically no air-drag, and, at the same time, is not seriously screened from the incoming signal. The recess can be covered over by an air-streamed cowl, provided the latter is insulated from the metal fuselage.

Standard Telephones and Cables, Ltd. (assignees of Le Materiel Telephonique). Convention date (France) April 2nd, 1936. No. 473866.

o o o o

"DIELECTRIC" GUIDES

IT is now known that centimetre waves can be propagated, with small attenuation, through a hollow tube enclosing air or other dielectric. The energy is transmitted in the form of displacement waves, which are more akin to ether waves than to the go-and-return current flowing through an ordinary transmission line.

The invention is concerned with means for generating and modulating carrier waves in such a system, particularly for multiplex working. An electron-multiplier tube is used for generating the centimetre waves, and modulation is effected by controlling the number of primary electrons which are allowed to impact upon a secondary-emission electrode inside the tube.

Standard Telephones and Cables, Ltd. (assignees of Le Materiel Telephonique Soc. Anon.). Convention date (France), May 19th, 1936. No. 476024.

o o o o

CUTTING OUT "ATMOSPHERICS"

DISTURBANCES due to atmospherics usually make themselves felt in the loud speaker as comparatively high-pitched notes having a frequency of 4,000 cycles or over. It has already been proposed to minimise their effects by using "limiter" valves, which cut-off all voltages above a certain amplitude. This remedy is reasonably satisfactory so long as the disturbing impulse happens to coincide with a period of maximum signal strength, provided the two voltages are also in phase. But if the disturbance occurs during quiet passage of the signals, then the atmospheric disturbance is not appreciably masked.

As a more effective remedy, the AF output from the detector valve is, according to the invention, passed through a filter which separates the frequencies above 4,000 cycles from those below. The two frequency bands are fed into separate channels, and a limiting device is included in the higher-frequency channel only, where its action in eliminating the disturbance is much more effective. The two frequency bands are recombined before being fed to the loud speaker.

Telefunken Ges fur drahtlose Telegraphie m.b.h. Convention date (Germany), April 9th, 1936. No. 476218.

o o o o

FLUORESCENT SCREENS

AN approximately "white" fluorescent light can be produced from a mixture of substances giving a naturally blue light with others giving a naturally yellow light, plus a small proportion of a substance with green fluorescence. In cathode-ray tubes having oxide-coated cathodes there is inevitably present some proportion of oxygen ions, and these in course of time cause a deterioration of such a screen.

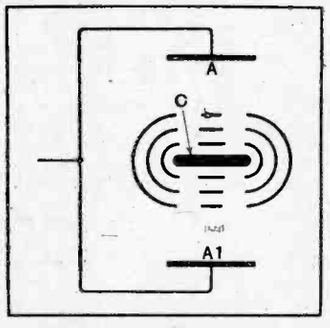
In order to prevent this, the screen is made up of a mixture of non-activated zinc or cadmium tungstate (which emits a blue fluorescence) and zinc borate activated by manganese for emitting a yellow light. Such a screen is stated to be highly sensitive and to resist damage by ionic bombardment.

S. T. Henderson. Application date, May 22nd, 1936. No. 475582.

o o o o

"BEAM" VALVES

THE figure shows the electrode arrangement of an "electron beam valve" in which the discharge takes the form of a "jet" rather than a mere stream. The electrons are liberated from a central "gun" or cathode C, and are projected simultaneously in opposite directions to two anodes or collectors A, A1. A slotted



Beam valve in which the inner electrodes are slotted plates.

control grid is located nearest the cathode, a slotted accelerator grid coming next, whilst the outer grid acts as a suppressor. The slots break up the stream into jets, and a separate anode or "collector" is arranged to receive each jet.

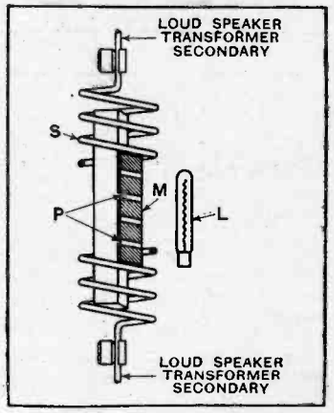
The advantages of this type of valve are (a) a high degree of isolation between the control grid and output electrode, with a corresponding absence of capacity coupling, and (b) a substantially flat anode-voltage-anode-current characteristic curve.

Marconi's Wireless Telegraph Co., Ltd., and E. O. Smith. Application date May 12th, 1936. No. 475106.

o o o o

VISUAL-TUNING INDICATORS

AS the tuning of a superhet set approaches the resonance point, a "false" intermediate frequency is produced, and this can be used to create a "beat" note with the true intermediate



Construction details of the visual-tuning indicator.

frequency. The closer the control is brought to the correct setting, the lower this beat frequency becomes until it finally reaches zero at the precise tuning point. The effect is utilised to give a critical indication on a visual-tuning device.

As shown in the figure, the indicator consists of a lamp L arranged to illuminate a "striped" mirror M which is mounted inside a spiral spring S. The beat frequency currents mentioned above are passed through this spring from the secondary of the output transformer of the set, and when the beats sink below, say, 300 cycles a second, they cause the spring S to vibrate mechanically.

Normally the coils of the spring mask the "clear" parts P of the mirror, so that no light from the lamp can be seen. But as soon as the manual tuning control is brought sufficiently close to the exact setting, the vibration of the spring exposes the reflecting strips P of glass and a visual indication is given. At this point the loud speaker—which has previously been out of circuit—is switched on, and the low-frequency beat note is simultaneously cut out.

E. K. Cole, Ltd., and G. Bradfield. Application date May 20th, 1936. No. 475064.

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EDITORIAL COMMENT

Simplified Tuning

A Process of Evolution

THE earliest type of broadcast receiver, viewed in the light of the modern development, was a veritable "box of tricks" and it required quite a considerable amount of skill to coax it into its best performance by the correct manipulation of the many knobs and controls which decorated the ebonite panel of the instrument.

A big reduction in the number of controls came about when separate variable filament resistances were no longer supplied for each valve, and perhaps the next important improvement to simplify tuning was the inclusion of the names of the principal stations on the tuning dial. About the same time came the ganged condenser, enabling tuning to be done with one control instead of having to adjust each tuned circuit separately.

A more recent improvement to simplify tuning has been automatic tuning control, where precise tuning is carried out by the set itself after the tuning control has been set approximately to the position of the wanted station.

We are now about to witness a further development in receiver design incorporated in a large number of new types of set. The arrangement is what is known as "push-button tuning," where the mere pressing of a button on the receiver automatically tunes in the set to the station represented by that particular button. Some sets have been designed with as many as twenty push buttons, so that a wide selection of possible stations is available to the listener without the necessity for rotating the tuning dial and looking for the stations thereon.

It may not be easy to explain just why it is that the public finds fault with the present arrangment where it is necessary to rotate a knob until the pointer on the dial scale coincides with the name of the desired station scale, but there seems little doubt that the press-button innovation will achieve wide popularity, and we are inclined to think that in course of time the ordinary user of a receiver, who is interested only in listening to programmes of good strength and quality, will be content with a selection from a number of push-buttons and will no longer even trouble to use the alternative tuning arrangement. But we must not forget that the incorporation of push-button tuning in some forms means an added complication to the set with an increase in cost, and no doubt some tendency to an increase in the risk of minor defects.

Combination with Remote Control

We believe that the most promising development of push-button tuning lies in the direction of the more expensive sets where precautions can be taken liberally to insure that changes in circuit conditions in operation do not result in a variation of tuning adjustment, and where also that extra expenditure is possible to see that the push-button tuning device is, in itself, unlikely to develop faults. But this is not all. We incline to the opinion that the ultimate utility of press-button tuning will be found in combination with remote control, and already a number of such devices are being marketed or developed. Naturally, the cost will be considerably higher than in the case of press-button tuning incorporated on the set itself, but the advantages will, we believe, prove sufficient to justify the combination of the two features on most of the luxury sets of the future.

Push-Button Tuning Systems

MODERN METHODS OF STATION SELECTION

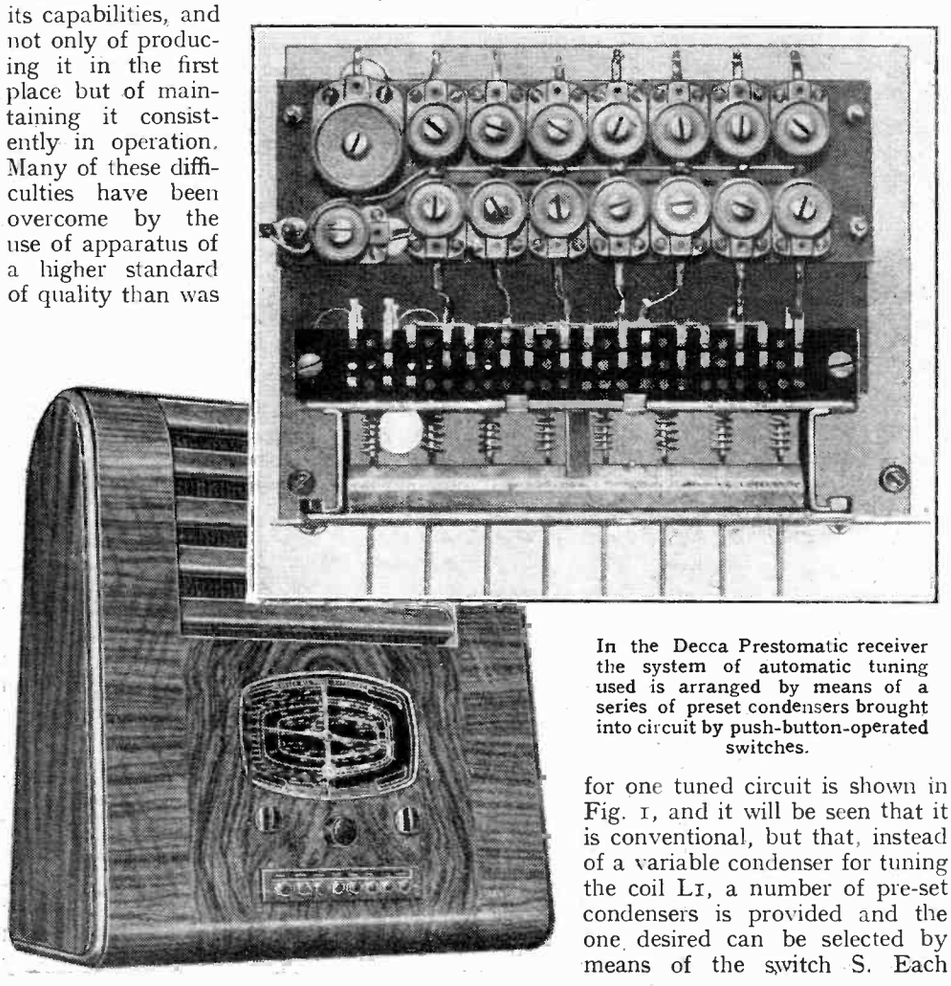
TUNING controls which function merely by the pressure of a finger on a button or lever are rapidly coming to the fore. They enable from six to a dozen selected stations to be tuned in automatically and are often combined with remote control. In this article some of the more widely used arrangements are described and their characteristics discussed.

THROUGHOUT the history of wireless, attempts have frequently been made to simplify the process of tuning by the use of mechanical arrangements which permit a selected number of stations being tuned in by the movement of some control to pre-determined positions. Until recently, however, these systems have not achieved any large measure of popularity, and this is probably because of the technical difficulties involved in producing a receiver which is not inferior to an ordinary set in its capabilities, and not only of producing it in the first place but of maintaining it consistently in operation. Many of these difficulties have been overcome by the use of apparatus of a higher standard of quality than was previously available, and also through a better understanding of the problems involved.

In the matter of remote control there are many different systems employed, and there are also many different methods of control. Sometimes a series of push buttons, one for each station, is provided, and these may be fitted on the receiver itself or to a remote control unit, or the buttons may be duplicated, one set being fitted to the receiver and another at the end of suitable extension leads. Instead of such a series of buttons, a similar effect may be secured by mechanism similar to the ordinary automatic telephone, and indeed it is perfectly possible to use standard telephone parts for constructing such a system.

Electrically, these tuning systems divide themselves into two classes, those in which a large number of pre-set switch-selected condensers are used, and those in which an ordinary variable condenser is provided for tuning but can be remotely controlled by means of an electric motor.

Taking the former first, the basic circuit for one tuned circuit is shown in Fig. 1, and it will be seen that it is conventional, but that, instead of a variable condenser for tuning the coil L1, a number of pre-set condensers is provided and the one desired can be selected by means of the switch S. Each tuned circuit in the receiver, of course, must be provided with a similar bank of condensers and switch.



In the Decca Prestomatic receiver the system of automatic tuning used is arranged by means of a series of preset condensers brought into circuit by push-button-operated switches.

With such a system the switch is set to the first position, and one station is tuned in on the appropriate condensers; the switch is then set to the next position and another station tuned in on the next condenser, and so on. For every station required it is necessary to provide an extra condenser and switch contact for each tuned circuit. This particular system has been commonly employed in the past in simple types of receiver, and one such is *The Wireless World* Pre-Tuned Quality Receiver.[1] Where only two or three stations are required it has the great merit of simplicity, but it is obvious that if a dozen or more stations are needed, then

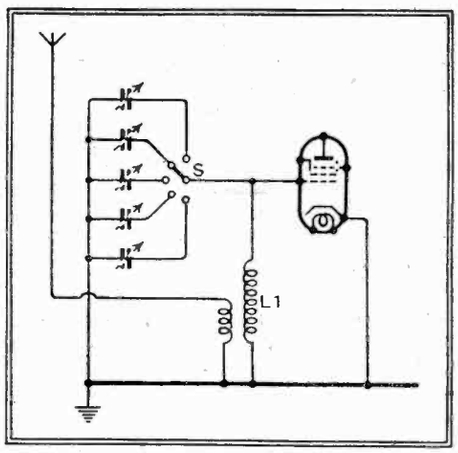


Fig. 1.—The basis of one of the simplest tuning systems is shown here. A separate pre-set condenser is provided for each station and selected by a switch.

it begins to get complicated by virtue of the large number of condensers which must be used. There is also a further drawback when it is applied to a selective receiver such as the superheterodyne, and this drawback is that it may not prove stable enough for satisfactory operation. Where the circuits are all flatly tuned, as in the case of the Local-station Receiver, small changes in the trimming capacities and in the input capacities of valves have very little effect upon the performance of the receiver, but where the set is selective, then these changes do exercise quite a large effect.

In a superheterodyne the oscillator is the critical circuit, and it is a common experience with ordinary receivers that the tuning drifts somewhat, for perhaps a quarter of an hour or so, after switching on. Such drift is naturally intolerable in a pre-tuned receiver. Where systems of this nature are used, therefore, great care must be taken to maintain stability, and the oscillator circuit must itself be designed

[1] *The Wireless World*, September 25th and October 2nd, 1936.

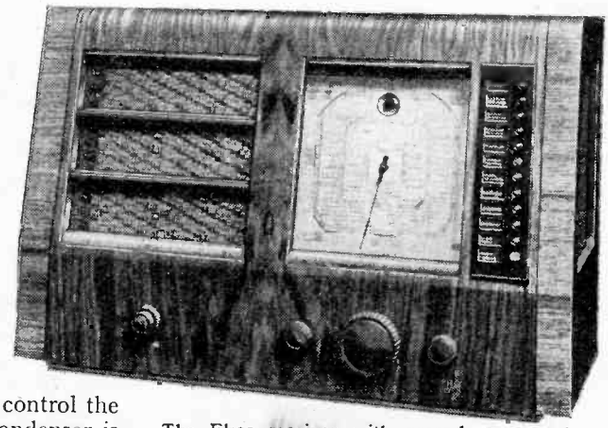
Push-Button Tuning Systems—

to this end. In addition, the layout of components must be carefully chosen so that their temperature remains as nearly as possible constant and the condensers themselves often have to be of special types, with unusually high stability of capacity.

It is clear, therefore, that the arrangement of Fig. 1 is by no means as simple as it appears at first, but there is no doubt that if the difficulties of stability can be overcome it is capable of giving a very satisfactory performance. For the complete avoidance of the bad effects of oscillator drift it is very desirable to include automatic frequency control in the receiver. This, however, applies to nearly all systems of remote control.

It will, of course, be understood that the switch need not be a switch of conventional type operated by a panel control, and there are many ways in which a remote controlled switch can be employed. For instance, a barrel-type switch operated by a solenoid and ratchet could be used and it would be by no means difficult to link the switch up with a control operating on the principle of the automatic telephone.

The second main type of remote control system requires the use of a standard type receiver with a gang condenser. For the purposes of control the tuning condenser is driven through a chain of gears from a small electric motor of the reversible type. This motor usually operates off a 24-volt supply and the method of operation can readily be understood from Fig. 2. Mounted on the condenser shaft are a number of metal discs, each carrying one insulated segment. Two of these discs are shown in Fig. 2, but there will be one disc for every station required and at the remote control there will be one push-button for every disc.



The Ekco receiver with press-button tuning. A motor-drive is used and AFC is included. Up to eleven pre-selected stations can be obtained.

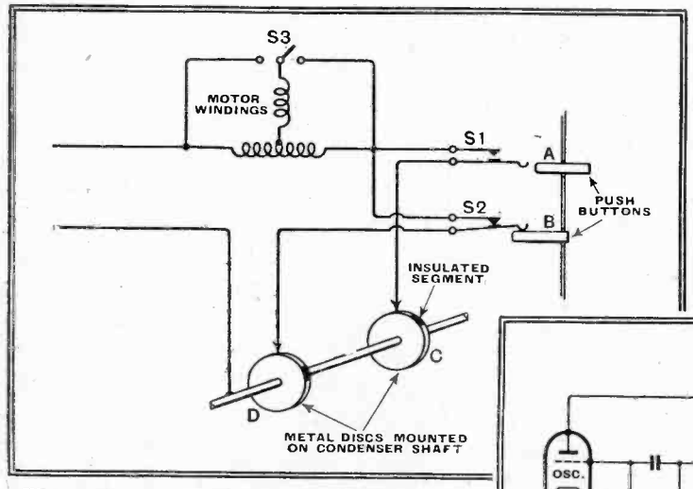


Fig. 2.—One system of remote control works in the manner shown in this diagram. The tuning condenser is driven by an electric motor which is controlled by the press-button.

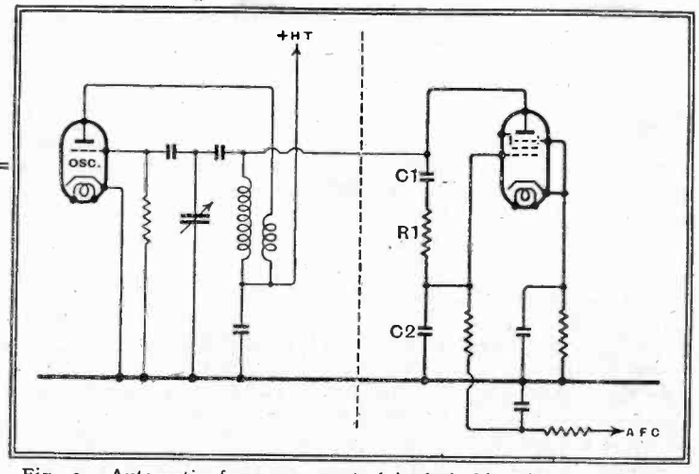
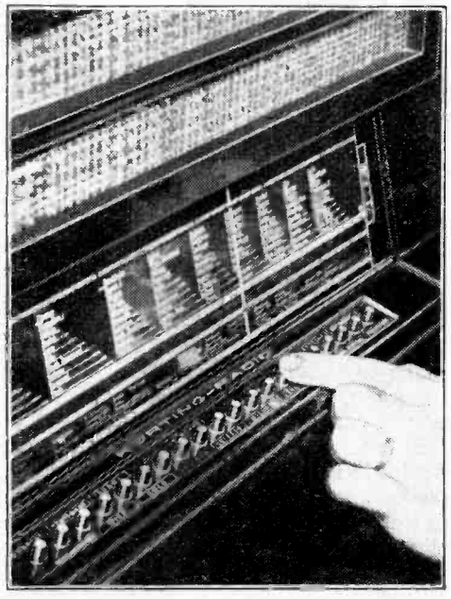


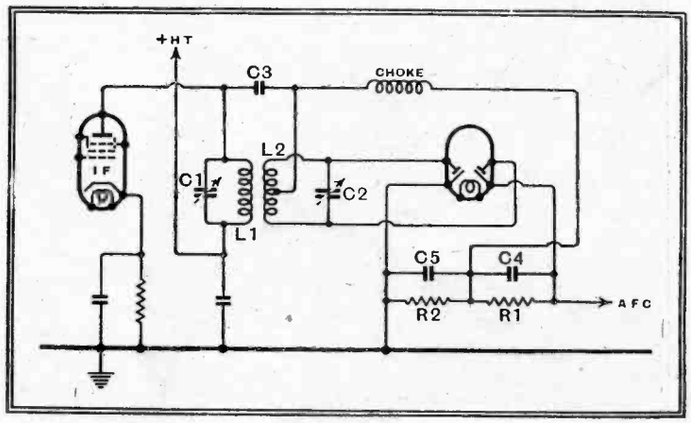
Fig. 3.—Automatic frequency control is desirable with press-button tuning, and the oscillator control is shown in this diagram.



The idea of foolproof operation is well exemplified in the latest German Körting receiver. There are buttons for 20 stations.

It will be seen that of the two push-buttons shown A is out while B is pushed in, so that the contacts of S2 are closed. The circuit is then completed through the ring D and the motor revolves, turning the variable condenser and also the disc D. When the insulated segment comes opposite the contact the circuit is broken and the motor stops. The receiver is then tuned to the desired station, for in the initial set-up the discs have been so aligned on the condenser shaft that the insulated segments in every case correspond to the condenser positions for the wanted station. This is a comparatively easy matter, and one might, for instance, imagine each disc being held on by its own set screw to the shaft. To set up any one disc for a particular station one would tune in that station manually in the usual way and then twist the disc so that the insulated segment comes opposite to the contact, and then tighten up the grub screw. It will be seen that upon pressing a button the condenser may start moving away from the desired station instead of towards it. When this happens the condenser goes on moving to minimum or maximum, as the case may be, and then trips the automatic reversing switch S3 and comes back to the wanted station. With some of the latest systems this reversing switch is unnecessary, for means are included to ensure that the motor always

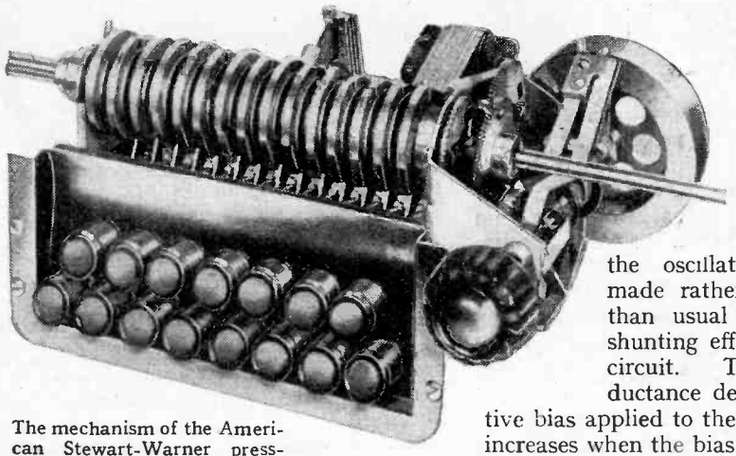
Fig. 4.—The discriminator circuit of an AFC system is shown here.



Push-Button Tuning Systems—

starts off with the correct direction of rotation.

In order to avoid the unpleasant noises which would be inevitable if the receiver were operative while the tuning condenser were thus moving backwards and forwards, a QAVC system is normally included which takes the form of a switch short-circuiting some part of an AF coupling and which is always closed when the tuning condenser is moving.



The mechanism of the American Stewart-Warner press-button tuning system. A motor drive is used.

It is clear that a system of this nature would, by itself, hardly be satisfactory, since it would not be possible to guarantee sufficiently accurate tuning for a selective receiver. It is, therefore, almost invariably associated with an AFC system. This system usually takes the form shown in Figs. 3 and 4. On the left-hand side of the dotted line in Fig. 3 is shown the circuit of a conventional oscillator such as that used for frequency-changing in a superheterodyne, while on the right-hand side is shown the circuit of an AFC control valve. When the correct values are assigned to the various components a change in the grid bias of the valve results in a change in the effective inductance of this portion of the circuit. It is clear that the whole oscillator voltage is applied to the anode of this valve and a portion of it is applied to the grid with a phase shift of 90 deg. because of R1 and C2. C1 is merely a blocking condenser to insulate the grid from the HT supply. This voltage applied to the grid is reversed in phase in the valve and so makes the anode current in the same phase as it would be if the whole combination were an inductance. When using automatic-frequency control, therefore, the oscillator inductance is made rather higher in value than usual to allow for the shunting effect of the control circuit. The effective inductance decreases with negative bias applied to the control valve and increases when the bias changes in a positive direction. In order to obtain control, therefore, we have to arrange a circuit to produce a bias voltage for this valve, which follows certain laws. When the oscillator is at exactly the right frequency for beating with the signal to produce the correct intermediate frequency, no control voltage must be developed. When the oscillator is too high in frequency so that the intermediate frequency produced is also too high, the control circuit must produce a positive voltage so that the inductance of the control circuit is increased and the oscillator frequency lowered. If the oscillator is too low in frequency, however, the control circuit must produce a negative voltage.

The type of control circuit used is shown in Fig. 4, where the first valve is the last IF amplifier. The primary L1 of the IF transformer is coupled in two ways to the centre-tapped secondary. It is coupled by the mutual inductance between primary and secondary and also by the condenser C3. There are two detectors arranged so that their rectified voltage outputs produced across R1 and R2 act in opposition and so tend to cancel one another. When the input frequency is equal to the resonance frequency of the tuned circuits, the voltages across R1 and R2 are equal and opposite and the output to the AFC line is consequently zero. When the signal, however, is no longer of the same frequency as that to which the circuits are tuned, the conditions are different, for there is now a phase shift in the secondary voltage and the outputs of the two diodes are no longer equal and opposite. On one side of the resonance the output of one diode is greater than that of the other, whereas on the other side of resonance the output of the other diode is greater.

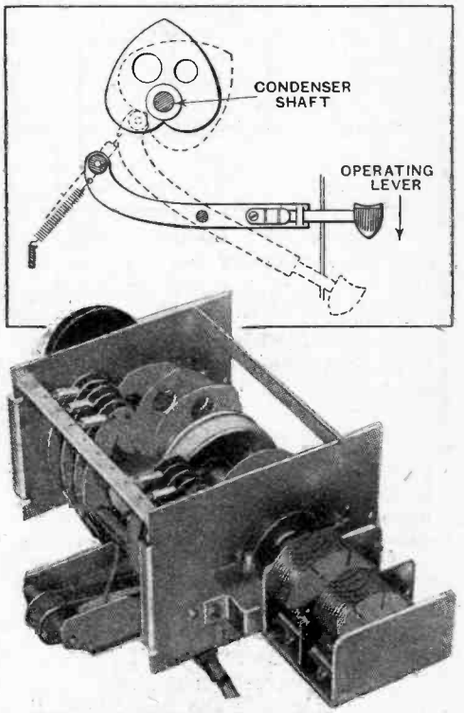
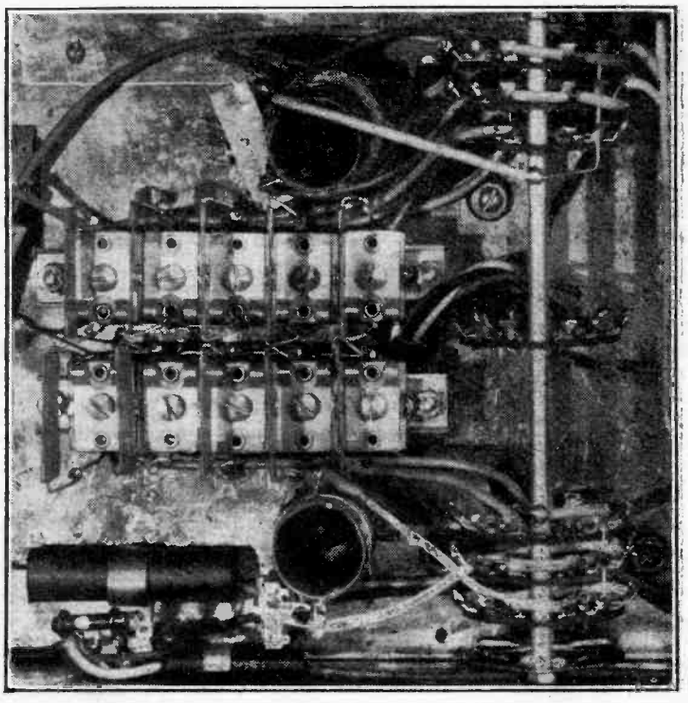


Fig. 5.—A method of control in which the tuning condenser is rotated by the pressure of a lever against a cam in the manner shown in the above drawing.



An underside view of the Invicta receiver showing the trimming condensers for pre-set tuning and the control switch.

The output to the AFC line is always the difference between the voltages across R1 and R2, and is zero when the input signal has the same frequency as the tuned circuits, but is a positive voltage when the input signal is different from the resonance frequency on one side and a negative voltage when it is different on the other. Such AFC circuits will give very good control and take out quite large changes in tuning on the medium- and long-wave bands, but, in general, they are not directly applicable to short-wave reception, although, naturally, they can be employed in a double superheterodyne.

It is clear that such a self-compensating device is ideal for use with remotely controlled receivers, for it not only relieves one of the necessity for providing extreme stability of components, but it also renders the receiver far less likely to go out of adjustment during a long period of use. The disadvantage of AFC is that it increases the cost of a set because it increases the number of valves, and the initial ad-

Push-button Tuning System—

justment of the circuits involved is fairly critical. It is consequently generally found only in the more expensive types of receiver. In the cheaper sets it is less often included, and a good performance is then secured by paying great attention to stability. This is actually easier in the cheaper class of sets because they are, in general, less selective than the larger receivers, so that it is quite possible to use arrangements in such sets which would not be permissible in an extremely selective receiver.

Mechanical Methods

So far, we have discussed chiefly the electrical side of the problem, and it is not intended to go deeply into the mechanics of the actual control circuits because these vary so widely and do not affect the principles of operation. The use of systems which may be known variously as push-button tuning, or dial tuning, is not confined to remote control, and in some cases these controls are mounted instead of the ordinary tuning dial on the receiver itself. They are then often very much simpler, and one arrangement consists merely in mounting a telephone type of disc with the usual finger holes on the shaft of the gang condenser. Measures are naturally taken to see that the amount by which the condenser is rotated cannot vary through imperfect operation, and one scheme is to have a notched wheel with a spring engaging in the notches. Even if the operator does not then pull the dial round quite

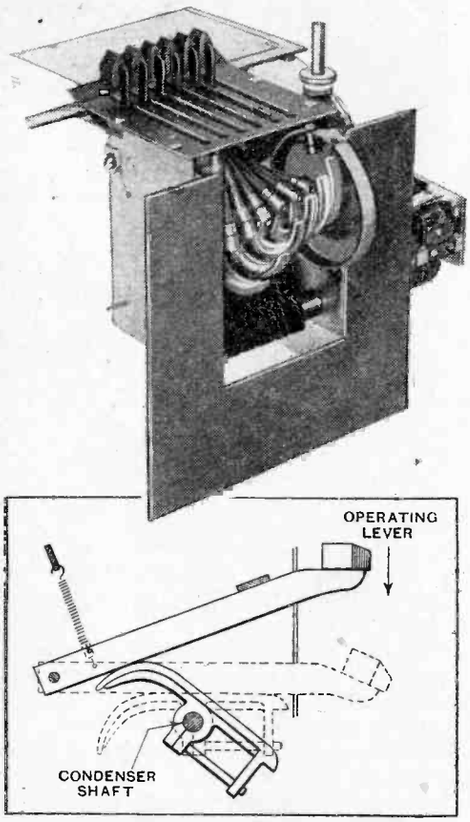


Fig. 6.—Another method of controlling a condenser by a lever system is shown here. On pressing the lever it contacts with the rounded portion of the control bar and so twists the condenser until the flat portion is parallel to the lever.

A press-button remote control system lends itself well to car radio.

sufficiently the spring will have fallen partially into the notch and complete the rotation.

In another system the condenser shaft carries a number of heart-shaped discs, one for each station. One operating key is provided for each disc, and its pressure moves the disc round in the manner shown in the drawing of Fig. 5. Still another system is to have a series of control bars mounted on the condenser shaft. One such bar, with its actuating lever, is shown in Fig. 6. The lever presses against the rounded portion of the bar and so rotates the condenser shaft, until it reaches the flat part.

With all these arrangements, careful set-up is necessary in the first place, and in some the question of mechanical wear must be considered as well as the usual problems of stability.

We are indebted to Messrs. Rothermel for the illustrations of American apparatus in Figs. 5 and 6, and also for photograph of the Stewart-Warner mechanism.

Aircraft Radio. By D. Hay Surgeonar. Pp. 151. 19 diagrams and 54 plates. Published by Sir Isaac Pitman and Sons, Ltd., 39, Parker Street, London, W.C.2. Price 12s. 6d.

THE author of this book sets out to give "a practical indication of the extent to which radio is at present applied to the service of aviation and of the various methods of application," and, though he certainly gives no more than this, the book contains a surprising amount of information on a vast and important subject.

Tracing the development of the aeronautical radio services from pre-war days, the book proceeds to a survey of the communication and radio-navigational services and equipment available to-day. The international regulations for the control of the airways radio-networks are given in some detail, and the characteristics of the various waves mentioned. The communication and aircraft-guidance requirements of the airways are discussed, and it is shown how, and to what extent, these have been fulfilled. There is an interesting chapter on airport approach beacons and fog-landing beams, both the American and European systems being dealt with. Modern aircraft radio equipment for communication and navigational purposes, suitable for all types of aircraft as well as for airport use, is briefly surveyed, and the final chapter is devoted to airport and airway lighting apparatus, which the author considers, perhaps rightly, to be a relevant part of the subject he is discussing.

The treatment of wave propagation and of DF principles is a little crude, and rather irritating to the radio man is the complete absence of circuit diagrams from the book. There are, however, a large number of excellent photographic plates, and where diagrams are made use of they fulfil their explanatory purpose admirably.

The book is a useful presentation of aircraft radio problems and practice in a non-technical form, and, as such, should be of great service to all those interested in aircraft flight and air traffic operation as well as to many members of the radio profession.

T. W. B.

Television Programmes

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

Sound	Vision
41.5 Mc/s	45 Mc/s

THURSDAY, MARCH 10th.

3, Flotsam and Jetsam. **3.20,** Gaumont-British News. **3.30,** 127th edition of Picture Page.

9, Flotsam and Jetsam. **9.20,** British Movietonews. **9.30,** 128th edition of Picture Page.

FRIDAY, MARCH 11th.

3, Lina Menova in Songs. **3.5,** Marcel Boulestin demonstrates the making of Rognons Flambés. **3.20,** British Movietonews. **3.30,** "Have you Brought your Music?"—a play devised by Quentin Tod, written by Eleanor Farjeon. **3.55,** Preview.

9, Leonard Henry. **9.10,** Repetition of 3.5 p.m. programme. **9.35,** "C'est la Guerre"—an incident in the Great War, by Morland Graham. **9.55,** Preview.

SATURDAY, MARCH 12th.

2.30, O.B. from the White City of Inter-University Sports. **3.15,** Grafting Fruit Trees—Talk by C. H. Middleton. **3.25,** Gaumont-British News. **3.35,** O.B. from White City (continued).

9, Cabaret Cartoons. **9.30,** British Movietonews. **9.40,** Exhibition of All-in Wrestling, described by E. R. Voigt.

MONDAY, MARCH 14th.

3, Cabaret, including Walsh and Barker, Nelson Keys and Marjorie Dale, with Russell Swann, compère. **3.40,** Gaumont-British News. **3.50,** Music-Makers.

9, Repetition of 3 p.m. programme (Relayed on Regional wavelength). **9.40,** Comedy Film—"Tell Me if it Hurts."

TUESDAY, MARCH 15th.

3-4, "The Crooked Billet," an adaptation of the thriller by Dion Titheradge.

9, Starlight. **9.5,** Design. **9.20,** Gaumont-British News. **9.30,** Sketches "The Cup that Cheers," by V. C. Clinton-Baddeley and "The Split in the Cabinet," by Stephen Leacock. Casts include Diana Churchill, Douglas Stewart and V. C. Clinton-Baddeley.

WEDNESDAY, MARCH 16th.

3, Marcella Salzer. **3.15,** Gaumont-British News. **3.25,** Light Musical Programme. **3.30,** "Words Upon the Window Pane," a play by W. B. Yeats. Cast includes Beatrice Wilson, Jean Moncrieff and William Devlin.

9, Charles Heslop with Maidie Field and Sydney Smith in "On the Sands." **9.10,** Experiments in Science. **9.20,** British Movietonews. **9.30,** "The Post Bag"—an operetta in one act by Alfred Percival Graves.

Loud Speaker versu

FIRESIDE AND CONCERT HALL VOLUME COMPARED

HERE at last are the results of the sound measurements I promised.[1] Regular readers will remember that a certain amount of controversy followed my article[2] "Scale Distortion," in which I had tried to show how the peculiarities of the human ear cause it to hear a distorted version of a programme if it is reproduced at a less—or greater—intensity than the original.

While nobody seems to have questioned the existence of this phenomenon, there are some who thought that my idea of "original" sound intensity meant the result that would be obtained if the whole

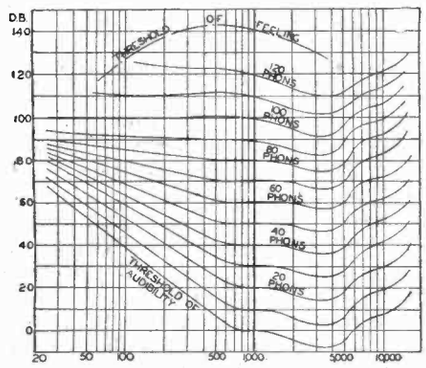


Fig. 1.—The loudness and intensity curves once again.

B.B.C. Symphony Orchestra or other source of sound were performing in the listener's back parlour; in other words, if the orchestra is capable of putting out 100 watts of sound, so must the loud speaker. I hope the subsequent correspondence succeeded in making clear that such a dreadful thought was far from me. At the same time, I did feel that as my examples were based on assumed figures it would be much more satisfactory to work on actual measured sound intensities.

As this article is by way of being a serial, or at least a sequel, I must fall in with the usual conventions, so——

New Readers Start Here

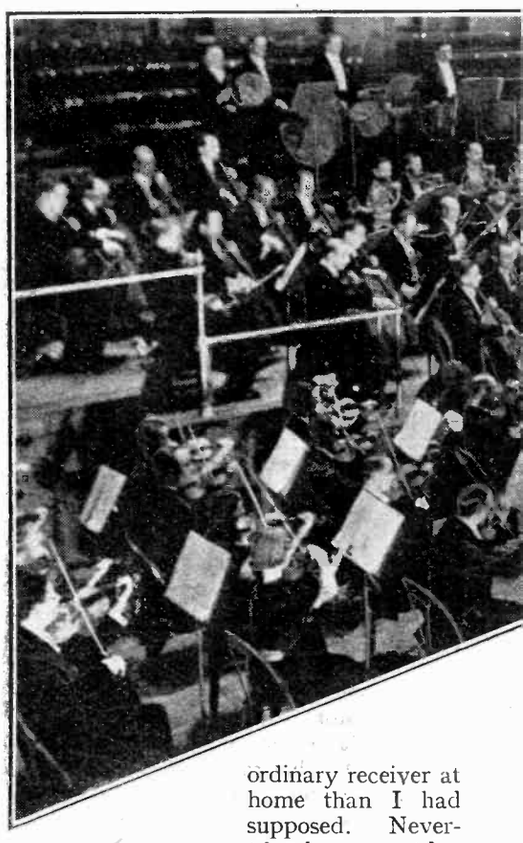
Sound Intensity is measured in decibels relative to the weakest sound at 1,000 c/s that can be detected by a person of normal hearing. Sound at 50 c/s has to be more than 50 decibels stronger before it can be detected by ear.

The *phon* is the unit of *loudness*, as judged by ear. Around 1,000-2,000 c/s it corresponds to decibels, but in the bass it only does so when sounds are very loud indeed. (See Fig. 1.) Therefore, if by adjustment of volume control the intensity of a reproduced programme is reduced a certain number of decibels below that of the original performance it loses considerably more than that number of phons loudness in the bass, and is, therefore, *distorted*. Effect on frequency characteristic of reducing from 90 db. to 70 db. is shown by Fig. 2. (Sensation!) Similarly, a programme reproduced *above* original intensity is distorted in the opposite direction. The aural equivalent of photographic enlargement or reduction is not possible. It looks serious for the quality enthusiast. (See Fig. 2 again.) *But what do the mysterious figures mean?*

Now Read On

By the courtesy of the B.B.C. and of Messrs. Claude Lyons, Ltd., I have been able to compare the loudness of an original performance in the concert hall with the same programme reproduced by loud speaker in the home. The former admitted me to a rehearsal of the full B.B.C. Symphony Orchestra, and to sound measurement tests they were doing themselves, while the latter kindly provided me with a General Radio 759-A Sound Level Meter.

I will admit right away that there was a closer agreement between the original loudness and what could be done with an ordinary receiver at home than I had supposed. Nevertheless, the measured results have not made it necessary to withdraw or modify anything, but rather have provided very satisfactory confirmation of the estimated figures I quoted. Fig. 2, for example, was based on the supposition that 90 phons is typical of a loud radio set, and that a Hungarian Rhapsody played on a grand piano might come at least up to that figure. But late in the evening, for the benefit of neighbours, one might discreetly turn the volume down 20 db., giving 70 phons in the treble ("Medium radio set") but much less than that in the bass. The result, in fact, would be just as bad as using an amplifier having the frequency characteristic B in Fig. 2, which is enough to make any reputable quality-enthusiast commit *hara-kiri*.



The maximum loudness of ordinary piano playing at home, as measured, was 80 phons. The very loudest playing was 90 phons. Reproduction of piano broadcast at a loudness that is not enough to be life-size but is too obtrusive to be comfortable as a background to conversation measures about 70 phons.

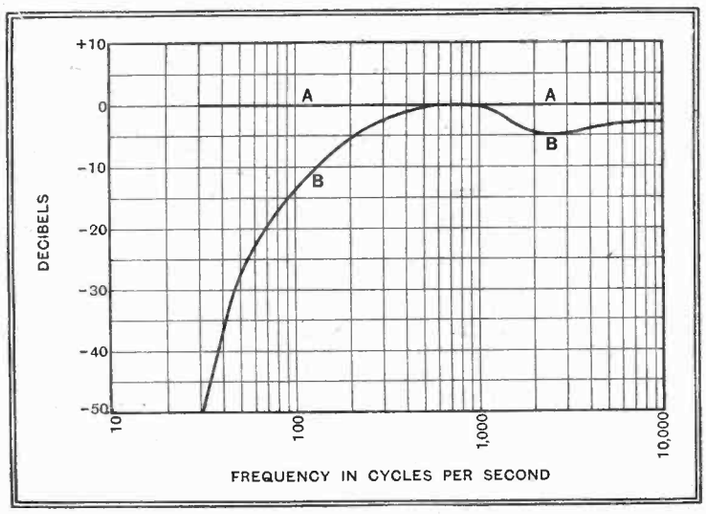


Fig. 2.—Curves reprinted from the previous article, "Scale Distortion," showing how adjustment of a volume control to reduce the volume 20 db. (one-tenth the signal voltage) is equivalent to replacing the perfect amplifier characteristic A by the very bad one B.

[1] A letter in the issue of Nov. 18th, 1937.

[2] *The Wireless World*, Sept. 24th, 1937.

Orchestra

By "CATHODE RAY"

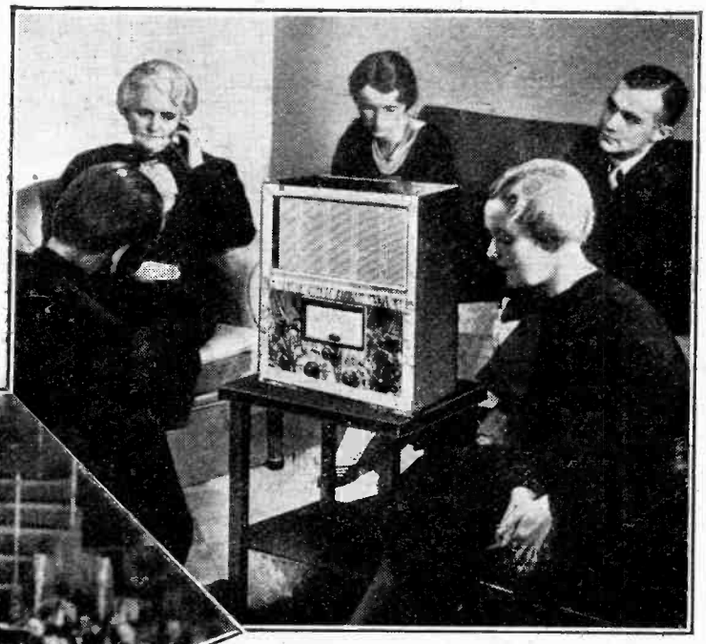


Photo above by courtesy Marconiphone.

Of course, these figures and others to be given are very rough guides, because there are so many unspecified quantities —efficiency of loud speaker, volume and reverberation of room, nature of programme—entering into them, and they must be regarded as a general indication of fairly average conditions. The reading of the instrument itself leaves quite a lot to personal judgment, so perhaps I had better describe it.

Fig. 3 is a functional diagram of the instrument shown in Fig. 4. The essential features are a microphone of level and stable characteristics, an amplifier, an attenuator, a frequency-weighting circuit, and a meter to read the output of the amplifier due to sound picked up by the microphone. As the meter covers only a limited part of the enormous range of sound intensity, the attenuator is used for much the same purpose as the range switch in a multi-range milliammeter or voltmeter. The microphone, amplifier, attenuator and meter are designed to have a flat characteristic, i.e., to respond equally to sounds of all frequencies. As such, the instrument (if properly calibrated) measures sound *intensity*. For example, looking at Fig. 1 a sound of 40 db. intensity gives the same reading on the meter, whatever its frequency, but in loudness it varies from total inaudibility below 100 c/s to 43 phons at 3,500 c/s. Remember that a sound has intensity whether there are any human beings to listen to it or not, whereas loudness varies with the acuteness of hearing of the individual.

There are two ways of measuring loudness. One, the subjective method, is for the operator to compare the sound being measured with a standard sound generated by an instrument. Besides being rather a wearing sort of job to do for long, especially with fluctuating sounds, the results depend on the hearing of the operator. The other, the objective method, is to calibrate the intensity-measuring instrument in terms of the curves of Fig. 1, which are the average of tests made on a good many ears. This is where the frequency-weighting circuit comes in. By converting the flat frequency response of the amplifier into one of the shape of the Fig. 1 curves it stimulates the response of an average human ear, and the meter readings can be regarded as indicating *loudness*.

The matter is complicated by the fact that the response curves themselves depend very largely on the loudness. At the threshold of audibility, for instance, there is nearly 80 db. difference between sounds of 20 c/s and 3,500 c/s; whereas at 100 phons the difference is less than 10, and one would not be badly out in using the undoctored amplifier. As it is impracticable to get the weighting to adjust itself automatically to the right curve as the sound fluctuates in strength, an approximation to the truth is obtained by providing several alternative weightings. In the 759-A meter one has the choice of 40 db., 70 db., and "flat" for working on sounds between the limits of 25-60, 50-90, and 80-130 respectively. Sounds below 25 are not commonly experienced in this restless world, except perhaps in the middle of the Sahara, and in any case are obscured by the electrical "noise" in the amplifier. The instrument is calibrated in decibels because in the U.S.A. they are not yet sufficiently enlightened acoustically to have adopted the "phon" as a unit of loudness to distinguish it from sound intensity, but the db. readings can be taken as phons provided that the appropriate weighting is used. It is easy enough to confuse loudness and intensity without the additional handicap of measuring them in different sorts of units, both of which are called decibels.

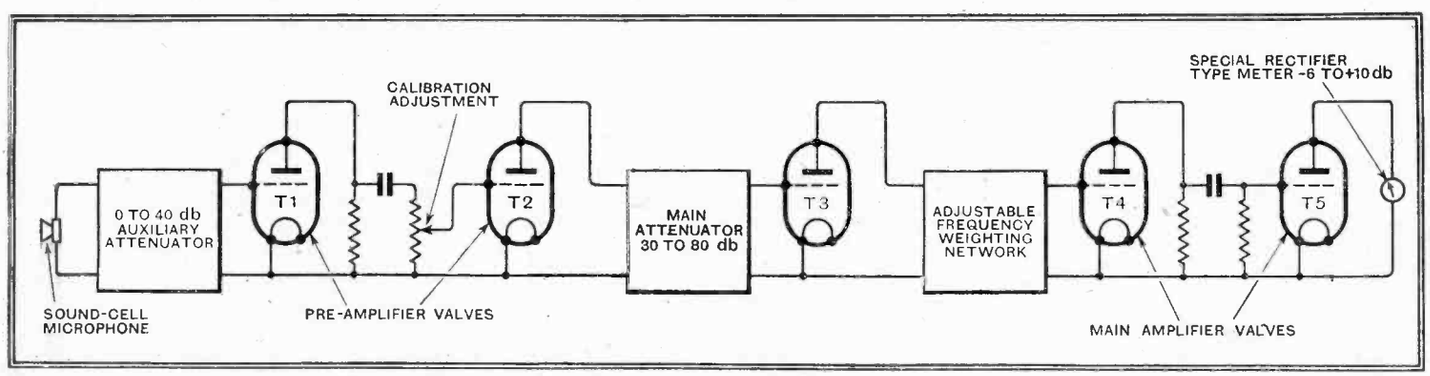


Fig. 3.—Functional diagram of the General Radio 759-A Sound Level Meter.

The procedure in measuring sound is quite simple. The instrument is held with the microphone in the place at which the loudness is to be measured; it is switched on, and the attenuator is adjusted so as to bring the indications on to the scale, the weighting switch being set to the nearest agreement. The read-

ings of meter scale and attenuator are then added. There are facilities for checking batteries and calibration when necessary.

But most of the sounds in which one is interested are fluctuating more or less violently. Short of using a recording meter, it is difficult to make up one's mind what reading represents the loudness of the sound. The General Radio meter has a very rapid response, and gives full measure to such short-lived sounds as hammer blows or drum taps. If the sound is chiefly of this nature it is almost impossible to form an estimate of the *average* intensity, but fairly easy to read the peaks. On the other hand, with most organ music, for example, the pointer fluctuates over a limited part of the scale, and a fair average can be struck. The fluctuations are far less for a given type of sound in a large reverberant hall than in a small "dead" room, for obvious reasons.

The meter used during a number of years by the B.B.C. for programme control is similar in its type of response, but for the sound measurement tests that they carried out simultaneously with mine they were using a new type of peak meter that responds very rapidly to the peaks and then falls back slowly, until another burst of sound carries it forward again. With this it is much easier to read the peaks, which are what matter when a transmitter has to be protected from overloading.

In all arguments on realistic reproduction of programmes the Queen's Hall is cited, so it seemed the proper place in which to measure the sound of an original performance. A final rehearsal suggested itself because measurements could be compared with those made later in the day on the same programme by loud speaker at home, and also because a paying audience might not be tolerant of even such an unobtrusive piece of apparatus as the 759-A. There is a small audience at rehearsals, but as it presumably does not pay it has to be prepared to put up with engineers strolling about with meters. Even so, a stern gentleman was sent after me to make enquiries, being under the impression that I was taking photographs of the orchestra in their *négligés*.

Distribution of Sound

Meticulous readers may object that the acoustics of a practically empty hall are not the same as when full. True, but with the new Queen's Hall seating the difference is too small to worry about.

Most of the readings were taken in the front row of the balcony, but in the stalls about half-way back they did not appear to be very much higher. If the hall were padded throughout like one of the early studios one would expect the loudness to be affected by distance from the orchestra, but in a "live" building of good acoustics the sound is distributed fairly uniformly.

After careful observation of various types of orchestral music the following sums up my results, and is in substantial agreement with those of the B.B.C.

Peak readings of the loudest climax in a programme, such as might be expected in music by Wagner, Richard Strauss, Elgar or Tschaikovski, but certainly not in Haydn or Mozart . . . 105 phons.

General level of loud playing, such as in the climaxes of a Brahms Symphony . . . 90 phons.

Moderate orchestral playing . . . 80 phons.

Rather quiet orchestral playing . . . 70 phons.

Quiet music such as muted strings . . . 60 phons.

The quietest music in an orchestral work . . . 55 phons.

Some sounds go below this—the tailing off of a violin solo, for example—but the B.B.C. engineers reckon on a total range of no more than 45-48 db. between least and greatest, which is considerably less than the 70 db. commonly quoted. The latter evidently includes the least sound (such as the proverbial fall of the pin) just audible with everyone holding his breath—which would certainly be lost on broadcast listeners, however much the amplifier gain might be increased—up to the biggest noise an orchestra can make—which would equally certainly require some holding down by the control to avoid over-modulation. Apart from these two extremes it appears that hardly any control is needed, and it is not uncommon for a whole symphony of the less exciting type to go through without any control at all; again, rather contrary to general belief.

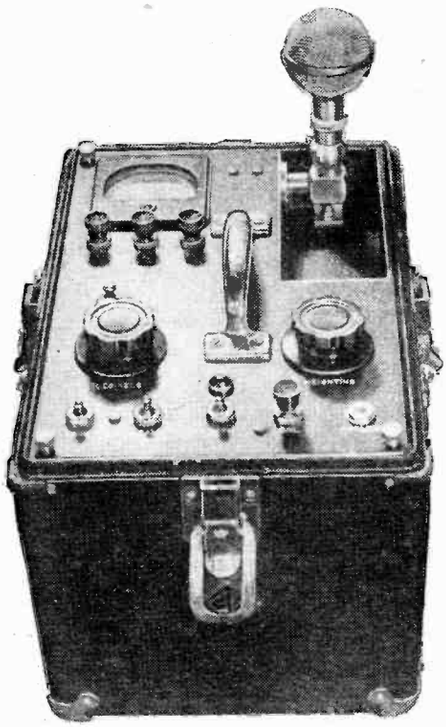


Fig. 4.—The General Radio 759-A Sound Level Meter with microphone in working position.

This was confirmed by tests at home in which the readings taken with a receiver adjusted to a comfortable level for serious listening were remarkably similar. The extreme contrasts were less by at most about 10 phons than those noted direct.

What is more, these readings were given in a moderate sized (13 × 12 × 10 feet) room, fairly heavily damped acoustically by upholstery and curtains, by a receiver with an output of only 1½ watts. The loud speaker was rather efficient for a moving coil; but horn-type speakers, such as the Voigt, are much more efficient, while some of the high-quality moving coils are less. Using one of the latter, and a contrast-expander to restore the extreme peaks, one would have to provide perhaps 20 watts output, or even more, to avoid the slightest overloading.

Apparent Loudness

That is assuming that the listener is at a reasonable distance from the loud speaker. A typical commercial receiver, with a rated output of 3½ watts (actual about 2) turned up to overload badly on dance music gave 110 phons close up to the loud speaker, but less than 100 some distance away. This introduces another point. Although an objective sound meter, properly used, should agree fairly well with the ear's impression of loudness, I am quite convinced that it does not. A simple test showed this. With a nearly pure 400-cycle continuous note from an oscillator adjusted to 1 watt output to the loud speaker, the sound meter reading was as high as 110 phons in the mouth of the speaker, and varied greatly elsewhere in the room owing to standing waves set up by reflection. But wherever measured the readings agreed with those taken after substituting a very impure 400-cycle note also adjusted to 1 watt. But the rough note *sounded* far louder, or, if you prefer it, more obtrusive. That is one of the problems that has to be faced in measuring the "objectionableness" or "annoyance value" or noises of various types. It is also presumably why a raucous motor horn (i.e., one with harmonics probably much stronger than the fundamental) commands more attention than a smooth-toned one of the same power.

Not only is this result indicated by tests on steady notes, but when listening to musical programmes one gets an impression of far greater loudness when many sounds are going on at once than when there is a single note of the same total power or measured loudness. In one of the musical items I measured there were several outbursts from the whole orchestra, followed each time by a vigorous assault on the tympani alone. Now, although the remaining 113 members of the orchestra seemed to add enormously to the amount of sound when they did their bit, they only raised the measured level from 98 to 100. And that was in spite of the fact that the drum strokes were only intermittent, and might therefore have been expected to give a rather low reading.

This demonstrable discrepancy between

Loud Speaker versus Orchestra—

meter readings and personal impressions makes the next thing sound less pig-headed. You remember that I implied, if I didn't actually say, that normal home listening loudness seemed less than concert loudness. Measurements have shown that they are practically equal. It is not that I am reluctant to admit being wrong, even in a small degree, nor do I think there is anything wrong with the meter, but even when it says the home reception is as loud, I can't quite believe it. It may be that "loud" is the wrong word. It may be that "big" or "real" is more correct.

In both places (Queen's Hall and home) I closed my eyes and tried to be conscious only of the sound. In spite of the meter showing equality, the reproduction was somehow smaller. I wanted to turn it up more to get greater reality. And that was not only at climaxes, where the B.B.C. control might be holding it back, but during a comparatively quiet and steady Handel concerto.

"Scaled-down" Reproduction

The hearing of sound is a very subtle matter, and there are several things that might have something to do with this apparent scaling down. In the hall, with eyes shut, I could hear the sound reverberating and coming from all directions. A blind man could estimate the size of the place. At home it is true that the reverberation of the hall is reproduced. Not quite as much, because the microphone is closer to the orchestra than most of the seats;[3] and perhaps the audience was having some effect, too. But it comes from the loud speaker, and the illusion is lost. It is a miniature even if it measures to the same strength. Moreover, any reverberation due to the small room is superimposed, and the ear is very sensitive to the difference between this and what it ought to be when listening to a big orchestra. Then there is the stereophonic effect that the possession of two ears gives us. I may have something more to say about that. All these illusion-destroying conditions would exist if my receiver were perfect, which it is not.

One may not always have even the advantage of hearing the programme reproduced at its original intensity. Near neighbours are likely to complain, and other members of the family, too, if they do not happen to be interested in it. With the reduced volume there is "scale distortion." It is always present, also, when dance bands, large orchestras, organs, etc., are used as a "background" to other activities, though it is unlikely that the hearers—I will not call them listeners—are seriously perturbed about this.

At 70 phons a programme is still rather uncomfortable to talk against, and somewhere about 60 is more likely when conversation is general. Some people apparently find it worth while to have a set switched on at a considerably lower level. Fig. 1 shows that scale distortion is then tremendous. The bass is almost non-existent.

I had no opportunity of measuring the loudness in an announcer's studio, but the voice sounds natural at about 65 phons. Obviously, if the receiver volume control is left untouched during the interval in a Symphony Concert the News Bulletin literally booms forth at about 90 phons, with serious scale distortion exaggerating the bass. Actually the conductor's remarks to the orchestra during rehearsal were only about 55, and quite clear at that. In a small, quiet room 50 phons is enough for speech to be heard without strain, and at 40 it can still be followed, assuming the voice is up to B.B.C. standard of diction. In a public building the same loudness would not do, because, apart from any disturbance due to the audience, the words are more or less obscured by reverberation. On the other hand, if there is not enough reverberation, the voice may be too weak to be audible.

Having already exceeded my usual limits, I may as well be hung for a sheep as a lamb, and put in some theory for what it is worth. There is a formula for connecting the sound intensity in a room or hall with the power required to create it, after allowing time for the sound to build up to a steady state.

$$I = \frac{WT}{11.4V}$$

Where I is the sound intensity in watts per cubic centimetre, W the sound power in watts emitted from the source, V the volume of the room in cubic feet, and T its reverberation time in seconds.

The reference level from which sound strength is reckoned is $W = 10^{-16}$, so if d is the number of decibels above this, the formula can be written—

$$10^{\left(\frac{d}{10} - 16\right)} = \frac{WT}{11.4V}$$

$$\text{or } \log_{10}\frac{WT}{11.4V} = \frac{d}{10} - 16$$

According to this, to produce a level of 100 db in the Queen's Hall, which is said to have a V of about 250,000 cubic feet and a T of about $1\frac{1}{4}$ secs.,

$$10 = \frac{1.25W}{11.4 \times 250{,}000}, \text{ and } W = 2.28 \text{ watts.}$$

This is a good deal less than the 100 watts quoted in American books for a large orchestra, but perhaps American orchestras make more noise than ours. If the programme were being reproduced by loud speaker in the Queen's Hall, the power to be supplied by the amplifier would, of course, depend on the efficiency of the speaker. I believe typical figures for horn and moving-coil speakers respectively are 30 and 5 per cent., requiring 7.6 and 45 watts respectively.

In a smallish room, with a volume of 1,500 cubic feet, and a reverberation period of 0.6 sec., the power required for the same sound level (100 db.) works out at 28.5 milliwatts. Assuming again a 5 per cent. loud speaker efficiency, the required input is 0.57 watt. If 5.7 watts is available, the sound could go up to 110 db., and ought to provide for all eventualities. Personally, though, I think this formula gives wattages on the low side.

[3] I believe I am right, too, in saying that the microphone is directional to the orchestra, and thus reduces the apparent reverberation.

News from the Clubs

West Sussex Short-wave and Television Club

Headquarters: Tangmere, Sussex.
Meetings: Wednesdays at 8 p.m.
Hon. Sec.: Leading Aircraftman J. Williams, H.Q. Flight, 43 (F) Squadron, R.A.F., Tangmere, Sussex.

The Club has now acquired new headquarters at Tangmere, Sussex. The meeting on February 17th was followed by a sale of disused apparatus. The following programme has been arranged for the remainder of the season:—

April 6th.—"Microphones" by Mr. Orr-Ewing, of Shaftesbury Microphones.
April 13th.—Lecture and demonstration of "Hi-Q" components and receivers by a representative of Lissens.
April 28th.—Lecture by a representative of the "Avo" Co.
May.—"Electrical Measuring Instruments" by a representative of Westons (exact date to be announced later).

Kingston and District Amateur Radio Society

Headquarters: The Three Fishes Hotel, Richmond Road, Kingston, Surrey.
Meetings: Alternate Wednesdays at 8 p.m.
Hon. Sec.: Mr. D. N. Biggs, 44, Pooley Green Road, Egham, Surrey.

The lecture given by Mr. Kempster, of E.M.I. Service, entitled "High Definition Television," proved very popular. At a later meeting a representative of the Mullard Service Co. gave a lantern lecture entitled "Valve Applications in Television Receivers."

Croydon Radio Society

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

Mr. H. L. Bowen, of the Mullard Wireless Service Co., recently gave a lecture on "Valves and Their Application to Television." The lecturer also dealt with special valves for short-wave work. At the next meeting on March 15th Mr. R. P. Jonas, the Hon. Librarian, is giving a talk on quality reproduction at which he will demonstrate his new Voigt loud speaker in conjunction with *The Wireless World* Quality Amplifier.

Derby Short-wave Radio and Experimental Society

Headquarters: Nunsfield House, Boulton Lane, Alvaston, Derby.
Meetings: Tuesdays at 8 p.m.
Hon. Sec.: Mr. H. Turner, Nunsfield House, Boulton Lane, Alvaston, Derby.

At a recent debate on the subject of straight sets v. superhets the latter won the day, but by a very narrow majority.

Will those in the district who are experimenting with five-metre transmission or reception kindly get into touch with the Secretary as the summer programme is being arranged and this will include a number of five-metre field days.

Exeter and District Wireless Society

Headquarters: 3, Dix's Field, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

A somewhat unusual lecture was given recently entitled "Electricity in the Home," the speaker being Mrs. Rumball. The lecturer dealt with the efficiency, cleanliness and economy of electricity and demonstrated many pieces of apparatus. Mr. Rumball then followed on and demonstrated several small electrical accessories such as heating pads. At a later date Mr. D. R. Barber lectured on "Radio and the Stars." On March 14th Mr. R. C. Lawes will demonstrate the Hammond Organ, this being the first time that this has been demonstrated publicly in this part of the country.

To tell me that . . .

UNBIASED

By FREE GRID

. . . it did not function.

A Disturbing Discovery

I AM feeling very exhausted and worn out at the moment, having just concluded a somewhat acrimonious correspondence with a well-known set maker which has resulted in a rather disturbing discovery. An acquaintance of mine, who had, against my advice, purchased a certain make of wireless receiver, rang me up as soon as he had taken it out of its packing case and tried it out to tell me that it did not function.

I replied that this was perfectly normal as the maker of this particular set still adhered to the old-world custom of sending a dummy model on one or two occasions before he allowed the purchaser to have the working one. This old system was originally adopted in the good old palmy days of set making, when the rush of orders was greater than a factory could cope with; naturally, this "dummy" model system enabled valuable time to be gained during which the factories could catch up with orders.

However, after he had duly returned and received back the set six times, I began to realise that I should have to take a hand in the matter if my friend, who had passed the prime of life, were to have his ambition fulfilled of hearing the set in action before he joined his ancestors. I, therefore, got him to bring the set round to my place and I soon found out that several resistors were burnt out.

I wrote to the set maker explaining that I was going to make myself responsible for repairing the receiver, and I ordered the requisite replacements together with the necessary blue print giving details of resistance values, etc. When the resistances arrived, one glance at the colour coding was sufficient to tell me that they were of the wrong value, but I did not let this worry me as I naturally supposed that they were out of stock of the correct ones and were using this old dodge to gain time. I forthwith returned them and when new ones were sent I did not even bother to open the parcel, but merely readdressed it to the makers.

The third lot to arrive were still incorrect, and so I sent a somewhat sharply worded letter. When incorrect values arrived once more, however, I became really annoyed and wrote to the actual manufacturers of the resistances for a supply. To my amazement I had no sooner opened the parcel they sent me than I realised by the colour coding that they also were wrong. I naturally suspected that some new system of colour coding had been adopted, but a letter of enquiry brought forth a denial together with a fresh supply of the wrong ones.

This time my letter was so strongly worded that the chief engineer of the company came in person. It was soon evident that we were talking at cross purposes and suddenly a great light seemed to dawn on his face, and the whole cause of the trouble was revealed. It appears that as a result of my long and arduous laboratory work I had become colour blind and was unable to identify the resistances correctly, and so had been wrongly anathematising both set and component manufacturers.

Apparently, this colour blindness is no uncommon thing, but, fortunately, I understand, I shall be able to have the defect corrected by using colour-correcting filters over my spectacles as in the case of a camera lens, and this I intend having done.

Birds of a Feather

I CAN'T say that I'm a great admirer of proverbs and the other so-called wisecracks of the ancient philosophers as most of them, when analysed, are so sordidly commercial in the sentiments they express. Take, for instance, "Honesty is the best policy," which most of us had impressed upon us in our very early days. When analysed it simply means that the only reason for being honest is that it pays to be so; honesty is, in fact, debased to being a means rather than an end. Apart from this, of course, the proverb is manifestly untrue, as you and I can testify

The codfish eye of suspicion.

who have steadfastly plodded our way through life along the path of honesty, and have seen other less scrupulous people leave us far behind in what an American journal calls the great radio race to riches.

However, there are exceptions to every rule, and, much as I hate to admit it, there are one or two proverbs which do appear to express great truths in brief and pithy form. Among these there is one in particular, namely, "Birds of a feather flock together," which, it has recently been brought home to me, is very apt in certain circumstances. The birds in this particular case are Government departments and semi-Governmental departments which have a confirmed habit of sticking together for mutual protection, as witness, for instance, the Post Office and the B.B.C.

It is not the B.B.C. in this case, however, but the Mint and the G.P.O. Now, as you know, if you suffer from electrical interference with your radio reception, it is only necessary to complain to the Post Office, and the anti-interference squad will be round in no time; moreover, although there is no legal power at present to compel the owners of the interfering apparatus to fit suppressors, the G.P.O. wallahs do approach them in a tactful manner when they find them out, and enlarge upon the great good they would be doing their fellow creatures if they fitted suppressors. More often than not this polite approach completely succeeds in its object.

Now, quite recently, a friend who is a great radio enthusiast moved his abode to the vicinity of the Royal Mint. He was immediately struck by a very peculiar form of electrical interference which he suspected came from the Mint, and he at once wrote to me about it. The interference seemed far worse after dark and in order to confirm my friend's suspicions I spent several weary nights wheeling special portable DF apparatus round the Mint premises in an old and dilapidated-looking perambulator, and thereby drawing the codfish eye of suspicion on me from several policemen hanging about the neighbourhood. As a result of my experiences I became absolutely convinced that the Mint was the offender, and advised my friend to send for the P.M.G.'s anti-interference squad.

Upon their arrival he immediately acquainted the sleuths with the source of the interference, but to his amazement was immediately met with a vehement denial that the Mint could possibly offend. Furthermore, after a pretence at DF work, they merely expressed their regrets at their inability to trace the source of the interference. This is not the first time I have come across this "birds of a feather" business in the case of Government departments, but I have never previously experienced it in connection with wireless. If any of you know of any other instances of this kind I shall be glad if you will let me know.

Short-Wave Distortion

SOME SECONDARY EFFECTS OF FADING

THE causes of short-wave fading are now fairly common knowledge, but the secondary effect of distortion — which fortunately is not always present to any serious extent — is not so generally understood. This article describes the influence of various types of fading on quality of reproduction.

IN enjoying the thrill of listening to short-wave stations thousands of miles away we are apt to overlook the fact that, in spite of the almost magical space-spanning properties of waves in the 10-80-metre region, there are other properties which are not so attractive.

First, it will be noticed that the signal volume varies in a random manner, sometimes slowly and steadily and sometimes rapidly, perhaps at the rate of 10 or more fades per second. Secondly, it will be noticed that the purity of tone also varies in a random fashion, the signal in the depth of a fade being sometimes accompanied by severe distortion. Thirdly, the audio response from the receiver apparently varies in random fashion, at one moment the low frequencies will be absent and at another the high ones.

Now, it is unfortunately true that even though the receiver may be operating perfectly normally and correctly on the short-wave range, the effects described above may still be observed, sometimes to a quite minor degree and sometimes more markedly. Even the resources of the B.B.C. have not been completely successful in removing these characteristics from their long-distance short-wave relays.

An Inconstant Medium

The peculiar characteristics of the 10-80-metre waveband are caused by the lack of constancy of the reflecting power of the medium which is responsible for the transmission of these waves.

As is well known, this medium consists of a number of fairly well-defined layers of ionised gas situated at heights of between 60 and 200 miles above the surface of the earth. The ionisation is produced by ultra-violet light radiated by the sun, and the result is that free electrons are produced so that the ionised layers become conducting media capable of reflecting any electro-magnetic waves which may impinge upon them. The propagation of short waves takes place by successive reflections between the surface of the earth and the ionised layers. It will be clear that transmission between a transmitter A (Fig. 1) and a receiver B may take place over a number of paths of different lengths. However, since at each reflection the transmitted wave is attenuated, the signals arriving over paths including a large number of reflections will be so weak as to be negligible. Usually not more than two or three different paths are involved, but these are sufficient to produce the effects described in the opening paragraphs.

It may be of interest to see how these signals can interfere with one another so as to produce the effects described.

Suppose we are receiving an imaginary American short-wave broadcasting station on, say, 30 metres wavelength. The signals will be travelling over a path of about 3,000 miles or nearly 5,000,000 metres; we may be receiving two signals whose paths differ by perhaps 37.5 miles, or 60,000 metres.

This path difference means 2,000 complete wavelengths at 30 metres, or 10,000 kilocycles per second. It also means 2,001 complete wavelengths at 29.985 metres, or 10,005 kilocycles per second. If, now, conditions are such that at 30 metres (10,000 kilocycles per second) the two incident waves add, they will also add at 29.985 metres (10,005 kilocycles per second). On the other hand, at a frequency mid-way between these, the signals will oppose one another, and the resultant will be smaller than either. We may now visualise an interference pattern of resultant amplitude on a frequency scale; in the example quoted the interference maxima will be spaced at intervals of 5 kilocycles per second only (see Fig. 2, *c* and *d*).

Suppose, now, that the difference of path length is 6,000 metres; this will mean 200 complete waves at 30 metres (10,000 kilocycles per second) or 201 complete waves at 29.85 metres (10,050 kilocycles per second). It is clear that a smaller difference of path length results in a wider separation of the interference maxima (Fig. 2*b*).

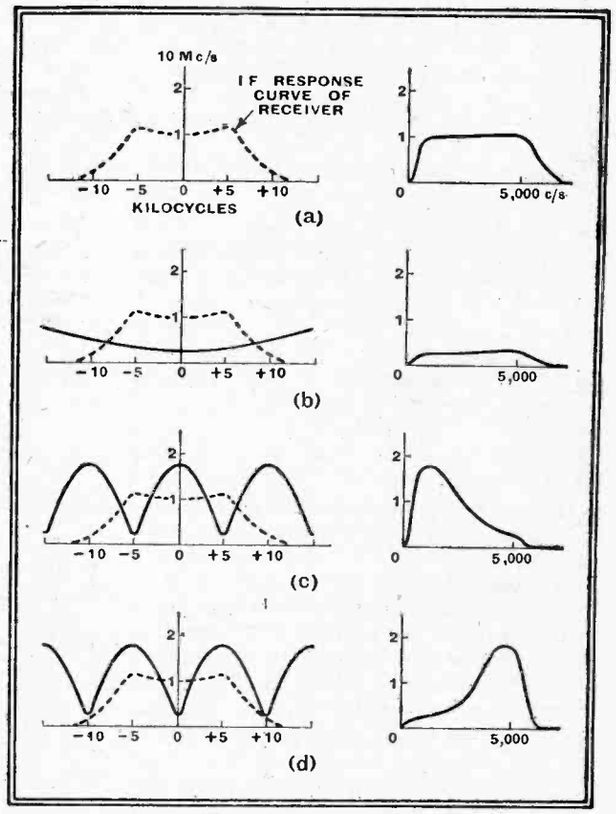


Fig. 2.—Various types of fading, and their effects on the audio-frequency characteristics of a receiver. (a) No interfering wave; (b) general level fade; (c) selective fade causing loss of high audio-frequencies; (d) selective fade causing loss of low audio-frequencies and carrier.

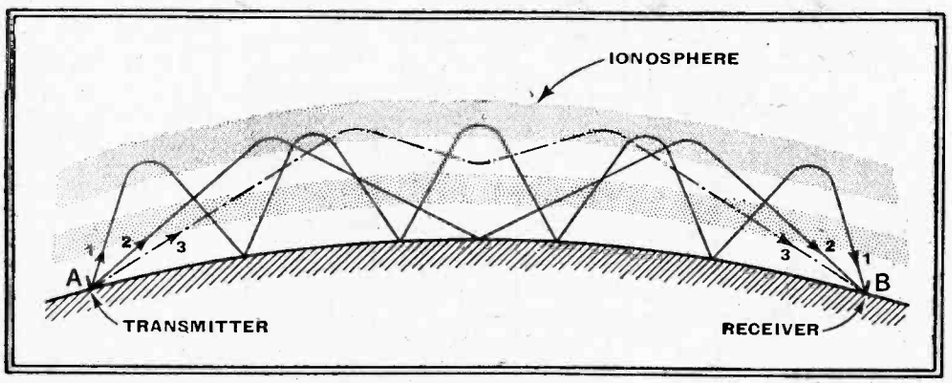


Fig. 1.—Multiple paths that may be taken by a signal on its journey from transmitter to receiver. The height of the ionosphere layer is greatly exaggerated.

Short-Wave Distortion—

So far we have only considered cases where the path lengths remain constant with time. In practice, of course, the ionosphere is far from being an ideal, steady reflecting medium. The layers are constantly shifting, tilting, rising and falling. The result is that the difference of path length also varies rapidly with time. When it is realised that a change of path length of one-half wavelength (15 metres in our example) will produce a change from an interference maximum to a minimum, it is small wonder that signals fade erratically when they have traversed paths probably several hundreds of thousands of wavelengths long. We may, in effect, visualise the interference patterns of Fig. 2 moving to and fro along the frequency scale. We may now go on to consider how these are associated with fading and distortion.

This may be due to either changes in the

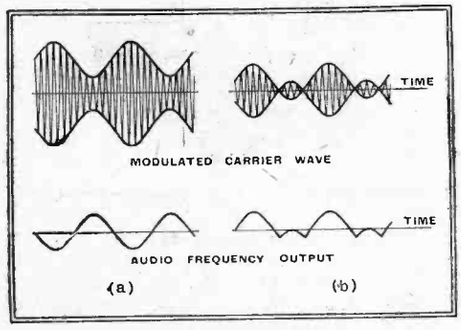


Fig. 3.—The effect of selective fading of the carrier on audio-frequency output.

density of ionisation of the ionosphere or to shifting interference patterns of the type shown in Fig. 2*b*, i.e., one corresponding to a fairly small path difference and widely spaced interference maxima as in the second example quoted above. The time period of the fading is usually of the order of one second to several minutes. This type of fading may be successfully overcome by automatic gain control of fairly quick time constant (i.e., 1 second). The whole audio-frequency band rises and falls simultaneously, and, providing that the automatic gain control system is effective, little distortion results.

The characteristics of this type of fading are that it is rapid (frequency perhaps 10 per second) and that severe distortion ensues; this is usually accompanied by an apparent tilting of the audio-frequency response curve of the receiver. This is evidently a case of a large difference in path length and closely spaced interference maxima (as in Fig. 2*c* and *d*). On 16 metres the maxima of the interference pattern may be spaced only a few hundred cycles per second. These conditions produce considerable deterioration of quality, due to selective fading of the carrier, another phenomenon that must now be considered.

Occasionally the interference pattern trough passes through the carrier frequency of the transmission. This produces a condition similar to over-modulation at the transmitter. A single-tone modulation should normally produce the sinusoidal carrier envelope shown in Fig. 3*a*; when the carrier is attenuated the carrier envelope degenerates to that shown in Fig. 3*b*. Since the audio output from a linear detector follows the envelope of the modulated carrier, a selective fade of the carrier results in considerable distortion.

When speech or music is modulated on the carrier and a fade of this sort occurs, the effect is that the side frequencies beat together and so produce in the audio output from the detector frequencies never to be found in the original transmission.

Unfortunately, when the carrier wave fades the automatic gain control action tends to make the set amplification rise, so that these distorted passages are reproduced at high volume level.

There is another type of distortion which may occur, due merely to the phase shift of the carrier frequencies relative to the side frequencies, but perhaps by this time the reader may have begun to wonder how it is that his short-wave receiver performs as well as it does!

Readers' Problems

A Selection of Queries dealt with by the Information Bureau, and chosen for their more general interest, is published on this page.

Baseboard or Metal Chassis

A CONSTRUCTOR of the Straight Six receiver is proposing to use a wooden baseboard in place of the metal chassis specified, and we are asked if this modification is permissible.

We do not particularly care for the idea of building this set as suggested, for, as it includes three RF stages extra special precautions have to be taken in the screening. The top ought to be covered with metal and some vertical screens may also be required below the chassis and between the RF valve holders.

In the original set the three RF valves were enclosed in metal cans, which points to the need for more than the customary amount of screening.

Normally some latitude can be allowed in the choice of a chassis, and where a wooden structure is employed it is always best to cover the top with a sheet of metal, but we hesitate to extend this latitude to the Straight Six receiver.

Low Voltage DC Supplies: A Way Out

A READER has just moved into a house in the country which has its own 50-volt DC lighting system; we are asked to suggest a way of using this form of supply for feeding a receiver to best advantage, and also to consider the possibility of using a vibratory generator for HT.

From most points of view the use of a DC-to-AC rotary converter operating from the 50-volt supply would afford the best solution to the difficulty, as the reader's choice of receiver would then be in no way cramped. However, the use of a vibratory generator does certainly open up possibilities of solving the problem economically, both with regard to initial outlay and consumption of current. It should be easy to devise a receiver in which the heaters were fed direct from the house-lighting system, while the HT problem would be solved by using a vibratory generator of the type designed to run on 32 volts input (we believe no higher voltage type is available) with the appropriate value of limiting resistance in series with it.

Audio AVC

AN automatic volume limiter is required for a deaf-aid set in order to minimise the distressing effects produced by sudden loud sounds.

The manual volume control is of very little help as, owing to the unexpected nature of the sounds, no time is allowed to take the appropriate action beforehand.

We think a solution might be found by using a form of audio AVC. The circuit of the unit is shown in Fig. 1, and the additions needed for automatic control of the volume are indicated by heavy black lines.

A portion of the audio signal in the output valve is passed to a rectifier, which for convenience can be a Westector, and the DC component fed back to the first valve in the form of a negative bias.

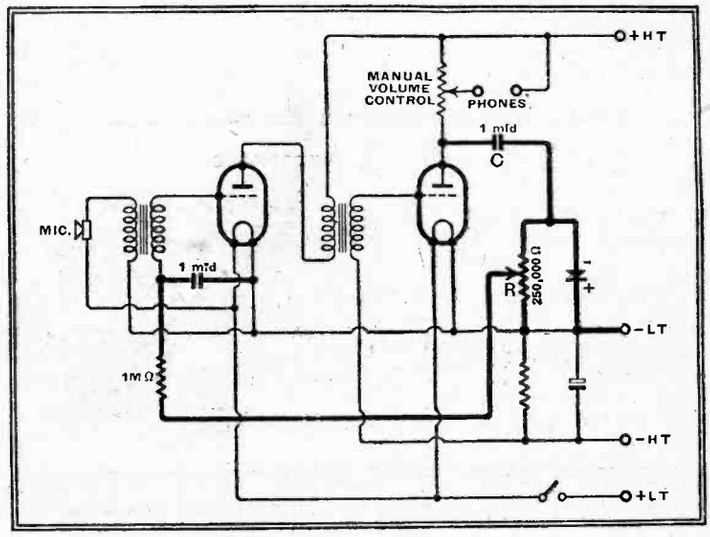


Fig. 1.—Method of obtaining automatic control of volume in a deaf-aid set.

The fact that this is a triode and does not possess variable-mu characteristics will not prevent the scheme from functioning satisfactorily, though a very loud sound generating a comparatively large bias voltage will probably cause rather bad distortion.

The 250,000 ohms potentiometer R has

been included so that the amount of negative bias required to reduce the volume to a comfortable level can be adjusted to suit individual cases.

This addition will tend to lower the sensitivity of the unit, as some bias voltage will be produced by normal sounds. If, however, the condenser C is connected to the slider of the volume control resistance instead of to the anode of the valve, the AVC voltage developed will then vary automatically with the setting of the manual volume control, being greatest with maximum output. With this arrangement it might be possible to dispense with the variable bias control R, which could be replaced by a fixed resistance of the same value, the lead shown joined to the slider then being connected to the junction of C and the Westector.

RF Stage in All-wave Superhet

ADVICE is required on the arrangement of the circuit for an all-wave superheterodyne, it being undecided whether to have an RF stage before the frequency-changer, followed by one IF amplifier, or omit the RF and use two IF stages.

If a tuned RF stage is employed, and we see no point in using one otherwise, the former scheme is certainly preferable in this case, for it will enhance the signal-to-noise ratio.

This will be more noticeable on the short than on the medium and long waves; also, there will be less likelihood of heterodyne interference from image signals with two than with only one tuned circuit before the frequency-changer.

On the ordinary broadcast bands there will not be very much to choose between the two arrangements so far as selectivity is concerned, but the single IF arrangement will be slightly less selective on the short waves, as the signal circuits will contribute very little in this respect.

If good IF transformers having air-dielectric trimmers are employed, the selectivity will be adequate for all normal requirements.

New Apparatus Reviewed

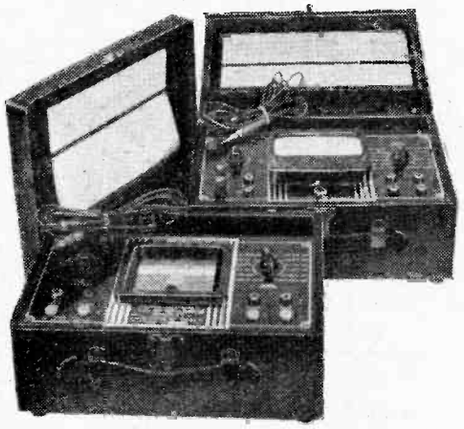
CLAUDE LYONS METERS

A NUMBER of multi-range test meters has been received from Claude Lyons, of 76, Old Hall Street, Liverpool. The smallest of these is the Simpson Model 205; this has a scale measuring 1½in. across the arc and has voltage ranges of 0-10, 0-50, 0-250, and 0-1,000, with a resistance of 5,000 ohms per volt. There are two current ranges of 0-10 and 0-500 mA. and three resistance ranges of 0-2,000, 0-200,000 ohms and 0-2 megohms.

This instrument is of pocket size, measuring only 2in. × 5¼in. × 1¾in. and it is priced at 85s.

The larger instruments are of two kinds and are fitted in carrying cases; there is Model 275 Roto-Ranger, in which the change for different ranges is effected by a switch which also rotates a scale below the pointer so that only a single scale is in view at any time. This point makes for great clarity of reading.

The meter has three resistance ranges, reading up to 20 megohms and three AC voltages ranges up to 1,000 volts. There are four DC voltage ranges up to 1,000 volts and two current ranges of 100 mA. and 500 mA. controlled by the range selector switch. In addition, separate terminals

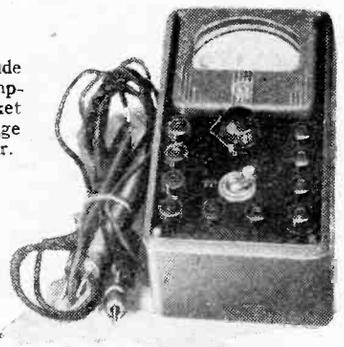


Simpson Roto-meter and AC/DC combined voltmeter, milliammeter, and ohmeter—marketed by Claude Lyons.

are provided for current ranges of 100 micro-amps. and 10 mA.

Connections are also made for using the instrument as an output meter. The voltage ranges for DC have a resistance of 10,000 ohms per volt and for AC, 1,000 ohms per volt, and the instrument is priced at £13.

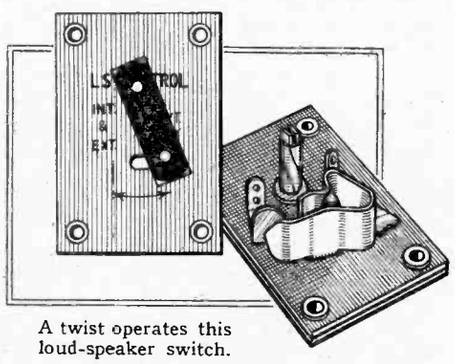
The model 250 is a similar instrument but without the rotating scales. There are five DC voltage ranges with a resistance of 20,000 ohms per volt and five AC ranges with a resistance of 1,000 ohms per volt.



The Claude Lyons Simpson pocket multi-range test meter.

There are seven current ranges and three resistance. A switch is used for the range selection and the instrument can be used as an output meter. This Model is priced at 15 guineas.

CLIX LOUD SPEAKER CONTROL

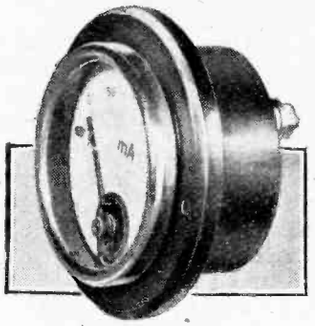


A twist operates this loud-speaker switch.

THE well-known switch plug and socket marketed by British Mechanical Productions, Ltd., of 79a, Rochester Row, S.W.1, has been modified. It will be remembered that this component consists of a two-pin plug and socket and is intended for the connection of an extension loud speaker. When the plug is inserted it can be twisted in such a way that it operates an internal switch contact, which can be used for the connection or disconnection of an internal loud speaker. The modifications consist of a strengthening of the spring and the fitting of silver-plated contacts. The component is priced at 1s.

DENCO METERS

A RANGE of meters is marketed by Denco, of 234, Burrs Road, Clacton, Essex. Types are available with maximum readings of from 1 mA. to 500 mA., and they are priced at 21s.

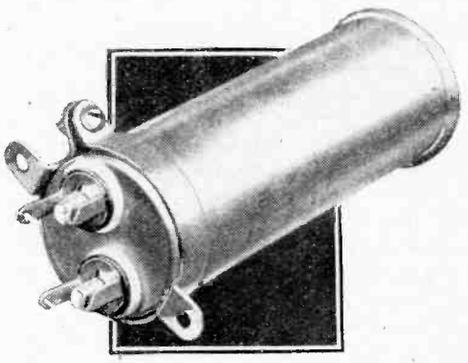


Denco 0-200 m.A. moving-coil milliammeter.

Of the moving coil type, they have a scale length of 1¼in. across the arc, with a window of 1⅛in. diameter. Designed for panel mounting, the overall diameter is 2¾in. and the back-of-panel depth 1¼in.

T.C.C. ELECTROLYTIC CONDENSER

HITHERTO aqueous electrolytic condensers have been available only in single units, but the Telegraph Condenser Co., Ltd., of Wales Farm Road, North Acton, London, W.3, has now introduced a dual unit. This is available in two types, 8—8 mfds. or 8—16 mfs. with a common negative terminal.



T.C.C. Dual wet electrolytic condenser.

The condensers are in a cylindrical aluminium container which forms the negative terminal; it is mounted to the receiver chassis by a clamp. The diameter is 1½in., and the height above the chasis 4½in.

The 8-mfds. sections are rated for 440 volts DC working with a limiting voltage of 460; the power factor is 0.15. The 16-mfds. sections, however, are rated for 320 volts DC working with a limiting voltage of 350; the power factor is 0.25. With both capacities the leakage current is given as 0.12 mA. per microfarad, and the maximum permissible ripple current is 120 mA.

Human Relay System

ELECTRICAL IMPULSES IN LIVING TISSUE

By G. PARR

THE majority of us are so actively engaged in dealing with radio impulses that we have little time to spare to consider the impulses of far greater importance on which our very existence depends. Considering how important the human electrical relay system is, surprisingly little consideration is given to it, outside the medical profession, although it possesses strikingly similar characteristics to the telephone and radio relay systems to which we are accustomed.

WITH the help of apparatus developed, at least in part, for wireless purposes, important researches have been carried out on the part that nerves play in controlling our voluntary and involuntary functions. The high-gain amplifier and the cathode-ray tube have added greatly to human knowledge in this field, and may eventually help towards the alleviation of pain and the general improvement of our bodily comfort and welfare.

The nerves are essentially the link between each component of the body and the central exchange, the brain. Each action, voluntary or involuntary, is undertaken on instructions from the brain transmitted through the nervous system, and our response to various stimuli is dictated by the message which is relayed to the brain from the source of the disturbance.

The Human Control System

The transmission of the message is accompanied by electrical impulses along the nerve, as distinct and characteristic as the dialling impulses on a telephone line or the ICW radiated when a morse signal is sent. The arrival of the impulses at the brain sets into action a fresh set of impulses along the appropriate nerve, which in turn are translated into muscular activity.

In one respect our own relay system is not so efficient as a radio relay—the impulses do not travel with the same rapidity. Take the familiar case of the blink of the eye when a strong light is flashed on to it. The high-speed camera has shown that the flash is completely extinguished before the eye responds to the urgent message sent from the brain and closes! Another example of time-lag is shown by the reaction of the hand to heat. A series of photographs taken of a hand to which a cigarette was approached showed that the cigarette could touch the skin and then be removed long before the hand was jerked away by the message from the brain.

The rate at which an impulse travels along a nerve depends both on the stimulus which is applied, e.g., heat, pain, and also on the composition of the nerve, and has been estimated to be between 30 and 80 metres per sec. It is also possible that we have two kinds of impulses transmitted at varying speeds—the one which tells the brain that something is hurting us and the other which follows on and asks, "What about it?"

The nature of the impulse has been experimentally investigated by many workers, and the names of Adrian, Bronk, and Matthews are well known in this field. It has been found that when a stimulus is applied to a nerve ending such as is present in the palm of the hand a small impulse starts to travel along the nerve which is accompanied by changes in the physical structure of the nerve itself. It is presumed that the nerve is surrounded by a polarised membrane or coating, and that the immediate effect of the stimulus is to break down the membrane with a production of a local potential difference between it and the nerve fibre at the point where the action is initiated. This local disturbance results in part of the nerve becoming negative with respect to the parts immediately on either side of it. As soon as this occurs a local current flows from the active region to the part immediately above it, restoring the original condition of the membrane and propagating the disturbance further up the nerve. The impulse thus travels up the nerve by a series of local disturbances, and if two electrodes are connected a short distance apart on the nerve the rate of propagation of the disturbance can be estimated.

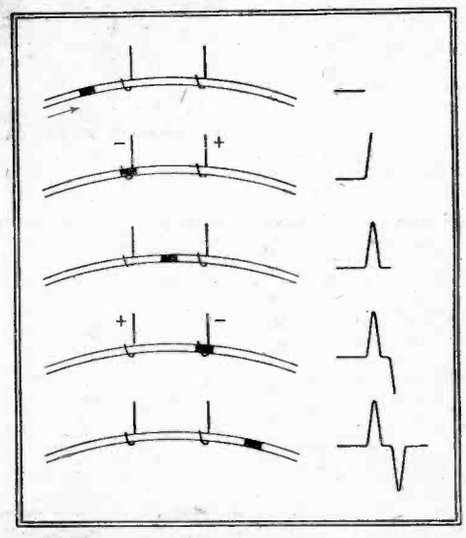


Fig. 1.—How a complex wave form is produced by the passage of an impulse along a nerve.

The potential difference which is obtained from two electrodes placed on the nerve is all important, as this gives us an indication of the nature of the impulse. It might be thought at first that the impulse would be unidirectional, but the diagram of Fig. 1 shows that the result is the familiar complex waveform. If we represent the impulse by the black dot travelling along the nerve in the direction of the arrow, the first electrode will be at a negative potential to the other when the impulse reaches it. As it passes along the potential dies away until when the second electrode is reached the potential is reversed in polarity. The resultant wave is shown at the side of each successive position of the impulse, and it will be seen that between any two electrodes an impulse produces a single cycle of alternating potential.

The impulses are fundamentally the same whether they convey a message to the brain from a sensory nerve or convey a message from the brain to the muscles by means of the "motor" nerves. They differ, however, both in frequency and amplitude, and it is these factors which determine the type and nature of the message transmitted in a manner exactly analogous to the sending of a telephone or morse signal. For example, we may stimulate a nerve by three separate methods—a light touch on the part to which it is attached, by warmth, or by heavy pressure. In each case the frequency and amplitude of the record obtained will differ and we can estimate the relation between cause and effect with a reasonable degree of certainty.

The recording of the nerve impulses, or "action potentials" as they are usually called, requires an amplifier of exceedingly high gain. The value of the potential obtained seldom exceeds a few microvolts, and to produce a reasonable amplitude of trace on the screen of a cathode-ray tube a magnification of several hundred thousand is required. At such high values the question of valve noise is, as usual, the controlling factor, but fortunately the range of frequency required in the amplifier is not wide.

The Human Relay System—

The frequency of the action potentials is usually less than 1,000 c/s and the general contour of the waves is not appreciably altered by "high-note cut-off."

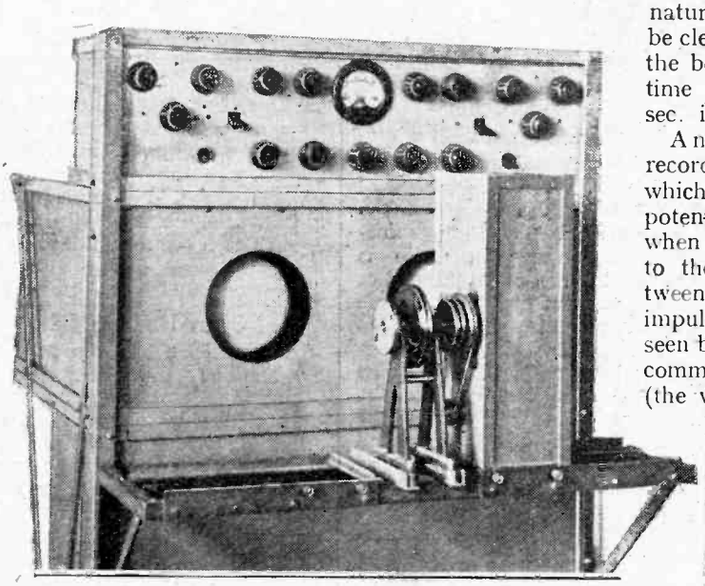


Fig. 2.—Action potential recording equipment used at the Royal College of Surgeons.

Fig. 2 shows a recording equipment at the Royal College of Surgeons for the investigation and photographing of action potentials in living tissue. Two "Ediswan 5" tubes are mounted side by side and fed from a common time-base circuit to ensure absolute synchronism between the two traces. A rack in front carries the recording cameras, only one of which is shown. The trace is focused on to 35-mm. recording paper by means of a wide-angle lens in front of the screen. With the two tubes it is possible to obtain simultaneous traces of action potential and heart action potential or traces from two points along the same nerve.

A separate rack carries the amplifier unit, which is connected to the electrodes by screened cable, the subject also being enclosed in a metal screening box. To avoid instability, separate HT batteries are used for each stage. The interior of the amplifier is shown in Fig. 3, the first three valves being AC/S2PEN's and the last AC/P's in push-pull. Each valve is mounted on springs and the whole amplifier case is supported on rubber. An example of the records taken is given in Fig. 4, which shows the impulses obtained from a frog's nerve when a portion of its back is touched.

The nerve is a sensory nerve serving a small area of the back and the rhythmic nature of the impulses can be clearly seen. The dots at the bottom of the trace are time markings of 1/20th sec. interval.

Another interesting record is that of Fig. 5, which shows the action potentials in the optic nerve when a light is flashed on to the eye. The lag between the application of the impulse and the response is seen by the gap between the commencement of the light (the white band below the wave) and the "kick" of the impulse. The cessation of the light is also marked by a "kick," and it is a curious fact that while the amplitude of the initial kick is proportional to the intensity of the light stimulus the amplitude of the final kick is practically constant. Records such as these can be used to determine the persistence of vision and the effect of flicker on the optic nerve.

It is possible that the waveform of the impulse will be affected by the colour of the light stimulus, and the cause of colour blindness may be attributable to the presence of band-pass filters in the optic nervous system!

An interesting experiment by Wever and Bray in 1930 showed that the nerve impulses were very closely allied to the nature of the cause which produced them. The auditory nerve of the ear which conveys sounds from the drum to the brain in the form of action potentials was tapped and connected to an amplifier and loud speaker. To the delight of the experimenters, a sound applied to the ear was reproduced in the loud speaker through the intermediary channel of the nerve and amplifier, thus showing that the action potential was a true rendering of sound impulse applied to the external ear.

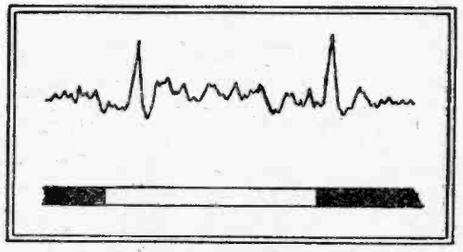


Fig. 5.—Stimulus of the optic nerve by the action of switching a light on and off. (Wang: *The Chinese Journal of Physics.*)

To those who wonder what the practical application of this research will be—and there are some who prefer to view everything from the utilitarian viewpoint—the answer is that the nerves are the communications system of the body. Without them we are as helpless as an inanimate thing; if they are out of adjustment they give as much trouble as a 200-core cable with every line crossed. We have found out the mechanism of the internal communications system—when we are able to control it at will we shall have gone another step in the alleviation of pain and the general improvement of our bodily comfort and welfare.

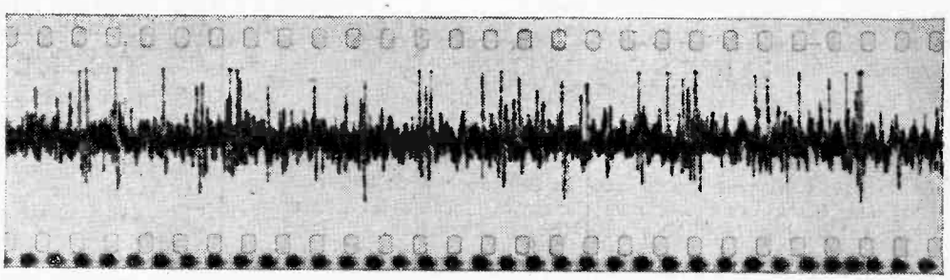


Fig. 4.—Impulses from a sensory nerve of a frog when stimulated by touch.

The photographs illustrating the article are reproduced with acknowledgments to the Royal College of Surgeons, whose technical assistant, Mr. S. P. Steward, constructed the apparatus and took the tracing reproduced.

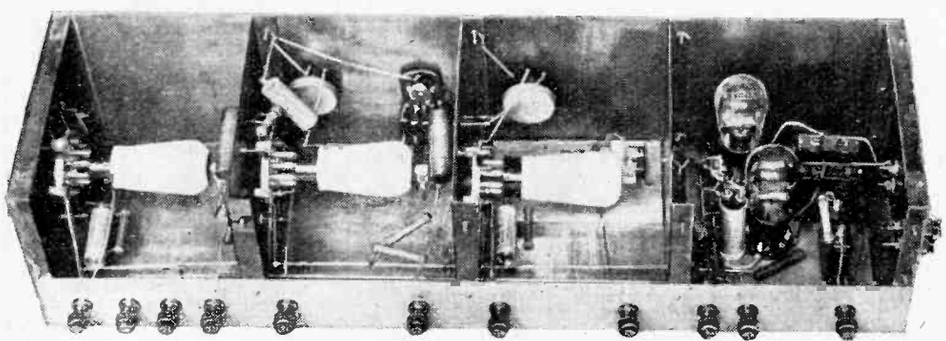


Fig. 3.—Special precautions, including generous screening and separate HT batteries for each stage, are taken in the design of the amplifying unit of the recorder.

Sound Engineering

THE Research Council of the Academy of Motion Picture Arts and Sciences, which operates on behalf of the eight leading American motion picture companies, deals on a co-operative basis with various technical and research problems of the industry, including those of sound recording and reproduction. A series of technical courses on the latter subjects have been conducted during the past few years, and the Council has now decided to publish the subject matter in book form under the title of "Motion Picture Sound Engineering." A copy of the announcement is available from the Council; its address is: Suite 1217, Taft Building, Hollywood, California, U.S.A. The book costs $4.

NEWS OF T

INSULATORS. An unusual view taken from one of the I.N.R. masts at Velthem, where the two Brussels transmitting stations are located. The transmitters are identical in construction, they are housed in the same building and each has a power of 15 kW. The scattered studios in the capital are linked to them by landline and they will serve the new Brussels Broadcasting House, which is nearly completed. It is expected that the power of the two transmitters will in the near future be increased to 100 kW.

AMERICAN RADIO DEVELOPMENTS

R.C.A. Annual Report

THE eighteenth annual report of the Radio Corporation of America, which was issued at the end of February, shows some interesting highlights of the year's operations. Among them is the net profit for the year 1937 of $9,024,858, which is a 46.6 per cent. increase over the $6,155,936 for 1936.

An increase in network stations of the N.B.C. from 102 to 143 during the year is reported, and the number of short-wave broadcasts to foreign countries in English, French, German, Italian, Spanish and Portuguese has increased from 184 to 3,179 during the year under review.

Among the technical achievements of the year enumerated in the report are: The development of mobile television units; the inauguration of facsimile transmissions by radio of news bulletins for home reception; and the marketing of the automatic radio alarm, which ensures reception of SOS signals when the operator is off duty.

Of the total of nearly 20,000 N.B.C. programme hours, 70 per cent. came under the category of "sustaining" and 30 per cent. under "sponsored." The former is a service rendered at the expense of the N.B.C., while the latter, of course, are paid for by advertisers.

FIVE YEARS OF EMPIRE BROADCASTING

SOME interesting facts are revealed with the completion of five years of Empire broadcasting by the B.B.C. In December, 1932, when the service opened, the staff totalled five; it now numbers 65. Then there were five transmissions per day from two transmitters, now there are six from the six transmitters. In 1932 the station had but nine frequencies allocated—it now uses sixteen. And last, but not least, the total programme-hours per day has jumped from ten to approximately eighteen.

P.M.G. VISITS A.P.

A TELEVISION welcome awaited the Postmaster-General and Lord Selsdon when they visited Alexandra Palace last Monday afternoon. Cameras were in readiness on the terrace for their arrival, which was seen by viewers. This was Major Tryon's second visit to the London Television Station, which he opened on November 2nd, 1936.

SPONSORED PROGRAMMES

IF the proposal submitted by Mr. F. W. Phillips, head of the British delegation at the International Tele-Communications Conference in Cairo is accepted it will mean the end of English sponsored programmes from the Continent.

The proposal is that advertising broadcasts shall only be made in the language of the country from which they are transmitted, and it applies to all wavelengths between 200 and 1,875 metres. It is reported that the proposal has been approved by the Technical Sub-committee of the Conference.

CHAMPIONSHIP FIGHT TO BE TELEVISED

TELEVISION'S outstanding sporting feature is the Light Heavyweight Championship fight between Jock McAvoy and Len Harvey at the Harringay Stadium on March 23rd. Beginning at 9.30, the whole of this 15-round contest will be televised, with a commentary by Lionel Seccombe.

The Harringay Stadium is within optical distance of Alexandra Palace, the grandstand being plainly visible from the terrace, so it is believed that the radio link will be able to offer a better signal than ever before.

100-kW S.W. STATIONS

DURING a recent interview published in *Radiocorriere*, Signor Raoul Chiodelli, Managing Director of the Italian Broadcasting Organisation, EIAR, stated that the work on the buildings, which are to house the three new short-wave stations at Rome's short-wave centre, are progressing apace, and that the first building, for the 50-kW transmitter, will be ready by the end of this month. The second building, which will house two 100-kW transmitters, will be completed a month or two later.

These new stations, which are almost entirely of Italian manufacture, will, it is hoped, be put on the air on October 28th this year.

It is also announced that the short-wave station which is to be erected at Addis Ababa will be equipped with receiving apparatus capable of picking up the Rome broadcasts for re-transmission.

The new 100-kW station at Essarts-le-Roi, in the Paris suburbs, has made preliminary tests on wavelengths of 16.87, 18.33, 25.33, 31.41, and 49.67 metres. It has been heard at various times, but has transmitted fairly consistently from 1.30 to 2.30 p.m. each day.

TEST MATCH RELAYS FOR AUSTRALIA

AUSTRALIA is getting anxious over the Test Match broadcasts from England during the coming summer. Although the B.B.C. has promised every assistance by relaying the commentaries from the cricket grounds, it is realised that during the Australian winter it is frequently difficult to pick up good short-wave signals until 2 a.m.—and to sit up until then is a severe test even of Australian cricket enthusiasm.

It is, perhaps, worth while to remind our Australian friends that Daventry will be transmitting tape records of the commentaries during most of the twenty-four hours each day. In fact, it is rumoured that the Arabs are already discussing the acoustic merits of Lords and the Kennington Oval.

GLASGOW v. EDINBURGH

BROADCAST rivalry between Edinburgh and Glasgow, which has persisted ever since the Clydeside city opened the first Scottish broadcasting station, 5SC, in 1923, will be carried a stage further in July, when the inaugural programme is broadcast from the new B.B.C. building at Queen Margaret College, Glasgow.

For many years the nerve-centre of Scottish broadcasting was at 5, Queen Street, Edinburgh, but once more Glasgow wins the ascendancy. Many of the staff will, however, remain at Edinburgh.

TELEVISION'S NEW ANNOUNCER

THE successor to Leslie Mitchell, the B.B.C.'s first television male announcer, who resigned to take up work as a news-reel commentator, is David Hofman, who started his duties last Monday. Although this is his television début, announcing is not new to him, for he was at one time an announcer at the Montreal Station, CFCF.

During his first week or so at A.P. he will not, however, be seen by viewers, for he will be acclimatising himself to his new surroundings.

THE WEEK

NEW REGIONAL TRANSMITTERS FOR SWEDEN

Network System Abandoned

A NETWORK of about thirty small transmitters has until recently been considered the most efficient means of wireless distribution in Sweden owing to the elongated nature of the country. Reconstruction of the system is now a matter of necessity, and the Swedish Post Office is reported to have abandoned the network principle in favour of establishing four 100-kW stations in addition to the new 100-kW station at Hörby, the 60-kW Stockholm transmitter, and the 150-kW long-wave station at Motala.

VOX POPULI

A PARABOLIC microphone is used by the producer of the N.B.C. feature, "Town Meeting of the Air," which has been broadcast regularly during the past three years from the Town Hall, New York. The microphone is brought into circuit at the conclusion of the principal speaker's address, when members of the audience are invited to ask questions, and in this way the atmosphere of the big forum is conveyed to listeners.

The scope of the subjects covered during these impromptu broadcasts can be gathered from two of the recent titles, "Should Congress Adopt the President's Armament Proposals?" and, "What Will Japan's Victory Mean to America?" It would be an interesting innovation for the B.B.C. to try something like this.

ORGAN PLUS RECORD

REGINALD FOORT, the B.B.C. organist, will wear headphones on Monday next, when he accompanies on the Theatre Organ a gramophone record made by Ernest Lough when a boy chorister at the Temple Church over ten years ago. The record, "Oh, for the Wings of a Dove," will be played in the basement of St. George's Hall, the output from the pick-up being mixed in the control room with the sound of Mr. Foort's accompaniment, and broadcast on the Regional wavelengths.

AMATEURS' STRENGTH

AT a recent meeting of Norwegian shipping owners it was stated that Norway will probably have to renew at least 50 per cent. of her wireless installations in merchant ships within the next two years, in order to be up to international standards, and cargo ships exceeding 3,000 tons ought to be equipped with telephony facilities. It was further suggested that in view of the greater efficiency of the amateur waveband over that which was allocated to shipping an exchange of frequencies should be made.

The speaker added that the amateurs were hardly likely to show a spirit of understanding when it came to giving up their wavebands to shipping, and a possible fight to this end might result in the defeat of the shipowners owing to the strong international organisation of short-wave amateurs.

BOMBAY RECEPTION

A CORRESPONDENT in Suffolk writes confirming the wavelength of Bombay's new short-wave station, VUB, as 49.3 metres (6.085 Mc/s), as given in these pages last week, when the call-sign was erroneously printed as VUD.

In "Ethacomber's" notes in the same issue he gave the station's daylight frequency as 6.125 Mc/s. The explanation of this apparent discrepancy is that the station has been testing on more than one daylight frequency before adopting 49.3 metres, which was confirmed by the announcer when the station was heard by our correspondent.

AMATEUR ACHIEVEMENT

SUCCESSFUL telephonic communication was recently established on the 14-megacycle (20-metre) waveband between amateurs in each of the six continents, according to the British amateurs' journal, *The T. & R. Bulletin*.

The stations participating were located at Kenilworth (England), Brisbane (Australia), Goulds (Florida), Alexandria (Egypt), Bombay (India), and in the South American Republic of Colombia. Each one could hear and work the remainder, and the British station, G5ML, worked the other five stations in less than four minutes.

FRENCH TELEVISION

THE French Radio Minister states that his departmental budget for 1938 includes estimates to cover the building of a television station at Lille. The system of transmission will be decided upon when a special commission has considered the several advantages of the different systems which are being used experimentally in Paris. The station should be working by the middle of the year.

FROM ALL QUARTERS

Frequency Instead of Wavelength

AT the recent American radio conference it was suggested that frequencies instead of wavelengths should be marked on receivers' tuning dials.

Radio Traffic Control

THE 6 lb. radio equipment of the Lancashire mounted police, referred to in last week's issue, will be used when the traffic to and from the Grand National at Aintree is controlled from an aeroplane by the Chief of the Lancashire Police Traffic Department.

Police Wireless in Finland

FOUR police cars in the Finnish capital, Helsingfors, have been equipped with wireless and a short-wave transmitter has been installed in the tower of Berghalls Church. The system will be inaugurated at the end of next month.

Popular Short Waves

THE 1938-39 Budgeted estimate for Danish broadcasting leaves a net surplus of 1.44 million kroner, which is to be used in the improvement of short-wave transmissions. Television development has been emphatically vetoed by the broadcasting authorities.

Russian Television Service

TEN television receiving points have been established in Moscow to pick up transmissions from an experimental station just outside the city. A service is expected to start in April.

Listeners as Jury

Is an eye-witness account of a football match, prepared after the the event, more effective than a running commentary? National listeners will be able to decide on March 26th, when the record of a running commentary of a Cup-Tie Semi-final, given for Empire listeners in the afternoon, will be broadcast in the National programme at 6.45 p.m., and will be followed immediately afterwards by an eye-witness account.

Radio Limoges

IT is hoped that the new transmitter to be built near Limoges will make its test transmissions early next year. It will take over the wavelength of 328.6 metres, at present used by Radio Toulouse.

More USW Broadcasting

ROME'S ultra-short-wave transmitter, Monte Mario, which has been using a wavelength of 6.9 metres since its inauguration two months ago, now radiates at a power of 2 kilowatts on 7.4 metres (40.54 Mc/s) also.

Wireless Pioneer Dead

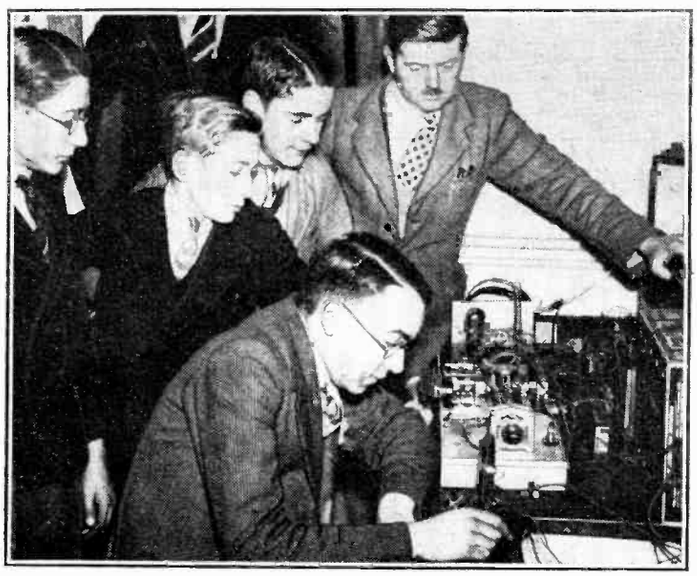
WITH regret we record the death, in Berlin, of Professor Max Wien, aged 72. Famous for his pioneer work on wireless telegraphy, he will be particularly well remembered for his quenched-spark investigations which culminated in 1910 with his discovery of a new kind of impact excitation of an oscillatory circuit.

Checking Station's New Home

THE Brussels checking station of the U.I.R. will be operating from its new and commodious home on April 1st.

Valve Testing Centres

COMPREHENSIVE valve-testing equipment has been installed at the trade counters of the G.E.C. in Magnet House, Kingsway, London, W.C.2, for the convenience of suppliers and servicing dealers. This equipment is duplicated at every one of the company's branches throughout the British Isles.



SCHOOLBOY AMATEURS. Boys of the West Central School, Bath, meet after school hours to construct receivers for their own use and have now completed a transmitter which they operate on 7,132 kc/s (40.06 metres). They have at present only a non-radiating licence with the call 2COU, but after tests the science master is applying for a full licence.

Invicta MODEL 430

A FOUR-WAVEBAND AC SUPER-HETERODYNE OF NEAT DESIGN

FEATURES. ***Waveranges.***—*(1) 13-52 metres. (2) 50-200 metres. (3) 200-560 (4) 900-2,100 metres.* ***Circuit.***—*Triode-hexode frequency-changer—var. mu pentode IF amplifier—double-diode-pentode second detector and output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Volume and on-off switch. (3) Tone. (4) Waverange.* ***Price.***—*9 guineas.* ***Makers.***—*Invicta Radio Ltd., Parkhurst Road, London, N.7.*

A SUPERFICIAL examination of the specification of this receiver was a strong inducement to make further acquaintance with its performance to find out if the promise of such good value for money was more than skin deep. For less than £10 one is offered a superheterodyne with four wavebands covering 13-2,100 metres with a single break between 560 and 900 metres, an output stage rated to deliver at least three watts to an 8in. energised loud speaker, a tone-compensated volume control, flywheel tuning and a coloured range dial with edgewise illumination.

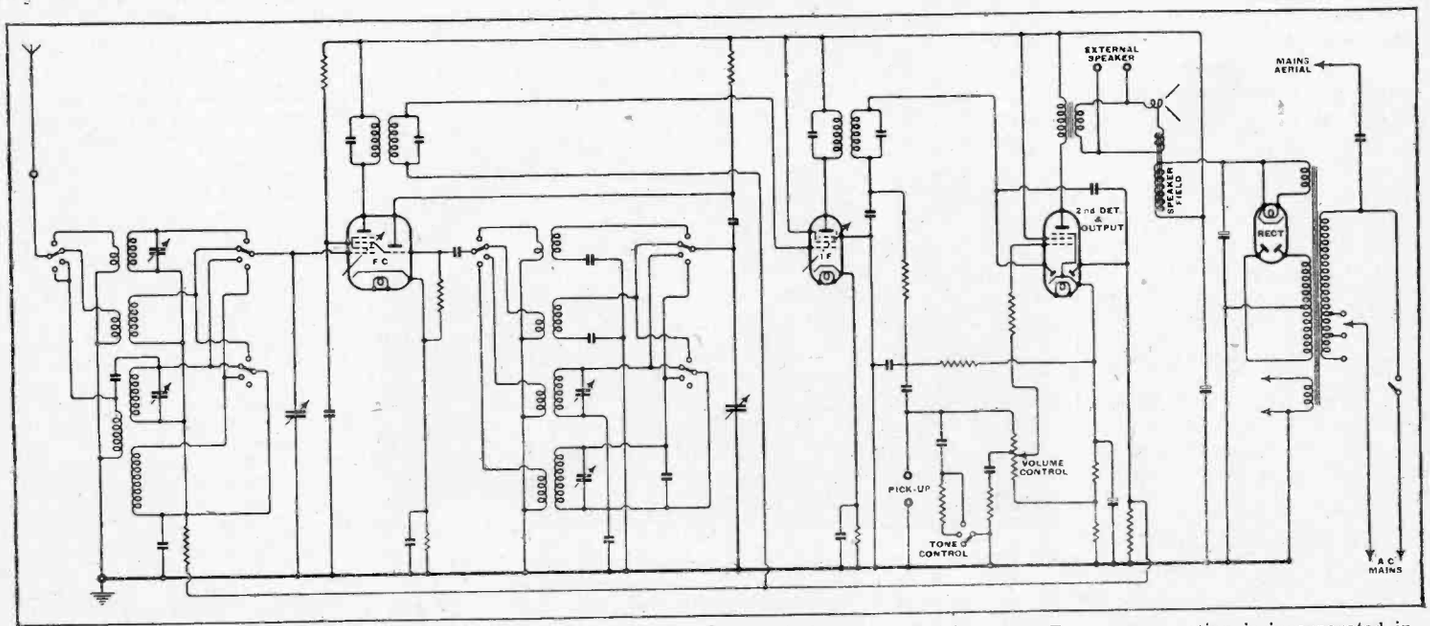
Certain economies have been effected in the construction of the chassis, but these have all been proved sound from the technical point of view and in many cases contribute to the efficiency and stability of the performance. The IF transformers, for instance, are individually unscreened and are mounted on opposite sides of the metal chassis. There was no evidence of direct pick-up resulting from this practice and the absence of screening cans is certain to contribute to the efficiency of the circuit. No trimmers are provided and the adjustment of the IF circuits is made on the inductances, the whole unit being finally sealed before leaving the works. Stability is assured by the use of mica condensers in which the electrodes are in the form of sprayed coatings in actual contact with opposite sides of the dielectric.

The IF amplifier is a variable-mu pentode and is preceded by a triode-hexode frequency changer. In spite of the fact that there is only a single tuned circuit in the aerial on each waveband, selectivity satisfies all practical requirements and second-channel rejection is surprisingly good. A careful search is necessary to find double tuning points even at the bottom of the shortest waverange and the performance in this respect is better than some receivers with tuned RF stages which we have tested. On medium waves the London Regional station can be approached to within 1½-2 channels without incurring interference, and on long waves the Deutschlandsender, although of excellent strength, just fails to shake off side band interference from Radio Paris and Droitwich. In other respects the long-wave range scores full marks and a bonus for sensitivity, taking into consideration the fact that there are only three valves in the circuit apart from the power rectifier.

Tone-Compensated Volume Control

The functions of second detector, AVC and output stage, are performed by the double-diode-pentode which follows the IF stage. The AVC bias is delayed and applied to both IF and frequency-changer valves. The tone control, which is operated by a three-position switch, takes the form of a resistance-capacity circuit across the manual volume control. This in turn is tone-compensated by a second RC circuit connected to a tapping on the potentiometer to give a relative increase of bass response as the volume is reduced.

Were it not for the contrary evidence of the circuit diagram, one might be excused for believing that negative feed-back is applied in the output stage, for the quality of reproduction exhibits many of the characteristics usually associated with



Complete circuit diagram. The IF transformers are adjusted at the works and do not carry trimmers. Tone compensation is incorporated in the manual volume control.

Invicta Model 430

this development. The response is clear and, to use a term often applied to musical instruments, the loud speaker "speaks freely." There is none of the confusion of sound in concerted music which results from an admixture of harmonics, and the tone-compensated volume control ensures good balance under all conditions.

The medium-wave band is second only to the long waves in the matter of range, and quite as many useful stations are available as from the majority of four-valve table model superheterodynes. No appreciable falling-off of sensitivity at either end of the scale was noted, and apart from one whistle just above the London Regional station, the range was free from self-generated interference.

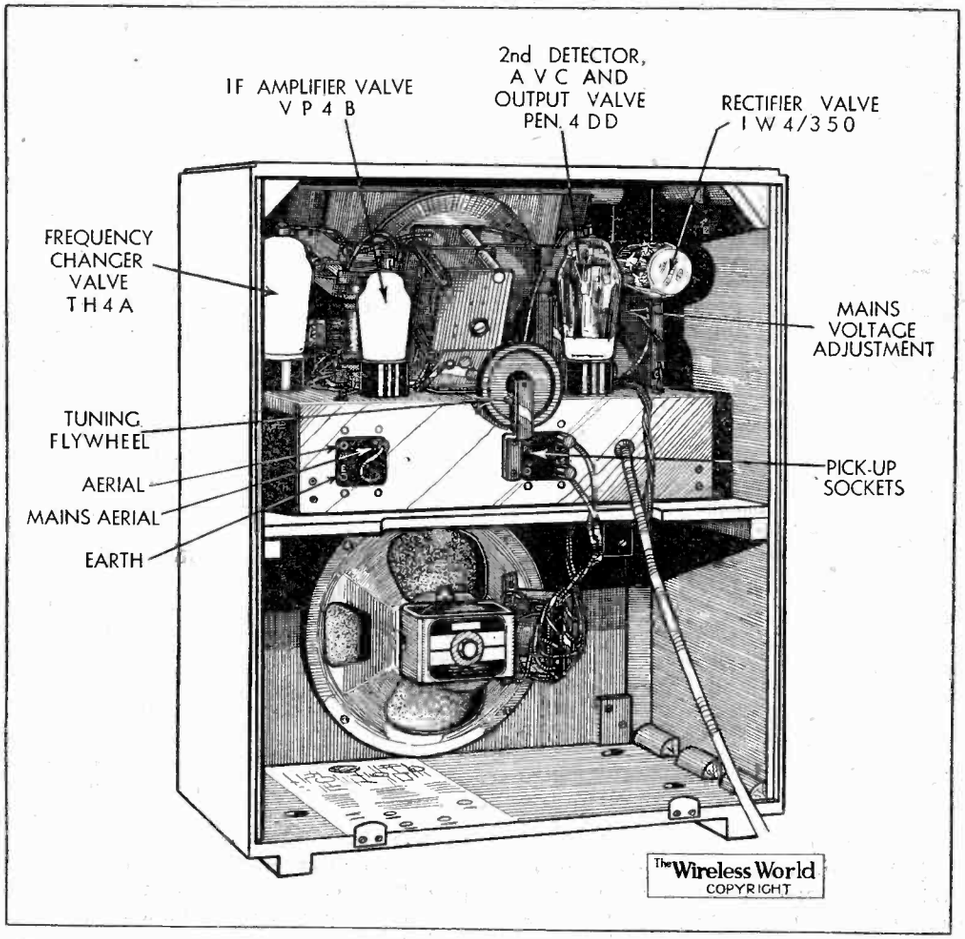
On the two other waveranges the magnification available was hard pressed to provide a performance comparable with the normal broadcast bands, but on many of the more powerful European transmissions, whose strong carriers incidentally were able to provoke microphony, the volume control could be reduced from the maximum position where it is normally left for general searching. The principal American broadcast stations on the 13-, 16- and 19-metre bands were all received during the course of a single afternoon, and, when conditions are favourable, there is no doubt that they would produce a programme of satisfactory volume through the medium of this receiver. The trawler waveband on the second short-wave range produced several carriers, but the modulation was barely intelligible through the somewhat severe local interference prevailing at the time of the test. In normal circumstances there is little doubt that this additional waverange, as yet so rarely provided, will earn its keep from the entertainment point of view.

The reduction gear associated with the flywheel tuning control is necessarily something of a compromise, but final adjustments on short-wave stations were by no means critical. The control is smooth in action and the full range of the dial can be traversed, if required, in two spins. Unusually lucid scale calibrations are provided, and these are up to date, including as they do the names of the latest B.B.C. transmitters.

There is nothing cheap about the finish of the walnut cabinet, which measures 19½in. × 16in. × 10in. In addition to the silk front-covering a wire-mesh grille has been provided to protect the loud speaker, and we would especially commend the practice which the makers have adopted of pasting a circuit diagram complete with component values inside the cabinet.

Taking everything into consideration, it can be freely acknowledged that this receiver represents very good value for money, and should give complete satisfaction to those who want good quality of reception of B.B.C. and foreign programmes with the ability to explore a wide range of short waves as a second string.

At the moment of going to press, we learn that a console version of this receiver will shortly be available. It is to be known as the model 431, and the price will be £12 12s.



Plugs and sockets are provided for the internal loud speaker in order that it may be disconnected if desired when using an external speaker.

New H.M.V. Battery Receiver

AUTOMATIC bias is included in the Model 680 three-valve battery set just released by the Gramophone Co., Ltd. The three waveranges include a short-wave band from 16.5 to 50 metres, and the tuning scale, which carries a waveband indicator, carries station names and wavelength calibrations. There are four controls with sensitivity as well as AF volume control, and the tuning pointer is driven through a 12 : 1 reduction gear.

The set is housed in an attractive horizontal cabinet, and the price of 8 guineas includes batteries.

The Wireless Industry

AS a result of repeated increases in the cost of labour and materials during the last few months, Ferranti has found it necessary to make increases in the prices of small ammeters and voltmeters. Lists showing the new prices will shortly be available—probably by the time that this announcement appears.

The business of Cable & Wireless, Ltd. in the West Indies, previously handled by several companies, is now consolidated in the hands of a single subsidiary concern which in future will bear the title of Cable & Wireless (West Indies), Ltd.

New Philips headquarters are to be built at the northern end of Shaftesbury Avenue, London. The building, which is to cover some 15,500 sq. ft. and have nine floors, has been specially designed to meet the requirements of the company.

L. A. MacLachlan, of Strathyre, Perthshire, sends us a leaflet describing "Precision" test equipment, for which he is agent. A feature of the "Precision" Universal Meter is that it provides voltage readings up to 2,500 volts; there are also exceptional facilities for resistance measurements, which are made with self-contained batteries.

Prospective exhibitors at, or visitors to, the French Trade Fair—The Foire de Paris—which is to be held between May 21st and June 6th, 1938, may obtain full information from the London office of the Fair at 17, Tothill Street, London, S.W.1. An Inventions Competition (which includes a special division for wireless developments) is announced in connection with the Fair.

Trix sound equipment has recently been installed at several more London theatres, including The Queens, Royalty and the Tavistock Little Theatre. Another interesting Trix installation, this time for staff-calling purposes, has been made in a large glass works in South London, where the noise of numerous glass cutting and grinding machines has to be overcome.

Elaborate sound amplifying equipment, including a 60-watt amplifier and 16 speakers, was installed by B.T.-H. for the official opening of the new Health Centre, Cardiff.

Television Topics

CORRECT CHOICE OF INTERMEDIATE FREQUENCY

SUPERHETERODYNES are very widely used in television reception, but, if they are to give satisfactory results, very careful design is necessary because they are liable to certain serious interference effects from which the straight set is entirely free. Where very high amplification is needed there is probably no alternative to the superheterodyne because its use makes it much easier to obtain stability, since the total gain of the receiver can be split into three sections, the RF amplifier, the IF amplifier and the VF amplifier. Furthermore, the superheterodyne has the advantage that the characteristics of the IF amplifier can readily be determined with the aid of simple equipment which is fairly commonly available, whereas it is more difficult to determine those of an RF amplifier, in view of the high frequency.

Probably the greatest single factor in the design of a successful superheterodyne is the choice of intermediate frequency, because the interference effects are due chiefly to the feed-back of harmonics of the intermediate frequency to the input circuits. Thus, if we happen to choose a frequency of 9 Mc/s we shall find interference because the fifth harmonic is 45 Mc/s, the same as the input signal. Similarly, if we choose a frequency of 11.25 Mc/s we shall again have interference, this time from the fourth harmonic. Frequencies quite close to these will also cause trouble, because the harmonic fed back will form a beat with the signal, and the beat frequency, although high, will show up as a pattern on the picture.

The simplest method of picking out good intermediate frequencies is by drawing a diagram such as that shown in Fig. 1. This graphical method is a particularly convenient one and is due originally, the writer believes, to L. H. Bedford.[1] In this diagram the horizontal scale represents intermediate frequencies and the vertical scale the signal frequencies. A pair of horizontal lines is drawn at 42.5 and 47.5 Mc/s to represent the vision frequency at the transmitter and its sidebands. The two lines *fo* show the oscillator frequencies necessary to produce the intermediate frequencies of the bottom scale and the two lines *fsc* show the signal frequencies from which second-channel interference may be found. The diagonal lines represent harmonics of intermediate frequency and they are numbered in accordance with the degree of harmonic. Wherever such a line crosses the signal frequency band a shaded area can be seen, and this represents a band of interference which is likely to be obtained if such an intermediate frequency is used. The clear patches represent frequencies at which this type of interference cannot occur when receiving a television signal at 45 Mc/s. The intensity of the interference, in general, increases the lower the degree of harmonic involved, but even so it is found that serious trouble will, in practice, occur for harmonics up to at least the tenth.

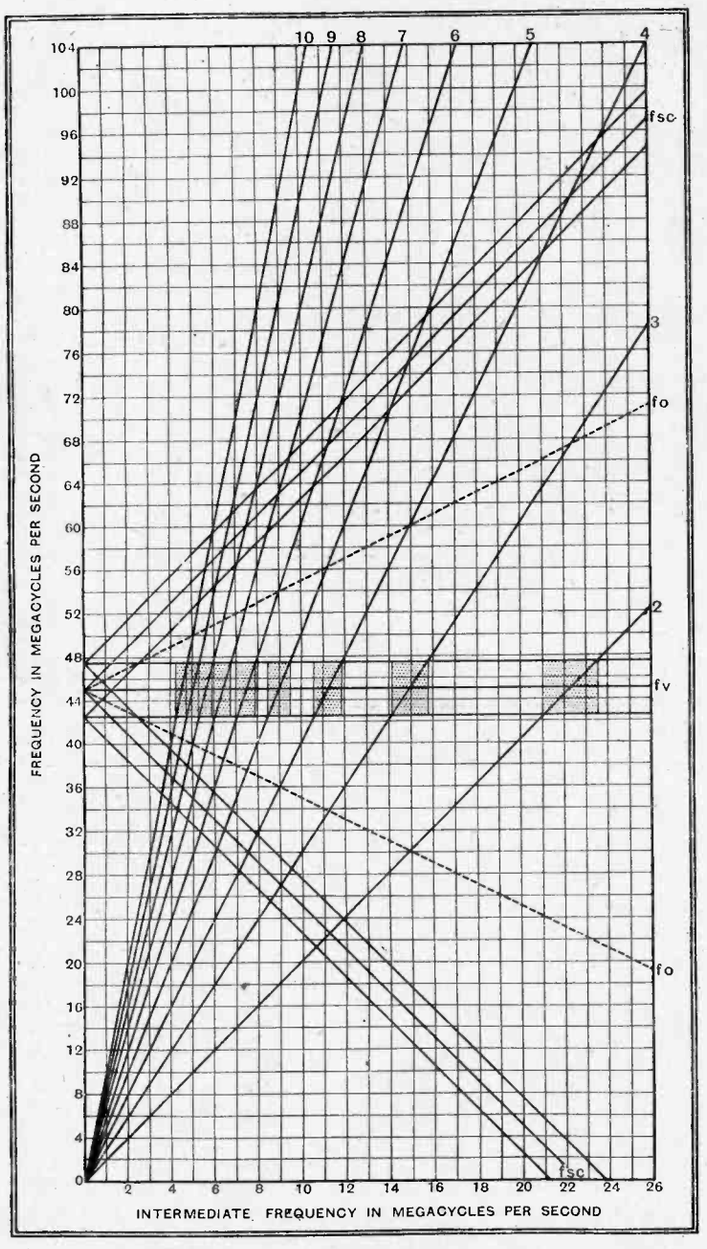


Fig. 1.—Intermediate frequencies at which interference may occur are indicated by the shaded areas in this diagram.

As the interference bands of the different harmonics overlap for those higher than about the eighth, it is clear that it is undesirable to use a low intermediate frequency, for there is actually no clear point to be found. The first clear point of sufficient width is the one at 6.9 Mc/s and the next occurs at some 8.2 Mc/s. A wider band is available centred on 10 Mc/s, but there is a much greater factor of safety to be obtained by choosing a frequency in a still wider band. Between about 12 and 14 Mc/s there is such a band, and an intermediate frequency of this order is a commonly used one.

It should not be thought, however, that the choice of the correct intermediate frequency will alone give complete freedom from interference in all cases. It will certainly remove the worst effects of interference, but it is often found that even at the theoretically clear point a certain amount of interference is present from other causes. This is, however, comparatively easy to remove by preventing feed-back from occurring. Now this prevention of feed-back is, of course, the ideal solution to the trouble in all cases, but it is not always practicable. Thorough screening of the IF amplifier and the detector circuits is needed and careful filtering of the detector output. If one has chosen an intermediate frequency such that a harmonic falls on the signal frequency, then the amount of screening and filtering needed for the avoidance of interference is such that the cost of the equipment is materially increased, whereas if one chooses an intermediate frequency which is inherently free from this trouble, other feed-back effects can be remedied by a comparatively small amount of screening and a comparatively simple filter in the detector output.

One other factor enters into the choice of intermediate frequency, and this is the question of second-channel interference. A high degree of preselection is not always available, and it is consequently wise to select a frequency such that

[1] *Journal of the Television Society*, March, 1937.

Television Topics—

second-channel interference is improbable on account of an absence of stations. Suppose we choose a frequency of 13 Mc/s, Fig. 1 shows that the oscillator can be at 32 Mc/s or 58 Mc/s. With the former frequency, second-channel interference is possible from stations in the band 16.5-21.5 Mc/s (18.2-13.95 metres)—an especially crowded part of the short-wave spectrum.

On the other hand, if we have the oscillator at 58 Mc/s, interference is only possible from stations on 68.5-73.5 Mc/s (4.38-4.08 metres). There are few, if any, stations working in this band, and it is accordingly wiser to choose the higher of the two possible oscillator frequencies.

Letters to the Editor

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

Battery v. Mains

I WAS extremely interested to read Mr. James Nicol's remarks *re* Class "B" in your issue of February 3rd, and would like to offer my experiences. I am using a Mazda Class "B" valve, type P.D.220, with a driver transformer specially wound by Mr. N. Partridge, to suit the driver and output valves.

I, like Mr. Nicol, find that the driver resents any reduction of anode current, and certainly rebels at reduction to anywhere near the maker's recommended figure as a driver. I find that the driver gives most satisfactory results when operated under strict Class "A" conditions. (The driver is a Mazda P.220.)

The grids of my output valve are returned to earth, as apparently the output valve may be operated with zero bias, but the whole arrangement fails on organ reproduction.

I, like Mr. E. R. J. Robbins, am an organ fan, and whenever I try to reproduce either cinema organ, grand organ, or even a piano, especially at quiet volume, I get a result similar to holding the point of a pencil on the cone whilst working—a sort of a slight rattling or dithering sound. The only way I can reduce this sound is to cut out desirable "top register," and then the organ sounds like a battery of 16ft. pipes. The trouble is more noticeable on some stops than others, e.g., Diapason is practically faultless, but a Tibia and Flute combination is a real offender. My speaker is a "Marconi 91," and I know is not at fault because I have tested it on all kinds of music on a Haynes Radio Duophase Amplifier at a full 6 watts with perfect results. Has your correspondent had any experience of this trouble, and if so could he suggest a cure, as he seems to have had a lot of experience with Class "B"? I must say I have a sneaking regard for Class "B," and am disappointed to see so much of your valuable journal devoted to mains equipment, while there must be thousands like myself who are not fortunate enough to have the mains. Class "B" seems to be one of the most difficult systems to get going properly, but the one on which there is least information. GERALD GIBSON.

Harpenden.

I FEEL that I cannot let Mr. Robbins' letter in the issue of February 17th concerning the controversy battery *v.* mains go unchallenged.

One point on which I agree with him is the fact that a wireless set should be first and foremost a quality reproducer. It is definitely not a musical instrument, however, as its only job is to reproduce the original sounds and not to create sounds with an individuality of its own. Mr. Robbins' analogy between volume of sound and size of photograph or portrait is rather far fetched, I think. I certainly cannot bear to listen to an organ reproduced at mouth-organ strength, or vice versa.

Admittedly the 230 milliwatts output mentioned would be quite adequate given a speaker with a high enough electro-acoustic efficiency, but the *average* speaker with its efficiency of 3 or 5 per cent. requires more than this for realistic reproduction. A point which Mr. Robbins has overlooked is the relative difficulty of making a cheap permanent magnet with a deep enough gap and high enough flux density to ensure good transient response and freedom from treble modulation.

In conclusion, if Mr. Robbins' receiver does not include a "rectifier," or even two, I am very much surprised at its functioning.

GEORGE A. HAY.

Newcastle-on-Tyne.

Gramophone Recordings

I THINK Mr. Aldous has given the impetus to a highly interesting and useful series of correspondence with his letter in your issue of February 17th.

There must be many parallel cases of readers who have spent considerable time and money compiling a selection of really outstanding records of high quality.

Your correspondent probably knows the gramophone companies are pleased to offer their choice of the finest records, and, in reply to a recent letter of mine, the Columbia Graphophone Company considered their finest cinema organ recording to be FB113 (Orient Express) made in the Regal Cinema, Edmonton.

To supplement the foregoing, may I give the following:—

"Le Canari," Columbia, FB1769 (violin solo).

"Ragging the Scale," H.M.V., BD5094 (dance Orchestra).

"Scherzo No. 2 in B flat Minor," Columbia, DX433 (piano solo).

"Hot Dog," Columbia, FB1359 (organ solo).

Although I take excellence of recording as the primary consideration, the above records are, incidentally, of high artistic standard.

Warrington. H. W. DAVIS.

BEFORE I append my list of high-quality recordings, I would like to unburden my mind on the subject of "echo" in recordings. At the moment European companies seem to be having a competition to

Letters to the Editor—

see who can make a staccato note last the longest. Now, it seems common sense to me that when an arranger or composer writes a staccato note it is meant to sound "short, sharp and sudden" and not "lengthy, lazy and lingering." In short, when listening to a gramophone record, I like (with apologies to Mr. Fell) the kick from a staccato note to resemble that of an Army mule. Some of my friends say that this "echo" adds an "effect" to the music. This is certainly true—but what a cheap effect!

For a good all-round performance I would recommend Beethoven's 7th Symphony played by Toscanini, on H.M.V.

For its transients, "Amapola" on Columbia FB1273.

For its clean bass and excelling brass, I would recommend "Liebestraum," on H.M.V. B8578.

Oxford. DONALD I. GRAHAM.

I AM entirely in agreement with your remarks in your editorial of February 10th with reference to gramophone records being a good alternative to the wireless. The only time I get really good quality from my local (Stagshaw) is when the programme is direct.

I think the proposal put forward by your correspondent, D. W. Aldous (February 17th), is worth following up, and I propose to hear the records mentioned at the earliest opportunity.

I would like to add to the list and suggest these records: "O Lovely Night," by Kirsten Flagstad, H.M.V. DA1512, and the Overture "Semiramide," by the New York Philharmonic Symphony Orchestra, conducted by Toscanini, H.M.V. DB3079-80. The last records have marvellous contrasts, and, incidentally, will give the "transient wallahs" something to think about.

Newcastle, 6. W. H. WRIGHT.

IT seems clear, from Mr. J. A. Hartley's letter in the February 24th issue, that he buys his records "blind"; in other words, when one of the companies announces an issue of a favourite work of Mr. Hartley's, he is tempted to buy it solely on the catalogue description—often, naturally, eulogistic!

With the spate of records of to-day one needs more than ever an unbiased opinion as to which discs are worth buying, and which are second-rate; or it may be that two companies will issue the same work, and how, then, is the buyer to choose?

I should like to mention that I know the complete solution to Mr. Hartley's difficulties, in the form of a monthly letter sent out by E.M.G., a high-grade firm of gramophone dealers, which covers the month's records entirely on their merits and saves many a false purchase. I have no connection with these people other than as a delighted customer. R. F. B.

London.

RANDOM RADIATIONS

By "DIALLIST"

The B.B.C. at Charing Cross

MORE than once before now I've called your attention to the interesting little exhibitions staged at intervals at Charing Cross Underground Station. You will find the B.B.C.'s Travelling Exhibition there now and it's well worth a visit, for it gives you a useful impression of its wide activities if your visit can be but brief, and a considerable knowledge of them if you can spend some time in a more careful examination. The B.B.C. describes the exhibition as a "three dimensional poster" and that sums it up very well. Models, maps, plain photographs and clever photo-montage displays all play their part in showing the listener how the B.B.C. does its big job, not only in providing this country with entertainment, but also in forging one of the strongest links of Empire. After its stay at Charing Cross, the little travelling show is to live up to its name by moving to Glasgow, where it will be seen at the great Exhibition this summer. Later on it may be taken to towns in many parts of these Islands.

* * *

Listening Hours

THE B.B.C. has recently discovered, rather to its surprise one gathers, that the time when by far the greatest amount of listening to broadcast programmes takes place is between 6 o'clock and 10 o'clock in the evening. The discovery certainly didn't surprise me; in fact, I think that most of us could have given them that answer pat without the need for any sort of referendum. It has always seemed to me that some of the "highbrow" late night programmes of a rather expensive kind were a sheer waste of money, since the proportion of listeners who hear them must be minute. At the same time it would hardly be fair to jump to the conclusion that there is no justification for spending any but very small sums on programmes outside the peak period. There are thousands upon thousands of folk whose working day doesn't end at 5 o'clock or 6 o'clock in the afternoon and they have every right to expect good programmes during their leisure hours. The fact that most parts of this country are covered by both Regional and National services makes it possible to cater for them. Most big items are repeated one day or two days after their original broadcast, regionally if they were originally from the Nationals and vice versa.

Programme Timing

The great difficulty is to select a time for the repeat broadcast which will enable it to

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Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, MARCH 10th.

Nat., 6.40, Betty Humby, pianoforte. 7.45, Geraldo and his Orchestra. 8.30, Talk by Hon. Harold Nicholson on "The Balance of Power."

Reg., 6, "Golden Rose," a musical romance. 7.30, The City of Birmingham Orchestra, conducted by Leslie Heward. 9.35, Commentary on 'Varsity Boxing, Oxford *v.* Cambridge.

Abroad.

Munich, 6.10, "Tumult in Himmelreich"—new operetta (Stimmler).

Vienna and Frankfurt, 8.10, Recently discovered music of Josef Haydn.

FRIDAY, MARCH 11th.

Nat., 6.45, Recital of Madrigals, by the B.B.C. Singers (A). 8, The Fol-de-Rols. 9.40, Sir Granville Bantock conducts the B.B.C. Orchestra (D).

Reg., 7.30, Scotland—an impression of the Isle of Mull. 8.40, Discussion on the German Claim to Colonies. 9.20, Teddy Joyce and His Band.

Abroad.

Hamburg, 7.10, "The Bird Fancier"—operetta (Zeller).

Brussels I, 8, Programme from the Royal Opera.

SATURDAY, MARCH 12th.

Nat., 6.45, Programme of Bach Music by the Boyd Neel Orchestra. 8, Music Hall, including Will Fyffe and Sandy Powell. 9.20, Weekly Affairs, from America.

Reg., 8, "Madam, Will you Walk?" a Ghost Story of the Seventeenth Century. 8.40, Reginald Paul, pianoforte and String Quartet in programme of Schubert's music. 9.20, B.B.C. Ballroom with Lou Preager and his Band.

Abroad.

Warsaw, 7, "Frasquita"—opera (Lehár).

Milan, 8, "Tristan and Isolde"—opera (Wagner).

SUNDAY, MARCH 13th.

Nat., 7.20, "A Voyage to the Sun"—the story of man's attempt to conquer the air. 9.35, "Hero and Heroine"—songs and duets from famous operas.

Reg., 6.30, Sunday Orchestral Concert—XXII. The B.B.C. Symphony Orchestra, with Ethel Bartlett and Rae Robertson at two pianos. 9.5, Mario de Pietro and his Estudiantina. 9.35, Sermons in Stone—The City Temple.

Abroad.

Brussels I, 8, "Les cloches de Corneville"—comic opera (Planquette).

Paris PTT, 8, "Peer Gynt"—drama.

MONDAY, MARCH 14th.

Nat., 7, "Monday at Seven." 8, Talk on the Film in Education. 9.20, World Affairs.

Reg., 6, Songs without Words, played by the Little Orchestra. 8, Dance Music. 9, Sound and Vision Cabaret, from the Television Studios.

Abroad.

Cologne, 6.10, Waltzes from Opera.

Lyons, 8.30, "Hans the Flute Player"—operetta (Ganne).

TUESDAY, MARCH 15th.

Nat., 7.30, Progress Talk by H. A. Mess. 8, "Snow White"—adapted from the Walt Disney film. 9.20, America Speaks. 9.40, Malcolm Sargent conducts B.B.C. Orchestra (D).

Reg., 7.30, Pipe Band from Glasgow. 7.50, Life of Richard Trevithick, inventor of the locomotive engine. 9.20, Billy Thorburn and his Music.

Abroad.

Rome Group, 8, "Cavalleria Rusticana"—opera (Mascagni).

Stuttgart, 8, Handel Evening—The Première of "Rodelinde," London, 1725.

WEDNESDAY, MARCH 16th.

Nat., 7.15, Band Waggon. 8.15 and 9.40, B.B.C. Symphony Orchestra, conducted by Sir Adrian Boult in the last concert of the 1937-8 series.

Reg., 7.30, The World Goes By. 8.15, Excerpts from "Going Greek," with Leslie Henson and supporting cast. 9, Commentary on Amateur Billiard Championship. 9.15, Sir Harry Lauder.

Abroad.

Lille, Toulouse PTT, 8.30, Richard Strauss Concert.

Radio Paris, 9, France in Song.

be heard by as many as possible of those who could not listen to the original. And here we are up against the fact that the "first night" may be missed through a large variety of reasons not directly connected with the working hours of the listener. The counter attractions of the theatre or the films, for instance, may be responsible; the original broadcast may have taken place during a meal time, and so on. All of these things must be taken into consideration, but it seems to me that in timing repeat performances in the programmes the greatest importance should be attached to the claims of the listener who either finishes his day's work late in the evening or starts it at just about the time when others are going home. For this reason I would plead that many of the repeats of important items should be given at times well outside the 6 p.m. to 9 p.m. peak period.

Programme Novelties

THE transatlantic spelling bee goes down very well with listeners, most of whom regard it as the brightest spot in the Sunday programmes that we have had for a very long time. I hope that we'll go farther with these "fun and games" programmes. In the United States, programmes in which the entertainment is given by listeners invited to the studio have become more and more popular ever since they were started by the introduction of "Amateur Hours." One that is going very well over there just now is a kind of general knowledge competition between teams. The other day teams from Yale and Harvard Universities staged a brains contest before the microphone and one of the stations from which the broadcast took place announces that it has been inundated with applications from would-be teams of all kinds—spinsters, taxi-drivers, journalists, railwaymen, and so on—who are eager to display their prowess in answering questions about this and that. I can't help thinking that "Do You Know?" contests would make a hit in this country. It seems an idea particularly suitable for Regional programmes: one town, for example, could take on another in the same service area. I am sure that Mr. Tommy Woodroofe would be in his element in running these contests.

The British Octal Base

THE recent correspondence on the new British octal base in *The Wireless World* has raised some interesting points. The two protagonists, "B.M./B.F.J." and "British," hold diametrically opposite views on the subject. Put into a nutshell they amount to this: One writer is all for standardisation of valves and for the use of existing valve bases. The other holds that if you can produce a better valve by making use of an entirely new base, it is best to do so and not to worry about standardisation. There is a good deal in the latter argument; or, rather, there would be if it were proved that the new British octal base really does give in practice advantages of overwhelming importance that are not obtainable in any other way. But on that point I must confess that I have my doubts. There is no question that the new system of connections to the valve pins is theoretically sound, but does it matter all that much in the broadcast receiving set? As I see it, it isn't more efficient valves but valves of the present quality at much lower prices that would be the greatest of all aids to real progress in broadcast receiving sets in this country.

All for Standardisation

You'll have gathered that I'm all for standardisation. I certainly am, for, so long as British valves run to nearly a thousand different types, I cannot see that we are ever going to be able to buy them cheaply. "British" makes the point that valves with American octal bases made and sold in this country last year amounted to less than 5 per cent. of the total. But British-made octal-base valves, at prices ranging from 10s. 6d. to 15s. or more, can hardly hope to compete with the American article at less than half the price. That's why we imported from America a long way over two million valves last year. Our prices are high because just a few firms make these valves in smallish quantities in addition to a multiplicity of other types. American prices are low because their large manufacturing concerns concentrate mainly on a limited number of valve types. If you buy a 6F6 or a 6Z5 over there it will have the standard characteristics of its type, no matter by which of the manufacturing companies it was made.

All-round Advantages

Apart from any question of prices, it would be a great boon to all wireless folk if British valves could be standardised. You know the kind of thing that happens now. You come to the conclusion that one of the valves in your receiving set needs renewal, and you walk round to the nearest wireless shop to buy a replacement. Arrived there, you ask the man behind the counter for, say, an Osranti-Cossard PY4B. "Afraid I don't stock them," says he, and, after all, how could he be expected to have the best part of a thousand different kinds of valves on his shelves? "I've got a full range of Mazram; probably there's an equivalent." He then consults a list, and tells you that the Mazram something or other is stated to be the equivalent of the valve you want. Upon asking to see particulars of its mutual conductance, AC resistance, and so on, you find that, though it's something like the Osranti-Cossard PY4B, it isn't quite the same thing. He thinks, after further consulting his list of equivalents, that a Mulvac might do. You buy it because you are getting a bit bored with these intricacies and the next wireless shop is a long way off, anyhow. When you put it into the set there are three possibilities. It may suit quite well; it may suit indifferently; it may not suit at all. Wouldn't it be a blessing if all manufacturing firms turned out a PY4B which was just the same thing, no matter who made it?

The Four-Band Super Six

A REPLICA of *The Wireless World* "Four-Band Super Six" is now on view in the Radio Section of the Science Museum at South Kensington. It will be demonstrated on request being made to the attendant.

(A full description including the circuit diagram and constructional details of this receiver were included in our issues of December 9th and 16th, 1937.)

Recent Inventions

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

A "DOUBLE-DUTY" VALVE

IN a well-known type of visual tuner the critical point of resonance is indicated by a miniature cathode-ray tube, the necessary deflecting voltages for the latter being supplied through an auxiliary valve. If the receiver to which the indicator is fitted is a radio-gram, both the tuning indicator and the auxiliary valve are normally "idle" when the set is switched over for gramophone reproduction.

According to the invention, the change-over switch automatically inserts the auxiliary valve into circuit with the other AF stages, so that it does useful work in helping to amplify the pick-up voltage.

E. K. Cole, Ltd., and A. E. Falkus. Application date, July 10th, 1936. No. 474932.

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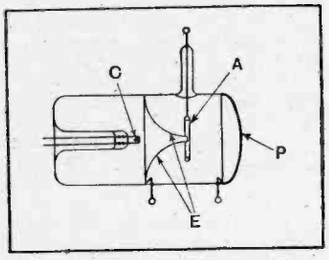
PHOTO-SENSITIVE CELLS

THE introduction of gas into a photo-electric cell generally increases its sensitivity, though not, it is stated, when very rapid fluctuations of light are concerned. The figure illustrates a cell of the evacuated type in which the electrode arrangement is said to give an output considerably greater than that normally obtainable.

Between the cathode C and anode A is a funnel-shaped glass electrode E which is coated on its



Electrode assembly in photo-electric cell designed to give relatively large output.

inner surface with a metallic deposit. The anode is in the form of a ring surrounding the narrow end of the funnel. These electrodes are so biased that normally there is no electron flow from cathode to anode. When, however, light is thrown on to a photo-sensitive coating P, at the end of the tube, an electrostatic field is created which draws the electrons from the cathode through the funnel on to the anode.

Baird Television, Ltd., and E. B. King. Application dates May 25th and August 20th, 1936. No. 475807.

o o o o

DIRECTION-FINDERS

ONE known method of obtaining a visual reading of the direction of a distant beacon station is to use the pick-up from a rotating frame aerial to control a Neon-lamp indicator. The associated amplifier is arranged in such a way that each time the aerial passes through the critical "minimum" position a pulse of current lights up the lamp. Then if the rotation of the aerial is made sufficiently rapid, the glow will appear as a stationary line-of-light, pointing out the required direction.

Such an arrangement works satisfactorily on an unmodulated carrier-wave, but if the latter is interrupted or strongly modulated the signals create "false" lines of light on the dial of the indicator, and so make an accurate reading difficult. According to the invention, the first aerial is combined with a second, which is so coupled to the associated amplifier that it opposes and nullifies the effect of any signal modulation. The unmodulated carrier, which gives the directive indication, is not affected.

M. Parisier and Soc. des Etablissements Henry-Lepaute. Convention date (France) June 26th, 1936. No. 476289.

o o o o

REMOTE TUNING CONTROL

A RECEIVER which is already fitted with "automatic" tuning control, that is with means for automatically correcting for any initial error in the setting of the station indicator, is, according to the invention, provided also with means for tuning the set from a distance.

A variable oscillator-valve is located at the remote point from which the control is to be exercised, and feeds RF oscillations, through a transmission line, to the input or RF stage of the receiver. The remote oscillator is provided with a calibrated dial, which is first set approximately to the wavelength of the desired station. This setting is then gradually varied, at the remote point, and as the oscillations so produced "beat" with the incoming signals they actuate the automatic tuning control in the ordinary way. Directly this "takes charge" the remote oscillator is automatically cut out of circuit.

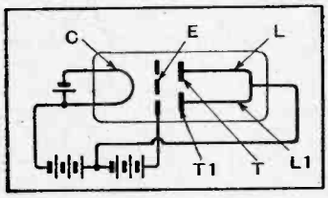
N. V. Philips' Gloeilampenfabrieken. Convention date (Germany) July 27th, 1936. No. 475643.

o o o o

SHORT-WAVE OSCILLATORS

IN generating waves of very high frequency, a stage is reached when the time taken by the electrons to travel from the filament to the plate occupies an appreciable fraction of the cycle of oscillation. This sets a limit to the frequency which can be generated, without the use of special methods such as the Barkhausen-Kurz circuit, or special valves such as the Magnetron.

According to the invention the problem is tackled by using secondary emission. As shown in the figure, the electron stream from a cathode C is accelerated by a positively-biased electrode E, which is provided with holes or slots so as to allow part of the stream impact against two target electrodes, T, T1. These are coated to produce secondary emis-



Micro-wave oscillator valve utilising the principle of secondary emission.

sion, and so set up currents in the associated Lecher-wire circuit L, L1. The latter is tuned to have a period equal to that of the time of transit of the electrons from the cathode to the targets. One of the targets is bound to emit more electrons at the first impact than the other, and this initiates a transient current, which rapidly builds up, in push-pull fashion, under the impact of the electron stream. The output oscillations are taken off from the circuit L, L1 by any usual form of coupling.

Marconi's W.T. Co., Ltd. (assignees of E. G. Linder). Convention date (U.S.A.), April 30th, 1936. No. 476020.

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TELEVISION TRANSMITTERS

THE electron stream produced when the picture to be televised is focused on the sensitive electrode of a cathode-ray tube of the "image-dissector" type is intensified by secondary emission, after the stream has passed through the aperture in the anode and before it reaches the final stage, where it is converted into signalling current.

The part of the original electron stream that is swept across the "dissecting" aperture is arranged to fall upon a highly-emissive target where it liberates secondary electrons. These are collected and focused, in turn, upon a series of similar targets, which progressively increase the strength of the stream before it reaches the output stage of the tube.

Zeiss Ikon. Akt. Convention date (Germany) March 24th, 1936. No. 475995.

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AERIAL INSULATORS

A "STRAIN" insulator for an aerial is made in two halves, which, when fitted together, resemble the standard egg-shaped insulator. The usual coupling transformer is housed inside the hollow interior.

The aerial wire and supporting halyard are threaded through the two halves in such a way that the strain automatically holds them together. The threading holes are disposed at right-angles so as to prevent any lateral displacement.

The Gramophone Co., Ltd., and L. A. Chapman. Application date June 4th, 1936. No. 476235. (Addition to 444494.)

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MAGNETRON VALVES

IN a magnetron valve, as used for generating ultra-short waves at high power, the external control field is produced not by an electromagnet as usual, but by a permanent magnet made from powdered or granular material. This enables the magnet to be more easily moulded to the shape of the electrode system of the valve, and this, in turn, reduces the air-gap and minimises stray magneto fields.

H. J. C. Forrester (communicated by J. Pintsch Akt.) Application date June 4th, 1936. No. 476530.

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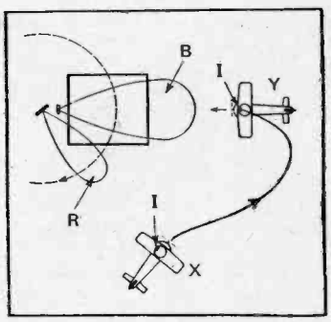
"BLIND LANDING" GEAR

IN order to assist an aviator to land in fog, or in conditions of low visibility, the aerodrome in addition to the usual wireless beacon B for indicating the gliding angle to ground is provided with a second beacon which transmits a constantly rotating beam R. The aeroplane is fitted with a rotating directional receiver, which gives a visual indication I of the direction of the incoming signals.

The indicator on a machine approaching the aerodrome, say from the point X, will show a flashing signal each time the beam R crosses its path. So long as the signal is intermittent, the pilot knows that he has not picked up the landing beam B,



Scheme for guiding an aeroplane to ground using guiding and rotating wireless beacons.

though from the direction of the flash shown on the indicator I he knows that the aerodrome is on the port side, and he steers accordingly.

When he finally rides into the landing beam B and finds the median line, the indicator will show a continual light, which is not affected when the rotating beam R happens to cross the track of the machine.

Telefunken Ges fur drahtlose Telegraphie m.b.h. Convention date (Germany), April 9th, 1936. No. 475853.

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EDITORIAL COMMENT

Graphical Symbols

The Shorthand of Wireless

WHEN the British Standards Institution issued a glossary of technical terms at the end of 1936 we likened the vocabulary of wireless to a kind of code, and stressed the need for universal agreement as to the precise meaning to be assigned to the code-words of which the vocabulary is composed. Freedom from ambiguity was regarded as more important than elegance, or even aptness of the expressions adopted.

If it is permissible to compare our vocabulary with a code, then the graphical symbols used in circuit diagrams may equally be likened to shorthand, as the symbols serve to convey a great deal of information in a very small space to those versed in the art. It is self-evident that the graphical symbols must be universally understood and accepted by all those who have occasion to use them.

Standard Symbols

When a committee of representatives of Government and private bodies produced, early last year, a revised edition of "British Standard Symbols for Telephony, Telegraphy and Radio Communication," we did not make any hasty revision of our own standard symbols, because we felt that to do so without making sure that the new ones were to be universally adopted would have caused confusion, and we believed most readers preferred our own methods of drawing circuit diagrams. Many of the B.S.S. symbols, too, seemed open to criticism.

A few examples of B.S.S. symbols that run contrary to the practice generally accepted and used in this journal are illustrated on page 247 of this issue. Conductors crossing without connection (1) are shown without the customary loops; junctions are indicated by dots as at (2). Another symbol that seems to be lacking in graphical significance is that for a screened conductor (3).

The conventional zig-zag symbol is retained to indicate generally an impedance, reactive or non-reactive, including resistance or a resistor, but the Continental symbol (4) is introduced to show a pure resistance.

In a few cases the proportions might have been improved; for example, the iron-cored inductor (5), if drawn strictly to its relative size, calls for a very high standard of printing to prevent running of the ink.

Though the DC and AC generator symbols (7 and 8) are admirably graphical and an improvement on those generally used, the same cannot be said for (9) and (10). Few readers will be able to guess what they represent; actually, (9) is a microphone and (10) a telephone receiver.

Loud speakers are not much happier. The general symbol (11) seems rather more appropriate to a microphone; symbol (12) represents an electro-dynamic speaker. Frame aerials, plain and centre-tapped (13 and 14), are graphical but difficult to apply to modern multi-range frames. The symbols for use on plans, of which (15), a transmitting and receiving station, is an example, would appear to be useful.

Official Standards Ignored

A full year has passed since the B.S.S. publication appeared, and there are few signs that the B.S.S. symbols are coming into general use; instead, we observe that *Wireless World* methods in drawings are being increasingly adopted in wireless and electrical journals and in technical publications generally. This is understandable enough, as the drawing office of this journal, in its twenty-seven years of life, has certainly had more experience in the preparation of diagrams for publication than any other organisation in the world, a fact which we might excusably have expected would have prompted the B.S.I. Committee to invite our co-operation, but apparently they felt sufficiently confident in their own judgment alone.

Tracing Loud Speaker Curves

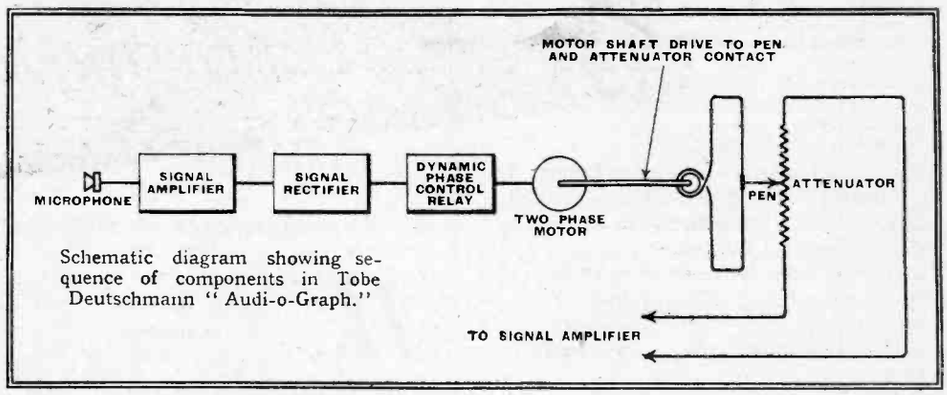
NEW DEVELOPMENT IN COMMERCIAL ACOUSTIC MEASURING INSTRUMENTS

AUTOMATIC recording gear for the tracing of response curves of audio-frequency components is now available in commercial form, and the present article deals with the features of a leading American design.

By W. N. WEEDEN

IN spite of the perfection and acceptance of the signal generator, beat frequency oscillator, cathode-ray oscilloscope and the wave analyser, for the visual alignment of tuners and the checking of distortion, relatively little is known of the overall fidelity of the radio receiver and associated loud speaker, in their cabinet! While several of the largest receiver manufacturers are equipped to make acoustic measurements, many well-designed chassis having good electrical fidelity are combined with speakers about which little is known except that the president or sales manager may like its mellow tone or fine (resonant) bass. Of course, the speaker manufacturer supplies curves of his product, but a critical ear frequently indicates a sad "slip 'twixt the cup and the lip" (fidelity of the chassis, speaker curves, and performance). In fact, several of our so-called "high-fidelity" receivers of a year or two ago have been guilty of such unpleasant screeches and edginess as to give the high-quality movement a "black eye."

In America the Tobe Deutschmann Corporation has introduced a compact, well-designed, and relatively inexpensive piece of equipment, the "Audi-o-Graph," which should considerably simplify the measurement of acoustic systems. This instrument is a complete self-contained, automatic, curve-tracing equipment for the measurement of variations in sound-pressure output of a loud speaker, overall fidelity of a radio receiver including the effect of cabinet or baffle construction on its performance, the variations in electrical output of microphones and gramophone pick-ups, and the electrical fidelity of AF amplifiers and filter networks of many sorts.

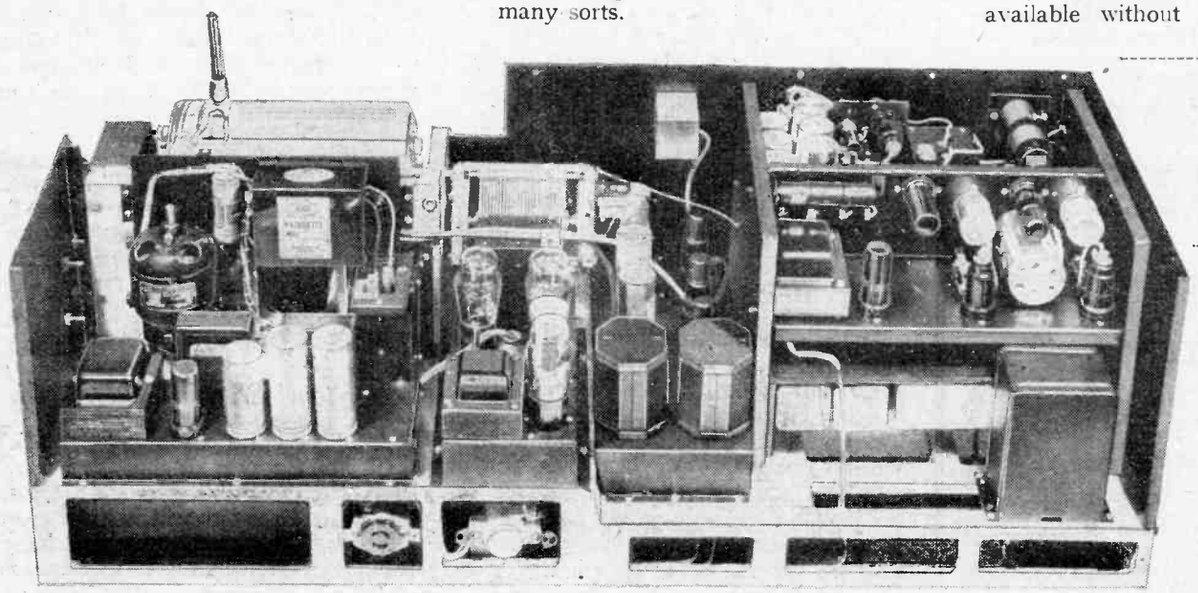


Schematic diagram showing sequence of components in Tobe Deutschmann "Audi-o-Graph."

To accomplish these results the "Audi-o-Graph" utilises the following components:

1. A source of continuously variable audio-frequency voltage of constant amplitude.
2. A means of coupling this voltage to the device under test.
3. A means of picking up the sound pressure or audio-frequency voltage developed in the apparatus under test.
4. A means of recording the variations in sound pressure or audio-frequency voltage.

The source of continuously variable audio-frequency voltage is provided by a well-designed beat frequency oscillator (located at the left of the instrument) whose output varies less than ½ db. over the recording range; harmonic distortion of less than ½ per cent.; very slight drift with temperature and mains voltage variation, and stable frequency calibration available without "warm-up" period.



Rear view of Tobe "Audi-o-Graph" showing drive motors, control amplifier, input amplifier, and beat frequency oscillator.

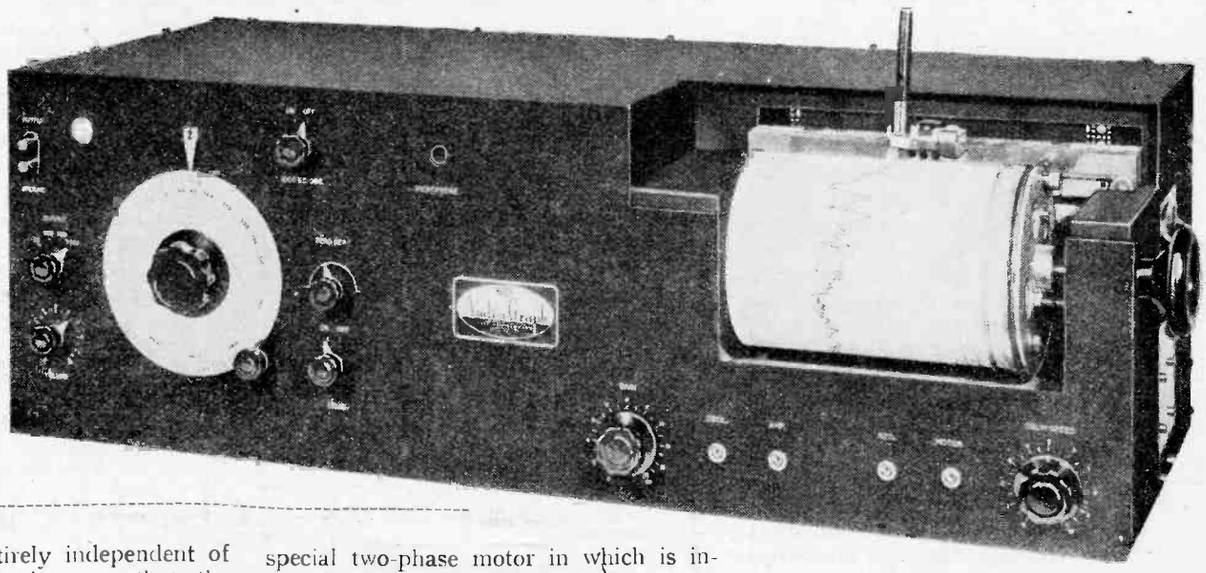
This stability is all the more remarkable in view of the number of valves and of the high output power of this completely enclosed self-contained unit. One other feature of interest is the inclusion of a small cathode-ray oscilloscope for ease and accuracy of setting to zero beat.

For automatic recording, the frequency control condenser of the oscillator is directly connected to the motor-driven drum of the record chart-holder, around the periphery of which is engraved an approximately logarithmic frequency calibration of 30 to 12,000 cycles, corresponding to the calibration of the record

Tracing Loud Speaker Curves—

chart. The total length of this frequency scale is 17⅜in., and the height of the decibel scale is 7½in. for a range of 40 db. In addition to its motor drive the recording drum has a manual control so that the chart may at any time be sent back to allow immediate retracing of any desired portion of the graph.

The beat frequency oscillator is also provided with a manual control which is entirely independent of the recording mechanism, so that the oscillator may be used as a separate instrument. This control is located on the front panel of the "Audi-o-Graph" and makes available a frequency range of 20 to 23,000 cycles.



The Tobe "Audi-o-graph"—a self-contained, fully automatic curve tracer producing a permanent record of performance and characteristics for electro-acoustical and audio-frequency apparatus.

In the recording of sound pressure or audio-frequency voltage variations the energy picked up by a calibrated microphone or delivered by the device under test is fed into an amplifier which in combination with the microphone is flat within ½ db. over the recording range. A gain control graduated in twenty steps of 2 db. serves as a means of calibrating the amplifier. The output of this amplifier is applied to an attenuator having a fixed impedance of 50,000 ohms graduated in eighty steps of ½ db. each. This attenuator constitutes one arm of an electro-mechanical bridge assembly so constructed that a motor-driven controller maintains a constant input balance. The extreme accuracy with which this balance is maintained results from the use of a special two-phase motor in which is incorporated a dynamic braking system that effectively prevents overshooting. Thus the amount of unbalance resulting from variations in sound pressure or voltage input to the instrument is accurately indicated by the position of the attenuator control arm to which is directly connected a carriage for a recording pen having large ink capacity.

Superimposed Curves

Three interchangeable pens are supplied, so that by using different coloured inks a number of graphs may be superimposed on a single chart for comparison.

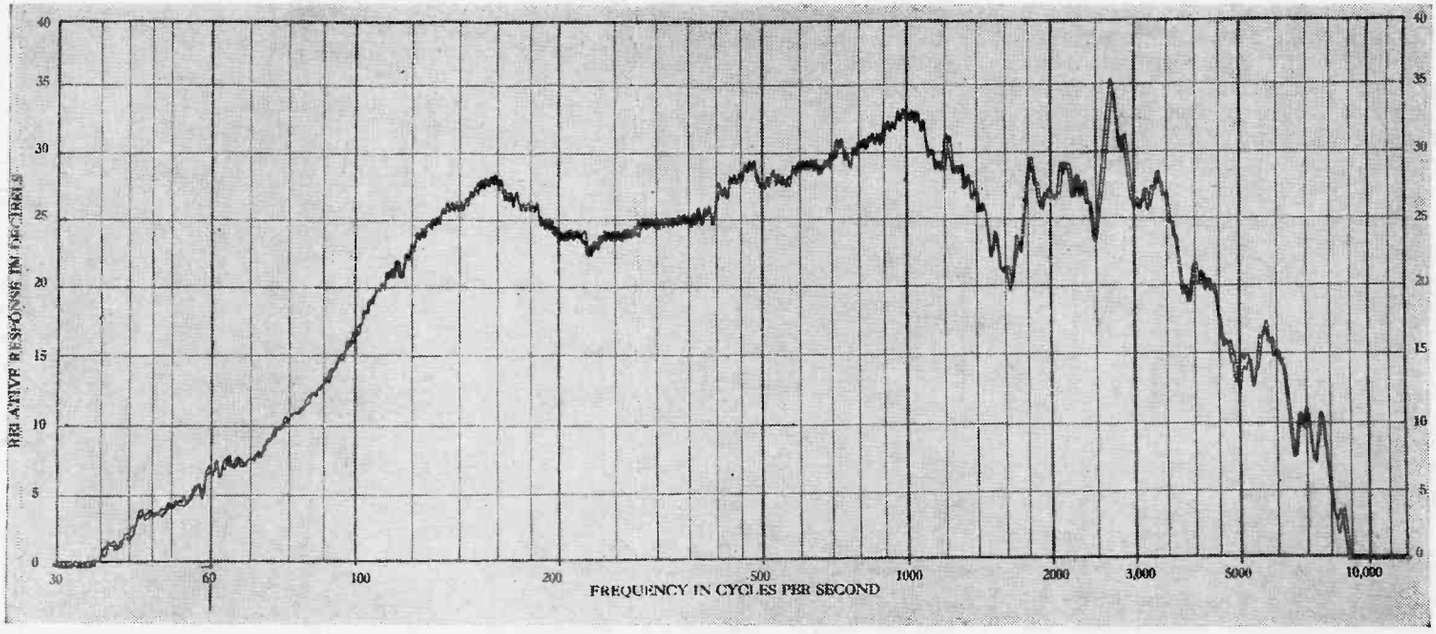
A control is provided on the front panel so that the time required for securing a complete graph may be varied between one and five minutes. While the accuracy of recording is theoretically greater with slow speeds, the instrument may be operated at full speed for production testing without appreciable error.

Also of interest is the fact that the "Audi-o-Graph" will repeat acoustic curves within 1 db. (certified by the writer, who "ran" the sample curves).

The input circuit of the recording amplifier is designed to accommodate impedances from 50 to 10,000,000 ohms.

Of great interest to the radio receiver manufacturer is the fixed radio-frequency oscillator delivering 5,000 microvolts at 1,000 kc/s, modulated 30 per cent. by the beat-frequency oscillator.

In closing, it should be mentioned that for all types of work in which the "Audi-o-Graph" may be employed the data it produces conform to established standards and are obtained in a small fraction of the time required by the manual or semi-automatic methods often used.



Specimen curves of a 7-inch moving coil loud speaker taken with the microphone at 12 inches from the speaker show remarkable repetition accuracy.

How a Receiver is Designed.—VIII.

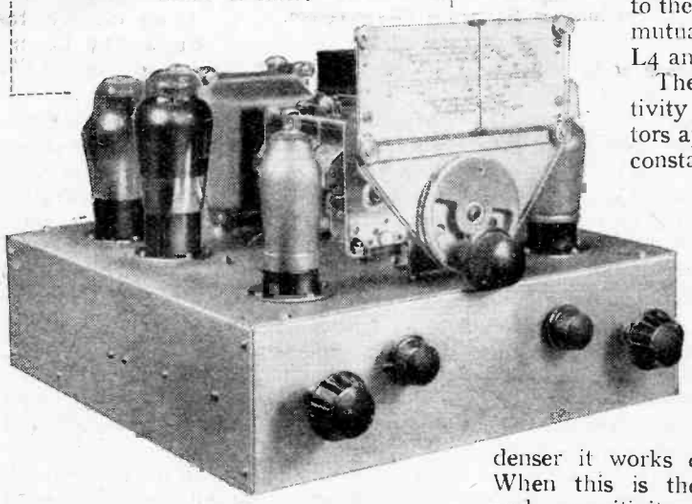
Three-Valve Straight Set

RADIO-FREQUENCY AMPLIFICATION

IN spite of the fact that the small straight set is not now used as widely as it once was, it is still capable of giving a high standard of performance provided that it is correctly designed to meet exacting modern conditions. In this article, the more important points in design are discussed and it is shown that the performance depends very largely upon the correct arrangement of the tuned circuits.

AT one time the most popular type of receiver was the three-valve straight set with one RF stage, grid detector, and pentode output valve. Of recent years, however, this type of set has been largely displaced by the superheterodyne, because of the greater ease with which high selectivity can be obtained with this type of receiver. This does not mean, however, that there is not still a sphere of usefulness for the three-valve straight set, but it does mean that such a set requires much more careful design to give a satisfactory performance under modern conditions than was necessary some years ago. There is no great difficulty in securing adequate sensitivity for most requirements, together with good quality reproduction, from such a receiver. The major difficulty in design lies in obtaining this sensitivity as well as adequate selectivity for the crowded conditions of the ether existing to-day. It will, therefore, be instructive, as well as useful, to consider the design of such a receiver in detail, for it will give a good insight into the characteristics of RF circuits—information which is useful when considering any type of receiver.

Let us therefore decide to design a three-valve set of the RF-detector-pentode type and arrange it for operation from AC supply mains. So far as the basic detector and output stage circuits are concerned, the design will follow in essentials that of the two-valve receiver dealt with in Parts I to III of this series. The alterations will, in fact, be no more than those dictated by the use of different valves and AC operation. We need not, therefore, consider this part of the receiver in any detail at this stage and can concentrate straight away upon the radio-frequency equipment. Experience shows that with a single RF stage it is not possible to secure adequate selectivity with less than three tuned circuits, and with three circuits and a single RF stage there are only two ways in which the circuits can normally be arranged. We can use a single tuned aerial circuit and a pair of coupled tuned circuits between the RF and detector valves, or we can use the single circuit between the valves and the coupled pair preceding the RF valve. In general, the latter is the better course to adopt because we shall naturally have to use reaction, and the application of reaction to a pair of coupled circuits usually leads to serious difficulties.



The basic arrangement of the RF circuits thus takes the form shown in Fig. 1, where the three tuned circuits L2 C1, L3 C2, and L5 C3, are shown with mutual inductance couplings throughout, that is to say, the aerial is coupled to the circuit L2 by mutual inductance between L1 and L2, while the two input tuned circuits are coupled by the mutual inductance between L2 and L3. In the intervalve circuit the primary L4, is coupled to the tuned secondary by the mutual inductance between L4 and L5.

The selectivity and sensitivity depend upon two factors apart from the valve, the constants of the tuned circuits and the degree of coupling adopted. For a given variable condenser and wavelength range the inductance of the tuned circuits is fixed, and for the medium-wave band with the usual 0.0005 mfd. condenser it works out at about 157 μH. When this is the case, the selectivity and sensitivity depend upon the radio-frequency resistance of the tuned circuit. This is made up of many factors; there is first the actual RF resistance of the coil; secondly, losses introduced by the tuning condenser; thirdly, losses caused by the input resistance of the valve; and fourthly, losses introduced by the coupling to other circuits. All these sources of loss reduce selectivity and all but the last reduce sensitivity. In order to obtain the necessary sensitivity and selectivity, therefore, it is necessary to keep all losses at a minimum and then to adjust the couplings so that they are no greater than is necessary. The first step in design, therefore, is to choose coils having as low an RF resistance as possible. This alone is not sufficient, however, for they must be used correctly if they are, in practice, to prove any better than much poorer coils.

There is also another factor which is often overlooked in theoretical discussions but which is, in practice, extremely important. This factor is the accuracy of the matching of the coil inductances. It only enters, of course, when the tuning condensers are ganged, but as they always are ganged nowadays the factor is always important. If the inductances are not

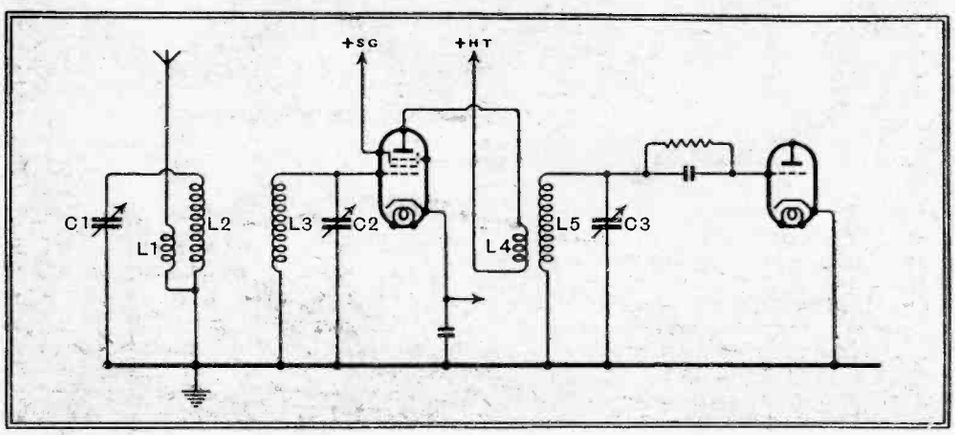


Fig. 1.—The basic circuit of a single RF stage and detector with three tuned circuits is shown here.

Three-Valve Straight Set—

identical it is theoretically impossible for the ganging to be adjusted so that it holds accurately throughout the tuning range. At the point where the ganging is adjusted the results will, of course, be accurate, but at all other points in the waveband the tuned circuits will be tuned to slightly differing frequencies. The result is a broadening of the resonance curve and lower selectivity, and also a falling off in sensitivity. Where a receiver is inherently highly selective, as in a superheterodyne, this may be of minor importance, but where the whole selectivity depends upon these tuned circuits, as in the straight set, it is of the very first importance to maintain accurate ganging. For correct ganging it is essential not only that the inductances be matched within very close limits, but also that the circuits should be used in such a way that the inductance is not affected appreciably by the form of coupling adopted. Furthermore, the sections of the ganged condenser must be closely matched and the stray circuit capacities must also be identical in all circuits. A high degree of accuracy is now obtained in ganged condensers and the stray circuit capacities can readily be equalised in practice by means of adjustable trimmers. The coils, however, remain and it is by no means easy to obtain coils which are matched to the same degree of accuracy as the ganged condenser. There is one obvious remedy, and this is to make the coil inductance adjustable over a small range, so that in the initial set-up of the receiver the inductance of the different circuits can be adjusted precisely to the correct values, just as the stray capacities are equalised.

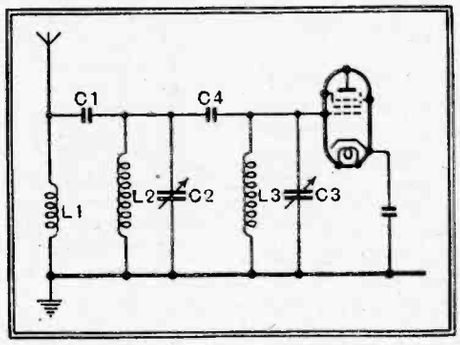


Fig. 2.—In many cases it is wise to adopt capacity couplings between the circuits in the manner depicted in this diagram.

The Pre-selector

We thus find two basic requirements for the coils; they must be of high efficiency and they must have adjustable inductance values. Fortunately, such coils are available commercially and we shall accordingly decide to adopt this type, for they are not only efficient, but, provided they are used correctly, they enable all ganging difficulties to be overcome.

The coils which are available are provided with tappings and with a reaction coil. They are also available with a primary winding for use as an RF transformer. Such additional windings and tapping points, however, are determined by the makers to give a suitable compromise between the conflicting requirements of different receivers. Actually, each receiver requires a different primary winding according to the number of stages employed, and the precise compromise between sensitivity and selectivity which the design calls for. It would, therefore, be too much to expect that the windings provided are ideal for our purpose, except perhaps in the case of reaction.

We are, therefore, likely to do better by ignoring the tapping points on the coils and by using merely the tuned winding in conjunction with an external method of of coupling. This will prohibit us from using mutual inductance couplings, but fortunately alternative methods are available. The circuit of such an arrangement for the pre-selector is shown in Fig. 2. The two tuned circuits are L2 C2 and L3 C3, and they are coupled by the capacity C4 between their high potential ends. The larger the value of this condenser the tighter the coupling, and when it exceeds a certain value a double-humped resonance curve will be secured of the familiar band-pass type. We cannot, however, afford to lose selectivity by adopting such tight coupling, and we must, in practice, keep C4 below this critical value. The value of the capacity required cannot be calculated without knowing the effective RF resistance of the tuned circuits when they are actually connected in place in the set, and it is consequently easiest to determine it experimentally. Its value, however, is of the order of 1 $\mu\mu$F.

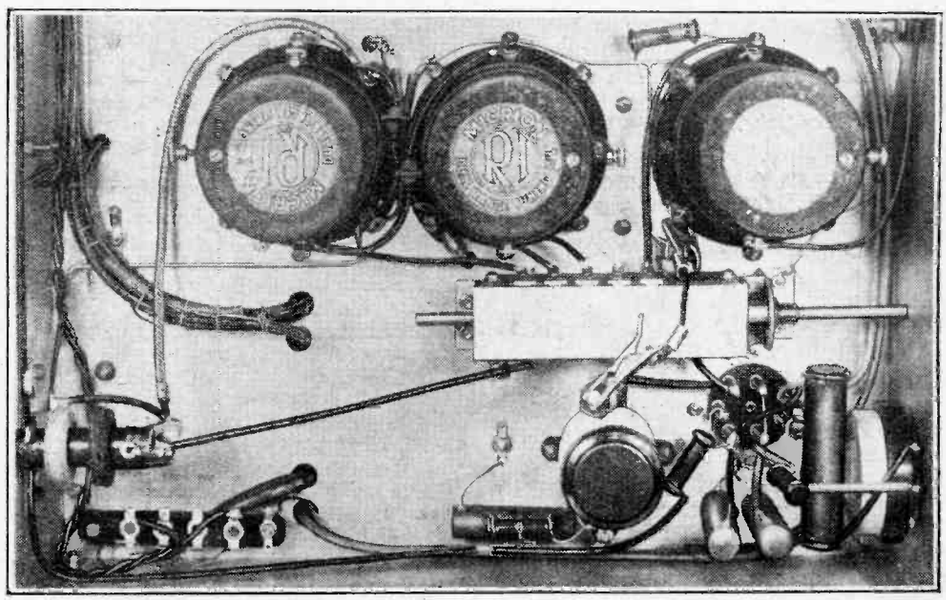
For the coupling of the aerial to the first tuned circuit we adopt the arrangement shown, in which the coupling is provided by C1. The aerial circuit as a whole, however, includes the coil L1. This is chosen to resonate with the aerial capacity at a frequency lower than any within the tuning range. When such a resonance is adopted, the effect of the aerial circuit on the tuned circuit L2 C2 is to change the effective inductance of L2 by an amount which is nearly independent of frequency and which can consequently be corrected by an adjustment to the inductance trimmer of L2. In addition, the efficiency of the transference of energy from the aerial to the first tuned circuit tends to increase as the frequency goes down and thus tends to offset the natural tendency of the tuned circuits to vary in an opposite manner.

The Intervalve Coupling

Turning now to the intervalve circuit, the RF valve itself will introduce very little loss into the tuned circuit if we choose an RF pentode of high AC resistance. The detector, however, will introduce considerable loss if it is a grid detector, as it must be if we are to obtain the combination of good quality with sensitivity.

Our first step in design is obviously to make the detector input impedance as high as possible. To a first approximation the input resistance is equal to half the value of R in Fig. 3, so that we must obviously use as high a value grid leak as possible. The use of a high value grid leak, however, will cause a loss of the higher audio frequencies, unless the capacity in the grid circuit is proportionately reduced, and if we do reduce the capacity we shall lose out in detector efficiency. This loss, however, will not be as great as one might expect, because the lower damping on the tuned circuit will increase the efficiency here, and so tend to offset the reduction in the detector circuit. From the point of view of circuit damping, a reasonable value for the grid leak R is 1 megohm, and with such a resistance we must not exceed about 25 $\mu\mu$F for the grid condenser C3 if we are to obtain good quality.

Using such values the tuned circuit will be fairly lightly damped, not only because



An underview of part of the receiver in the course of development. The aerial coil can be seen on the extreme left.

Three-Valve Straight Set—

the detector input resistance is higher than usual, but also because the detector is, in effect, tapped down the circuit to some degree by the effect of C3 in conjunction with the grid-cathode capacity of the detector valve. It is simplest to use

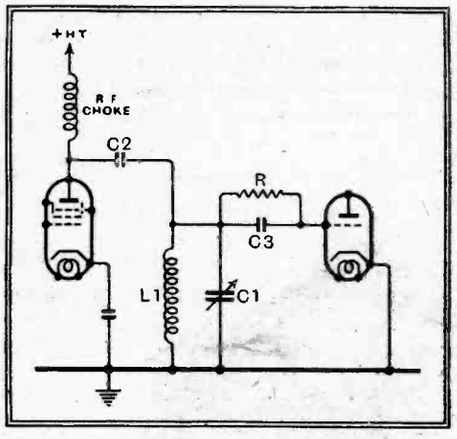


Fig. 3.—The tuned-grid intervalve coupling is in most cases the best to adopt.

the tuned grid circuit, as shown in Fig. 3, and if we make the coupling condenser C2 of high value and the RF choke is good, we shall obtain quite high amplification and reasonably good selectivity. One difficulty is likely to be found, however. The intervalve circuit will have a much higher value of stray circuit capacity than either of the two input tuned circuits, for it has the capacities of two valves across it, whereas the grid circuit of the RF valve has the capacity of only one valve across it. In practice, it is often found that correct ganging is not possible, because the trimming condenser on the intervalve tuned circuit has to be at minimum with the trimmers on the other circuits at maximum. If the trimmer capacity available in the early circuits is increased, then the tuning range is restricted. Obviously the correct thing to do is to reduce the stray capacities on the intervalve circuit. Fortunately it is quite easy to do this, but only at the expense of amplification.

Amplification, however, does not depend only upon the tuned circuit, but also upon the RF valve, and if we reduce the coupling between the valve and the tuned circuit to reduce the stray circuit capacities, then we can bring the gain back to normal again by choosing a valve of higher mutual conductance. In practice, it would not be possible to use a large capacity for C2 with the type of circuit we have discussed and a valve of high mutual conductance, because the gain obtained would be too great for the maintenance of stability, and if we were to use such an arrangement we should find it necessary to reduce the mutual conductance of the valve by increasing its grid bias.

The choice of exact values is again one which is best settled by experiment, and we start by choosing a valve of high mutual conductance and then selecting C2 experimentally to give the required performance. In practice, the capacity of C2 works out at some 5 to 10 $\mu\mu$F, a value much smaller than has often been adopted in the past.

(To be continued.)

On the Short Waves

Notes from a Listener's Log

IN view of the interest which is being taken in the somewhat revolutionary indirect-ray, short-wave service now being introduced in India by C. W. Goyder, Chief Engineer of All India Radio, it is felt that readers would be interested in rather more complete information than was given in my last notes.

This information is as follows:—

Stations at Present in Operation:—

Delhi 2.—Day frequency, 9.59 Mc/s (31.3m.); night frequency, 3.47 Mc/s (86.5m.).

Bombay 2.—Day frequency, 9.55 Mc/s (31.4m.) and 6.85 Mc/s (49.3m.); night frequency, 3.31 Mc/s (90.6m.).

Calcutta 2.—Day and night frequency, 6.11 Mc/s (49.1m.).

Opening in April:—

Delhi 3.—Day frequency, 15 or 11 Mc/s (19 or 25m.); night frequency, 9 Mc/s (31m.).

(The corresponding medium-wave stations are known as Delhi 1, etc.)

With the exception of the third Delhi transmitter, all these stations are operated to serve the area in which they are located—that is, the frequencies chosen for day and night operation are ones which show no appreciable skip-distance effect during the period when they are in operation.

In order to give a quasi-local service on these frequencies, however, the type of transmitting aerial used must also be carefully chosen, and both theory and practice indicate that the best aerial for such a service should be a half-wave horizontal di-pole erected half a wavelength above earth.

In fact, this is the type of aerial that is actually being used.

Many readers will be familiar with the "figure of 8" horizontal polar diagram of this particular aerial, for the direct-ray or horizontal projection case, but it should be remembered that for projection at 30 degrees to the horizontal (in order to give an indirect-ray service), the "horizontal" diagram is sensibly circular.

The third Delhi transmitter (10 kW?) is intended to serve distant areas in India, and for this reason will work on rather higher frequencies than the other transmitters, and will use, therefore, a half-wave di-pole erected as high as possible above the ground. Perhaps later a more complex aerial than this will be adopted.

It should, of course, prove possible to obtain quite good reception from this last transmitter in this country after it comes into operation in April. Of those at present working Delhi 2 on 9.59 Mc/s should be receivable in this country between 2 and 5 a.m. G.M.T. and Bombay on 9.55 Mc/s between 2 and 3 a.m. G.M.T.

What is now required for India seems to be a cheap but robust superheterodyne receiver—mixer-DD/triode-output pentode or mixer-IF-DD/pentode—having two tuning ranges 25-100 metres and 200-550 metres or, perhaps, only the 25-100-metre range.

Keeping in mind the signal strength received in this country from the 0.5 kW transmitter at Jelöy on 9.525 Mc/s last year, Jelöy used an aerial similar to that of the Indian station, it appears the field strengths of about one-millivolt per metre can probably be anticipated at a radius of a few hundred miles from Delhi, Bombay, etc. A field strength of this order means that the two- or three-valve receiver should give satisfactory results, providing that some AVC control is provided and that the selectivity is adequate. A straight receiver is not likely to be successful for these reasons.

Communal Receiver

For many years to come the masses in India will probably only be reached via the village communal receiver, and Europeans and wealthy Indians will continue to purchase and use sensitive all-wave receivers for the purpose of listening to inter-Continental short-wave broadcasts, such as those from Daventry. Nevertheless, one believes that there are many thousands among India's teeming millions (340 millions approximately) who would welcome some such simple receiver as that described above.

It must be remembered that the programme radiated by A.I.R. is almost exclusively Indian in character.

With the exception of two or three days when conditions definitely favoured the lower frequencies from N. America, reception has, in general, remained excellent, and some very good programmes have been taken at various times and dates from all the regular U.S. broadcasters.

W2XE continues to excel on 21.52 Mc/s. W2XAD on 21.50 is not as good as W2XE, but better than W8XK in this band.

In the 17 Mc/s band W3XAL has improved, and W2XAD still continues to surpass W8XK slightly in the 15 Mc/s band.

Both W2XE and W1XAL have been excellent at times on 11.83 and 11.79 Mc/s respectively in the late evenings; but for the reception from the U.S. the 9 and 6 Mc/s bands are now much less valuable.

Nevertheless, strong signals have been obtained from JZ1, Tokio, on 9.535 Mc/s.

Twenty-eight megacycle reception is now peaking again, and good signals from the States have been available until 8 p.m. on some nights.

Reception of the Alexandra Palace sound transmissions is again being reported from distant points, such as Cairo.

Finally, during the last few nights a Russian station doing propaganda broadcasts has been working on an adjacent channel to Rome on 9.63 Mc/s, with the result that both Rome and Moscow have been blotted out by the "special interfering station" with which listeners are now so familiar.

ETHACOMBER.

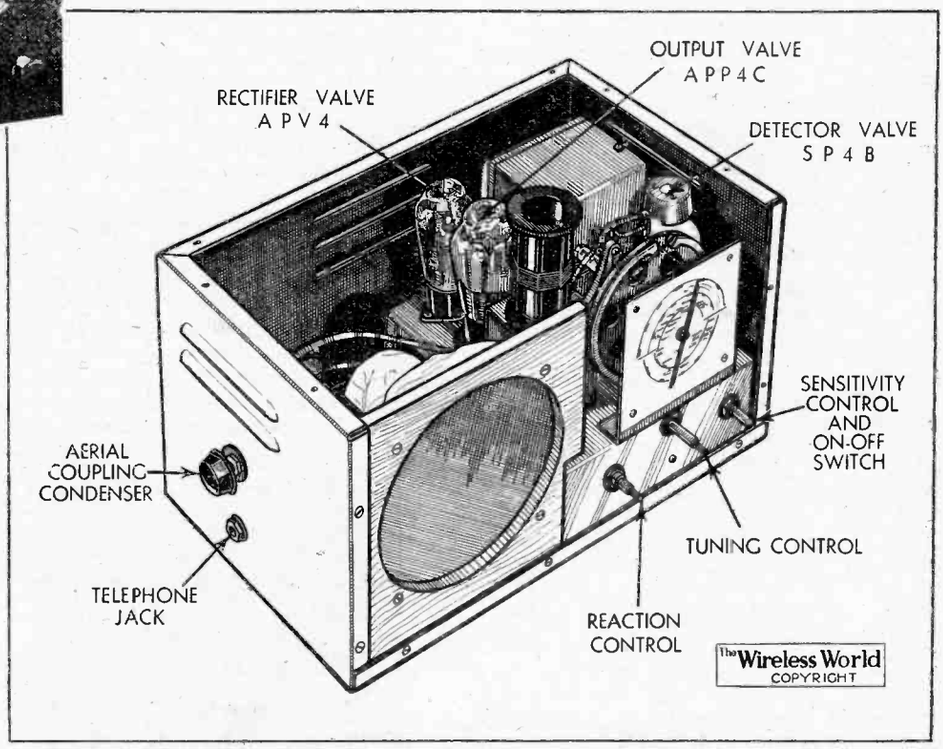
GRAMOPHONE RECORDINGS

IN a letter from Mr. H. W. Davis, published in last week's issue, the Columbia "Orient Express" record number should read FB 1133.

B.T.S. "Trophy 3"

A SENSITIVE SHORT-WAVE RECEIVER FOR AC MAINS

FEATURES. ***Waveranges (approx.)***—*(1) 6—13 metres. (2) 12-26 metres. (3) 21-52 metres (4) 40-96 metres. (5) 70-200 metres. (6) 200-550 metres.* ***Circuit.***—*RF pentode detector with reaction—pentode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Reaction. (3) Sensitivity and on-off switch. (4) Aerial coupling.* ***Price.***—*(Including valves and two coils) 6 guineas.* ***Makers.***—*British Television Supplies Ltd., 8-10, Charing Cross Road, London, W.C.1*



Interior of spot-welded steel cabinet with front and top removed. Access to valves is normally obtained by removing a small inspection door in the top plate.

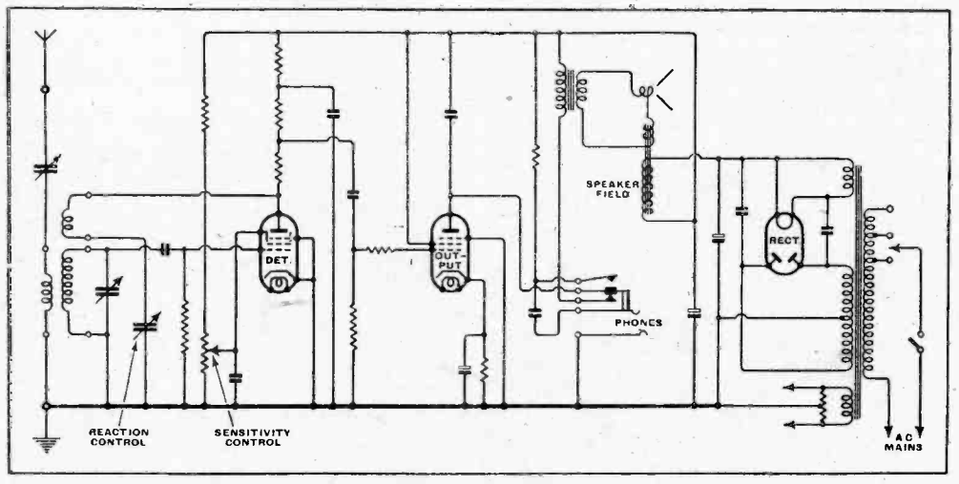
TO the confirmed short-wave enthusiast the average "all-wave" broadcast receiver will always appear in the nature of a compromise, since many of the components, notably the main tuning condenser, must be constructed to fulfil the requirements of medium and long, as well as short waves. A set specifically designed for short waves only is always potentially a better performer than the general purpose set.

Although the circuit of the "Trophy 3," apart from the power rectifier, consists of only two valves, its sensitivity, derived chiefly from the judicious use of reaction, is extraordinarily high and signals at full loud speaker strength are easily obtained from American stations, as well as from the many interesting British and Continental transmitters which are now crowding the short-wave bands.

Unlike the all-wave set, which provides a stable and more or less standardised response, the "Trophy 3" is a set whose performance will bear a strict relationship to the skill which is brought to its handling. There are no fewer than four controls, each of which may require careful adjustment to get the last ounce out of the set on any given station, but when this is done there can be no doubt that the results, at least from the point of view of sensitivity and general liveliness, would put to shame many a four- or five-valve superheterodyne.

Both the main tuning and reaction controls are fitted with slow-motion drives giving fine adjustment. The smoothness of reaction, and to some extent the sensitivity, are controlled by the knob on the extreme right, which varies the screen potential of the pentode detector valve. Incorporated with this control, incidentally, is the mains on-off switch. Failure to obtain oscillation at some parts of the scale when the screen volts are otherwise adjusted to their correct value may be overcome by decreasing the series aerial capacity by the knob on the left side of the cabinet. This will also increase selectivity in the few cases where the effect of regeneration is insufficient to give adequate separation.

When going through the various adjustments care should be taken to allow the detector valve to oscillate as sparingly as possible, for without an RF stage to act as a buffer, there will be some radiation from the aerial. Conversely, the aerial will be sensitive to hand and body capacity effects, and should preferably lead away from the back of the set and be steadied in some way to prevent it swaying. Very complete screening of the receiver as a whole reduces hand capacity in other directions, but is dependent for its success on a short earth lead. If this



The simple circuit derives its efficiency from the use of reaction and the careful design of tuned circuits.

B.T.S. "Trophy 3"—

is not practicable some improvement may result from earthing the metal case at a point other than the earth socket, and as a final refinement the set could be provided with extension spindles of insulating material for the various control knobs.

The strength of signals in the loud speaker is generally so good that listening into the small hours might prove unpopular with the rest of the household were it not for the fact that a telephone switch-jack has been thoughtfully provided by the designer. When the 'phone plug is inserted, sensitivity is reduced by substituting a resistance of less than the normal valve load for the output transformer primary, and the 'phones are then filter-fed from the anode through a condenser.

Waverange changing is by means of plug-in coils wound on ribbed formers. The pair supplied with the set covered bands of 12-26 and 21-52 metres, and others are available to extend the range down to 6 metres and up to 550 metres. Calibrated scales are printed on the circular tuning dial for wavelengths between 6 and 200 metres, and although the accuracy will depend on the setting of the coupling condenser it is always near enough to form a useful guide to the identity of a broadcast or amateur band.

The main tuning condenser is of a special short-wave type with brass vanes and ceramic insulation. Control is effected through a cord drive working over a large-diameter die-cast pulley. Other constructional details worthy of mention are the short grid leads, shielding of the grid cap on the detector valve, partial screening of the main transformer where it approaches the detector stage, and the neat manner in which the mains voltage adjustment is arranged to be readily accessible from the back.

There can be no question of the sensitivity of this set and its ability to "pull them in," and if its liveliness extends to the handling of the controls, that is a challenge to skill in manipulation which the seasoned short-wave enthusiast will be quite ready to accept. None of the usual troubles associated with modulation hum is present, and the occasional microphony inseparable from the use of reaction does not rob the receiver of any usable sensitivity.

Two- and three-valve battery receivers built on similar lines are also available at £4 15s. and £5 15s. respectively—less batteries.

New Murphy Sets

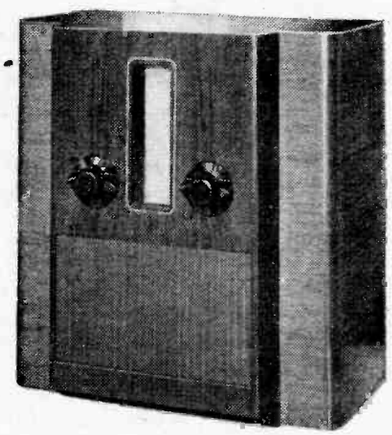
The Backbone of the 1938 Programme

DETAILS are now available of the new Murphy receivers which will form the foundation of the firm's programme for 1938. Certain existing models, notably the A40C and A40RG, reviewed in our issue of March 3rd, will be continued, and later in the year some additional receivers of advanced design will be introduced. In the meantime the present range of receivers will meet the requirements of those who want a soundly designed instrument at moderate cost and with no frills, but in which a good balance has been maintained between the essential features of quality of reproduction, range, selectivity and reliability.

46 Series

The basic chassis for this group is a 4-valve superheterodyne with triode-hexode frequency changer, var. mu pentode IF amplifier working at 465 kc/s and employing fixed-tuned transformers with iron cores, a double-diode-triode second detector and a beam tetrode output valve rated at 5 watts. The overall amplification available on short waves (16.7-50 metres) is in excess of the requirements for medium and long wave reception, and accordingly a simple form of inverse feed-back is introduced in the output stage for the two latter wavebands. Vertical wavelength scales with white lettering on a black glass background are framed in a rectangular escutcheon and selectively coloured illumination is provided in the AC models.

In the universal sets a refinement of more that usual interest is included. Most readers will be familiar with the effect common in AC/DC sets of the pilot lights burning at excessive brilliance during the warming-up period. If the rating is chosen to afford protection during this period the normal illumination provided is often insufficient. To overcome this difficulty a thermal delay switch has been incorporated in order that pilot lamps of normal rating may be used.



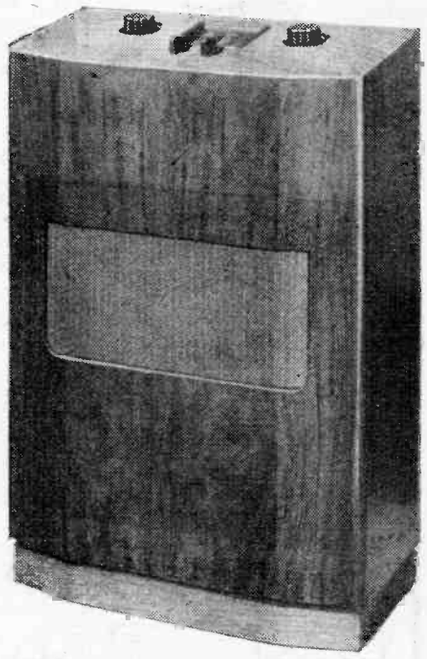
Alphabetical tuning of a new design is incorporated in the Murphy 48 table model.

In addition to the table models, consoles and radiogramophones are available and the prices are as follows:—Table Models: A46, £9 10s.; D46, £9 15s. Consoles: A46C, £13 15s.; D46C, £14. Radiogramophones: A46RG, £20; D46RG, £22.

48 Series

The design and the circuit in this series is based on that of the "46." An improved type of inverse feed-back is, however, employed and a filter circuit is included to give a sharp cut-off at 5,000 cycles. The inverse feed-back has the effect of considerably reducing the output impedance of the beam tetrode output valve, with the result that the loud speaker resonances are heavily damped, It has been found possible to produce quality of reproduction approaching that of console receivers in the table model. Accordingly a console has been omitted in this range, but a radiogramophone version incorporating a record-changer is available.

All the sets in this series make use of an improved alphabetical dial in which station names appear on a rotating drum. Both



Console version of the Murphy 46 receiver.

table models and radiogramophones are available for universal as well as for AC operation, and the prices are as follows:—Table Models: A48, £12; D48, £12 5s. Radiogramophones: A48RG, £30; D48RG, £32.

Battery Models

The model B45 is a two waveband straight receiver based on the earlier B31 and costs £7, less batteries. Improvements have been made to the reaction circuits, with the result that the setting of its control is now substantially constant throughout both wavebands. In the interests of range and efficiency it has been decided to use simple tuning circuits instead of band-pass, but a Droitwich filter for chassis mounting is available for customers living in the Midland Counties.

In the B47, which is virtually a battery version of the 48 series, an illuminated alphabetical drum scale is provided, and in order to obtain a comparable performance on other waves an increased HT current consumption is permitted on this range (16.7-50 metres). Actually the average HT consumption on medium and long waves is 8mA and on short waves 12mA. A QPP output stage is used in conjunction with a sensitive PM speaker and, as in the case of the B45 receiver, grid bias is automatic throughout. The price of the B47 less batteries is £11 10s.

H.M.V. MODEL 653

TO meet the demand for an all-wave superheterodyne table model at a reasonable price the Gramophone Co., Ltd., have introduced this AC receiver which, housed in an attractive walnut cabinet with sloping control panel, sells for 10½ guineas. The circuit consists of frequency changer, IF amplifier, second detector AVC and LF amplifier and tetrode output valve. The arrangement of the chassis is interesting for the fact that the tuning control is offset, the pointer being driven through the medium of a light metal chain. Wave ranges are as follows: (1) 13.5-50 metres, (2) 195-580 metres, (3) 1,000-2,000 metres.

An energised loud speaker with circular diaphragm is mounted behind a curved metal grille at the top of the cabinet, and its electrical input is rated at 3 watts.

Television Topics

DETECTOR FILTERS

WHEN the question of interference caused by the feedback of harmonics of the intermediate frequency in a superheterodyne television receiver was dealt with last week, it was said that any trouble which remains when the intermediate frequency has been correctly chosen can often be eliminated by the use of a suitable filter in the detector output circuit. Such filters are often needed, also, in a straight set, but this time to confine RF currents to the detector circuit, for if they are

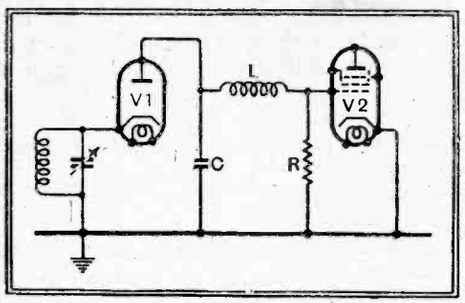


Fig. 1.—The simplest form of filter in the detector output circuit.

allowed to wander into the VF amplifier sufficient feedback may occur to cause instability.

Whichever type of receiver be used, the circuit of the filter will usually take the same form, but the values of components are likely to be very different. The basic circuit takes the form shown in Fig. 1. The condenser C must, in general, be of very small capacity and its main purpose is to provide a path for the RF signal to reach the detector. The main filtering action is provided by the coil L and the following condenser in shunt with R. This condenser is not shown on the diagram because, in general, it is not a component but the input capacity of the VF valve, V2.

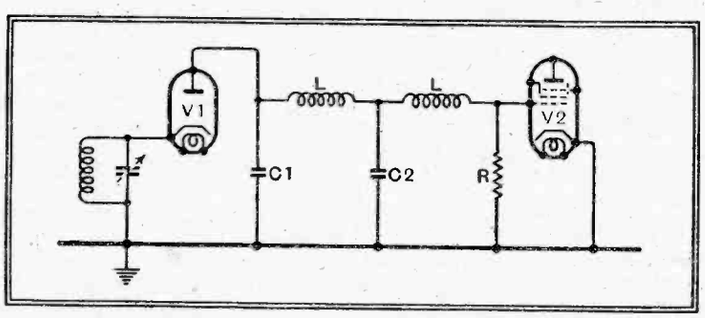


Fig. 2.—A more complex filter is advisable in sensitive superheterodynes. The capacity of C1 should be one-half that of C2.

The main difficulty in choosing the constants for a filter lies in the self-capacity of the coil L. With normal coils this is of the order of 5 $\mu\mu$F. and, as the input capacity of V2 is probably about 10 $\mu\mu$F., it can be seen that the coil L will resonate with its self-capacity at a frequency not enormously higher than the cut-off frequency of the filter. At the frequency at which this natural resonance occurs, the impedance value will be very high and an extremely good filter action will be secured, but at higher frequencies the filtering will be greatly reduced because the actual inductance of L will play little part, and it will be the self-capacity of the coil which forms the series impedance of the circuit. Thus, with the values referred to above the filtering action will at very high frequencies reduce the RF output to no more than one-third of the input, whereas an enormously greater reduction would be secured if the coil had no self-capacity.

In the case of a straight set the maximum filtering is required at signal frequency, 45 Mc/s; consequently it would seem best to choose such a value for L that it resonates with its own self-capacity at 45 Mc/s. If this is done, however, care must be taken to see that the choke circuit is carefully screened, otherwise feedback from this circuit may lead to instability. From this point of view it is probably safer to choose a value for L such that the resonance occurs at a rather lower frequency than 45 Mc/s but still high enough for the circuit to have considerable impedance at this frequency. An inductance of the order of 3 to 5 μH., with the usual form of construction, would seem satisfactory. At modulation frequencies the coil L then has a negligible effect so that the value of R is chosen in relation to the total circuit capacity in the usual way.

For use at intermediate frequency, the filter must be effective at a much lower frequency, and it is desirable that it should remain effective even at high frequencies if it is to reduce harmonic interference.

The calculation of the circuit constants is probably best undertaken from ordinary filter theory, but is complicated by the number of doubtful factors which must be taken into consideration. In the writer's experience, however, the values are by no means critical with an intermediate frequency of 10 Mc/s or more, and an inductance of about 150 μH. is a suitable value for L when C is 10 $\mu\mu$F., the same as the input capacity of V2. The resistance R should then be about 4,000 ohms. In most cases a single stage filter, such as this, will remove all IF harmonic troubles, but two stages can be adopted as shown in Fig. 2. Both coils should have the same value but the centre capacity, C2, should be twice that of the end capacities.

Television Programmes

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

Sound	Vision
41.5 Mc/s	45 Mc/s

THURSDAY, MARCH 17th.

3, Douglas Byng in "Byng-ho," with Cyril Fletcher and Queenie Leonard. **3.20,** British Movietonews. **3.30,** 129th Edition of Picture Page.

9, Repetition of 3 p.m. programme. **9.20,** Gaumont-British News. **9.30,** 130th Edition of Picture Page.

FRIDAY, MARCH 18th.

3. Charles Heslop with Maidie Field and Sydney Smith in "On the Sands." **3.10,** Gaumont-British News. **3.20,** "The Postpag"—an operetta in one act by Alfred Perceval Graves. **3.50,** Preview.

9, Diana Ward in Songs. **9.5,** Artists and Their Work—"Magic Casements," an interview with Robert Gibbings. **9.20,** Cartoon Film. **9.25,** Preview. **9.30,** British Movietonews. **9.40,** "Words Upon the Window Pane"—a play by W. B. Yeats. Cast includes Beatrice Wilson, Jean Moncrieff and William Devlin.

SATURDAY, MARCH 19th.

2.50-3.40 and **3.50-4.30,** "O.B." from Twickenham of International Rugby Football—England v. Scotland match for the Calcutta Cup. **3.40,** Jane Carr, Songs at the Piano.

9-10, "The Crooked Billet"—an adaptation of the thriller by Dion Titheradge. Cast includes Dorothy Hyson and Basil Gill.

MONDAY, MARCH 21st.

3, Starlight. **3.5,** Window Boxes, talk by Mrs. Walter Elliot. **3.15,** Comedy Film, "Tell Me if it Hurts." **3.30,** Sketches: "The Cup that Cheers," by V. C. Clinton-Baddeley, and "The Split in the Cabinet," by Stephen Leacock. Casts include Diana Churchill, Douglas Stewart and V. C. Clinton-Baddeley.

9, Marcella Salzer in a one-woman entertainment. **9.15,** Cartoon Film. **9.20,** Artists and Their Work. **9.35,** Gaumont-British News. **9.45,** Orchestral Feature.

TUESDAY, MARCH 22nd.

3, Peter Dawson and the Television Orchestra. **3.5,** "Henry IV"—a play by Luigi Pirandello. Cast includes Ernest Milton and Valerie Hobson.

9, Speaking Personally. **9.10,** Cabaret, including Reine Paulet, Syd Walker and the Geddes Bros. **9.40,** British Movietonews. **9.50,** Repetition of 3 p.m. programme.

WEDNESDAY, MARCH 23rd.

3, Forecast of Fashion. **3.10,** S. P. B. Mais compères "Craftsmen at Work." **3.20,** British Movietonews. **3.30,** Preview of Boxing from Harringay. **3.40,** Nat Gonella and his Georgians.

9, Repetition of 3 and 3.10 p.m. programmes. **9.20,** Gaumont-British News. **9.30,** O.B. of Boxing from Harringay, McAvoy v. Harvey.

Frequency Changing with the Octode

EFFECTS FOUND ON SHORT-WAVES

By E. LUKÀCS
Tungsram Research Laboratories
(Translated by J. A. SZABADI)

IT is well known that, in an octode frequency-changer, it is the second space charge which enables multiplicative mixing of the input frequency with the self-generated oscillator frequency to be accomplished. However, another unforeseen effect of this space charge is to couple the input circuit to the oscillator circuit, which causes the gain of this stage to be dependent on frequency. The phenomenon is studied, and explained by influence effect of the second space charge. The dependence of the anode current on frequency, shown by experimental results, is theoretically proved. Means are indicated whereby the frequency dependence of the gain is corrected. As an application of the theory, an oscillator is described which functions by virtue of the principle of influence, and from this the production of parasitic oscillations in an octode is explained.

THE phenomenon, to be described in this article, occurs in some frequency-changer valves which perform the combined rôle of modulator and oscillator. Typical representative types of valves are heptodes and octodes.

American designers found that the gain of a heptode depended on wavelength. If the tuned circuit attached to grid 4 of the valve is short-circuited by means of a condenser or conductor, the same anode current is observed as at long waves, but when the grid circuit is not short-circuited the anode current is different.

In order to study the phenomena, the circuit shown in Fig. 1 was arranged with an octode valve; in the mechanical design of the circuit, allowance was made for independent operation of the variable condensers of the input and oscillator circuits. The anode circuit contains a milliammeter.

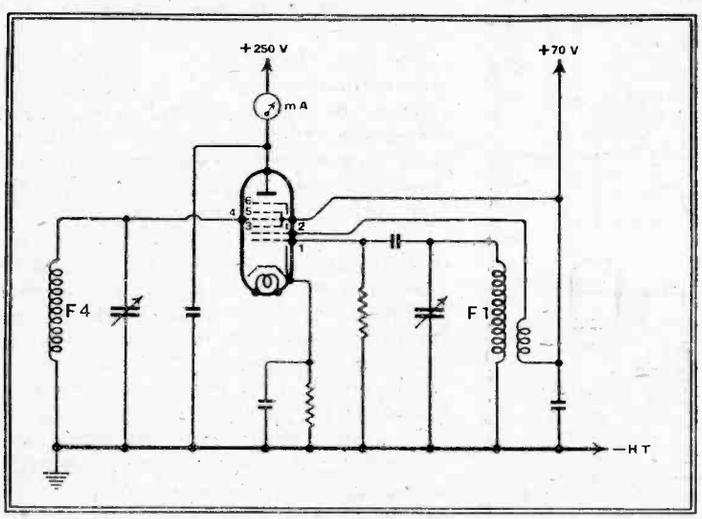


Fig. 1.—The basic circuit diagram of the octode frequency-changer is shown here.

In Fig. 2 (a) is shown the variation of anode current as the input circuit condenser is rotated, the oscillator condenser remaining constant. If the resonance frequency of the input circuit differs largely from the oscillator frequency, the anode current has a value of approximately 1 mA. As the difference between the input circuit frequency and the oscillator circuit frequency decreases, so the anode current falls, and achieves a minimum, then rises again rapidly to a distinct maximum. As the frequency of the input circuit is increased still further, the anode current again drops asymptotically to the same value as it had at the beginning. At the point where the oscillator and input circuit frequencies are identical, the anode current of the valve is normal.

The frequency dependence of the anode current undoubtedly originates from an alternating voltage, built up on the tuned circuit of the fourth grid. An explanation will be given of how this alternating voltage arises, and how it causes a variation in anode current.

The transference of the oscillator frequency to the input circuit is caused by electron coupling. Besides the primary space charge in a valve having many grids, in which the grids have different potentials and polarities, a second space charge will occur. Thus, in an octode a second space charge occurs between the third and fourth grids. The formation of this is caused by the decelerating action of the negatively biased fourth grid. Similar space charges have in the past been referred to as virtual cathodes. Besides the fact that such space charges can be controlled in a similar manner to the space charge surrounding the real cathode, they share the property of all electrical charges of producing in neighbouring conductors other electrical charges due to their influence.

An alternating influence charge occurs on the fourth grid by virtue of the periodical variation in the second space charge, which oscillates in sympathy with the voltage on the first grid. The influence charge causes a current to flow in the circuit of grid 4, which builds up a voltage which, as shown below, is the reason why the anode current depends on fre-

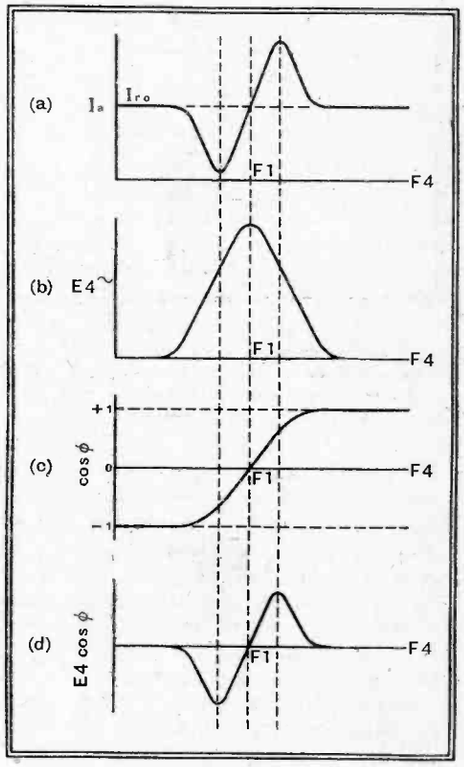


Fig. 2.—The variation in anode current with tuning is shown at (a), and the voltage at grid 4 at (b). The variation of the cosine of the phase angle between the voltages on grids 1 and 4 is shown at (c), and at (d) the calculated change of anode current.

Frequency Changing with the Octode—

quency. That the current variations shown in Fig. 2 (a) really occur is confirmed by the examination of the phase relationships.

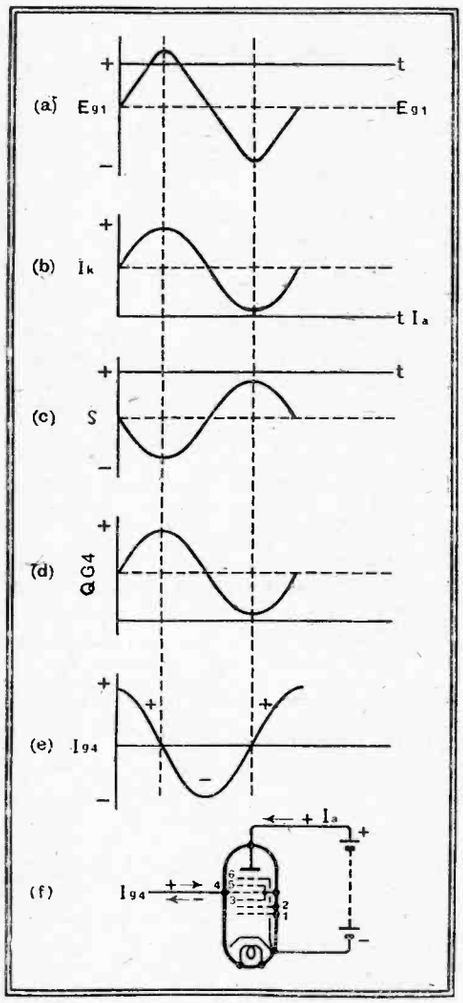


Fig. 3.—The voltage on grid 1 is shown at (a) and the corresponding current at (b), with the variation in space charge at (c). The charge induced on grid 4 is given in (d) and the resulting grid current at (e).

The individual factors that have an effect on the phase of the alternating voltage in the circuit of the fourth grid are shown in Fig. 3. The sequential variation of voltage on the first grid is shown in Fig. 3 (a); the valve current (Ik) flows in phase with the above (Fig. 3b), whilst the space charge is 180° out of phase. This is very easily appreciated if one considers that when the current flows a greater quantity of negative electrons pile up in the space between third and fourth grids (Fig. 3c). As the sign of the induced charge is opposite to that of the space charge (Fig. 3d), it is again in phase with the alternating voltage on grid 1. The current caused by influence leads the charge on grid 4 by 90°. This is the result of the fact that the direction of the current is positive when the influence charge increases, and becomes negative when it decreases (Figs. 3e and 3f).

The frequency and magnitude of the anode current variation can be resolved from the following consideration: the anode current variation has zero frequency, as the alternating voltages on the first and fourth grids, which produced this variation, are of the same frequency; the anode current variation is proportional to the amplitude of both alternating voltages.

If we indicate these values, in sequence, as E_1 and E_4, then the anode current is given by the well-known formula:—

$$S_c E_4 \cos\phi.$$

Here ϕ indicates the phase difference between the two voltages. S_c is the conversion conductance of the valve. The latter value contains the amplitude of the oscillator voltage, and as the oscillator circuit constants do not alter it is a constant. Thus, the anode current variation is proportional to $E_4 \cos\phi$.

In order to calculate the latter expression, one requires to know the phase angle. This can be arrived at from the following:—

As is known, a relationship exists between the phase of the control voltage and the instantaneous value of anode voltage, which is best shown in a tabular manner, as follows:—

TABLE I.

Loading.	Phase angle between anode voltage and control voltage.
Ohmic	−180°
Capacitive...	− 90°
Inductive	+ 90°

The same relationship exists between the control voltage and the voltage on the fourth grid, remembering that the voltage on the fourth grid leads by 90°. The latter is a consequence of influence, which was responsible for the voltage on the fourth grid. Thus, we find the following phase relationship:—

TABLE II.

Loading.	Phase angle between voltage on fourth grid and first grid.
Ohmic	− 90°
Capacitive...	−180°
Inductive	0°

The load resistance of the circuit of the fourth grid is pure ohmic if $F_4 = F_1$; inductive if $F_4 > F_1$; capacitive if $F_4 < F_1$, where F_4 indicates the natural frequency of the input circuit, F_1 the natural frequency of the oscillator circuit. The phase angles are, in consequence, 90°, 180° and 0°.

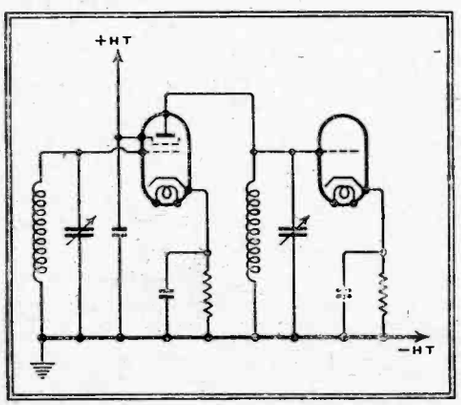


Fig. 4.—The basic circuit of an "influence" amplifier.

From these values we can calculate the anode current alteration from the expression $E_4 \cos\phi$.

Thus, Fig. 2d was calculated, which, as will be seen, is identical with 2a. The theory that the anode current is a function of frequency is thus confirmed. From this theory we can draw the following conclusion, that it is possible to compensate for the decrease in gain of a mixer valve, by impressing upon the fourth grid an alternating voltage of the same magnitude but of opposite phase to that produced by the influence of the space charge coupling. If one introduces a small capacity between the first grid and fourth grid, then a voltage is transferred to grid 4, in phase with the voltage on grid 1, provided the impedance of the fourth grid circuit is mainly capacitive, but in opposite phase if the impedance is inductive. The voltage produced by the small condenser is 180° out of phase with the voltage induced by space charge coupling.

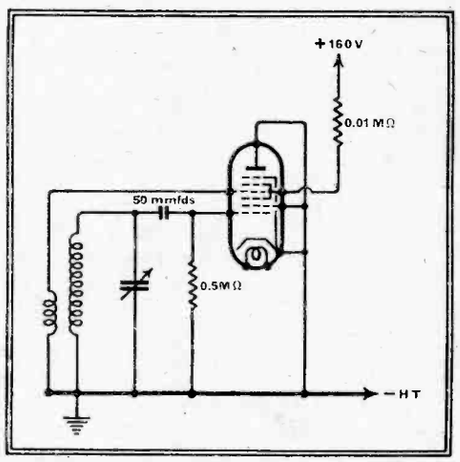


Fig. 5.—An oscillator circuit making use of the "influence" effect.

The compensating condenser will have a constant value over the whole waveband provided that the modulation coils stay constant.

An Oscillator Circuit

We have found that a capacitance of approximately 2 $\mu\mu$F. is sufficient to achieve the required compensation in a Tungsram Octode, TEK2 (VO6s), on the whole waverange from 20-50 metres. Hence, a small capacitance is actually built in to type TEK2 (VO6s).

This effect, which is usually an unwanted one, can sometimes be turned to good account, and an application of it is described by C. J. Bakker and G. de Vries, in an article in *Physica*, Vol. I, 1934, pages 1045-1054.

The circuit principle is shown in Fig. 4. For the sake of simplicity all electrodes of the octode not affecting the action are omitted, the remainder forming a tetrode whose anode has a negative voltage. The space charge which oscillates in sympathy with the frequency of the voltage on the first grid sets up an influence voltage on the anode, which causes a current

Frequency Changing with the Octode—

to flow in the anode circuit, which can be further amplified. In this article the theory of the influence amplifier is described, and in order to be able to include the short-wave lengths in this consideration the finite transit time of the electrons between screening grid and anode is included in the calculation. Experimentally, the theory was confirmed on various wavelengths (namely, at 6, 15, 25 and 50 metres). Besides this, the above authors constructed a three-stage amplifier which, in principle, utilised the circuit shown in Fig. 4. The amplifier worked satisfactorily on wavelengths between 15 and 50 metres.

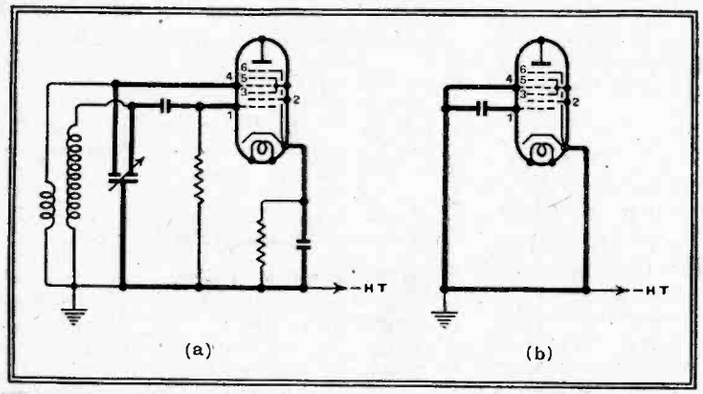


Fig. 7.—Parasitic oscillation can be caused by the "influence" effect, oscillation taking place in the part of the circuit shown in heavy lines.

The advantage of the influence amplifier is that it is not necessary to use a condenser-resistance-coupling between stages.

In the Tungsram Research Laboratory an attempt was made to evolve an oscillation generator from the influence amplifier. By the orthodox method the voltage produced on the fourth grid was fed back to the first grid (Fig. 5). The second grid and anode of the octode were returned to cathode, the fourth grid being connected to the cathode via the reaction coil. It was found that this arrangement permitted the production of wavelengths between 3-15 metres. At higher wavelengths, apparently, the amplification is insufficient to compensate for the losses in the oscillatory circuits.

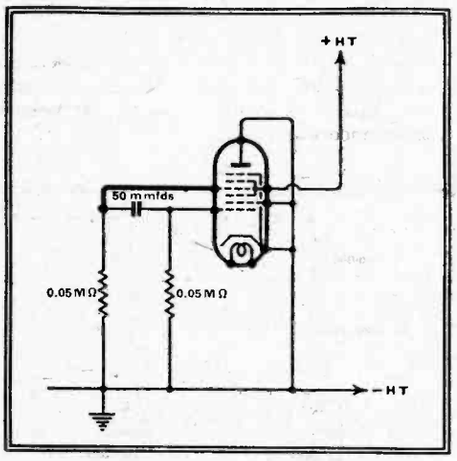


Fig. 6.—Oscillation can be secured at very high frequencies with this circuit.

In order to produce waves of even shorter length a relatively thick wire was directly connected between the fourth and first grids. In this circuit, which is basically a Colpitt's reaction circuit, the tuning capacity and the three-point division of the tuning circuit are obtained by utilisation of the valve capacities (Fig. 6). The shortest wavelength obtainable with this circuit was 1.5 metres. The fact that short waves can be produced in this manner explains the phenomena of parasitic oscillations in mixer valves. The usual explanation put forward for these parasitic oscillations is that the slope of these valves is too high. This assumption does not hold, however, as the slope of the octode is well below that of an output valve.

However, if one looks upon the octode as an influence amplifier, the production of parasitic oscillation can quite easily be visualised. The lead of the fourth grid acts as the inductance for the ultra-short wave oscillatory circuit. The impedance necessary for reaction is the common cathode lead of the tuning condensers of grid 1 and grid 4. Fig. 7*a* shows this circuit diagrammatically. The parts of this circuit of importance in the generation of oscillation are shown in heavy lines. Fig. 7*b* simplifies this circuit farther to show its similarity to Fig. 6.

The disadvantageous effect of the parasitic oscillation which can cause a reduction or discontinuation of local oscillation can be obviated, as suggested by Barkhausen, by introducing a small resistance into the cathode lead of the fourth grid. This resistance should be non-inductive and non-capacitive.

News from the Clubs

Radio, Physical and Television Society

Headquarters: 72a, North End Road, London, W.14.
Meetings: Fridays at 8.15 p.m.
Hon. Sec.: Mr. C. W. Edmans, 72a, North End Road, London, W.14.

The recent sale of disused apparatus was well patronised. The Society desires to point out that in addition to the usual advantages of membership, advice is obtainable on scientific matters of a non-radio nature; technical translations from and into various languages are available to members and also an efficient calibration service.

At the last meeting a lecture was given on the subject of "Electric Furnaces" by Mr. W. W. Standen, a representative of Messrs. Catterson-Smith.

Exeter and District Wireless Society

Headquarters: 3, Dix's Field, Exeter.
Meetings: Mondays, at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

A lantern lecture was given recently by Mr. D. R. Barber, of the Norman Lockyer Observatory, the title being "Radio and the Stars." The lecturer showed how sunspots and other solar manifestations affected both radio and landline circuits. In addition, the lecturer touched on Professor Stormer's theory of radio echoes. In conclusion Mr. Barber asked all members to concentrate on ultra-short-wave reception as he thought it quite probable for radio transmissions of a solar nature to be received.

At a later date Mr. V. C. Regan gave a talk on "Measurement in Radio."

The following programme has been arranged:

March 21st.—"Industrial Rectification," by Mr. W. S. Pyrah.
March 28th.—"Electronics," by a representative of the Mullard Co.
April 4th.—"Telegraphs, Wire and Wireless," by Mr. H. Ridge.

Wirral Amateur Transmitting and Short-wave Club

Headquarters: Beechcroft Settlement, Whetstone Lane, Birkenhead.
Meetings: Last Wednesday evening in the month at 7.30 p.m.
Hon. Sec.: Mr. J. R. Williamson, 13, Harrow Grove, Bromborough, Birkenhead.

At a recent meeting the members chose the subject and the speaker's name by drawing from a hat, and as a result Mr. W. Rogers gave a lecture entitled "My Transmitter—and Why." The lecturer explained an interesting regenerative doubler circuit he is trying and also advocated the use of Faraday shields between the final tank circuit and the aerial for the curing of spurious radiations and interference with broadcast listeners.

Maidstone Amateur Radio Society

Headquarters: 244, Upper Fant Road, Maidstone.
Meetings: Tuesdays at 7.45 p.m.
Hon. Sec.: Mr. P. M. S. Hedgeland, 8, Hayle Road, Maidstone.

A very enjoyable film social was held recently during which the R.S.G.B. films were shown and also a series of sound entertainment films.

The following programme has been arranged:

March 22nd at 8.30 p.m.—"The Cathode-Ray Tube and its applications," by Mr. Parr, of the Ediswan Co.
April 5th, at 8.30 p.m.—A lecture and demonstration of the Voigt loud speaker and other high-fidelity apparatus, by Mr. O. P. Lowther, of the Lowther Manufacturing Co.
April 19th, at 8.30 p.m.—A lecture on transmitting valves and the servicing of sets by the Mullard Co.

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne.
Hon. Sec.: Mr. J. P. Glickman, "Kersal," Brodrick Road, Hampden Park, Eastbourne.

At the recent general meeting of the Society Mr. F. E. Wingfield gave a lecture entitled "Elements of Transmitter Design." At the next meeting, on March 28th, there will be a discussion on the problems arising from the the above lecture and also a discussion on a proposal to establish two-way communication with the Hastings Radio Society.

London Transmitting Society

Headquarters: 40, Raeburn Road, Edgware.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Mr. G. Yale, 40, Raeburn Road, Edgware.

On March 3rd a film showing several well-known amateur transmitting stations was exhibited. This evening (Thursday) a talk entitled "An Outline of 50-watt Transmitters," will be given.

All members of the Society must possess an artificial aerial licence or a full transmitting licence. The Society will be pleased to hear from anybody with transmitting gear for sale.

Bradford Radio Society

Headquarters: 66, Little Horton Lane, Bradford.
Meetings: Tuesdays at 8 p.m.
Hon. Sec.: Mr. S. Hartley, 7, Blakehill Avenue, Fagley, Bradford.

On March 29th Mr. P. G. A. H. Voigt will give a lecture and demonstration of the Voigt loud speaker.

Kettering Radio and Photographic Society

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

On March 21st a lecture and demonstration will be given by Mr. P. G. A. H. Voigt.

Readers' Problems

A Selection of Queries dealt with by the Information Bureau, and chosen for their more general interest, is published on this page

Measuring Oscillator Volts

IN *The Wireless World* Valve Data Supplement the optimum oscillator volts are given for frequency-changer valves. As these are the valve-makers' figures, particulars of the method of measuring the oscillator voltage is required to ensure that the valve is being operated correctly.

Frequency-changer valves in which an injector grid is directly connected to the oscillator grid, as is the case in a triode-hexode, or the coupling is electronic as exemplified by the heptode, the peak value of the RF volts on the grid of the oscillator is the figure that it is required to know. In an orthodox oscillator circuit, as shown in Fig. 1, which depicts a triode-hexode frequency changer, the grid and cathode of the triode section is, in effect, a diode detector, and the rectified DC component of the RF will flow through the grid leak. By connecting a milliammeter (0-1 mA full scale reading) in series with the grid resistance, as shown, this current can be measured and the RF volts on the grid calculated very approximately by multiplying the resistance in ohms by the current in mA and dividing by 1,000.

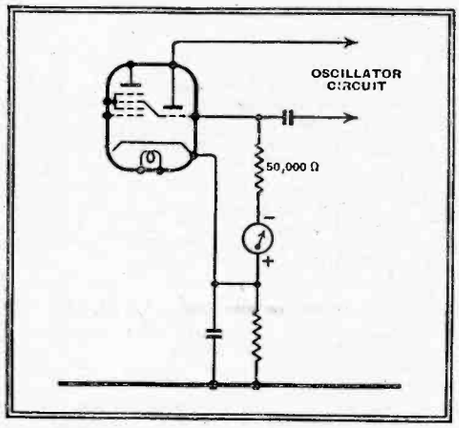


Fig. 1.—Method of measuring RF voltage applied to injector grid in frequency-changer valve.

A more accurate indication can be obtained by multiplying the amount so found by 1.2, an arbitrary figure for the rectification efficiency of the valve.

Thus, if the current is 0.2 mA and a 50,000 ohms resistance is used, there will be 12 volts peak of RF on the injector grid.

Side-band Cutting in TRF Sets

PARTICULAR care has to be given to the layout and assembly of a TRF, or straight, set when more than two RF stages with very efficient tuned circuits are employed.

If the screening is only just adequate to prevent instability, an excessive amount of stray regeneration may be present, with the result that the circuits will be very selective and good quality reproduction impossible of attainment owing to side-band cutting.

The long-wave signals will most likely suffer in this respect more than the medium-wave, because of the larger percentage of detuning represented by the ratio of the side bands to the carrier.

This may account for the marked difference in the quality of reproduction that is being experienced by a user of the Straight-Six receiver.

Attention to the screening will overcome this difficulty, as no such deterioration in quality was present with the original set.

Fortunately, in this set it is an easy matter to broaden the band-width on the long waves without affecting the medium-wave response, as the coils are fitted with separate inductance trimmers.

Mistuning two of the circuits would, however, achieve the desired result. Should this expedient be tried it is suggested that the second and third circuits be mistuned an equal amount either side of resonance, the first and fourth circuits being left correctly tuned.

2-RF Set and QA

IT has been suggested that the 2-RF Straight Set described in *The Wireless World* of November 18th last, if used with the Push-Pull Quality Amplifier, would form a good combination for high-quality reproduction of the more powerful broadcast stations.

Advice is asked regarding the best method of connecting the set and amplifier, the reader's idea being to follow the diode detector by a single-valve phase-splitting unit.

We do not think the scheme would be quite satisfactory, as the 2-RF set was intended to feed an amplifier requiring an input of 0.5 volt RMS, whereas the phase-splitting valve for the Quality Amplifier needs an input of approximately 2.5 volts RMS.

An extra AF stage is thus necessary, and this should precede the phase-splitting valve. Quite a low gain stage will suffice, and this can be obtained by using an MHL4 type valve; the circuit connections can then be as shown in Fig. 2.

In view of the fact that 4-volt valves are used in the Quality Amplifier, it is assumed that this class of valve will be employed throughout.

IF Instability

WHILE rebuilding an old receiver, which has now been converted for all-wave reception by fitting one of the latest-type tuning units, a reader decided also to rearrange the IF amplifier.

The difficulty that has arisen is that with the new IF transformers, which are iron cored and have air dielectric trimmers, the set is unstable, the IF amplifier oscillating uncontrollably

Two IF stages are used as hitherto, while the usual care has been taken in screening, and the question is, what can now be done to remedy matters.

As the tuner is made by a reputable firm and known to be quite satisfactory, the present trouble is most likely to be brought about by the changes in the IF amplifier.

The receiver was presumably quite stable originally with two IF stages, so it would appear that all reasonable precautions in regard to screening have been taken.

It is not usually possible to maintain stability with two very efficient IF stages if the valves are operated with the normal value of grid bias, and the customary practice is to raise the grid bias on both valves until stability is achieved.

Often the desired effect can be obtained by increasing the grid bias on the first IF valve only, and it is purely a matter of personal preference which scheme is adopted.

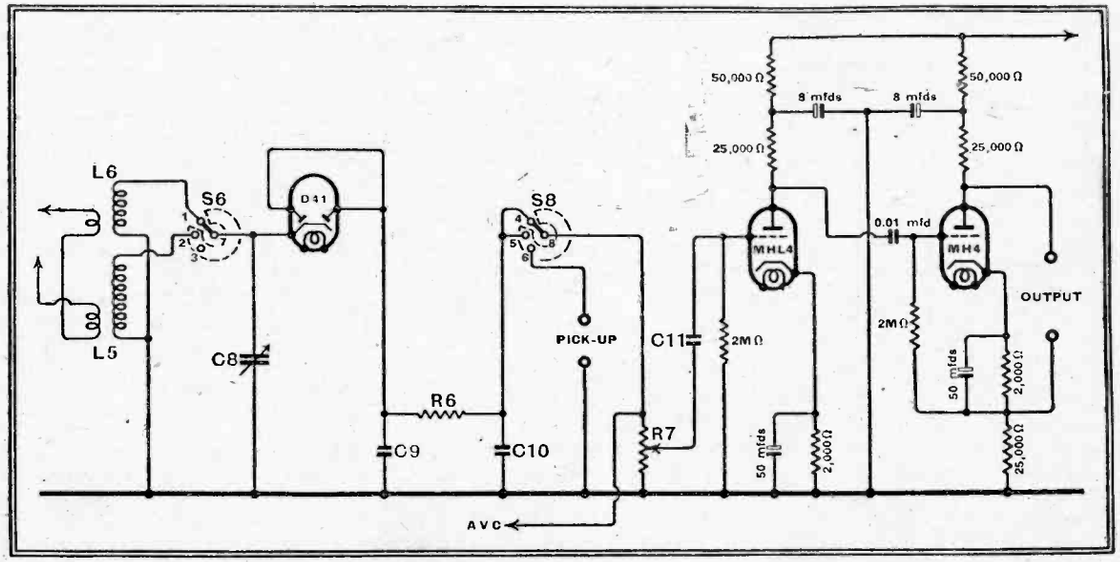


Fig. 2.—By the addition of an extra AF stage and a phase-splitting valve, the 2-RF Straight Set can be used with the Quality Amplifier.

MORE MONEY FOR THE B.B.C.

Grants for Television and Foreign News Service

MAJOR TRYON, the P.M.G., announced in the House of Commons last week a supplementary estimate of £360,000 for the B.B.C. It was explained that £50,000 of that sum was purely automatic because of the arrangement whereby the B.B.C. receives 75 per cent. of the net licence revenue. This extra sum is consequent upon the underestimation of the total licences which will have been issued by the end of March. It was originally estimated that the number would be 8,400,000, whereas it is now expected that no fewer than 8,540,000 will be in force.

The P.M.G. said that there were two entirely new features. First was the expansion of television which accounted for an additional £295,000, and secondly about £15,000 proposed for broadcasting news in foreign languages. This latter was not included in the original estimate because at that time it was not part of the policy of the Government.

Fostering Television Development

The additional sum for television is to be provided by allocating a further 8 per cent. of the net licence revenue to the B.B.C. for the express purpose of aiding it with this additional work. The P.M.G., in his speech, expressed the hope that the House would support this grant to foster the growth and development of an important industry in which we were at present leading the world.

The amount allotted for the foreign language broadcasts is small because the service has only just begun.

During the debate which followed the P.M.G.'s announcement not a few M.P.s spoke of the desirability of lowering the cost of television receivers and of extending the service beyond the environs of London. Replying, Major Tryon said that the price of television sets had already been reduced, and that they would be still further lowered, and as to the question of extending the service he said this was being investigated by the Television Advisory Committee, but there must be further research before anything could be settled in this direction.

THE LIP MICROPHONE makes it possible for two men to speak with the voice of one. Tommy Woodrooffe, the B.B.C. commentator, seen above, can talk naturally into the microphone, which is sensitive only to words spoken at very close range. Details supplied by an assistant commentator will be heard by the man with the microphone but will be inaudible to the listening public. The system was successfully applied to a broadcast of the Cheltenham Gold Cup last Thursday and will be used for the Grand National commentary on March 25th.

NEWS OF

GERMANY'S NATIONAL P.A.

Community Receiving Equipment

AS announced in *The Wireless World* a week or two ago, Germany is to be equipped with a gigantic PA system which will necessitate the erection of some 6,000 loud-speaker kiosks or columns in the large towns throughout the country. It was also announced at the same time that a smaller type of equipment would be installed in small towns and villages. A new association, the Gemeinderundfunk, has been formed which, during the next three or four years, will provide all the small communities, of which there are about 53,000, with transportable public address equipment.

All apparatus, the design of which has been standardised, will be bought from the industry through the Gemeinderundfunk, and the manufacturers will produce this jointly in a similar manner to that by which the People's Set is marketed.

A special community receiver called the "Kurmark" is to be produced for the Association. It consists of a superhet which can be used with one of three amplifiers. The smallest of the amplifiers has an output of 5 watts and is intended for communities of from 200 to 1,000 inhabitants. The next is of 20 watts and is intended for centres with 1,000 to 8,000 inhabitants, and the third, for communities of from 8,000 to 20,000 people, is a 40-watt amplifier consisting of two 20-watt sections.

The complete equipment with the largest amplifier includes: a "Kurmark" superhet and 5-watt amplifier, microphone, control earphones, microphone pre-amplifier, control loud speaker, gramophone turn-table, 40-watt amplifier, two special PA speakers with tripods, 50 metres of microphone cable, 200 metres of loud speaker cable, and sundry accessories. The complete installation, which, except for the loud speakers and microphone, is contained in a transportable case, costs RM.2,800.

For smaller communities, i.e., with less than 200 inhabitants, ordinary radio receivers will be employed. The Gemeinderundfunk equipment will, like the Reich loud speaker columns, be operated by the local radio officer of the Party.

Pictures on opposite page.

INTERNATIONAL DX COMPETITION

Amateurs' Proving Ground

THE wireless telegraphy contest of the 10th International DX Competition conducted by the American Radio Relay League was closed last Sunday, and the wireless telephony contest, beginning on Saturday, is to last for nine days.

Wireless amateurs in nearly a hundred countries throughout the world vie with one another for the honour of receiving the greatest number of foreign stations during the contest periods, and the winners are announced after the logs kept by the participants are examined and checked at the League's headquarters.

Last year logs were submitted by 1,400 wireless telegraphy and 400 wireless telephony contestants in sixty countries. Apart from being a useful guide to the extent of amateurs' enthusiasm, the contests provide an excellent test of operators and their equipment.

SUNDAY MORNING BROADCASTS

THE B.B.C. "interval" period between 10.45 a.m. and 12.30 p.m. on Sundays will, it is announced, be filled with programmes of a light character similar to those radiated on Sunday afternoons. These extended programme hours come into force on April 24th, and will be transmitted from Droitwich and the Regional stations.

The technical side of the extension will involve little, if any, more in the way of expense than at present, and will be offset by smoother running at the transmitters. From 9.25 a.m. on Sundays under the present régime, the switches are "on" and "off" at irregular intervals until normal broadcasting begins at 12.30, and although the stations are off the air for more than half the time, a full staff must be maintained.

Steady working during Sunday morning will mean less wear and tear of the plant.

F.A. BROADCASTS

A HAPPY solution to the dissension between the B.B.C. and the Football Association might be found if the proposal recently advocated in the *Sunday Referee* were adopted. It was suggested that the names of football teams taking part in a broadcast should be kept secret until the kick-off. In this way, loss of gate-money would be avoided.

"TELEVISING" THE GRAND NATIONAL

AINTREE is still beyond the range of the B.B.C. mobile television unit, but the Grand National on March 25th will be "televised" from the Alexandra Palace studios by means of a chart which will show the relative positions of the horses while the commentary for National listeners is relayed on sound.

THE WEEK

THE LEIPZIG FAIR

The Radio Section

BY general agreement among German radio industrialists the Berlin Radio Exhibition, which is held each summer, is *the* occasion for presenting new models and new developments to the public. This, however, does not apply to portables and receivers for export.

The Radio Section of the Leipzig Fair is, therefore, a representative show rather than one giving the latest developments. Three firms exhibited at the Fair a simple DC—AC inverter giving up to 80 watts. This instrument, which is priced at RM.49, makes it possible for any AC receiver consuming not more than 80 watts to be used on DC mains. The inverter, which is fitted with interference suppressors, has an efficiency of about 65 per cent.

Körting's were showing their new nine-valve export receiver, which had a total of eight tuned circuits, including an oscillator, and two signal frequency circuits. The receiver, which is specially designed for use in the tropics, has a wavelength coverage of 13 to 200 metres. An export receiver for South America and Asia which has three short-wave and one medium wave-bands was also shown by the Saba Company.

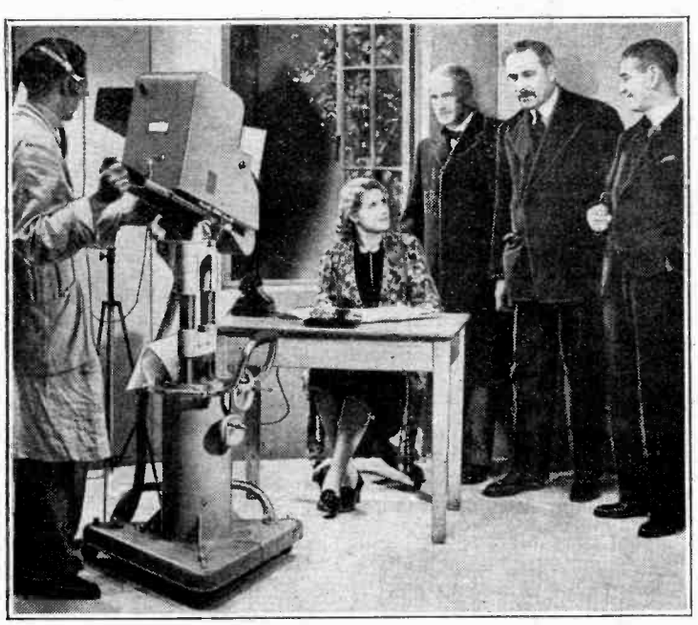
The sensation of the price reduction in the German car-radio receivers has now died down. With new types of valves and greater efficiency than last year's models these have been reduced from nearly 500 marks to 340. With this general reduction in price the German radio industry hope to bring to life a section of their activities which has become almost moribund. The number of car radio receivers sold in Germany in the first year of their introduction, 1934, was 74, and although last year's sales totalled 3,000 this number is very small compared with America's 1,350,000 in the same year.

BOAT RACE BROADCAST: NEW FEATURE

THE short-wave transmitter on the B.B.C.'s motor launch *Magician* will be used for a new Boat Race feature on March 24th, when George Drinkwater will follow the crews at practice. This is the first broadcast from the Tideway prior to the race. Normal programmes will be broken into between 2.30 and 3 p.m., and again between 4 and 4.30 p.m.

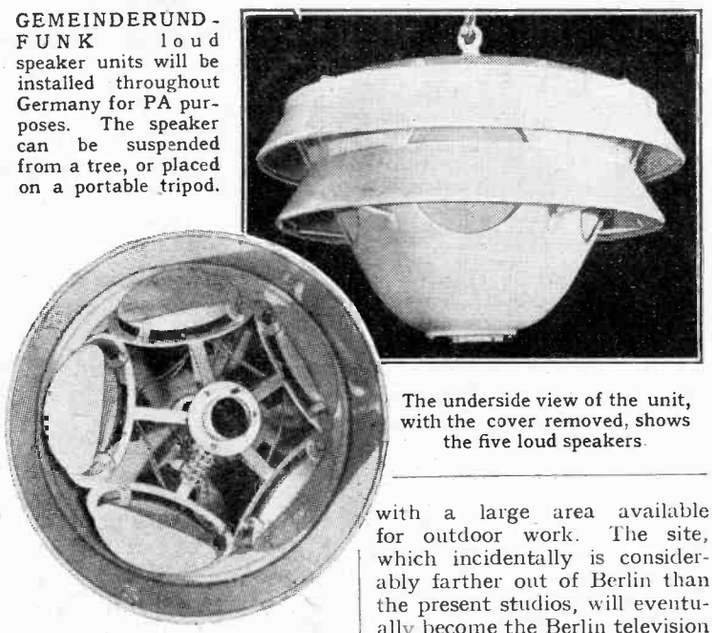
It is understood that a new wavelength is being used for transmission between the launch and the receiver on Harrods' roof, the object being to prevent a recurrence of alleged interference during previous transmissions.

On the day of the race the mobile television unit will be working on a wavelength slightly below five metres.



THE POSTMASTER-GENERAL, Major G. C. Tryon (centre), was accompanied by Mr. R. C. Norman, Chairman of the Board of Governors of the B.B.C., and (right) Lord Selsdon, Chairman of the Television Advisory Committee, when he visited the studios at Alexandra Palace last week for the first time since he inaugurated the television service on November 2nd, 1936.

GEMEINDERUND-FUNK loud speaker units will be installed throughout Germany for PA purposes. The speaker can be suspended from a tree, or placed on a portable tripod.



The underside view of the unit, with the cover removed, shows the five loud speakers.

CANADIAN RADIO TROUBLES

Public or Commercial Control?

MANY proponents of Government-owned broadcasting in Canada have changed their minds, and instead of the nationalised system they clamoured for, they now want a privately owned commercial organisation.

The Prime Minister, Mr. Mackenzie King, has announced that a committee of twenty-five, drawn from all parties, is to consider the problems of the year-old Canadian Broadcasting Corporation, but unlike the deliberations of previous years the outcome is uncertain, for the balance may go over to the advocates of a commercial system.

FACTS ABOUT GERMAN TELEVISION

TELEVISION has been in the experimental stage in Germany for three years, transmissions having begun in March, 1935. At present there are, however, only 500 television receivers in use, most of which are in the hands of prominent people. For all this, public interest is so great that the twelve viewing booths are always full during the two hours of transmission from 8 to 10 p.m. Last year the television programmes cost nearly RM. 250,000.

It is stated officially in Berlin that the Post Office have purchased over 160,000 square metres of ground close to the main road to Spandau, and not far from that town, for the erection of television studios, with a large area available for outdoor work. The site, which incidentally is considerably farther out of Berlin than the present studios, will eventually become the Berlin television centre.

RADIO NORMANDIE'S WAVE-LENGTH CHANGE

AS might well have been expected by those who have noticed the interference with Radio Normandie's transmissions since the starting-up of Prague's high-powered station on the same wavelength, Radio Normandie has made a change of frequency. It is now to be heard on 212.6 metres (1,411 kc/s), which wavelength, incidentally, according to the Lucerne Plan, is allocated to Romania and Portugal as a national common wavelength.

FOREIGN ARTISTES FOR BRITISH BROADCASTING

GREAT BRITAIN still leads Europe in broadcasting, but not invariably in ways which are commendable. Take the talent aspect. During the month of December last the B.B.C. gave employment to upwards of thirty-four foreign artistes, or groups in which the number of musicians numbered anything from three to half a dozen. One-fourth of the total were Germans; and what did Germany do in return? She gave engagements to sixteen foreign artistes, only one of whom, Henry Leigh, conductor, was British.

In the Netherlands A.V.R.O. employed thirty-two foreign artistes in the same period, Pat Hyde and Rudy Starita being the only British representatives, and V.A.R.A. had seventeen foreigners in its programmes, Glyn Eastman being the single Briton. Lance Fairfax (Great Britain) sang to Hungarian listeners, who heard a total of six foreign artistes; Switzerland had thirty-one foreigners, but not one of them was British. Sweden, with eight foreigners, and Poland, with seven, did not include any representative of Great Britain, neither did Den-

News of the Week

mark, with a total of nine, nor France, with a total of thirteen foreign artistes. In fact, throughout Europe, December was a thin month for British broadcasting artistes, although practically every Continental country was represented in the B.B.C. programmes.

RECORD "EFFECTS" BROADCAST

THE modern microphone is severely tested in such a broadcast as John Watt's production of "Snow White and the Seven Dwarfs," from Walt Disney's film. The feature, which was broadcast Nationally on Tuesday, will be repeated tonight (Thursday) on the Regional wavelengths. Styx Gibling, drummer of the B.B.C. Variety Orchestra, is in charge of "effects," and they include:—

One wind machine; one thunder sheet; one big door (with bolt and lock); bird effects; creaking door; steam effects; crockery; swish brush; rattle; scrub brush; wash board; anvils; cowbells; padlock (on door); temple blocks; syrens; creaking shoes; tin cans (saucepans); bubbling effects (light and heavy); glass crash; china crash; triangle and frog; spoons; horses' hoofs; bee effects; slap sticks; xylophone; glockenspiel; tympani; tenor drum; side drum; clicker; chains; giant drum; six tom-toms; Chinese cymbals; gong (small); water tank; enamel bowl.

These "instruments" demand varying degrees of playing skill; the real job is to play them in the right order.

RECORDING FROM FILM SOUND TRACKS

TECHNICAL interest attaches to the "Star Gazing" programme on April 11th and 12th, when the career of Anna Neagle, the film star, will be presented musically by Leslie Bailv and Charles Brewer. The B.B.C. Recording Unit recently visited the Denham Film studios, where excerpts from the sound tracks of many of Anna Neagle's films were reproduced and recorded by running lines from the B.B.C. van to the sound head in one of the operating boxes.

FROM ALL QUARTERS

B.B.C. Union

THE entire staff of the B.B.C. will take part in a ballot, the result of which will decide for or against the formation of a staff organisation which would deal with all matters affecting individual members or the staff as a whole.

We Are Great Listeners

THE average wireless set in Britain consumes 87 units of electricity a year, according to B.C.C. estimates; America, France, Belgium, and Holland use 54, and Germany 40 units.

Saturation Point

FOR every thousand inhabitants in Britain there are 160 set owners. In Germany there are 120 sets per thousand inhabitants. These figures place saturation point still a long way off since the maximum number of sets for each thousand inhabitants is estimated at 300.

Those Arab Steeds

THIS year, for the first time, an Arab observer will be present at Aintree on March 25th to gather impressions of the Grand National, which he will incorporate in an eye-witness account to be included in the B.B.C.'s Arabic broadcast the same evening. Arabs are interested in British racehorses, as these are partly of Arabian strain.

Legislation Six Years After

IT was not until the end of last month that the Bill ratifying the provisions of the Madrid Telecommunications Conference of 1932 made its appearance before the French Senate.

Train Transmitters

AT the annual meeting of L.N.E.R. shareholders it was suggested that short-wave communication between trains and signal-boxes should be introduced as a safety measure.

Tapping Police Wireless

OTLEY (Yorks) police have been seriously hampered in their work by people who have "tapped" their confidential wireless messages. The use of a code has not deterred the eavesdroppers, and, in future, offenders will be liable to a fine of £100.

New Milan Station

A NEW 1-kW transmitter located in the centre of Milan has been testing on 209.9 metres. The purpose of the station is to relay the Rome I programmes.

Ultra-Short Waves in New York

AN experimental 150-watt station on top of the State Office Building in Albany, N.Y., was officially opened on February 21st; it is transmitting on the wavelength of 7.31 metres.

No Power Increase for Bari

A NUMBER of statements have been made to the effect that Italy may increase the power of Bari, which has gained fame as Signor Mussolini's mouthpiece to Arabic-speaking peoples. This is stated in official Italian circles, as well as by the International Broadcasting Union, to be incorrect.

New Secondary Emission Cells

A NEW form of secondary emission cell which possesses an excellent frequency response making it ideal for sound film work is announced by the General Electric Company. This Osram cell, Type CWS8, is designed to overcome the main objection to the first secondary cell, the CWS24, i.e. its rather awkward size and shape. With a total voltage of 300 a minimum sensitivity of 100 microamps. per lumen is guaranteed.

More and More Power

CONTINUING its programme to make Italian broadcasting one of the best in the world, the Government has sanctioned the raising of the power of Rome I from 100 kW to 250 kW. This power will, however, be used only on *special* occasions. Two new medium-wave stations are also planned, and the building of these at Catania and Ancona will begin shortly.

Wireless in the House

THE M.P. for Consett, Durham, is agitating for the installation of a wireless set in a convenient room in the House of Commons so that members may have as ready an access to important broadcast events as the listening public.

Radio Officer

WIRELESS operators are shortly to have the elevated title of Radio Officer, and their organisation will be known as The Radio Officers' Union.

I.E.E. Meetings

A JOINT meeting of the I.E.E. with the Institution of Civil Engineers will be held in the Great Hall of the I.C.E., Great George St., London, S.W.1, on Tuesday next at 6 p.m. when papers on the Fulham Power Station will be read. Another joint meeting will be held on Thursday, March 24th, at 6 p.m. at Savoy Place, Victoria Embankment, London, W.C.2, with the Plastics Group of the Society of Chemical Industry and the subject will be "Plastics and Electrical Installation."

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, MARCH 17th.

Nat., 7.20, St. Patrick's Day—programme from Northern Ireland and Canada. 8, Variety from the Holborn Empire. 8.30, Talk on "The Way of Peace."

Reg., 6, Walt Disney's "Snow White and the Seven Dwarfs." 8, European Concert from Eire. 8.40, Joe Loss and His Band. 9.30, Ice Hockey Commentary—Brighton Tigers *v.* Wembley Lions.

Abroad.

Kalundborg, 7.10, Excerpts from Wagner Operas.

Radio Eireann, 8, European Concert.

FRIDAY, MARCH 18th.

Nat., 7, "La Rondine" (The Swallow)—a lyric comedy with music by Giacomo Puccini. Cast includes Ina Souez, Rose Alper and Heddle Nash. 9.20, Talk by Lord Strabolgi on "Britain's Battle Fleet and Other Navies." 9.40, "The Ghost Knows Best"—burlesque fantasy.

Reg., 7.30, Entertainment tour of Five Northern Music Halls. 8.25, Scotland—Life in Ardgour.

Abroad.

Frankfurt, 7, "The Barber of Seville"—opera (Rossini).

Warsaw, 7, Warsaw Philharmonic with Krasner (violin).

SATURDAY, MARCH 19th.

Nat., 7, "Carmen"—relay of Bizet's opera from New York. 8, Palace of Varieties. 9.20, American Commentary.

Reg., 7.45, Cardiff Ensemble Chamber Music. 9, "Katinka"—a musical play.

Abroad.

Munich, 7.10, 'The Year Dot"—a picture book of Old Munich.

Vienna, 8.35, Dvorák's Violin Concerto played by Kulenkampff.

SUNDAY, MARCH 20th.

Nat., 6.30, "The Good Companions"—an adaptation of the book by J. B. Priestley. 9.5, English Spelling Bee. 9.25, Service from Glasgow Cathedral.

Reg., 6.50 Philip Martell and His Forum Theatre Orchestra. 9.5, Sunday Orchestral Concert, conducted by Albert Coates, with Solomon, pianoforte.

Abroad.

Stuttgart, "Faust"—opera (Gounod).

Frankfurt, 8, Young People's Musical Soirée.

MONDAY, MARCH 21st.

Nat., 7, "Monday at Seven." 8, Talk on Film Censorship by Lord Tyrrell. 9.20, World Affairs.

Reg., 7.30, Modern Spanish Music played by Rosita Bal, pianoforte. 9.20, Catchword Songs, played by Percival Mackey and His Orchestra, with section of Revue Chorus.

Abroad.

Munich, 8, In Commemoration of the German Offensive on the Somme, Spring, 1918.

Radio-Paris, 8.30, Gieseking, pianoforte—Mozart, Ravel.

TUESDAY, MARCH 22nd.

Nat., 7.10, "The Psychological Rope"—Talk by a Harley Street Physician. 7.30, Savoy Hill Memories—a reminiscent programme, including Leonard Henry and Mabel Constanduros. 8.30, Hill-Billy Round-up. 9.20, America Speaks.

Reg., 6.25, Jack Wilson and His Five. 8, "La Rondine" (As on Friday at 7, Nat.).

Abroad.

Frankfurt, 7.30, Brahms Concert—Max Strub (violin), Hoelscher ('cello).

WEDNESDAY, MARCH 23rd.

Nat., 6.40, From the London Theatre. 7, Band Waggon. 8, B.B.C. Symphony Orchestra from Aberdeen, conducted by Sir Adrian Boult.

Reg., 2.35, The Lincolnshire Handicap. 6.20, Viennese Orchestra. 7.30, "The World Goes By." 8, Variety from Oxford. 8.30, "Cotton."—Men and Women of Industrial Lancashire speaking of their work. 9.30, McAvoy *v.* Harvey—boxing commentary.

Abroad.

Stuttgart, 8.30, Weber's Clarinet Concerto played by Phillipp Dreisbach.

Deutschlandsender, 8.30, Mozart's Symphony in C, by the Berlin Philharmonic.

UNBIASED

The Shadow of the Old Bailey

I SUPPOSE that somewhere amongst my many readers there must be scattered representatives of almost every profession, including that of the Law. It is in the hope that a representative of the latter profession may be able to give me the benefit of his advice that I am penning these few words, as I am faced with the possibility of being charged with obtaining electrical energy without paying the bill and with intent to avoid payment thereof.

Stripped of all ambiguous phraseology and technical jargon which lawyers, like certain wireless engineers, use to cover up their ignorance, it amounts to nothing more nor less than a charge of common theft, and I am in grave danger of standing in the dock like any common felon.

Like any common felon.

Needless to say, I am not guilty of this atrocious charge, and although at present appearances may be against me, I am convinced that virtue will triumph in the end as it always did in Victorian novels.

The circumstances are soon related. I have recently moved to a new district, as I have already had occasion to mention in these pages anent another matter. The district is one of the real old-fashioned type in which the habit of giving up seats to women in crowded trains, and other barbaric pre-war customs, still survive. I need hardly tell you, therefore, that the electricity supply is DC and, what is more, DC of the type where the voltage fluctuates violently according to whether the stoker at the local generating station remembers or not to chuck another shovelful of coal on to the boiler fire before going out to his evening game of darts at the local hostelry.

Something for Nothing

The ripple is so bad that the running of a normal AC/DC set is virtually an impossibility, and I was about to invest in a battery receiver when I happened to mention the matter to a member of *The Wireless World* technical staff. He at once suggested that if the aforementioned ripple was really bad enough, it might be possible to run an AC set from it. Sure enough this proved to be the correct solution to the problem, and I soon fitted up an elaborate arrangement of fat condensers to keep the purely DC component out, the set working quite happily from the ripple.

Now I need hardly tell you technical fellows that the ripple-energy which drives

By FREE GRID

my wireless set has no effect whatever on the electric light meter, so that I am getting energy absolutely free for wireless purposes, and the electric lighting company have just tumbled to it. I am not pretending, of course, that it is possible to get something for nothing, and the energy which I use in this manner undoubtedly comes from the generating station. My contention is, however, that it is an unwanted waste product which I am using, and as the company are in reality merely throwing it away, I am fully justified in rescuing it from the metaphorical dustbin and using it.

In any case, I maintain that if the energy thus used is not registerable on the meter—and, of course, it is not—then I am not legally liable to pay for it. The whole thing simply bristles with legal difficulties however, and if any of you can help me out of a nasty hole I shall be duly grateful.

The Future of the Race

IN the days when I was young and women hadn't displaced men wholesale in offices and such-like places, as they have to-day, a favourite topic of discussion in the correspondence columns of our newspapers used to be, "What shall we do with our Girls?" Judging by a letter I have just received, a more appropriate topic to-day would be, "What has become of our Boys?" In my young days the normal boy was like the proverbial Irishman, always "agin the Government," or, in other words, always ready to rebel against the stupid laws and restrictions made by those set in authority over him.

This good old healthy spirit of independence which made our Empire what it is seems, however, to have given way nowadays to a spirit of meek milk-and-water submissiveness and subservience in place of what I must, in view of the large number of my lady readers, politely call the viscera of my young days. The modern boy seems to be endowed with an altogether unhealthy respect for law and order, and even goes so far as to express concern at the action of his fellow-creatures who still possess sufficient of the old-time spirit to rebel.

Now that I have got that off my chest, I feel a little better, but no doubt you will all be wanting to know what all this has got to do with wireless. It has, I am sorry to say, quite a good deal to do with it. You will probably recollect that a short time ago there was published in *The Wireless World* an article describing a "wired wireless" remote-tuning-control system involving the sending of radio-frequency impulses along the house wiring. With this system there is a remote chance that to a very small degree some of the aforementioned impulses might stray beyond the confines of the user's house, thereby causing a technical breach of the law, insomuch that it would constitute a form of wireless transmission.

The Rising Generation

Remote as it is, however, the bare possibility of even a technical breach of the law has filled the breast of one of our modern boys with shuddering horror, as I have received a letter from one of the species at one of our most ancient seats of learning, in which he calls my attention to the article and expresses surprise that such an eminently respectable and law-abiding journal as *The Wireless World* should apparently acquiesce in a "violation of the will of the people as expressed by Parliament in the various Wireless Telegraphy Acts."

Now I don't know about you, but if in my young days a boy had used an expression such as I have just quoted I know full well what would have happened to him. There is a lot more in the letter to the same effect, but I will not weary you and sicken my soul further by quoting it. Unfortunately, I hear from friends that this type of law-abiding boy is not merely an odd specimen but is more or less representative of the rising generation. If such, indeed, be the case, it bodes ill for the future of our race, and I cannot help being thankful that I, at any rate, shall be comfortably out of it all, unless, by some mischance, I greatly exceed the Psalmist's allotted span, which, in view of certain wishes concerning my future expressed in some quarters, is rather unlikely.

The modern boy.

I may add that I have forwarded the boy's letter to his headmaster, together with my comments and certain strong recommendations.

Random Radiations

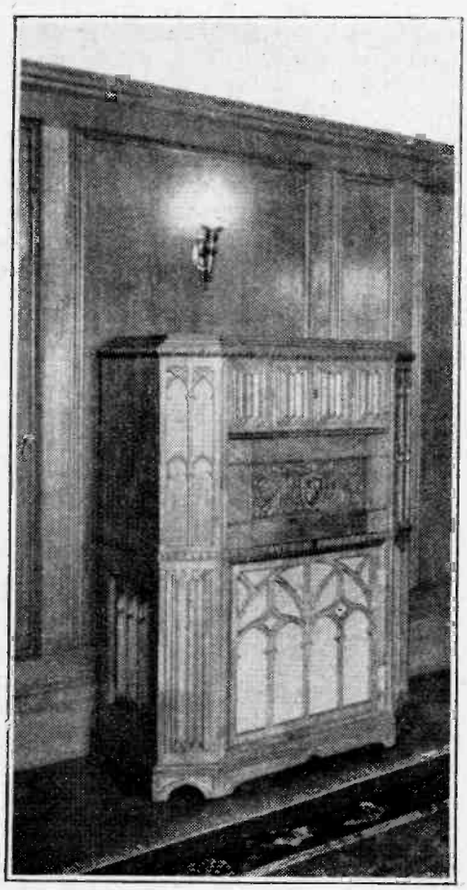
By "DIALLIST"

Harnessing the Wind

SOME time ago I said in these notes that though sets operated by wind-driven generators had been developed in the United States there was, so far as I could discover, nothing of the kind in this country. I still don't know of any wind-driven generator designed primarily for running wireless receiving sets. But there is an interesting little plant which seems to have distinct possibilities in this direction. This is the "Freelight," the declared object of which is to supply illumination to small bungalows, farm outbuildings, and so on. It consists of a 12-volt DC dynamo, similar to that used in motor cars but modified so as to make it weatherproof, directly coupled to a two-bladed propeller and mounted at the top of a mast 30 feet to 40 feet in height. The dynamo charges two 6-volt 130 ampere-hour accumulators connected in series, and two additional 6-volt batteries, making the total capacity 260 ampere-hours, can be used.

Facts and Figures

The plant is intended to light three 24-watt and three 6-watt bulbs, making a total drain on the battery, if all are used at the same time, of 7.5 amperes. The generator "cuts in" at a wind-speed of 10 miles an hour and is charging at 5 amperes when the wind-speed is 15 m.p.h. At 20-22 m.p.h. the charging rate is 10-12 amps, and the maximum rate is some 15.5 amps when the wind velocity is 30 m.p.h. or more. The dynamo is always in action at wind speeds of 10 m.p.h. or more, the battery, like that of a motor car, "floating" upon its output.



INDIVIDUALITY. An example of the cabinet work, invariably made to special order, to house Keates-Hacker receiving installations. In this instance the design is executed in carved oak to match existing panelling.

Possibilities

It seems clear, at any rate if the storage battery capacity is brought up to 260 ampere-hours, that in most parts of this country such a plant as this could undertake not only the supply to the half-dozen bulbs mentioned, but also the charging of wireless LT accumulators and that of a HT unit of the Milnes type. One wonders whether it could not also deal with the kind of vibratory converter used in car radio sets and thus make it possible for an AC receiver imposing no very great load to be run from the battery terminals. If any readers make use of the "Freelight" plant in either of the ways suggested I should be glad to hear from them so that their experiences may be passed on for the benefit of others who want good reception but are handicapped by having no electric lighting mains. There are many, too, who live so far from towns that the charging of filament or HT accumulators is a serious problem to them.

Knotty Problems

ALL-INDIA Radio, the B.B.C.'s offspring and counterpart, is getting it in the neck from Indian listeners at the moment, just as its parent does from us at times. The crux of the matter is this: India is rapidly developing her own broadcasting scheme, which has to be on lines quite different from our own owing to the vast size of the country, the prevalence of atmospherics, and the comparatively small amount of money available. In the Bombay Presidency, to take a typical example, service over an area as big as most European countries, has at present to be provided by one medium-wave and one short-wave transmitter. The low-power medium-wave transmitter's activities must necessarily be confined mainly to Bombay City and its immediate surroundings. As atmospherics are very bad in India except during the cold weather, wavelengths below 400 metres are used by all medium-wave stations. It is with the short-wave plants that the real troubles arise. It has, in fact, been found unsatisfactory for a short-wave broadcasting station to use the same wavelength both in the daytime and after dark. During the morning and early afternoon, for instance, Bombay works on 49.3 metres, a wavelength which is found to combine a reasonably good coverage with freedom from serious atmospheric interference. But after dark the problem of the skip area comes in.

A Choice of Evils

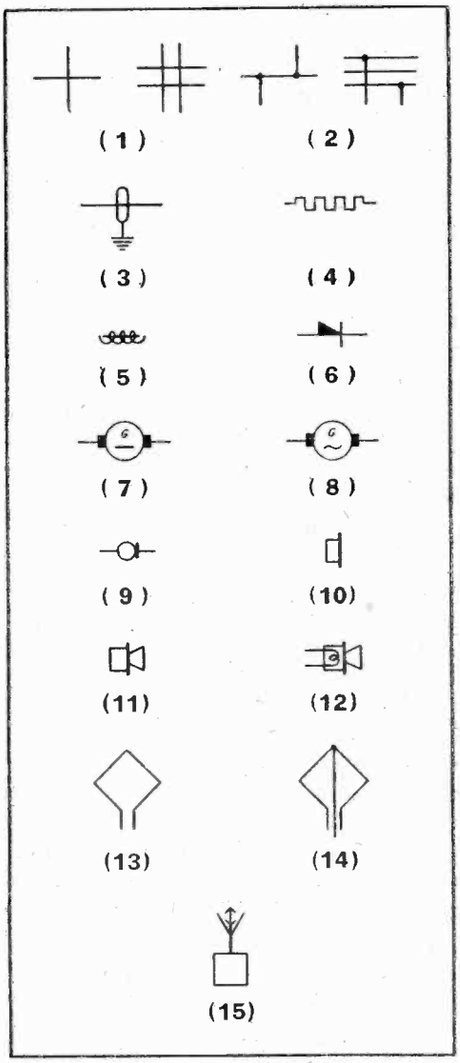
It was found that there was a region of considerable extent round the transmitting station in which short-wave broadcasts were not heard at all, whilst those on the medium waves were too weak and too subject to fading to be of value. The only solution was to use during the evening transmissions a higher wavelength for the short-wave plant. That selected is 90.8 metres, and with it results are pretty satisfactory. But the snag is that it was not until comparatively recently that A.I.R. announced its intention of using the 90-metre band; hence very few receiving sets bought before 1937 cover it. You can imagine the outcry. A.I.R., true to parental traditions, says: "It may hurt you for the moment, my boy, but it's all for your own good." It goes on to suggest that converters should be employed to enable sets that don't normally cover it to operate on the 90-metre band. To this the listener replies in the correspondence columns of the Press that a converter can't be obtained for less than about £7 10s., and that even if he bought one the odds are that 90-metre transmissions will be drowned by atmospherics during the hot-weather season which is just beginning. The B.B.C. may be thankful that it is not faced by problems of that kind!

Break-Through

WRITING from Kingussie, a reader tells me of several queer effects that he has noticed with his receiving set. One of them is that he receives the Scottish Regional transmissions on the long-wave band. This is very clearly a case of break-through which, as I have mentioned before, is noticeable in some of this season's superhets. I have just turned up an old copy of *The Wireless World*—that for July 29th, 1932, to be exact—in which there is a note on break-through, which had begun to be a serious nuisance with the development of the B.B.C.'s Regional scheme of high-powered stations. The writer of the note states that, in quite half the cases of break-through investigated, the trouble was found to be due to a defective wave-change switch. What he found was this. With the switch in the medium-wave position the loading coils for the higher wavelengths are short-circuited. They should, of course, be brought into action by the removal of the short-circuit when the switch is turned to the long-wave position. It was found, though, that where break-through occurred the switch failed in many instances to "open" one or other of the loading coils. A medium-wave coil was thus left in operation, with the result that a high-powered medium-wave station might be heard with the set apparently adjusted for reception of long-wave stations only. That is undoubtedly one cause of break-through, but it cannot be the only one since it is, I believe, possible for this unwelcome phenomenon to be observed in a set using plug-in coils when those for the medium waves are removed altogether and replaced by those for the 1,000-2,000-metre band.

Background Stations

The same Scottish correspondent also finds, amongst other strange things, that Droitwich comes in, after dark and when conditions are good, as a background to the 373.1-metre Welsh Regional. This might be due to one of two causes. Possibly it is an instance of the "Luxembourg Effect"; possibly, again, the cause is a harmonic of Droitwich. Droitwich's frequency is 200 kilocycles; that of the Welsh Regional 804.



STANDARDISING THE CIRCUIT DIAGRAM. Some of the graphical symbols that appear in the revised British Standard Specification, on which comment is made in this week's Editorial. No. 6 is a general rectifier symbol.

The fourth harmonic of Droitwich would thus occur only 4 kilocycles away from the frequency of the Welsh Regional. But there is another background to Droitwich which is more puzzling. This is caused by Athlone, which is surely much too far off a line joining Droitwich and Kingussie to give rise to a "Luxembourg Effect." Is it due to one of those extraordinary beats which may occur in superhets? It seems just possible. The frequency of Athlone is 565 kc/s, and that of its second harmonic would be 1130 kc/s. An intermediate frequency used in many superhets is 465 kc/s. Twice 465 is 930, and subtracting that from 1130 we have 200 kc/s, the frequency of Droitwich. If this is the true explanation, then Athlone appears as a background to Droitwich because the second harmonic of the former beats with twice the intermediate frequency of the receiving set and so produces the frequency of the latter. Can anyone suggest any other explanation?

Six Years Ago

GLANCING through that 1932 issue of *The Wireless World*, to which I referred just now, makes one think a bit. I shouldn't, for example, have said off-hand that much work below 10 metres was being done at that time. Yet under "Current Events" one finds that the Germans were then experimenting on wavelengths between 3 and 5 metres with a view to devising a means of guiding planes to the landing ground in foggy weather. And on the next page there's an account of "A Five-Metre Field Day." It describes the doings of a party of well-known amateurs with a portable 56-megacycle transmitter and three ultra-short-wave receiving sets. The transmitter, rated at 8 watts, was installed on a high point of the Sussex Downs behind Eastbourne, whilst two of the receiving sets were located near Dorking, and the third close to Haslemere in Surrey. At Dorking, 36 miles away as the crow flies, the transmissions were heard at such strength that "the voice modulation could be heard 15 yards from the 'phones." The third receiver was 41 miles away, but here voice signals were R6-7.

Changed Wavebands

At the end of July, 1932, there were 27 stations at work on the long-wave band, but none had an output greater than 120 kilowatts and only 5 had a three-figure rating. On the medium band a Moscow station working on 424.3 metres, and Prague on 488.6, were the only stations rated at 100 kilowatts or more. Then, as now, Prague was a 120-kilowatt station. Our own Regional scheme of high-powered stations was still in its infancy, the only 50-kilowatt stations being the North, Scottish and London Regionals and the London, North and Scottish Nationals. Wales and Northern Ireland were still served by the 1-kilowatt Cardiff and the 1-kilowatt Belfast. The German stations were of quite low power in the main—Munich, Berlin, Frankfurt, Hamburg and Breslau having 1.5-kilowatt transmitters, though Langenberg, Stuttgart and Heilsberg had 60-kilowatt *plants* at work. Since then, to take just one or two instances, Lyons P.T.T. has risen from 1.5 kilowatts to 100, Paris P.T.T. from 0.7 kilowatt to 120, Hilversum No. 2 from 7 kilowatts to 60, Radio-Toulouse from 8 kilowatts to 60, Rabat from 2.5 kilowatts to 25, Toulouse P.T.T. from 0.7 kilowatt to 120, and Horby from 10 kilowatts to 100. A pretty eventful half-dozen years!

Dummy Valves

BEFORE now I've given you some instances of the way in which the less scrupulous American manufacturers play up to the fixed belief amongst their countryfolk that the greater the number of its valves the better must the receiving set necessarily be. But until I saw it in cold print I'd no idea that they would go so far as to use valves in their sets which were nothing more or less than dummies. Yes, it really is done! If you look into the cabinet of one of these flat-catching sets from behind, you find an imposing array of valves; but from the radio point of view by no means all of them are what they seem to be. Two or three, in fact, may have no connections whatever save to the sockets into which the filament or heater pins fit. Pretty good, don't you think? And I am open to wager that some of those who buy them and know nothing of the blind valve-holders, stoutly maintain that performance is noticeably inferior unless valves of a particular make are used in them.

Letters to the Editor

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

"Hum in AC Receivers"

MR. R. E. DARNTON has diagnosed correctly the cause of hum with increased voltage if his supply is either from a single-phase transformer or a 3-phase unit without a delta-connected winding.

The magnetising current contains a third harmonic which appears in the secondary current in the above cases, making it peaked, and it will increase about 50-60 per cent. when the voltage rises from 230 to 250 volts.

The matter should be taken up with the supply company as the permissible limit of variation from nominal voltage is being exceeded. D. HALLIDAY.

Walton-on-Thames.

The Octal Base

MAY I support "British" in your issue of February 24th. As far as I can make out the only reason we started using the American Octal Base was that it had a locating pin which helped to avoid wrong insertion in inaccessible positions, and that it was becoming a menace in our market.

Well—the British Octal has the advantage of the locating pin, and several other advantages over the American Octal besides; and as for the menace, if we cannot combat American competition by beating them instead of just copying them we should be ashamed of ourselves.

There ought to be a B.S.S. for numerous features in a wireless set or valve amplifier, but it is only foolish to standardise a unit which is still the subject of rapid development.

Indeed, I query the assumption that the Octal base is suited to future development. Cheap standard valves are most likely to be of the Pentode type with a top grid connection, in which case a six pin base covers most requirements, especially as with cheapness a separate oscillator will probably be preferred for frequency changing; the "Octal" then becomes ridiculous, only the pin remains.

I suppose the name, though illogical, would still serve, but I personally see little advantage in trying to standardise the base until we have evolved a really good idea of what we want as a standard valve, or, at any rate, what we want in location and number as standard valve connections.

Hextable, Kent. H. G. P. T.

Is There Yet a Standard Receiver for Every Modern Need?

YOUR article, "Why Not Two Sets," by Mr. Wallace, touches upon two points of interest to me, and, I should imagine, to many others with little or no technical knowledge.

The first point is, whether there is a real demand for a receiver designed for those who have no particular desire to get foreign stations on long or short waves; a receiver which would give the very best quality reception from the local station only, and moderately priced in consequence, as your contributor says it could be.

The other point is that of the "discord in the home" arising from a strong desire to switch on, and an equally strong desire to switch off, being present in the same room at the same time. The nuisance of a neighbour's speaker may be a difficult problem of social organisation, but the nuisance of one's own should be easy of solution by the experts. This cause of objection (by some) to the presence in the home of any receiver at all, could surely be overcome by the provision of a cut-out for the speaker and connections for the use of headphones when required.

I visited Olympia last year confidently expecting to find the answer to these requirements, but I am still looking for its appearance in makers' advertisements. Now I see with regret that your contributor discloses that the big makers are of the opinion that there is no sufficient demand for the "High Quality Local Station Set." I cannot presume to seriously question this expert belief; though there may well be an inarticulate demand greater than it is thought to be.

I wonder how many of your readers would feel the interest that I would take in the publication in your paper of the ideal design for such a receiver; transportable, with interior aerial, and with connections for external speaker and headphones.

London, N.W. H. MOODY.

Wireless and War

I READ the article by Mr. R. W. Hallows on "Can Broadcasting Prevent War?" with considerable interest. I cannot, however, see any justification in recent history for his conclusions that broadcasting will be one of the most potent factors in bringing war to a rapid end. In Spain an ideal situation existed for the operation of broadcasting in the sense he suggests. So far from bringing the conflict to an early close broadcasting has been used by both sides for the most violent propaganda. There is war on the ground, in the air, on the sea, and on the air; yet no language problem existed as stations on both sides were naturally using Spanish.

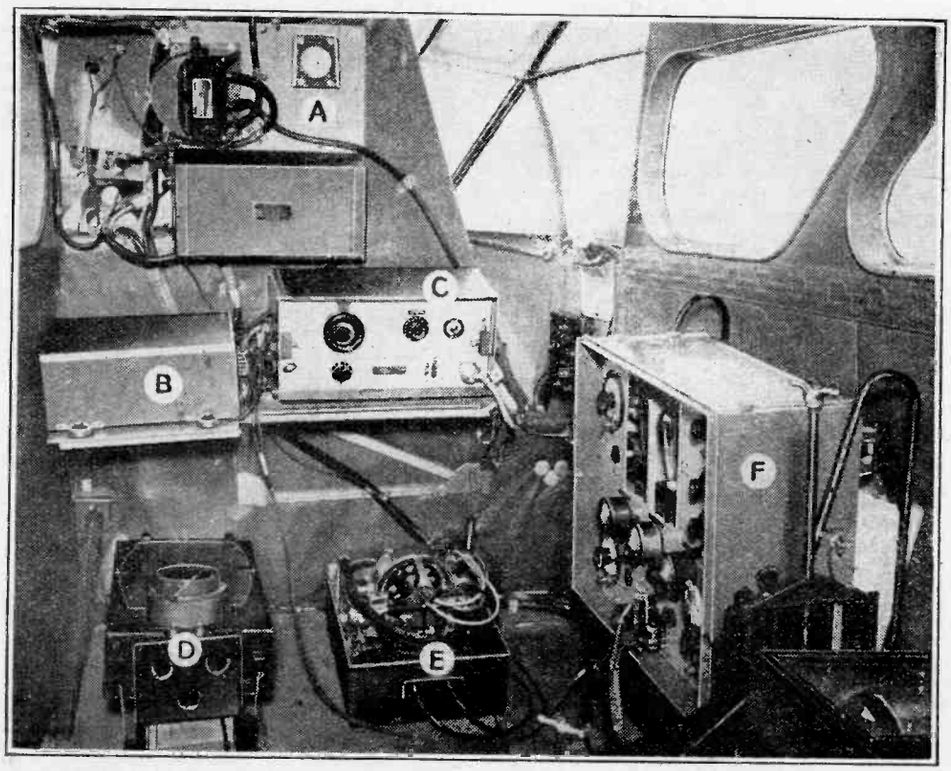
L. MARSLAND GANDER.

London, W.

Condenser Breakdowns

YOUR correspondent, Mr. C. F. N. Leahy, invites the opinion of readers on the subject of condenser packs. An examination of the literature of any reputable firm of condenser manufacturers will reveal that there is a big difference in the price of components according to the working voltage required. Your correspondent apparently paid a big price for his set, and he naturally assumed that the condensers fitted would be good ones. There are quite a number of these high-priced sets fitted with condensers that *Wireless World* engineers would not look at for any job they may have in hand. Mr. Leahy might like to read again Mr. Moore's letter on the same page as his own in the March 3rd issue, in which he referred to *The Wireless World* "Push-Pull Quality Amplifier" which was described early in 1934. Apart from a genuine fault condensers should have a safety factor in keeping with the demands of the set in which they are to be used and not just a bare clearance. I, myself, have had only one spot of trouble, this with an electrolytic condenser, and the manufacturer changed this free of charge.

Dagenham. L. MORGAN.



WIRELESS-CONTROLLED FLIGHT. An experimental installation of the wireless-controlled automatic pilot, described on the opposite page. A, DF receiver (in forward compartment, seen through window) and visual indicator. B, apparatus for linking automatic pilot and DF set. C, short-wave receiver. D, stabilised drift sight, for finding correction to apply to automatic pilot. E, automatic pilot. F, transmitter.

Wireless-Controlled Flight

LINKING DIRECTION-FINDER AND AUTOMATIC PILOT

THANKS to the daily Press, everyone has at least a nodding acquaintance with "George," as the "robot" aircraft pilot has been called. In our own sphere readers will also be familiar with the general principles of wireless "homing" devices; some details of recent developments in this particular branch of wireless activity were given in *The Wireless World* of January 20th.

These two aids to air navigation have now been successfully combined to give a control system devised to pilot an aeroplane over a pre-determined course without human intervention, except in so far as correction for drift may be necessary. The course is determined by the orientation of the direction-finding frame aerial with respect to the fore-and-aft line of the machine and to the position of the particular transmitting station which is chosen to act as a guiding beacon; the warning signals that would normally, by aural or visual means, show the human pilot when he wanders from his proper course are translated into electrical impulses which actuate the automatic pilot.

Development of apparatus for use as a link between direction-finder and robot pilot has been undertaken by Marconi's Wireless Telegraph Company, and the system devised has now reached the stage of commercial application. By means of this apparatus, signals received on a standard direction-finder, Type AD5062B, fitted with a visual indicator for homing, are caused to actuate a P.B. Automatic Control, made by P.B. Deviator, Ltd., of Croydon.

For homing flight controlled in the normal way by a human pilot, the frame aerial of the AD5062B equipment is orientated at right angles to the line of flight. The visual indicator, which is a centre-zero micro-ammeter with a scale suitably marked, shows deviations either to port or starboard from the correct course.

The first stage in linking the direction-finder to the P.B. automatic control system consists in the connection of a sensitive moving-coil relay in parallel with the visual indicating meter; matters are so arranged that the tongue of the relay faithfully follows the movements of the meter needle. When the machine yaws off its course the relay tongue makes contact with one of two studs provided, closing the circuit of the appropriate subsidiary relay through which the P.B. system is caused to apply port or starboard helm for correction as required.

The automatic control system is not only applicable to cases where it is desired to fly directly towards (or directly away from) the beacon station. By suitably orientating the frame the machine may be flown on any course with respect to the transmitter, varying from a direct straight line to a circle with the transmitter as its centre. The correct setting of the frame for any flight may be rapidly found with the help of a set of curves drawn on transparent material and known as an orientator.

Some idea of the accuracy of control expected from the combination may be gathered from the fact that it is to be used for mapping the unsurveyed parts of Australia; for this task it is essential that the machine's course be maintained with extreme precision.

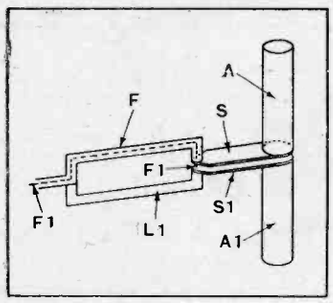
Recent Inventions

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

TELEVISION AERIALS

THE figure shows a method of coupling a feed-line to a dipole aerial as used for television, so as to keep the effective aerial reactance substantially constant over a wide band of signal frequencies.

The two limbs A, A1 of the dipole consist of cylinders of comparatively large size, say, a foot or two in diameter, set coaxially one above the other. The two inner ends are set close together and are connected to wide copper strips S, S1, which are extended at right-angles to the aerial and joined to a coaxial feed-line F, F1. A branch line L1 forms a "loop



Di-pole aerial and feeder system designed for television.

circuit" which prevents undesired leakage of high-frequency energy from the aerial.

E. C. Cork and J. L. Pawsey. Application date March 17th, 1936. No. 475348.

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DRY-CONTACT RECTIFIERS

IN a metal rectifier of the type in which one of the electrodes is a sulphide, preferably of copper, there is a tendency for the sulphide to be reduced by the action of the heat developed. This, in course of time, results in the production of small "points" of metal which act as short-circuits.

By way of remedy a proportion of free sulphur is mixed with the powdered sulphide used to form one electrode, so as to produce an atmosphere of sulphur in the immediate vicinity of the rectifying surface. This is stated to prevent the objectionable effect in question.

Standard Telephones and Cables, Ltd., and L. J. Ellison. Application date June 5th, 1936. No. 476250.

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DIRECTION-FINDING SYSTEMS

ONE method of direction-finding depends upon the use of a wireless beam which is carefully timed to complete one revolution, say, every two minutes. When the beam passes through the direction of geographic north, a characteristic signal is broadcast in all directions. The navigator of any vessel within range can then discover his bearings by starting a stop-watch immediately he hears the broadcast "North" signal, and stopping it when he receives the beacon signal at maximum strength (i.e., as the directed beam sweeps past him). From the time-interval between the two signals he can calculate the direction of true north.

According to the present invention the rate of revolution of the beam is speeded up, and a second, non-directional aerial is used to broadcast signals on a different carrier-wave. The two signals are rectified at the receiver and are then applied to a phase-meter which indicates automatically the required angular bearing. In addition, an irregular variation is introduced by clockwork at the beacon station, so that unless the receiver is provided with a similar clockwork, a reliable indication cannot be obtained. In other words, the system is "secret" to "unauthorised" listeners.

Standard Telephones and Cables, Ltd. (assignees of Le Materiel Telephonique Soc. Anon.). Convention date (France) April 10th, 1936. No. 476215.

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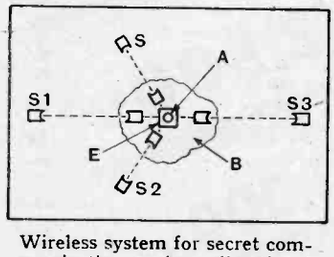
SHORT-WAVE SIGNALLING

THE figure shows a two-way signalling system for short waves, in which a central station B serves to link up a ring of outer subscribers S, S1, S2, S3. All the aerials are highly directive except one central aerial A, which is connected to the exchange E. When one of the outer stations, say S1, desires to speak to another, S3, it sends out a "call" signal to the non-directive aerial A, which



Wireless system for secret communication using directional aerials and a master control station.

either automatically actuates relays in the exchange to make the necessary connections, or warns the operator to make them by hand.

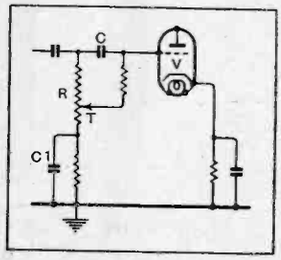
During the time of the ensuing conversation the central aerial A is automatically energised to send out a "busy" signal to all the other outlying stations, so as to prevent them from making fruitless attempts to link up with either of the "engaged" lines S1 or S3.

Telefunken Ges. fur drahtlose Telegraphie m.b.h. Convention date (Germany) May 8th, 1936. No. 476541.

TONE CONTROLS

WHEN a wireless receiver has been operated at a high level of volume and is then turned down or moderated the reproduction tends to fall off in quality, particularly as regards the high and low notes. The tone control shown in the figure is designed to overcome this difficulty.

Volume is at a maximum when the control tapping T is at the top of the potentiometer R, and is re-



Volume control giving automatic tone correction at low-volume setting.

duced as the tap is moved downwards.

The voltage across the resistance R is proportional to the frequency, because the voltage across the condenser C must fall with increased frequency. For a low position of the tap T the total resistance shunt across the condenser C is increased, and this serves to boost the high notes. In the same position of the tapping T, the potential difference across the plates of the condenser C1 is increased, particularly for the lower notes, which are accordingly intensified in the AF valve V.

In other words, for a low-volume setting of the control T both the high and low notes are relatively emphasised as compared with the high-volume setting.

E. K. Cole, Ltd., and H. A. Brooke. Application date June 23rd, 1936. No. 476396.

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TRAINING TO FLY BY WIRELESS

A PUPIL is taught how to fly a predetermined course under the guidance of wireless signals, or to make a "blind" landing down a radio-beam, without actually having to go into the air. For this purpose a dummy aeroplane is mounted on a rotatable support so that it can be manœuvred into any of normal positions corresponding to actual flight by a pupil seated inside a hooded cockpit.

Signals of the type produced by a wireless navigational beacon of the "overlapping" beam type are produced by a local buzzer circuit, and are fed by wire to the usual wireless indicators mounted on the dashboard of the dummy aeroplane.

The instructor controls the local signalling apparatus and observes the resulting steering responses of the pupil in the hooded "dummy."

E. A. Link, Junr. Application date June 19th, 1936. No. 476816.

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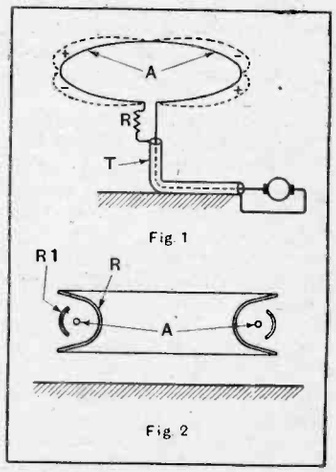
AERIALS

THE ordinary vertical dipole, as used for short-wave broadcasting, radiates vertically-polarised waves equally in all directions in the horizontal plane. It is, however, desirable in certain circumstances to broadcast a horizontally polarised wave in the same plane, because this is found to be less subject to local interference in reception. The ordinary horizontal dipole is not, however, well suited for this purpose since it only radiates a comparatively small amount of energy in a direction parallel to its length.

Fig. 1 shows an aerial specially designed to overcome this difficulty. It consists of a wire A arranged as a circle, the circumference being equal to a whole number of wavelengths, preferably two. Energy is supplied from a transmission line T connected across the gap between the two ends of the aerial, one of the feed-lines including a surge resistance R to prevent reflection. The result is that a "standing wave" formation is set up along the aerial, as shown in dotted lines. But the nodes and loops of the wave travel around the wire, so that substantially equal radiation takes place in all directions. To increase the field strength



Short-wave aerial (Fig. 1), consisting of a loop to give uniform radiation of horizontally polarised waves. Method of adding reflectors to aerial is shown in Fig. 2.

the aerial wire A may be backed with a cylindrical reflector R and also a front reflector R1, as shown in Fig. 2.

Marconi's Wireless Telegraph Co., Ltd. (assignees of H. O. Peterson). Convention date (U.S.A.) May 19th, 1936. No. 476726.

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CONTENTS

EDITORIAL COMMENT

Condensers

Set Makers Take Risks

ONE of the direct results of unbridled competition between set manufacturers, which has developed into a race to produce the cheapest sets rather than the best, has been an increasing tendency to take unwarranted risks in the matter of the choice of components. There was a time when set manufacturers were proud to incorporate the best makes of components in their sets, and with the early receivers it was quite the usual thing to find that the principal components carried the name of the component manufacturer, although incorporated in a set bearing the name of another firm.

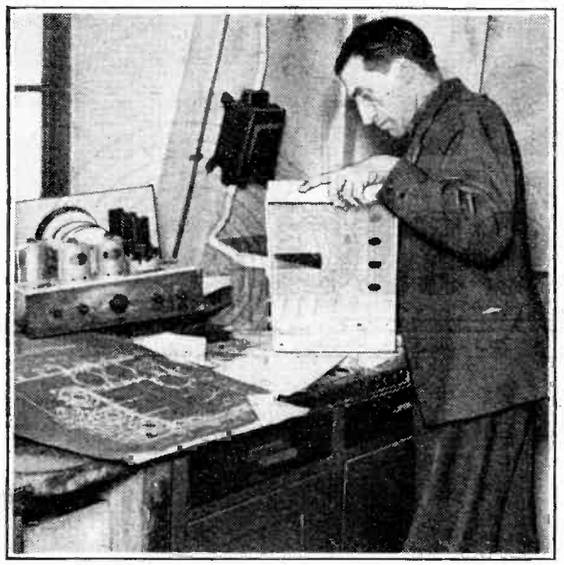
As competition increased the set manufacturers began to look round for the cheapest source of components, and it was natural that component manufacturers no longer cared for their names to appear on components which had to be produced to a price and, therefore, very often to a standard below that which they felt did credit to the reputation of their firm. Outstanding examples of cheeseparing are to be found in the liberties which set manufacturers when competing in price will take with those all-important components, condensers and resistances. It has been pointed out recently in correspondence in this journal that receiver manufacturers often employ condensers the rating of which leaves no margin of safety whatever, and that, in consequence, it is not in the least surprising that condenser breakdowns are of frequent occurrence, often with disastrous effects to other parts of the set.

The remedy for this state of affairs, whilst easily found in theory, is very elusive in practice. Set manufacturers of the highest reputation or, shall we say, sets of the highest reputation and, therefore, of higher-than-average price, can afford condensers adequate for the purpose for which they are required, and condenser manufacturers gladly co-operate with the set designer to see to it that the condensers they supply are suitable. But when it comes to the cheaper sets, or sets by manufacturers of less repute, the condenser suppliers have no control over the conditions under which their products are employed. Set manufacturers in such cases use the cheapest product which will pass ordinary factory tests, neglecting the probability that the margin of safety is not sufficient to ensure a reasonable life for the condenser and, therefore, for the set in which it is fitted.

Expectation of Life

There is yet a further aspect of this situation ; the idea is gaining currency that condensers, particularly those of the electrolytic type, are not permanent and that their breakdown is almost inevitable after so many hundred or thousand hours of service. We should suspect that there would be little cause for anxiety regarding the life of condensers if types were chosen with a proper margin of safety, and no doubt condenser manufacturers are in a position to supply an entirely satisfactory article if they are permitted to have a voice in the uses to which they are put rather than having to supply "blind" to the set manufacturer obsessed with the necessity to obtain the cheapest article.

It would be a welcome change to see a reversion to the old idea of essential components in receivers carrying the maker's name, plus an assurance that the components were being used under conditions approved by the component manufacturer himself.



Practical Aspect

I.—MECHANICS OF SET CONSTRUCTION

ALTHOUGH mechanical considerations are almost always quite subsidiary to the electrical design of wireless apparatus, it is true that many a good electrical idea has been spoilt by faulty mechanical execution. In this article and its sequel, the author discusses points that deserve more attention than they generally receive.

IN this article it is proposed to review a number of points in connection with the mechanical side of set and amplifier construction and design which may easily escape notice until attention is forced to them by the failure of the part concerned. The necessity for the observance of correct principles increases with the amount of rough usage the set has to withstand and, in the case of sets containing the speaker, with the acoustic output.

The first part of the construction to be considered is, or should be, the chassis; this may be made up in various forms, and of different materials, each of them having their special characteristics which fit them for particular uses. For permanent jobs suited to withstand hard usage there is virtually no alternative to the use of steel, since aluminium in economical thicknesses is easily bent and the other possible metals, brass and bronze, are expensive. For special purposes, however, cast aluminium, which is much stiffer than the rolled variety, though more brittle, is of great value, and this material is often used in laboratory equipment in the smaller sizes; since it cannot be bent, it must be cast to the desired form and is, therefore, more suitable for quantities than for odd items.

The one disadvantage of steel for this purpose is its liability to corrode, though in many cases the heat emitted from the components is quite sufficient to prevent this. However, since the set may be out of use for some time, it is usual to apply a protective finish, the usual choices being either cadmium plate or cellulose enamel. The former is less suited to the home constructor; cadmium is a conductor, but enamel is not and must be removed where any connection is to be made to the chassis.

For temporary and for amateur work a popular choice is aluminium foil mounted on plywood, sold under several trade names; this is easy to obtain and relatively simple to work, since rolled aluminium can be cut with woodworking tools; no reliance in design should be placed on the foil from the point of view of strength and the same thickness of ply used as if the metal were not there. The author has found considerable advantages in using tinned copper foil mounted on plywood; this has many good points, one of the chief being that soldered connections can be made to it at any point, wood screws can be easily inserted if a start is made with an awl, and earth paths are of lower resistance than with aluminium of the same thickness. The method lends itself well to temporary jobs, as components can be moved without much trouble and new earthing points made rapidly; 26 SWG is a suitable thickness to use. The copper can be tinned easily if it is cleaned and then heated gently on a gas ring or a hotplate and the flux and solder spread over it with a cotton rag and then wiped clean.

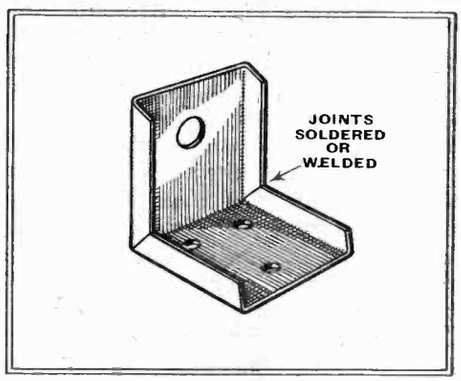


Fig. 1.—Method of strengthening a component bracket by means of flanged edges.

With metal chassis the turn-down at sides and end should not be omitted; it is a source of considerable strength and within the normal limits of use the deeper it is the better. The strength of a rectangular section is proportional to the square of the depth but directly to the width, so an increase of 50 per cent. in the depth increases the rigidity by more than 100 per cent. This fact should also be borne in mind when using rectangular section bearers for plywood chassis; to use the strip with the greatest dimension of the section vertical gives the stronger assembly. Struts, such as those that support the panel and hold it at right angles to the base, are much stronger if they are made in angle form, as they will then resist both tensile and compressive strains, while if they were simple strip they would only bear tensile stresses.

Cabinet design will be touched on here only from the mechanical standpoint and with no regard to considerations of heating or acoustics, which may sometimes modify the design, nor will the design of moulded plastic cabinets be treated as this is more determined by the special processes of manufacture.

Solidity and Rigidity

Wood cabinets may be divided broadly into two classes, those constructed of "solid" wood and those of framed ply. The former being of the same thickness throughout are to be preferred, since with the usual thicknesses used in the latter the ply is mainly a covering and contributes little to the strength, so that the solid cabinet is more rigid. Unfortunately, it is also more costly, but the extra cost is well repaid in durability. Cabinets which contain the set and speaker should receive special attention from this point of view; in the first place, quite apart from the increased strength, a heavy one will vibrate less for the same output, and this means less trouble with the joints, the wiring and the valves. The larger the output from the speaker the more rigidly should the cabinet be built. Audio outputs of from five to ten watts are now quite common in domestic sets and call for very careful securing of anything which might work loose.

For PA work and large amplifiers steel cabinets are generally used in order to withstand the abuse they have to suffer. Air circulation must be provided for cooling, and so there need be no attempt, save in special cases, to seal the joint between the chassis and cover, but on account of the expansion of the metal it is wise to interpose some soft material, such as rubber or asbestos, wherever there is a joint of this nature; in addition, all securing bolts and nuts should be fitted with spring washers. Special care must be taken in all steel-clad equipment to guard against

# of Design

By R. H. WALLACE

any possibility of the wiring or components touching the case, and all those hung in the wiring should be fastened in some way to prevent this. The construc-

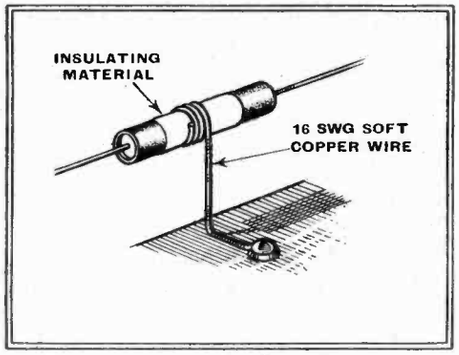


Fig. 2.—A wire anchorage for small components.

tion of these cabinets is not beyond the capabilities of the amateur, but requires special tools, so that it is better to get them made. The corner joints should be welded unless the whole is a pressing.

For small cases for short-wave work and for housing measuring instruments the cast aluminium article has many advantages, its lightness and rigidity making it especially suitable; in reasonable quantities in sizes up to about nine inches it is not unduly costly.

Wiring Details

Although apparently an electrical matter, the manner of the wiring is also a mechanical problem, since on the thoroughness with which this work is done depends the whole functioning of the set; it is of little use having a splendid circuit if one of the grid leads has come adrift due to bad soldering or a loose terminal. Many of the early failures of sets are attributable to faults in the wiring—dry joints and the like. There is no question that for permanently good contacts no method is as good as soldering, and almost all experienced constructors adopt it. It is not always realised that the quality of solder varies considerably; soft solder is an alloy of tin and lead in varied proportions, the commonest is one of two parts lead to one of tin, and this is called plumber's solder. Its properties make it suitable for plumbing work, but it is not fit for wiring. The best solder for electrical purposes and the one which is used in the jointing of important work contains two parts of tin to one of lead. This is often known as tinsmith's solder; it cannot be extruded, so is not available with a flux core. The strength of this alloy is considerable, and as it solidifies at once there is little danger of getting dry joints. This quality is known by the fact that if it is bent quickly near the ear a distinct crackling is heard; the coarser alloys do not give this effect.

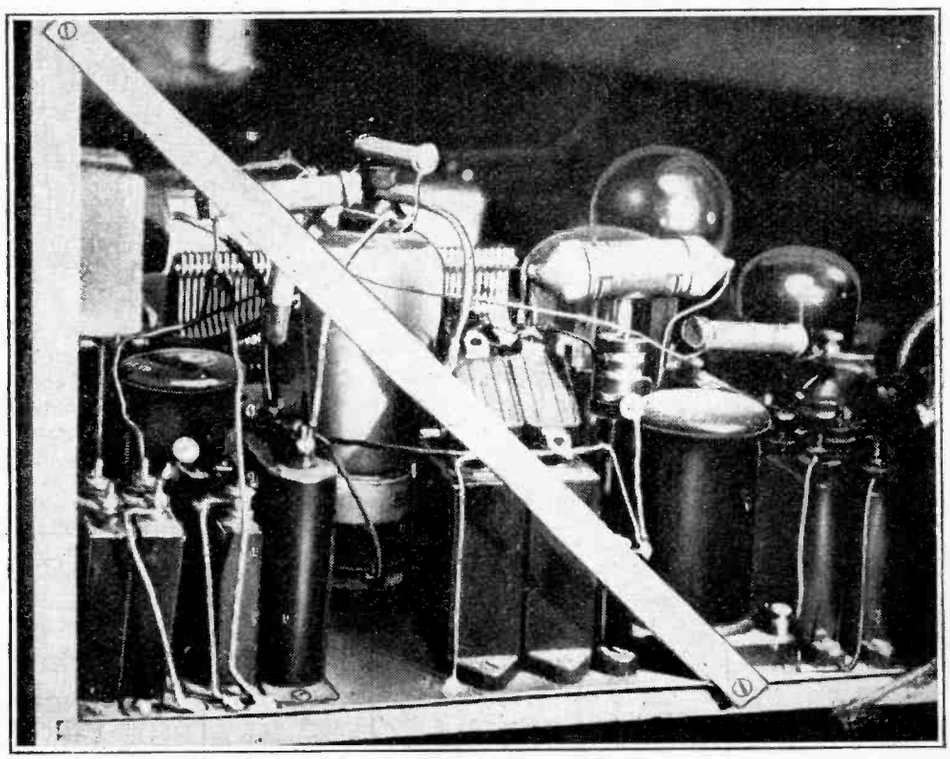
It is particularly necessary to have good joints for parts which are suspended in the wiring, and it is better to anchor the heavier of these in some manner; a suggestion is given in Fig. 2. The gauge of wire used for the actual electrical connections depends on the amount of vibration expected, the signal frequencies, and the audio-frequency output of the set. For example, if a short-wave set delivers great volume, there is a danger that the vibration will vary the stray capacities of the parts and modulate the signal at audio frequencies; a wire in the tuned circuit running near the chassis, or a grid condenser suspended too near the metalwork, can both cause this trouble, apart from the well-known case of the oscillator section of the condenser. The tip given in *The Wireless World* many times of stretching the connecting wire before using has the effect, too, of making it harder and more suitable.

Screw terminals, if used, should be fitted with soldering tags and the connection made to these, as few people have the delicacy or touch needed to tighten them properly without cutting the wire. Here, too, if there is much vibration, the use of spring washers is indicated. The gauge of wire used will depend on the frequencies handled; considerable liberties may be taken at medium and low values, but at the higher frequencies not less than 16 SWG should be used, while for laboratory work 14 and 12 SWG are often required. Long unsupported lengths are to be avoided.

Nowadays switches are generally bought ready made, but it is often necessary to make them up for special purposes; there is scarcely another component which gives so much trouble as a badly designed switch, or one made of unsuitable materials. There are few alternatives, so far as the contact blades are concerned; bronze, nickel-silver and brass (all in the hard rolled form) are reliable. Of these, nickel-silver is sufficiently untarnishable to be used alone, but the other two require to be tipped with silver or gold-silver alloy for good service. Bronze is the best for retaining its springiness. The hardness of these metals will be destroyed if they are unduly heated, and so care should be taken in soldering connections to the blades, and the iron should only be in contact for just long enough to make the joint.

Self-cleaning Contacts

The manner in which the contacts meet is all-important; they must wipe each other for satisfactory results. Blades which only press against the contact will rapidly become dirty and a rolling contact is nearly as bad, since the action is to spread any dirt over the surface and roll it in. Wave-range switches are the worst offenders, and a high-resistance contact here can spoil good coils. Another point that needs watching is that only first-class insulation be used; the leakage paths are always short and often only $\frac{1}{4}$in. separates the contacts across the tuning coil. A leak of as little as $\frac{1}{2}$ megohm can reduce the efficiency of a good coil. Switches should be enclosed wherever possible in a dustproof cover.



The use of tinned copper foil as a covering to the baseboard is seen above. It affords an easy way of making direct connections to earth.

Practical Aspects of Design—

It is possible, by careless assembly, completely to negative an otherwise good design. Modern variable condensers and other components look—and are—real engineering jobs, but that does not mean they will stand any sort of handling; they are pieces of precision machinery and can be permanently harmed by rough treatment. The chassis should be perfectly flat where a ganged condenser is to fit, and each screw must be tightened up a bit, then the next one given a turn or two, and so all the way round until all are fully up; to screw one fully up first tends to warp the frame. If the condenser does not fit correctly at first it should be carefully packed with washers till it does before screwing it down.

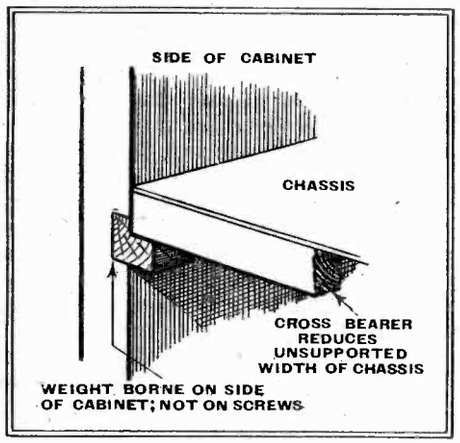


Fig. 3.—Strengthening the cabinet by rebating of side support and use of bearers.

When the spindles of controls mounted on the chassis project through the cabinet the hole in the latter ought to have more clearance than the greatest possible movement of the chassis; if the latter is mounted on rubber the whole effect of this is, so to speak, short-circuited if the spindles cannot move freely.

Loud speakers can be damaged if the frame is distorted by incorrect mounting; here, as with condensers, the screws should be tightened in turn so that the pressure is kept even. Unless the baffle is truly flat—and this is unlikely—felt or rubber should be interposed between it and the frame; neglect of these precautions can cause so much warping that the speech coil will foul the poles.

Finally, one more small point must be mentioned—one that is sometimes forgotten by those who ought to know better. If a unit is flexibly mounted, all connections to it will have to be flexible, too, since naturally if the lead cannot follow the minute vibrations of such a unit the joints will soon fail—to say nothing of loss of flexibility.

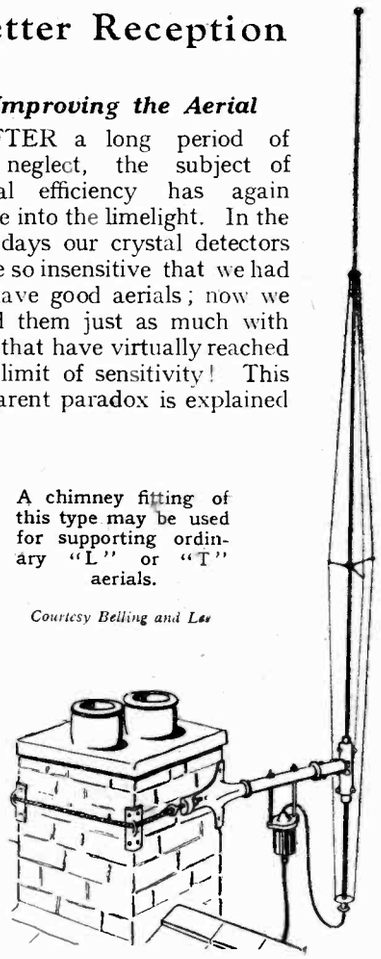
Although it is impossible, in a brief article, to cover all the many points of detail which go to make that reliability and freedom from breakdown we all endeavour to obtain, enough has been said to indicate the principles on which these things are based, and readers can apply them for themselves to the other cases which may confront them. Many of the matters dealt with may seem trivial to some readers, but it is these little details that make all the difference between good and bad results.

Hints and Tips

Practical Aids to Better Reception

Improving the Aerial

AFTER a long period of neglect, the subject of aerial efficiency has again come into the limelight. In the old days our crystal detectors were so insensitive that we had to have good aerials; now we need them just as much with sets that have virtually reached the limit of sensitivity! This apparent paradox is explained by the fact that range of reception is now limited mainly by various kinds of noise, and it is a demonstrable fact that a good aerial makes for a more favourable ratio between wanted signal and unwanted noise.



A chimney fitting of this type may be used for supporting ordinary "L" or "T" aerials.

Courtesy Belling and Lee

Without going into the niceties of aerial design, it is generally safe to say that a high aerial is a good one; any change that tends to raise the aerial above the field of man-made interference that exists around the average dwelling-house is a change for the better. Further, the signal pick-up of the aerial will be improved, less amplification will be needed for a given signal, and so inherent receiver noise will be reduced.

When attempting to increase the effective height of an aerial, a chimney often offers itself as a convenient point of support for one end. In such cases, the form of attachment devised for the Belling-Lee "spike" aerial, though intended for a rather more exacting duty than that at present under discussion, seems worthy of imitation. As shown in the accompanying illustration, the bracket is held in position by a wire rope round the chimney, angle-pieces being provided to prevent chafing and to distribute the stresses over several courses of the brickwork. A tensioning screw is provided to make all snug. A simple adaptation of this idea, with ordinary stranded galvanised iron wire, would serve well for an aerial of conventional pattern.

Resistance Ratings

WITH regard to the current series of articles on receiver design, the amateur designer may be reminded that, in choosing the wattage rating of a resistance, he may sometimes be wise to base his calculations, not on the value of current that *should* pass through it under normal operating conditions, but on that which would flow in the event of an accidental short-circuit. Naturally, this applies with especial force in cases where the apparatus is to be used for experimental purposes.

It is not suggested for a moment that every resistance should be so generously rated as to withstand even direct connection across the HT supply, but, in cases where a resistance breakdown is probable, the matter might at least be considered.

It is generally an advantage, when one end of the aerial is supported by a chimney in this manner, to interpose a length of rope, or of wire, broken by insulators, between the aerial wire and the chimney; in this way the aerial may be kept well clear of the building.

RECOMMENDED MINIMUM THICKNESSES OF CHASSIS MATERIALS.

Least Distance of Supports or Bearers.	Plywood.	Rolled Sheet Aluminium.*	Cast Aluminium.	Sheet Steel.*
6in.	$\frac{3}{16}$in.	16 swg., 0.064in.	$\frac{1}{8}$in.	20 swg., 0.036in.
12in.	$\frac{1}{4}$in.	14 ,, 0.080in.	$\frac{3}{16}$in.	16 ,, 0.064in.
18in.	$\frac{5}{16}$in.	12 ,, 0.104in.	$\frac{1}{4}$in.	16 ,, 0.064in.
24in.	$\frac{3}{8}$in.	10 ,, 0.128in.	Not used	14 ,, 0.080in.

* Assuming turned-down edges of at least $\frac{1}{2}$ inch.

RF Output Measurements

ABSORPTION WAVEMETER ADAPTED TO GIVE DIRECT READINGS IN WATTS

By L. COULSTON-JONES

DESCRIBING the theory and practical realisation of an instrument giving direct readings of RF power, and intended for use with oscillators and small transmitters. Calibration of the meter is done on DC, and so presents no difficulties.

ONE of the greatest obstacles which besets the average amateur or experimental user of power oscillators and transmitters is the difficulty of ascertaining, with any degree of accuracy, the output obtained from such apparatus.

The usual method is to measure the RF current with a meter, often of somewhat doubtful reliability, square it and multiply by the approximate RF resistance of the aerial circuit.

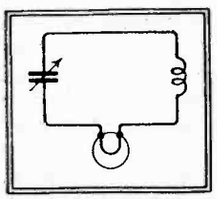


Fig. 1.—The familiar absorption wavemeter, with a lamp indicator for showing resonance.

This rough-and-ready calculation is perhaps good enough for obtaining a rough idea of the power in the aerial circuit, but it does not help in designing a transmitter to give a specific output.

Take the case of the average amateur who requires a transmitter to give, say, a twenty-watt output. His procedure would probably be somewhat as follows.

For the power amplifier stage he would procure a valve capable under, say, Class "C" conditions of giving the twenty watts required, with a drive of, for example, five to eight watts. He then most probably uses another valve capable of eight watts output to drive the PA and then decides, depending upon his own ideas, on a further valve as oscillator.

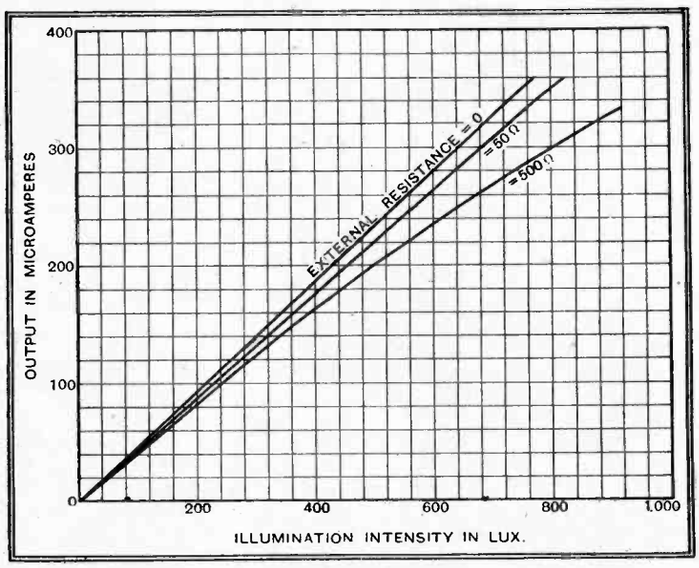


Fig. 2.—Characteristics of the Tungsram photo element, Type S44, with various values of load resistance.

The whole job is hooked up, and with moderate luck and a lot of patience the transmitter functions and the owner piously hopes that the output is giving its rated value of twenty watts.

Now if he had had some meter to measure his power output and to check the oscillator and sub-amplifier he would probably find that the oscillator was giving a lot more than necessary and perhaps being quite appreciably over-run, because few amateurs seem to realise the importance of the use of the optimum value of grid leak in the oscillator and the important part it plays in deciding the best conditions for operation of the valve for maximum output with minimum anode dissipation. The use of a reliable meter to check his power would rapidly and easily have shown him this.

Some method is therefore required which will give a direct reading of the RF energy, be accurate, if possible independent of frequency and finally reasonably cheap. It is the purpose of this article to describe such a method which has been used with very great success by the author in various experiments.

It seems safe to say that everyone who experiments with oscillators of the power type possesses the inevitable and admittedly valuable absorption wavemeter, normally consisting of a coil, condenser and lamp, as shown in Fig. 1. When this is coupled to an oscillating circuit and tuned to resonate with this circuit, the lamp glows, and, depending on the power of the oscillator, so the brilliance of the lamp will vary.

Now why does it glow? Simply because the energy in the circuit to which it is coupled is being transferred into the wavemeter circuit, which in turn causes a current to flow in this circuit, which lights the lamp, but the maximum transference will only take place when the meter circuit is in tune with the oscillator circuit; in other words, when the combined output circuit and coupled wavemeter form the optimum RF loading for the particular operating conditions of the valve in use.

Hence the brilliance is a definite indicative measurement of the RF power generated in the output circuit of the valve, and, what is more, since the impedance of the lamp to RF is comparatively negligible, particularly if it is decapped, it can be considered independent of frequency.

We have, therefore, a comparatively accurate method of measuring the power output from an oscillator, but only in terms of brilliance, which in itself is of no great value in assisting us to be able to state the definite output of an oscillator in watts.

Converting Light into Current

We require, therefore, some means of accurately measuring this brilliance and any variation of it. For this purpose we can utilise a photo element of the "boundary layer" type.

For the benefit of those who are not familiar with this piece of apparatus it may be stated briefly that it consists of a metal disc coated with a deposit of light-sensitive selenium, which is in turn coated with a layer of thin transparent metal. The contacts of the element are formed by the metal base plate and a pressure spring on the thin transparent metal coating.

The element in question used for this meter is the Tungsram Type S44, which is a small, easily mountable element of about 2in. diameter, fitted with two terminals at the back for connecting to the milliammeter.

The linearity of the output is greatest when the load resistance is at its minimum, as can be seen from the curves of Fig. 2, and since the resistance of the

RF Output Measurements—

average meter reading 2 mA at full scale deflection is aproximately 50 ohms, it can be appreciated that the meter readings are practically directly proportional of the light intensity.

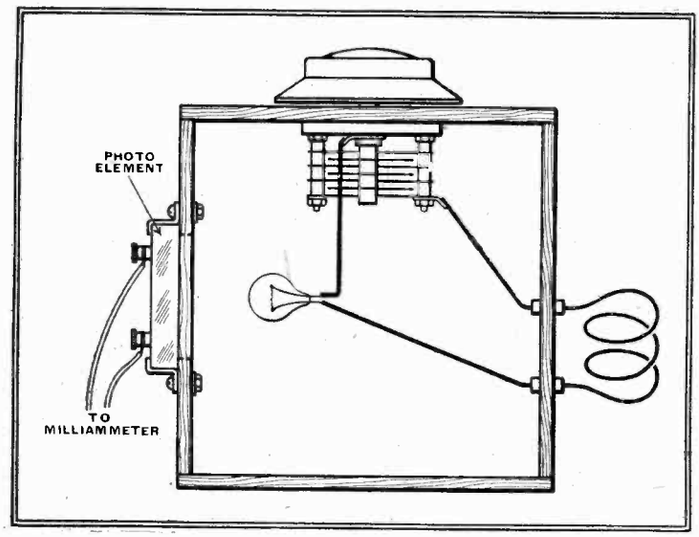


Fig. 3.—Adapting the absorption wavemeter circuit of Fig. 1 for direct readings of power. Light from the lamp is converted into current through the intermediary of the photo element.

A further advantage of this particular element is that it is of the self-generating type, and consequently does not require any external polarisation. Further, it is extremely sensitive, having a very large output, and is perfectly constant in operation.

By mounting the element in close proximity to the lamp in the wavemeter, the variation of brilliance can easily be measured on a milliammeter connected to the output terminals of the cell.

It is a simple matter to make a curve of element output against lamp wattage, and there we have a direct measurement of the power output of the circuit to which the wavemeter is coupled. It is still easier to mark the milliammeter in watts, thereby enabling a direct reading to be obtained.

When using the complete instrument for actually measuring the power output from a transmitter, the transmitter itself should be adjusted for normal operation and maximum efficiency, with the aerial with which it is to be used connected to the tank circuit of the PA stage, in the precise manner as for normal operation.

In order that the readings of the power output, as measured with the instrument, should not be erroneous, as compared with actual output being transferred to the aerial circuit, before the meter is connected, the anode current under operating conditions of the tank circuit of the PA stage should be carefully noted.

The aerial coupling should then be disconnected from the tank circuit and the measuring meter coupled to it. The wavemeter should then be tuned in the normal manner to the frequency of the transmitter and the coupling varied until the meter in the tank circuit of the PA stage measures precisely the same current as previously when the aerial was coupled to it.

This will then ensure that the same load is being thrown on the tank circuit.

The wattage then read on the photo element meter will be the actual wattage normally transferred to the aerial circuit; in other words, the power input to the aerial circuit of the transmitter.

The construction should present no difficulty whatsoever. The instrument used by the author was mounted in a wooden box measuring 4in. × 4in. × 3in. deep, with a hole cut in one end just large enough to allow the full light-sensitive surface of the element to be exposed to the inside of the box.

A lamp of suitable wattage, depending on the power of the circuits to be measured, was decapped and mounted, by soldering stiff 10-gauge wires to the connections in such a way that the lamp was held firmly about 1in. away from the cell, but, of course, inside the box. Through one of the other sides was fitted a suitable short-wave variable condenser and finally on the outside of a third side was mounted the coupling coil. A lid was then screwed on to the box to prevent external light from influencing the photo-element and so giving false readings. A plan of the meter is given in Fig. 3.

Since the brilliance of a lamp is dependent on its wattage dissipation and the losses on RF are extremely small provided a large coiled-coil type of lamp is not used, the photo-element current readings for various lamp brilliancies can be taken on DC and the meter connected to the element calibrated in watts.

For powers up to ten watts a two-milliamp. full-scale meter was used.

In conclusion, it must be pointed out that the greatest accuracy is obviously obtained when the instrument is used for small power measurements up to, say, twenty watts. For larger, the error due to lamp self-capacity and inductance will increase, but even so the results obtained would be far more accurate and simple than by the calculation method.

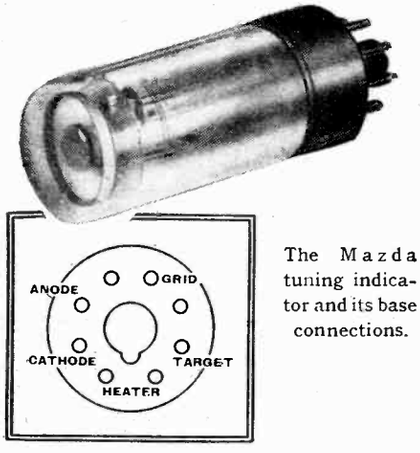
New Apparatus Reviewed

Recent Products of the Manufacturers

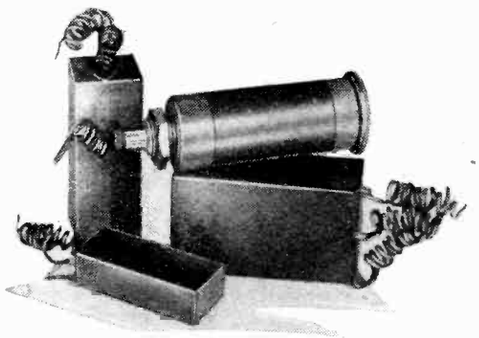
MAZDA CATHODE-RAY TUNING INDICATORS

THE Mazda ME41 and ME91 tuning indicators are fitted with the British Octal base. The ME41 is rated for 250 volts maximum and has a heater consuming 0.5 ampere at 4 volts, while the ME91 is rated for 200 volts and its heater takes 0.2 ampere at 9 volts; it is intended for AC/DC sets. The base connections are the same.

They are similar to the older AC/ME and give a shadow angle of 90 degrees, some 20 volts input being needed for full change. This voltage should be taken from the detector output rather than from the AVC line. The conventional circuit should be used with a coupling resistance of 1 megohm.



The Mazda tuning indicator and its base connections.



A group of various Dumont condenser types.

DUMONT CONDENSERS

A COMPLETE range of condensers is marketed by British Dumont Condenser Co., of Fitzgeorge Street, Rochdale Road, Manchester, 9. The range includes electrolytic, paper, silvered mica and ceramic types.

Among the specimens illustrated is an 8-mfd. electrolytic condenser for 350 volts maximum potential, which measures only 2½in. × ¾in. × 1in. It is of the cardboard-case type, and a similar component for 500 volts measures 3 7/16in. × 1in. × 1¼in. A triple 4-mfd. condenser with separate positive and negative leads is also remarkably small, being only 3½in. × 1¼in. × 2in. It is for 500 volts working.

Electrolytic condensers in metal containers are also obtainable and with the can insulated. This is very convenient for certain circuits in which the negative of the HT supply is at a different potential from that of the chassis.

Production and Reproduction

LOUD SPEAKERS AS THE SET MANUFACTURER SEES THEM

By "TEST ENGINEER"

TO the unfriendly eye of the line-foreman, the loud speaker is one more affliction, designed by some sub-human intelligence, to keep his output down and his costs up. To the test instrument designer the loud speaker presents other difficulties, as experience has shown that "Heath Robinson" tests inevitably mean trouble at a late and critical stage of production. The public, too, is becoming more "quality conscious," and "dud" sets mean deep depressions in the sales curves.

The job of the designer of test equipment therefore falls under three main headings:—

1. To ensure uniformity of components.
2. To ensure quality with economy, and
3. To ensure speed with reliability.

In the early days of wireless, the accepted method of testing "table-talkers" was to clamp them in a dummy cabinet, hook them on a changeover circuit, and compare them with a standard extorted from the harassed laboratory staff. A 50-cycle supply was switched to the speech coil, almost any field wattage being good enough.

This B.F.I.[1] process usually cleared the gap of scrap iron, any stubborn matter being removed with Plasticene feelers or vaselined cartridge paper. After this brutality, the loud speaker was subjected to audio supplies of varying quality, and if it sounded reasonably like the standard, was passed O.K. and handed to some cheery optimist for inclusion in his own individually produced receiver. When the speaker under test sounded better than the standard, we "rang the changes" and so Science progressed. All very matey and informal, but not applicable to 550-a-day production figures.

The modern loud speaker comes to the test section with 999 sisters, the genus being essentially feminine. Test times are cut to the bone, and no time is wasted on dummy cabinets. The speaker is clamped to a test baffle, speech coil and field connections being made automatically.

In many modern receivers, auto-bias is dependent on field resistance, and provision is made for rapid testing to narrow limits, often to ±3 per cent. A modification of the Wheatstone bridge serves for this, and here the first difficulty confronts the designer. Owing to the comparatively high temperature coefficient of copper, 0.00393 per degree centigrade, the DC resistance of a speaker field that has been stored in the cold overnight will change considerably after a run in the receiver. Taking an extreme case, with a very wide temperature range, the resistance variation on a 2,500-ohm field might amount to approximately 100 ohms.

The resistance tolerance, however, is only ± 3 per cent. = 75 ohms, and it is evident that Eureka, or other resistance wire with a low temperature coefficient, will be unsatisfactory for the comparative resistors used in testing. The designer therefore winds these with copper wire, and notes in the test specification that field resistance limits are given for 20 deg. C., or approximate room temperature.

Following the field resistance test, the speech coil resistance may be checked on the same instrument. The field coil insulation resistance is also measured, the specification usually calling for 20 megohms minimum at 500V. DC.

DESCRIBING various methods adopted in factories for testing loud speakers before they are passed to the assembly lines for mounting in receivers

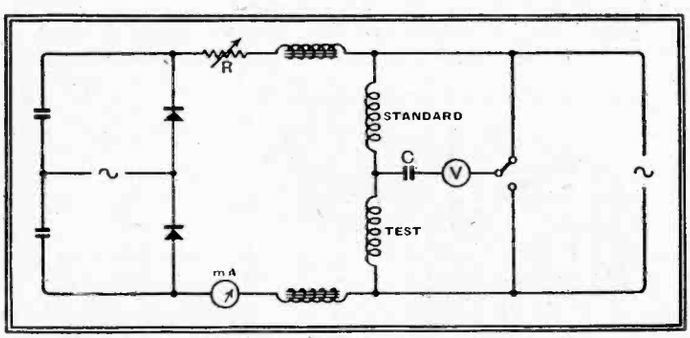


Fig. 1.—Impedance test for field coils; AC is superimposed on the energising DC, and the AC voltage developed across the coil under test is then compared with that existing across a standard winding.

A measurement of the field impedance is sometimes taken, using a circuit similar to that of Fig. 1.

A DC supply from a high-impedance source is fed to the standard and test speakers in series, the energising current being adjusted by R. An AC voltage is superimposed and the volt-drop across the field impedance measured on an AC voltmeter, the DC component being isolated by the condenser C. A changeover switch gives a check reading across a standard field.

These quantitative tests completed, the speaker on its baffle is clamped to a test panel and energised, the current being preset by a resistive network. The test panel also has a standard speaker connected, and the old practice of direct aural comparison still holds—but with a difference.

At one time it was usual for some manufacturers to check speaker response by microphone measurements; some taking readings under room conditions, others using a sound tunnel, the speaker being clamped at one end and the microphone suspended at the other. The acoustic output was thus converted into electrical impulses, thus allowing quantitative measurements.

An ingenious adaptation of this idea was to apply the rectified output from the microphone to a mirror galvanometer. A small motor driving a variable AF oscillator also rotated a second mirror, and the reflected light-spot traversed a translucent screen. The screen being calibrated, the spot position gave a measure of speaker response, and a permanent record could be obtained. A schematic diagram of this arrangement is given in Fig. 2.

Visual Indication

A more ambitious proposal was to feed a sinusoidal input to the speaker, the response from the microphone, when applied to an oscillograph, giving a picture of the distortion introduced by speaker "colouration." But these methods proved too slow and/or too costly for production, and present practice is to clamp the speaker to a flat baffle, and subject it to various aural tests. A variable oscillator, which may be motor driven, is used, but is more convenient when hand operated. An output meter is fitted, often an AC voltmeter calibrated in watts against a known impedance, the formula being Watts $= \frac{E^2}{Z}$ where E is the speech coil volts and Z the coil impedance.

[1] Brute Force and Ignorance.

Production and Reproduction—

Resonance is, therefore, indicated by a rise in volts as the speech coil impedance increases, and the variable audio oscillator finds its application here, and also in tracking down those rattles and buzzes so often associated with bulk-produced loud speakers.

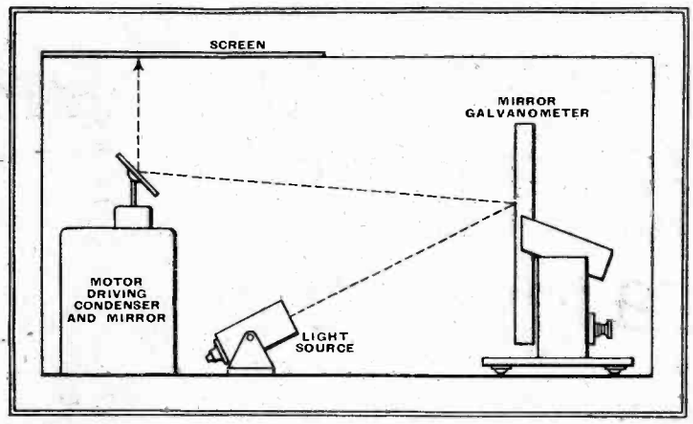


Fig. 2.—Set-up for visual examination of speaker characteristics.

Following the audio-oscillator test, a music-voltage source is switched to the speech coil and the output adjusted to the working amplitude. To explain to a doubting tester just how much noise makes 1,000 milliwatts output is often the hardest part of a test engineer's job.

In conclusion, I quote the operating data for testing loud speakers for a modern quality receiver.

The test time varies with different speakers, a table model taking from 2 to 3 minutes, a high-class quality job up to 15, and it is noticeable that this allowance is quite sufficient to grade the delivery, so well defined is the line of demarcation between good and indifferent reproduction when using well-designed apparatus.

Loud Speaker Test

Operating Instructions

1. **Set FIELD switch to appropriate value for speaker to be tested.**
2. **Set all controls to zero.**
3. **Fit and connect standard and test speakers. Close and clamp baffle doors.**
   Note: This switches on field supply and test voltages to both speakers.
4. **Adjust variable oscillator to zero beat against 50-c/s AC mains.**
5. **Rotate OSC. CONTROL and note resonance points, indicated by output meter. Check for rattle, frequency doubling, etc.**
6. **Compare test and standard speakers on music supply. If any departure from good quality is noticed on both speakers, notify the charge-hand immediately.**

volume control to be used both on radio and on gramophone as hitherto. Both pick-up loads must, however, be insulated, so that if screening is necessary a two-wire cable enclosed in metal-braided sleeving will have to be used.

Metal Chassis

SOME doubt has arisen in a reader's mind regarding the best kind of metal to use for the chassis of a radio set. He says that so far as he is aware all the chassis used for *Wireless World* sets have consisted of aluminium, yet one ordered by him recently for a set was found to be made of steel. He questions the suitability of this material.

Actually it makes no difference to the performance of the set what kind of metal is used, it can be copper, zinc, tin-plate, steel or aluminium.

The only reason that aluminium has come so much into favour is on account of the ease with which it can be handled. Of the more ductile metals, it is probably the most convenient to bend and drill, and it also has sufficient rigidity to retain its shape, at least in chassis of reasonable dimensions.

Readers' Problems

A Selection of Queries dealt with by the Information Bureau, and chosen for their more general interest, is published on this page.

Pick-up Connections in QA Super

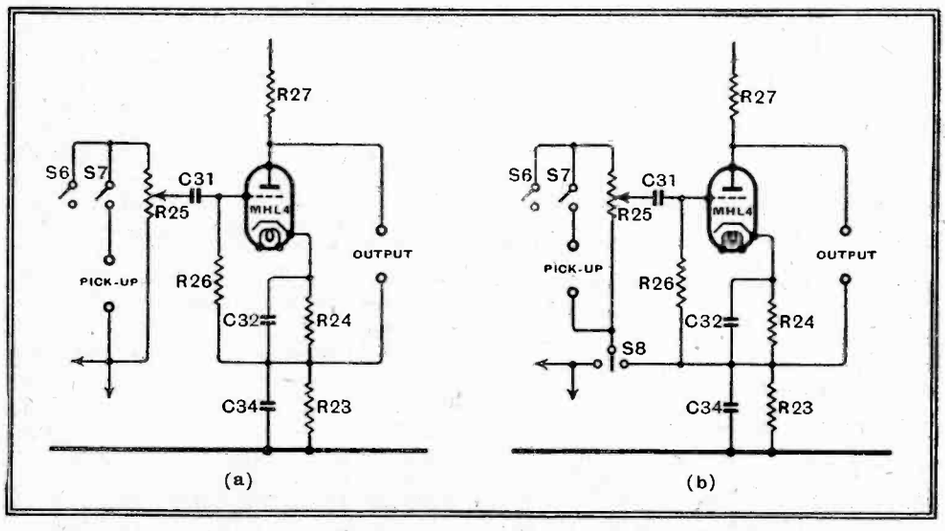
AS originally designed, the QA Super did not allow for much latitude in the choice of a gramophone pick-up, as only with those giving a relatively large electrical output could adequate volume be obtained.

The reason for this is that the phase-splitting stage contributes very little to the overall gain of the AF amplifier. Only a few minor changes, however, will be needed to increase the gain of this valve some ten times for gramophone reproduction.

The original circuit connections of the phase-splitting valve are shown at (a) in the Fig. and the suggested alterations to raise the amplification by the amount stated are given in (b).

An additional single-pole change-over switch, S8, is required, and this should be connected so that on gramophone the lower end of the volume control, across which is joined the pick-up, is connected to the junction of resistances R23 and R24.

This switching arrangement allows the volume control to be used both on radio and on gramophone as hitherto. Both pick-up loads must, however, be insulated, so that if screening is necessary a two-wire cable enclosed in metal-braided sleeving will have to be used.



Modifications to QA Super for a gramophone pick-up giving a relatively small output.

Cathode Bias Resistances

A READER is experiencing a little difficulty in calculating the value of the cathode bias resistances in a receiver, the main trouble being apparently in connection with screen grid and frequency changer valves.

The grid bias voltage is the potential developed across the cathode resistance by the flow of current through the valve. In the case of triodes this is the anode current under normal working conditions, this figure being given in *The Wireless World* Valve Data Supplement and in the valve-makers' leaflets.

The resistance is found by multiplying the grid bias voltage required by 1,000 and dividing by the anode current in mA.

With tetrodes and pentodes, whether AF or RF, the current flowing through the cathode resistance is the sum of the anode and screen currents, whilst in heptode, triode-hexode and triode-pentode frequency changer valves the cathode current is the sum of the anode, the screen and the oscillator-anode currents.

Trimming Straight Six Receiver

IN *The Wireless World* Straight Six receiver the inductance of the RF coils can be matched by varying the position of their iron cores. Both medium- and long-wave sections are accordingly provided with inductance trimmers and a reader is experiencing some difficulty in identifying them.

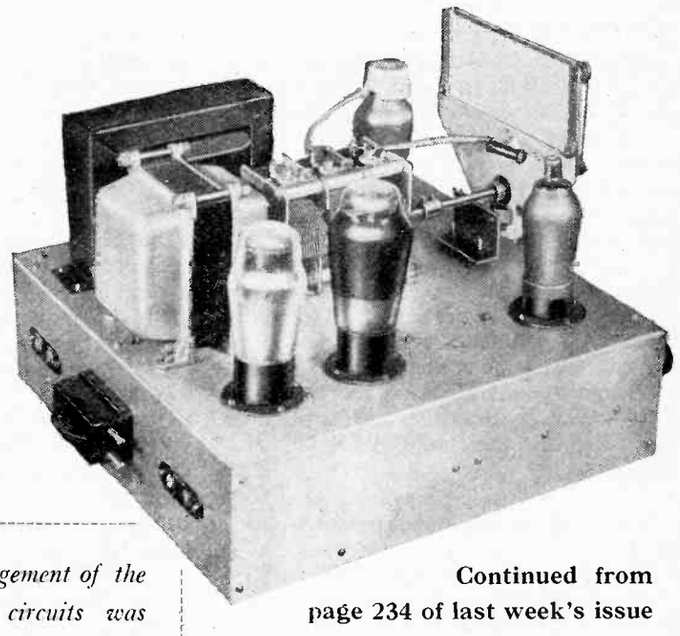
Adjustment of the inductance is effected by turning the small screws protruding through the sides of the screening can, the one nearer the top being for the medium-wave coil and the lower for the long-wave section.

Clockwise rotation produces an increase and anti-clockwise a decrease in the inductance.

How a Receiver is Designed.—IX.

Three-Valve Straight Set

AC MAINS OPERATION



THE basic arrangement of the radio-frequency circuits was discussed in the last article and is continued here, together with some notes on the special requirements of the long waveband. The mains equipment is also discussed.

Continued from page 234 of last week's issue

IN last week's issue the choice and arrangement of the RF circuits were discussed in some detail, and before dealing with the rest of the set it remains to consider the method of waveband switching to be used. With a receiver of this type only the medium and long-wave bands need be covered, for a somewhat specialised design is necessary for short waves, and it is by no means easy to secure a good short wave performance for a receiver which is primarily intended for use on the medium- and long-wave bands.

The coils we have chosen contain in the one screening can both medium-and long-wave coils, the two being connected in series, so that for waveband switching it is necessary to provide a single pole make-and-break switch for each tuned circuit. It will, therefore, be simplest to adopt this same method of switching for the aerial coil and the circuit

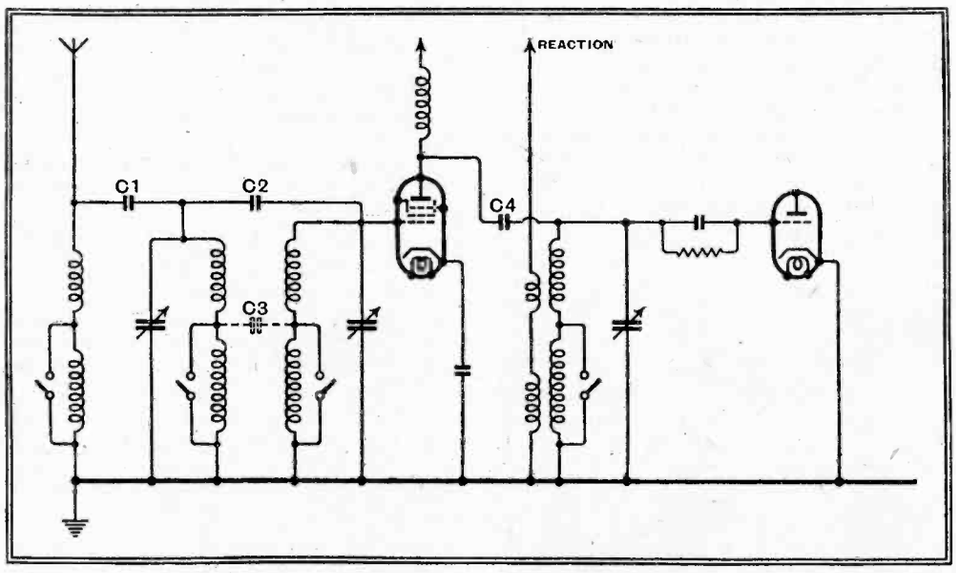


Fig. 4.—The RF circuits with waveband switching are shown here.

diagram of this portion of the apparatus, including switching, will take the form shown in Fig. 4. In general, it is not necessary to change the value of the aerial condenser C1 nor of the coupling condenser C4 in the anode circuit of the RF valve. It is, however, usually necessary to increase the coupling between the two input tuned circuits on the long-wave band, that is to say, the value of C2 must be increased. If it were necessary to increase the value of this particular capacity the switching would be seriously complicated, in view of the small capacity which is needed. Fortunately, however, it is sufficient to connect a small condenser, C3, between the high potential ends of the long-wave coils and no increase in the complication of switching is then necessary.

One other factor remains. Assuming the coils to be equally efficient on the medium- and long-wave bands, the stage gain will be considerably higher on the long-wave band than on the medium and the selectivity, also, will be higher. The stage gain will be higher because the larger coil inductance will give a higher dynamic resistance to the tuned circuits for coils of the same efficiency. The selectivity will be higher because a given frequency difference from resonance represents a bigger percentage change in frequency on the long-wave band than on the medium. We are, therefore, likely to find that on the long-wave band there may be a tendency to instability and there may also be excessive sideband cutting. We may find, therefore, that in trying out the set it will be desirable to damp one of the tuned circuits in order to limit the stage gain and selectivity. If we do this we shall, naturally, choose the intervalve circuit, for here it will be possible to remove any excess damping, when required, by means of reaction.

RF Circuit Design

It may be remarked at this point that the question of designing the RF circuits of a receiver has been tackled in a much less precise manner than the design of AF equipment in the earlier articles of this series. There is, however, a good reason for this. It is not that RF equipment cannot be designed on paper in a similar manner to AF equipment, but it is much more difficult to do so, and exact paper design can only be carried out when the magnitudes of all the factors involved are known or can be closely estimated. This can readily be done for a very large portion of the apparatus used in AF circuits, but is not nearly so easy in the case of RF equipment.

The estimation of stray circuit capacities and the consequent calculation of inductance values can be carried out with reasonable accuracy, but it is usually impossible to estimate the effective radio-frequency resistance of a tuned circuit, and unless this is known, or can be built to have the required value, little in

the way of calculation can be carried out. The effective radio-frequency resistance of a tuned circuit is, unfortunately, not merely that of the tuning coil, which can be measured fairly easily. It includes factors due to losses in all components connected to the tuned circuits, including valves, valveholders, switches, RF chokes, fixed condensers, variable condenser, and so on. These can, of course, all be measured, but such measurements only hold good for one particular set of components. A paper design can be carried out with reasonable accuracy if one has the facilities for measuring the constants of the various parts which will be used, or which one is considering the possibility of using.

The Mains Equipment

Having obtained the complete data on all the parts, one can proceed with a more or less exact design. The term "more or less" is used because even when the characteristics of each individual part are known, the performance of an RF amplifier may be seriously modified by stray couplings between different pieces of apparatus. Few outside the laboratory can obtain all this information, and their best course in design is consequently to combine an initial qualitative paper design with subsequent experiment. Usually, with a little experience, one knows what to expect with the simpler types of receiver, and quite a small amount of experimenting is needed in the final result, and it usually resolves itself merely into determining the optimum values for components such as coupling condensers.

Turning now to the rest of the equipment, the detector and output valve will naturally take a form similar to that adopted in the case of the two-valve receiver described in Part I, II and III, and we have now merely to choose valves and to design the mains equipment. A considerable output is advisable in the interests of high quality reproduction, and a suitable type of pentode output valve is the Tungsram APP4E. This requires 14 volts grid bias, with 250 volts for anode and screen, and it takes 72 mA anode current with 8 mA screen current. For the RF stage a valve of high mutual conductance is advisable, and it should, of course, be of the variable-mu type, since we shall control volume by varying its grid bias. A valve with a top grid connection is also advisable, since this lends itself better to a good layout of components than one with a top anode. The Tungsram VP4B is a suitable valve, and when operated under conditions giving a high mutual conductance, it takes 18 mA anode current. For the detector a valve with a low grid-anode capacity is advisable and a triode with a top grid connection is consequently likely to be better than one in which all the connections are brought out to the base pins. One such valve is the Tungsram HL4g, and we shall consequently decide upon these valves. The general arrangement of the supply circuits, including decoupling but ignoring the intervalve couplings and decoupling condensers, is shown in Fig. 5. This is actually the purely DC part of the apparatus.

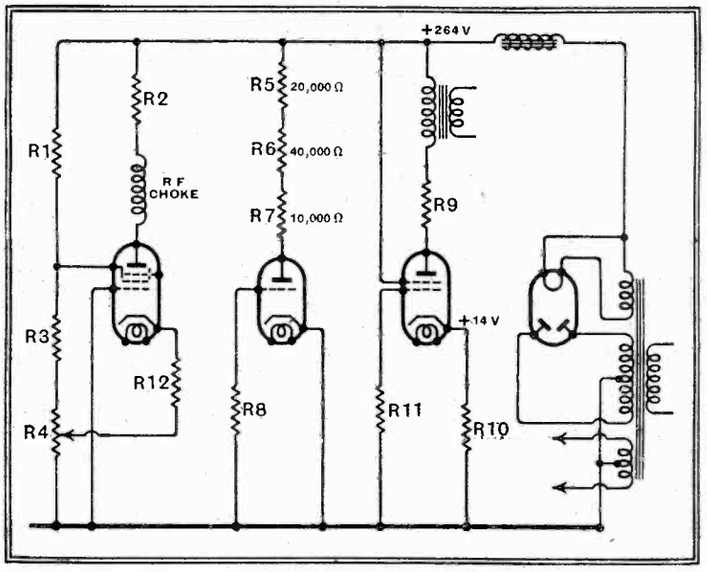


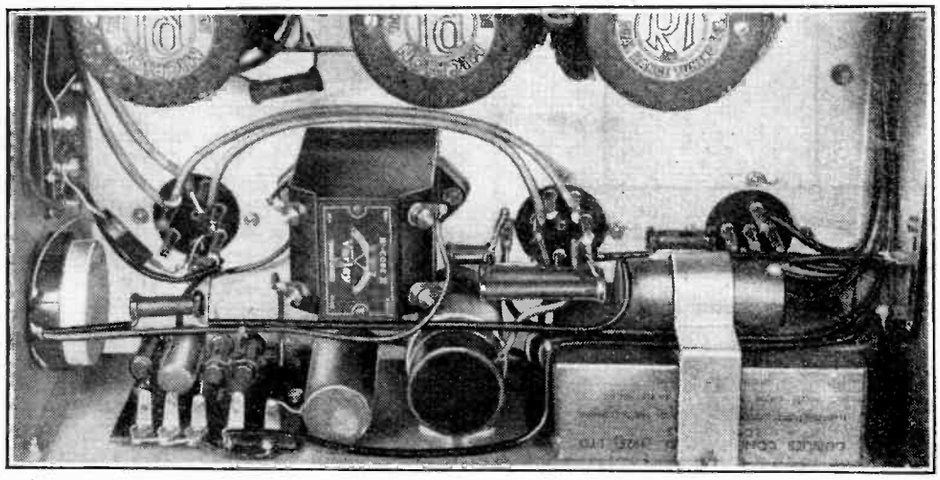
Fig. 5.—This diagram shows the DC circuits of the receiver with an outline of the rectifier and transformer.

Taking the output valve first, the bias resistance R10 must have a value of 175 ohms with a total current of 80 mA. This is not a standard value, and it will consequently be most convenient to use two 350-ohm resistances in parallel. The cathode potential will be +14 volts and, as we require 250 volts for the screen, the HT line must be +264 volts. The anode potential will then be less than 250 volts by the voltage drop in R9, and the output transformer primary. R9 is an anti-parasitic resistance of 50 ohms. The detector conditions are by no means critical and in the anode circuit we have R7, the filter resistance, R6, the coupling resistance, and R5, the decoupling resistance. R7 can be 10,000 ohms and R6 40,000 ohms, and a suitable value for R5 is 20,000 ohms. The detector current is difficult to calculate exactly and will, in fact, depend upon the signal strength. It will, however, be of the order of 3 to 4 mA. For the RF stage the initial bias with the volume control set for maximum gain is provided by R12. It should be about 2 volts. With a total current of 20 mA, the resistance R12 can then be 100 ohms.

In the anode circuit the current is 18 mA, and we wish to drop 12 volts to obtain 250 volts on the anode. The total resistance should, therefore, be 666 ohms in the anode circuit. This is made up, in part, by R2 and, in part, by the resistance of the RF choke. R2 also provides decoupling for RF currents and should not be less than some 500 ohms. Actually, the resistance of the RF choke will be of the order of 200-240 ohms with most current types, so that the anode voltage of this valve will actually be slightly less than 250. This is, however, unimportant.

In the screen circuit we have, also, to drop 12 volts and we have to make provision for volume control. This is best done with the network shown, for by moving the slider of R4 up this resistance the positive bias on the cathode can be increased, and hence the grid potential made more negative relative to the cathode. The values selected here are purely arbitrary, and there are many combinations of resistances which can be used with satisfactory results. The simplest course is to assume a definite figure for the potentiometer current, say, 10 mA. The screen potential must be about 250 volts with respect to earth, so that the total resistance of R3 and R4 must then be 25,000 ohms.

We should be able to apply some 35 to 40 volts bias to the RF valve to take care of a strong local signal, so that R4 should be 3,500 to 4,000 ohms. This, however,



An underview of part of the receiver showing the detector and AF equipment.

Three-Valve Straight Set—

will lead to non-standard values, and it is consequently more convenient to make R4 5,000 ohms and R3 20,000 ohms. Up to 50 volts bias will then be obtainable, but although this is more than is necessary there is no real disadvantage in it. The resistance R1 must drop some 12 volts with a current of 10 mA, plus the screened coil. This is about 2 to 3 mA, so that a resistance of 1,000 ohms will do nicely.

The total current of the equipment is about 115 mA, and it is consequently safe to design the mains equipment for the standard rating of 120 mA. There are many possible combinations which might be used, but there is one point which must be considered, and this is that if the mains transformer winding is more than 350 volts RMS we shall not be able to use an electrolytic condenser of ordinary type for the reservoir condenser because the peak voltage will exceed its rating. Instead of choosing a smoothing choke and working out the DC voltage required across the reservoir condenser, let us therefore adopt a 350-volt winding for the transformer and try to fit a smoothing choke to give us the required output, for this will enable us to use electrolytic condensers. With a full-wave rectifier, such as the Tungsram PV4 and the transformer rated 350-0-350 volts 120 mA, an unsmoothed output of some 300 volts is to be expected. We require 264 volts, so that 36 volts at 120 mA should be dropped in the smoothing choke. This means a resistance of 300 ohms.

This is a value which is easily obtainable, and we can consequently find a standard component with characteristics sufficiently near. In addition to the high voltage winding, the transformer must have a 4-volt 2 amp. secondary for the filament of the rectifier and also a 4-volt 4 amp. secondary for the heaters of the three valves in the receiver.

Full constructional details of the receiver being discussed will be included in the next instalment of this series.

LIST OF PARTS TO BE USED

1 Variable condenser, 3-gang **Polar "Bar"**
1 Dial **Polar VP horizontal drive**
1 Reaction condenser, differential, 0.0003 mfd. **Bulgin N24**
3 Coils **R.I. "Micrion" BY36**
1 Aerial coil **B.T.S. type ML/FTA**
1 RF choke **"Kinva" standard type**
1 Choke, 25H., 300 ohms, 120 m/A **Vortexion CH 300**
1 Mains transformer; Primary, 200-250 volts 50 c/s; Secondaries, 4 volts 2 amps., 4 volts 4 amps. CT; 350-0-350 volts, 120 m/A **Scientific Supply Stores**
1 LF transformer, ratio 4:1 **Varley "Nicore II" DP2**
1 Potentiometer, wire-wound, 5,000 ohms, tapered **Reliance SG**
1 Potentiometer, wire-wound, 10,000 ohms, non-tapered **Reliance SG**
3 Valve holders, 7-pin (without terminals) **Clix Chassis Mounting Standard Type V2**
1 Valve holder, 5-pin (without terminals) **Clix Chassis Mounting Standard Type V1**
1 Switch, SP, on-off **Bulgin S80T**
1 Fused mains input connector, with 1 amp fuses **Belling-Lee 1114**
1 Plug-top valve connector **Belling-Lee 1175**
1 Screened-top connector **Bulgin P64**
2 Lengths screened sleeving **Goltone**

Fixed condensers:
1 0.0003 mfd., tubular **Dubilier 4601/S**
1 0.0005 mfd., tubular **Dubilier 4601/S**
3 0.1 mfd., tubular **Dubilier 4603/S**
2 0.5 mfd., tubular **Dubilier 4608/S**
1 50 mfds., 50 volts, electrolytic **Dubilier 3004**
1 8-8-8 mfd., 500 volts, electrolytic **Dubilier 312**
1 1 mmfds., ceramic, ± 0.5 mmfd. **Dubilier CDE**
1 3 mmfds., ceramic, ± 0.5 mmfd. **Dubilier CDE**
2 10 mmfds., ceramic, ± 10 per cent. **Dubilier CDS3**
1 25 mmfds., ceramic, ± 5 per cent. **Dubilier CDS3**

Resistances:
1 50 ohms, ½ watt **Erie**
1 100 ohms, ½ watt **Erie**
1 500 ohms, ½ watt **Erie**
1 1,000 ohms, ½ watt **Erie**
1 5,000 ohms, ½ watt **Erie**
1 10,000 ohms, ½ watt **Erie**
1 20,000 ohms, ½ watt **Erie**
1 40,000 ohms, ½ watt **Erie**
2 50,000 ohms, ½ watt **Erie**
1 200,000 ohms, ½ watt **Erie**
1 1 megohm, ½ watt **Erie**
2 350 ohms, 1 watt **Erie**
1 20,000 ohms, 3 watts **Erie**

2 Skeleton captive screw strips, "Aerial-Earth" and "Speaker" **Bulgin T10**
1 Coupler, ¼in. bore **Bulgin**
1 2½in. length ¼in. rod **Bulgin 2005**
Chassis **B.T.S.**
Miscellaneous: **Peto-Scott**
8 lengths systoflex, 40z. No. 18 tinned copper wire, 3 aluminium clips for holding condensers, 1 angle bracket for holding dial, etc. **Screws:** 42 ¼in. 6BA R/hd., 12 ½in. 6BA R/hd., 8 ¾in. 6BA C/sk., all with nuts and washers; 4 1in. 6BA with three nuts to each, 5 ¾in. 4BA with two nuts to each.

Valves:
1 PV4, 1 APP4E, 1 HL4g, 1 VP4B **Tungsram**

The "Radio" Handbook. By Frank C. Jones. 1938 Edition. 503 pages, with numerous illustrations and drawings. Published by Radio, Ltd., 7460, Beverly Boulevard, Los Angeles, U.S.A. Price $1.50.

COMPILED especially for the amateur experimenter, this handbook deals with the design, construction and operation of short-wave apparatus.

The beginner is catered for as well as the experienced hand, as the first chapter is devoted to a brief description of the fundamental principles of electricity and wireless. The theory and operation of valves, an explanation of the use of logarithms and decibels, learning Morse and other matter of general interest to the radio experimenter are dealt with in subsequent chapters; the instructive portion, as this may well be described, covers about 62 pages of the book.

As in wireless transmission, the aerial is a very important part of the equipment; this subject has devoted to it more space than is usually found in a comprehensive book of this kind. Every type of aerial, including directional arrays for short- as well as for the ultra-short waves is described very fully and constructional data is given.

The remainder of the book is well proportioned between receiving and transmitting equipment. Considerable space is devoted to the ultra-short waves, and various receivers and transmitters are illustrated and described for use on wavelengths down to as short as ¾ metre.

Its scope is particularly broad, for it includes Radio Therapy, a description being given of a variable high-frequency Diathermy machine.

Constructional matter is not devoted exclusively to receivers and transmitters, but to all kinds of test equipment as well. Modulated oscillators, valve volt-meters, frequency meters and CR tube oscilloscopes are described.

There is a very comprehensive appendix of 34 pages containing a wealth of valuable data and even a circuit for an inter-communication audio system. In fact, everything the amateur requires in radio experimental work is given in the fourth edition of The "Radio" Handbook.

Copies can be obtained from F. L. Postlethwaite, 41, Kinfans Road, Goodmayes, Ilford, Essex, at the price of 7s.

H. B. D.

Notation for Piezo-Electric Quartz. Issued by the National Physical Laboratory.—According to the introductory statement, it was recently considered necessary to avoid confusion of nomenclature by standardising a method of defining the orientation, shape and size of discs and rectangular plates cut from quartz crystal. A report on the subject was therefore drawn up by the N.P.L. and other interested bodies, and then submitted for criticism to various scientists and organisations throughout the world. The present pamphlet, based on the report, was prepared after careful consideration of the comments received. Pp. 10, with 4 figures. Published by H.M. Stationery Office, Adastral House, London, W.C.2. Price 3d., postage extra.

Wireless Schools in Scotland

WE have received from the Principal of the Dundee Wireless College booklets dealing with the activities of that school and of its associated institution at Aberdeen. Both schools are equipped with Marconi CW, ICW and quenched gap transmitters and other apparatus for the training of students who wish to take the Postmaster-General's Examination for Wireless Operators. Copies of the prospectus may be obtained from either 41, Reform Street, Dundee, or 108, Crown Street, Aberdeen.

The Wireless Industry

TWO new amplifiers for A.C. mains operation, rated at 30 and 60 watts respectively, have been added to the G.E.C. range of sound equipment. A unit system is employed; e.g., the 30-watt unit can be converted into a 60-watt amplifier in a very simple manner. Detailed particulars are obtainable from the General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2.

Marconiphone has secured the contract for installing P.A. equipment at Plymouth for the display to be held in connection with this year's Navy Week.

Dr. L. F. E. Johnson, who has for some time specialised on hot-cathode rectifier equipment, has joined the technical staff of London Transformer Products, Ltd.

A "Spring Bargain List" has just been issued by Galpin's Electrical Stores, 75, Lee High Road, Lewisham, London, S.E.13. Although much space is devoted to measuring instruments, the list covers apparatus and components of all kinds.

Amplivox, Ltd., manufacturers of hearing aids and other devices for the deaf, are moving to more convenient premises at 2, Bentinck Street, London, W.1.

R.G.D. MODEL 623

A HIGH-GRADE TABLE MODEL RECEIVER FOR AC MAINS

THE practice which this firm has now adopted of making available as table models the radio chassis of some of their less expensive radio-gramophones will be welcomed by those who have appreciated the technical merits of R.G.D. design but have not wished to indulge in the more costly features usually associated with the larger radio-gramophones made by this firm.

Although the Model 623 is not technically the most advanced set in this year's R.G.D. range (the Model 1221 with automatic tuning, contrast expansion, etc., holds the palm in this respect), materials and workmanship are of the best, and the specification has not been skimped in any direction affecting the primary requisites of good performance. There is a signal-frequency RF stage which functions on all four wavebands, variable selectivity in the IF stage which is combined with a treble tone control and a separate bass tone control, so that the best possible quality of reproduction can be obtained from the $3\frac{1}{2}$-watt triode output stage under all conditions of reception.

Two degrees of selectivity are provided by switching in an additional coupling coil to increase the band-width of the first IF transformer. The third position of the selectivity switch does not increase selectivity, but brings about a further reduction of high-note response in the AF stages. Bass response is controlled in three steps by altering the coupling capacity between the triode portion of the second detector and the output valve. AVC, which is delayed, is derived from the primary of the second IF transformer.

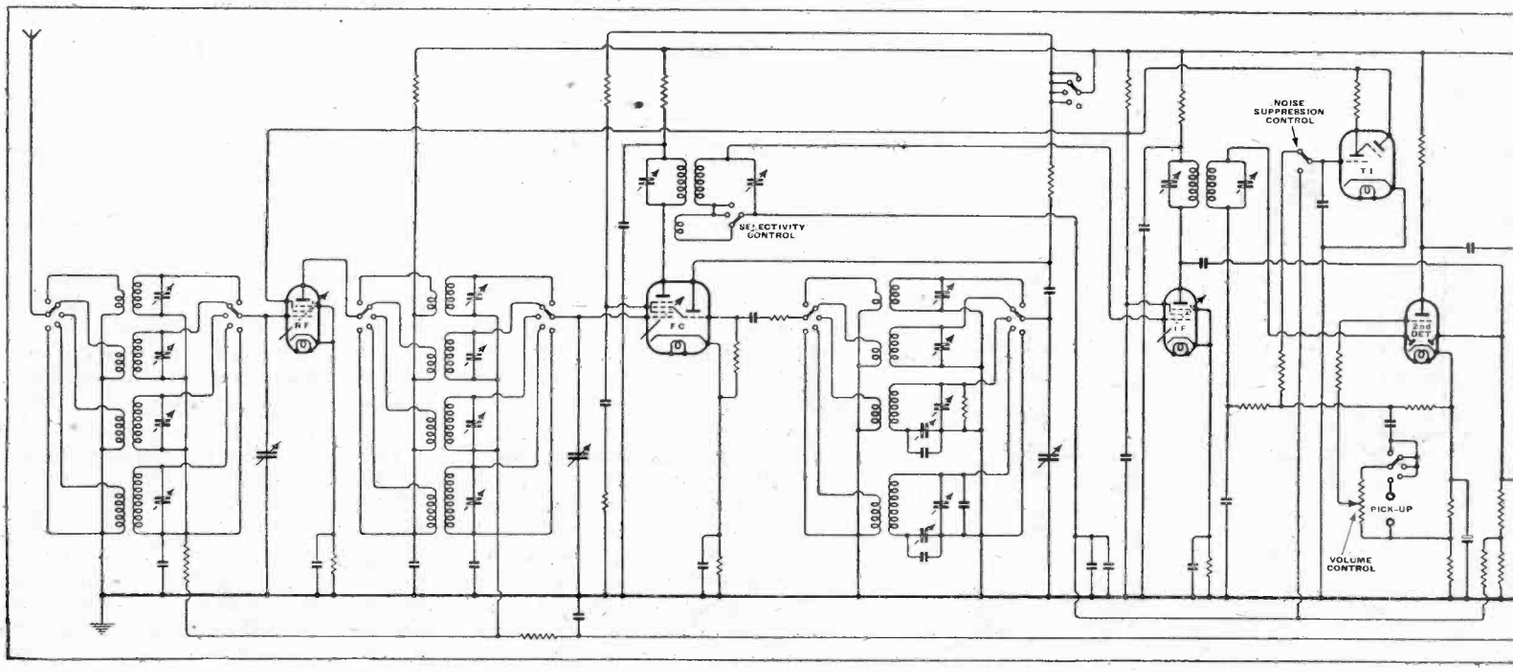
FEATURES. ***Waveranges.***—*(1) 16.5-50 metres. (2) 48.5-150 metres. (3) 195-550 metres. (4) 800-2,000 metres.* ***Circuit.***—*Var. mu pentode RF amplifier—triode hexode frequency-changer—var. mu pentode IF amplifier—double-diode-triode sound detector—cathode ray tuning indicator and noise suppression valve—triode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Volume and noise suppression switch. (3) Waverange. (4) Selectivity and treble tone control. (5) Bass tone control. (6) Internal loud speaker switch.* ***Price.***—*25 guineas.* ***Makers.***—*Radio Gramophone Development Co., Ltd., Globe Works, Newtown Row, Birmingham, 6*

Noise Suppression Circuit

The cathode-ray tuning indicator is used to obtain a degree of noise suppression between stations, and the function of the circuit is briefly as follows: With the grid of the TI valve connected to the signal diode load and in the absence of a carrier, it will pass current, since the TI cathode is at chassis potential, and the second detector cathode, due to the triode anode current, is positive with respect to the chassis. A voltage is thus developed in the signal diode load resistance which makes the diode negative with respect to its cathode, and so prevents it from functioning for small inputs. When a strong signal is tuned in, the voltage produced by the signal diode overcomes the delay voltage, the TI grid cathode circuit ceases to conduct, and the circuit functions normally. To cut out the noise suppression circuit the TI grid is transferred to a tapping on the AVC diode load.

The switch controlling this change in the circuit is combined with the volume

Complete circuit diagram. Separate bass and treble tone controls are provided and the tuning indicator is also used as part of the noise suppression circuit.



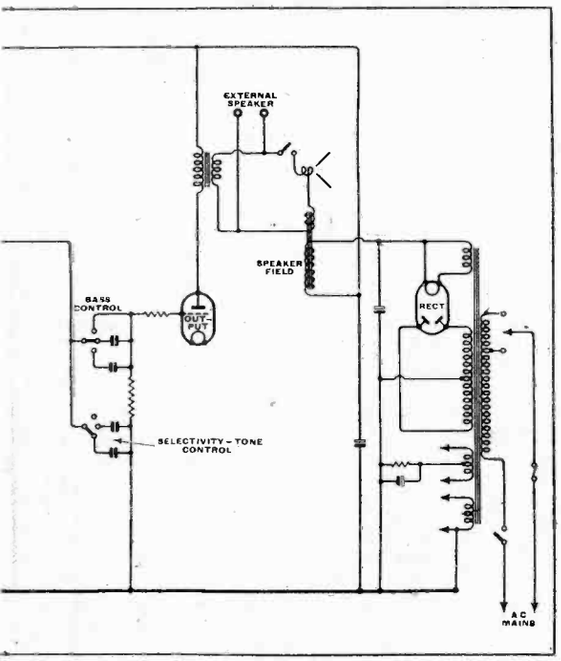
control, and noise suppression is brought into operation by pulling out the volume-control knob. This knob and the one operating the wave range switch are of a convenient key type, while the remaining auxiliary controls for selectivity and bass response and the switch at the back of the cabinet for cutting out the internal speaker are of a more conventional design.

Tuning is through the medium of a slow-motion drive in which reversal of the direction of rotation gives fine adjustment over a limited range of movement. The tuning scale is printed in colour on glass, and is indirectly illuminated against a black background. Indicating pointers are provided to show the setting of the selectivity and tone controls, and the waverange switch position is shown by lettering which appears in an aperture just above the main tuning pointer. An auxiliary "high-speed" pointer working over an arbitrary scale is provided for station logging on short waves.

Long-wave Performance

Nowadays, short waves and everything that pertains to them are apt to monopolise the attention, but for many people the long-wave range comes first in importance. To them we would specially commend this receiver, for the long-wave sensitivity is much above the average, yet it is not accompanied by any relative increase of background noise. Every station stands out quite clearly, and sufficient selectivity is provided to reduce side-band interference on the Deutschlandsender to a negligible level compared with the unusually high volume available from this and other distant transmissions.

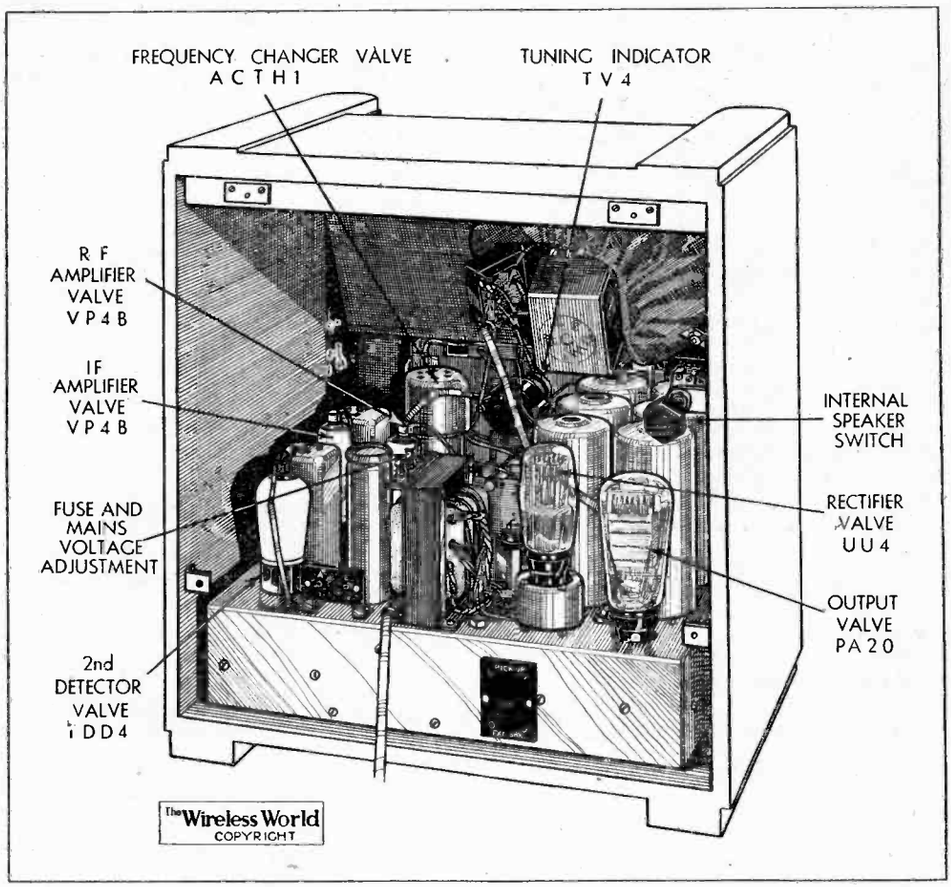
On the medium-wave range more than enough magnification and selectivity are provided to give the performance expected of this band. We were particularly impressed with the freedom from self-generated interference, and a careful search failed to reveal a single whistle.



Working with the selectivity at minimum only one channel was lost on either side of the London Regional station when using the set in Central London, and with maximum selectivity a further reduction of about 5 kc/s was obtained in the band width occupied by the modulation from this station.

There are two short-wave ranges which cover wavelengths from 16.5 to 150 metres, and include the trawler and ship-to-shore communication channels. Background noise at first seemed rather prominent, but was quickly suppressed by AVC when a signal was tuned-in. There can be no doubt that the RF stage in this receiver pulls its weight, and it was soon apparent that the background noise on short waves is not excessive when the high sensitivity is taken into account. Now that the 19-metre and other short-wave broadcast bands are becoming overcrowded, selectivity on short waves is as important as it is on medium and long waves. In this receiver it is well above the average, and repeat tuning points are also absent. The only criticism we have to offer is that the tuning indicator might have been given a little more sensitivity on short waves.

A small loud speaker is off-set towards the left-hand side of the curved metal grille. It seems well able to handle the full output from the last stage, and gives an open distribution of sound with none of the coloration often associated with units of less than 7in. diameter. With the bass tone control at maximum the low-frequency response is remarkably full, but we preferred the quality in the intermediate position of the switch. In most cases the middle position of the selectivity switch proved the best, and the slightly over-accentuated upper middle register associated with the first position of the switch was reserved for transmissions deficient in high-note response. The most striking quality of the reproduction is its clear forward quality and the absence of blurring in heavy orchestral passages. The minimum bass and treble tone control positions are useful when interference is bad, and the degree of reduction in both cases is a happy compromise, for it leaves the quality of reproduction still comparable with the average table model on both speech and music.



Mains voltage adjustment is effected by moving the fuse cartridge. Note the raised mounting for the power rectifier valve holder.

Provision is made for the use of the AF portion of the circuit for gramophone reproduction. The pick-up should be of the magnetic type and a screened cable is advised if the turntable is to be used at an abnormal distance from the set. Below the pick-up terminals are sockets for an external loud speaker which should have an impedance of 2 to 4 ohms.

The dimensions of the cabinet are 17½in. × 19in. × 13in., and the workmanship and finish are of the standard which one expects as a matter of course from R.G.D. The standard veneer is walnut with macassar inlay, but oak or mahogany finishes are available at 1 guinea extra.

ICE-FLOE WIRELESS

A Twenty-watt Link with Civilisation

THE four North Pole scientists, who returned to Moscow last Thursday after their nine-months' existence on a drifting ice-floe in the Arctic, have now made known some of the particulars of the wireless activities which were the means of their ultimate rescue from the melting ice.

During the period of their investigations over 75,000 words were transmitted from the 20-watt wireless station which derived its power from a windmill generator. This machine would function only when the wind travelled at speeds between 4 and 14 metres per second, and occasionally a hand-driven generator had to be substituted.

Early communications were held with Rudolph Island on a wavelength of 56 metres, then from January 15th followed a long period of interruption, and contact with the Norwegian station at Jan Mayen Island was established on the long waves. The transmitting apparatus successfully withstood the seeping dampness of condensation in the tent, and was worked by Krenkel, the operator, under appalling conditions, frequently in complete darkness. Towards the end he said that so accustomed had he become to finding and tuning requisite knobs by sense of touch that light was practically unnecessary.

Distances of nearly 600 miles were covered by the transmitter, from which 1,555 radiograms, as well as many thousands of weather reports, were sent.

The scientists paid special tribute to the staff of the State wireless laboratory in Leningrad where their apparatus was made, and Krenkel stated that, during the nine months, he had never had occasion to open the apparatus to correct defects, because there were none.

SHIP'S WIRELESS INSTALLATION

The "Strathallan's" Equipment

LAST Friday the new P. & O. liner, *Strathallan*, started on her maiden voyage to Australia. She is equipped with complete wireless installations for long-, medium- and short-wave communication and direction-finding.

The main transmitter, which is for CW and ICW, has an aerial power of 750-1,000 watts and a wavelength coverage of 600-800 and 1,800-2,400 metres. The associated receiver covers the extremely wide band of wavelengths of 15-20,000 metres. An emergency spark transmitter is also included in the main installation.

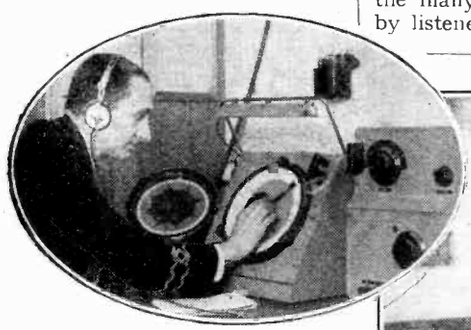
For long-distance short-wave work a Marconi 16-60-metre transmitter is fitted and also a short-wave receiver, which covers 14-80 metres in three ranges.

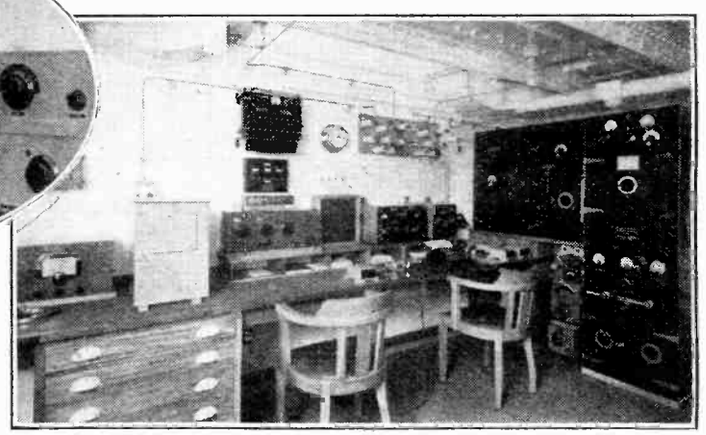
With this equipment, which has been installed by the Marconi International Marine Communication Company, the *Strathallan* will be able to carry on wireless telegraph communication with any part of the world or with any other ship.

The latest type of direction-finder and a Marconi echometer sounding device have been fitted. The latter is graduated to 160 fathoms and is fitted with a combined optical indicator and recorder which automatically provides the navigator with instantaneous and continuous information regarding the depth of water beneath the keel.

The liner is also fitted with Marconi sound-reproducing equipment with loud speakers in various parts of the ship. The equipment permits the reproduction of sound from microphone, radio and gramophone, either separately to all loud speakers or simultaneously to various groups of speakers. A broadcast receiver, covering 13-2,000 metres, is fitted in conjunction with the sound equipment to enable items from broadcasting stations to be received and relayed on board.

Two of the ship's lifeboats have also been fitted with transmitters and receivers.





THE WIRELESS OPERATOR'S CABIN on the new liner *Strathallan*. Inset, the operator is seen taking a bearing on the Marconi direction-finder.

NEWS ON U.S.W.

AS the result of an overwhelming vote in favour of a regular news bulletin on the television sound wavelength, this extra feature, which will be a tape recording of the Third News, is to be transmitted by line from Maida Vale to Alexandra Palace via Broadcasting House and broadcast at the end of the evening programmes. On Sundays the National news will be relayed direct, beginning at 8.50 p.m.

NEWS OF

THE STORY OF A LOAD METER

Solving Programme Builders' Problems

THE judging of programme interest has always been a problem for the programme builders, and it would probably pay the B.B.C. to keep in closer touch with some of the relay stations to ascertain which are most-favoured items. The load meter at the Northampton relay, with its 1,800 subscribers, registered recently at 7.30 p.m. the following:—

National: "Sweet and Lovely."
640 at the beginning.
620 at the end.
Regional: "The World Goes By."
770 at the beginning.
1,000 at the end.

At another hour the load meter registered 640 listeners to the Children's Hour against 890 listening to Mantovani on National. The co-operation of relay stations throughout the country would solve effectively the many problems engendered by listener research.

RADIO RELAYS

The System's Uncertain Future

AT the 74th Ordinary General Meeting of the Telegraph Construction and Maintenance Company, the Chairman deplored the uncertainty of the Government's attitude in regard to the future of the radio relay industry. He said that the new air-spaced cable capable of dealing with very high frequencies has already been used in several important connections, including television, and it has given great satisfaction. Such improvements as this, when embodied in radio relay, would help considerably to popularise the system, provided the attitude of the Government towards the issue of new relay station licences at the end of 1939 was satisfactory.

THE RUSTLE OF SPRING

DOGGED by unwanted decibels—the drone of aeroplanes, the screeching of cars and the general clatter of man-made noise—the B.B.C. Outside Broadcasts Department has at last found the ideal spot for transmitting that most elusive of all sounds, "the rustle of Spring."

At one time Surrey was a suitable venue for the broadcasting of the song of birds, but this is no longer so, the general noise level being too high. But up at Bury St. Edmunds, in Norfolk, there is a forestry commission plantation where nearly every kind of British bird builds a nest, and here the microphones will be installed. Regional listeners will be able to eavesdrop at 6 p.m. on April 24th.

POLYGLOTIC N.B.C.

American News for the World

COMPETITION in foreign news broadcasts increases. The National Broadcasting Company of America, already transmitting one bulletin in Portuguese daily over W3XAL'S directional beam to Brazil, has decided to give a second Portuguese bulletin daily from the same transmitter. Station W3XAL is now transmitting sixteen news bulletins daily from Monday to Friday; six are in English, three are in Spanish, two in French, two in Portuguese, two in German, and one in Italian.

THE WEEK

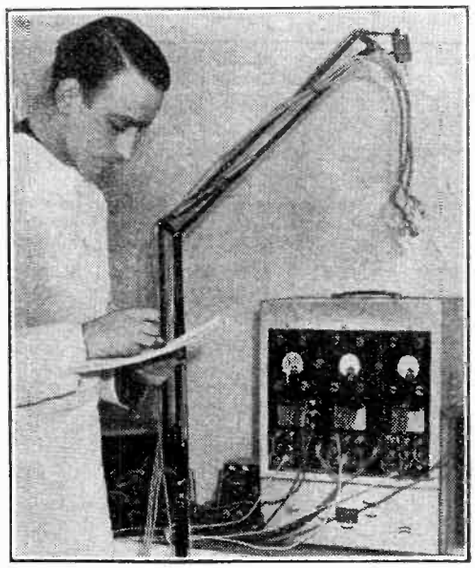
ELECTRO-ENCEPHALOGRAPHY

Apparatus for the Detection of Cerebral Abnormalities

EXPERIMENTAL apparatus designed by Mr. Grey Walter, M.A., a physiologist of Highgate, London, for the diagnosis of cerebral tumours and epilepsy, has been successfully used at the Hospital for Epilepsy and Paralysis, Maida Vale, London, and the Central Pathological Laboratory of the London County Mental Hospital.

The apparatus consists of three sub-audio-frequency amplifiers which, through separate channels, feed three cathode-ray tubes in a Standard Telephones line-tester. The three channels are necessary to secure a greater degree of accuracy in the location of tumours. The amplifiers are all resistance-capacity-coupled, since it is necessary for them to faithfully reproduce frequencies as low as 0.5 cycle per second. These amplifiers were designed and constructed by Mr. Walter himself, who is the only person in England to have designed and used such equipment.

Silver electrodes, dampened with saline solution, are strapped to the patient's head, and pick up the 10-microvolt impulses generated in the brain. Superimposed oscillations due to tumours on the brain are as low as 0.5 cycle per second, but average 3 c/s. These oscillations, amplified by the LF amplifiers, are seen on the cathode-ray tubes, which are of the long afterglow type, enabling the whole of the curve to be seen at once, although the traversing time is about 4 seconds.



When a daily newspaper recently published a note stating that a doctor was now able to listen-in to the brain, a member of the staff of the B.B.C. 'phoned Mr. Grey Walter to ask if it might be broadcast. The designer replied that the frequency used was a *little* below audibility.

The Edison Swan Electric Co. is soon to market apparatus, designed to Mr. Grey Walter's specification, which will be known as the Ediswan-Walter Electro-Encephalograph.

TALKS

Some Technical Aspects

WHENEVER possible the B.B.C. makes special arrangements to accommodate speakers who, because of standing agreements, have to address meetings at a time immediately preceding or following the time scheduled for a broadcast. Mr. Ernest Brown, Minister of Labour, had an engagement to address a Sunderland meeting last week before his talk in "The Splendour of the Bible" series, so the B.B.C. specially provided a line and microphone which enabled him to speak from Sunderland shortly after his meeting.

Another technical aspect of the talks organisation involves the control room. Before a speaker begins his talk he gives the engineers a "cue" sentence to prepare them for the conclusion. This arrangement caused a speaker in an evening sports bulletin to be faded out in the middle of his talk when he reached a passage similar to the words of his "cue." The B.B.C. duly apologised to the speaker, but declined to broadcast any explanation of the mishap.

ZEEBRUGGE AS A SOUND BROADCAST

SOUND broadcasting is to give B.B.C. listeners a description of how a television programme is carried out, the choice being the Zeebrugge feature which is being enacted with models on the Alexandra Park lake on St. George's Day, April 23rd.

For this special television broadcast, Michael Ellison, designer of the models, is setting up a scenic panorama of Zeebrugge and the famous Mole, which was stormed by the Channel Patrol in 1918 to enable block ships to be sunk at the entrance to the canal used by German submarines.

The Outside Broadcast Director is sending a commentator to describe for sound listeners some of the technical aspects of the broadcast from a television point of view.

The ship models will be actuated by under-water wires. The broadcast will be repeated in the Sunday evening television programme on April 24th.

DID MR. GLADSTONE SAY IT?

WHAT did Mr. Gladstone say in 1889? Mr. H. L. Fletcher, of the B.B.C. Recorded Programmes Department, is still uncertain, despite the interesting experiment at Broadcasting House last week, when several friends of the Gladstone family congregated to hear four phonograph records purporting to have been made by the great statesman in 1889, when he spoke words of congratulation to Mr. Edison on the invention of the phonograph. The "jury" consisted of Lady Gladstone of Hawarden (Mr. Gladstone's daughter-in-law); Sir George Leveson-Gower, his secretary; Mr. William Wickham, his eldest grandson; and Canon Edward Lyttelton. No one was able to say positively that the voice was Mr. Gladstone's.

This is not surprising. It is believed that some bogus records were made, as it seems unlikely that Mr. Gladstone made four recordings at the same time, and fifty years ago there were no means of taking fresh records except by re-recording. Moreover, the records were worn, and owing to their fragility it was not deemed advisable to use an electric pick-up for reproduction.

The mystery might have been solved if the B.B.C. had included on the jury some of the veteran members of the House of Commons Press Gallery, who still remember the "G.O.M." in his prime.

AMERICA DIRECTIONAL TO EGYPT

A SERIES of directional transmissions to Egypt has been undertaken by the C.B.S. International short-wave station, W2XE, New York.

The signal strength of W2XE in Egypt is better than that of any other American station, according to cabled reports from Columbia's engineering director, who is attending the World Telecommunications Conference in Cairo.

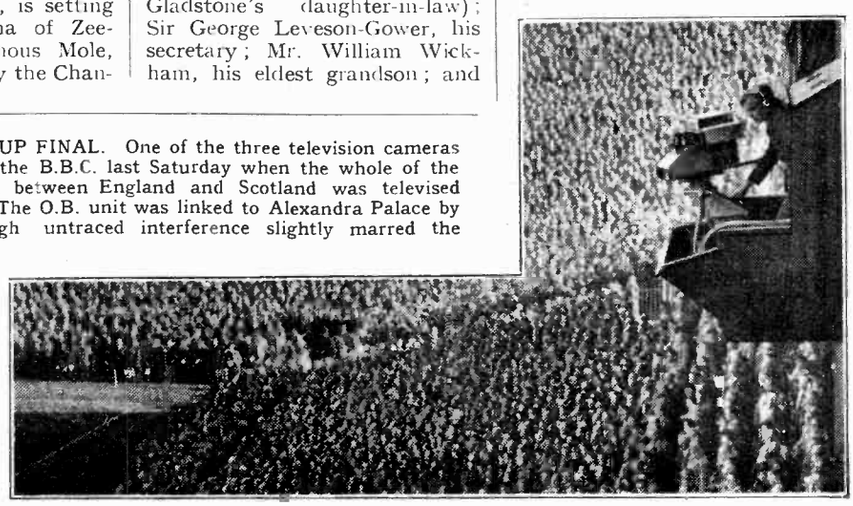
FROM ALL QUARTERS

Death of Fultograph Inventor

DR. OTTO FULTON, the experimenter and inventor of the facsimile radio receiver, the Fultograph, died a few days ago in New York at the age of 70. For some time in 1928 the B.B.C., during the afternoon programmes, transmitted pictures which many readers received on *The Wireless World* model of the Fultograph.

Why Not British Sets for Malta?

LISTENERS in Malta are bemoaning the fact that the local radio



TELEVISING THE CUP FINAL. One of the three television cameras which were used by the B.B.C. last Saturday when the whole of the Calcutta Cup Match between England and Scotland was televised from Twickenham. The O.B. unit was linked to Alexandra Palace by wireless and although untraced interference slightly marred the picture, this was not so when the King was seen in close-up. Permission has been granted for the televising of the F.A. Cup Final on April 30th and for the International Soccer Match on April 9th.

News of the Week—

market is flooded with Japanese sets which sell for less than £2. Most of them, it appears, can only pick up the Italian stations.

"The majority of Japanese sets in the hands of Maltese listeners," says the *Malta Chronicle*, "are not selective or sensitive enough to listen to England."

More Records

NEW ZEALAND listeners are enjoying "potted" programmes from Daventry. Transmissions picked up from the English station are recorded in Auckland and relayed later in the evening. As the B.B.C. programmes are often themselves recorded, Auckland listeners are being entertained by recordings of recordings—a real tribute to the quality of the original material.

Indian Listeners

FIGURES published in a recent issue of *The Indian Listener* show that the number of wireless licences issued in India at the end of 1937 was 50,680, an increase of nearly 13,000 over the previous year. This number is, of course, very small considering India's vast population, and shows that only one person in 10,000 has a receiver.

One Thousand Kilowatts

ACCORDING to American press reports, President Roosevelt has proposed the building of a number of Government stations, which will be used as the voice of the Government, and a big voice it will be, if the proposed power of 500-1,000 kW is adopted.

Naval Communications

A SHORTAGE of wireless operators and signallers in the Royal Navy has necessitated the drafting to shore stations abroad ratings who have not yet obtained the sea-going qualifications necessary for advancement in rank. Such service abroad will be counted as equivalent to sea service for purposes of promotion.

PRINCE BERNHARD opened the Utrecht Fair last week and showed great interest in the first television demonstration in the Netherlands which was staged by Philips. This photo was taken during the first broadcast. The Fair had a record number of 2,005 exhibitors, of which 52 were British, 60 French and 223 German and Austrian.

In the Cause of Peace

AN International Convention for the use of broadcasting in the cause of peace, which was signed in Geneva on September 23rd, 1936, will come into force on April 2nd, 1938.

The convention, which is only binding on those who have ratified it, will apply in South Africa, Australia, Brazil, Denmark, Great Britain, British India, and New Zealand.

Apply by Wireless !

THE following procedure is believed to be the first achievement of its kind in the history of the academic world: An applicant for a position on the staff of the Stockholm University, Sweden, was in Siam at the time of the academic competition for the post. Special arrangements provided by the broadcasting authorities enabled him to read his paper at Bangkok, whence it was relayed on short waves to Stockholm and recorded.

Legal but Unlicensed

THE German Embassy is in direct communication with Berlin through the medium of a private wireless station which has been installed there. Transmitting in code on an unknown wavelength, the station is protected from British supervision by international courtesy.

Austrian Broadcasting

RADIO VIENNA has become a German Regional station, and it will now be a branch of the Reichs - Rundfunk - Gesellschaft. The Director-General, Czeija, founder of Austrian broadcasting and RAVAG, Vienna, has been relieved of his post, and the RAVAG Executive Committee has been dissolved. The organisation is now under the supreme control of the National Socialist Party.

Parliamentary PA

IN a valiant attempt to improve the general audibility of members' addresses in the Danish Parliament, Rigsdagen, an experimental PA system has been installed. When the system is made permanent the House will, at the same time, be wired for future broadcasts of important matters.

Licensed Dealers

A LICENCE is now necessary for Swiss retailers to sell wireless receivers, and it is estimated that the number of radio dealers has thereby been reduced to less than a third.

Radio Library

MICHIGAN UNIVERSITY has now included wireless in its curriculum and has founded a radio library to which William S. Paley, President of the Columbia Broadcasting System, made the first gift of 135 books.

I.E.E.

THE next Wireless Section meeting of the I.E.E. will be held on Wednesday, March 30th, at 6 p.m., at Savoy Place, London, W.C.2, when a paper on "High-power Valves: Construction, Testing and Operation" will be read.

Can Mike Voices be Insured?

FRENCH insurance companies are refusing to negotiate with the recently formed Mutual Association of Broadcasting Announcers, members of which wish to insure their voices.

Dutch Export Figures

THE Dutch wireless industry during 1937 exported apparatus to the value of 52,640,000 florins, this was an increase of 18,203,000 florins over 1936.

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, MARCH 24th.

Nat., 7.30, The Fol-de-Rols. 8.30, Talk on the Way of Peace. 9.20, Weather Outlook—the first of a series of weather predictions, by Lord Dunboyne. 9.25, "Hickory House"—a recording of the broadcast from New York last January.

Reg. 6, The Showmen of England, No. 1—Bertram Mills. 8.15, The Royal Philharmonic Society's Concert, conducted by Sir Thomas Beecham.

Abroad.

Prague, 7.25, "Turandot," opera (Weber).

Milan Group, Berlin, 8, "The Barber of Seville," opera (Rossini).

FRIDAY, MARCH 25th.

Nat., 3, Commentary on the Grand National—and at 6.25, recorded extracts from the broadcast. 7.30, Lines on the Map—The first Atlantic Cable. 9.20, Talks on Spain—Both Sides of the Line.

Reg., 8, The Farm Worker and the Future. 9.30, Billy Ternent and his Orchestra.

Abroad.

Oslo, 6.30, "Carmen," opera (Bizet).

Kalundborg, 7.10, Concert of Mozart's Music.

SATURDAY, MARCH 26th.

Nat., 6.45, Recorded extracts from a commentary on a F.A. Cup Tie semi-final. 8, Music Hall, including Albert Whelan and Marie Burke. 9.20, American Commentary.

Reg., 6.40, The London Film Symphony Orchestra. 8.25, "Piers Plowman"—England in the Middle Ages. 9.20, Oscar Rabin and his Band.

Abroad.

Radio Eireann, Selections from "Our Miss Gibbs," "The Country Girl," "The Quaker Girl," and "The Arcadians."

SUNDAY, MARCH 27th.

Nat., 6.30, The Walford Hyden Magyar Orchestra. 7.10, Round the Horn in the 'Eighties. 7.30, B.B.C. Theatre Organ.

Reg., 6, The History of the Khyber Pass and its Inhabitants. 6.30, Sunday Orchestral Concert, conducted by Sir Adrian Boult. 9.5, The Story of the Waltz.

Abroad.

Hamburg, 7, People's Concert—XII, with Walter Gieseking, pianoforte.

Lille, Toulouse, etc., 7.30, From the Opera-Comique.

MONDAY, MARCH 28th.

Nat., 7, Monday at Seven. 8, The Cinema—Summing-Up Talk. 8.30, C. Ray Ventura and his Band from France, make their English début. 9.20, World Affairs.

Reg., 6.20, Troise and his Mandoliers. 8.30, Kamera ! an absurd film farce. 9.15, Roosters and ex-Roosters in "Roosters Cavalcade."

Abroad.

Radio-Paris, 7.30, 1914-18 Authors' and Composers' Concert.

Cologne, 8, Favourite Overtures.

TUESDAY, MARCH 29th.

Nat., 7, Reginald Foort and Alfredo Campoli. 7.30, Talk by a Harley Street Physician—Diet and Digestion. 9.20, America Speaks. 9.40, History of the Comic Song.

Reg., 8.15. Consider Your Verdict—The Scene in a Law Court at the Time of a Murder Trial. 9, Folies de Can-Can—cast includes Ronald Frankau and Mabel Scott.

Abroad.

Warsaw, 8, "Rhinegold," opera (Wagner).

Stuttgart, 8, Music by Handel.

WEDNESDAY, MARCH 30th.

Nat., 7.40, Congress Dances. 8.40, Character Sketches. 9.20, Thalben Ball at the B.B.C. Organ.

Reg., 7.30, "The World Goes By." 8, "Lillibulero"—a diorama of the great siege of Londonderry. 9, Band Waggon.

Abroad.

Warsaw, 8, Chopin Recital by Colette Gaveau, pianoforte.

Radio Lyons, 9.15, English and American music by the Indig Quartet.

Television Topics

ONE of the commonest defects in television reception is a failure to obtain proper interlacing of the successive frames. With the present transmissions there are 202.5 lines to each frame and the lines traced out in the first, third, fifth, etc., frames should fall precisely on top of one another. The lines of the second, fourth, sixth, etc., frames, however, should not fall on the lines of odd order, but in the gaps between them.

Thus the lines of the odd frames build up a course raster as shown in Fig. 1 (a), while the lines of the even frames build up a similar course raster (b), but displaced vertically by one-half the line spacing. When interlaced the two sets of lines mesh (c) and give the complete raster.

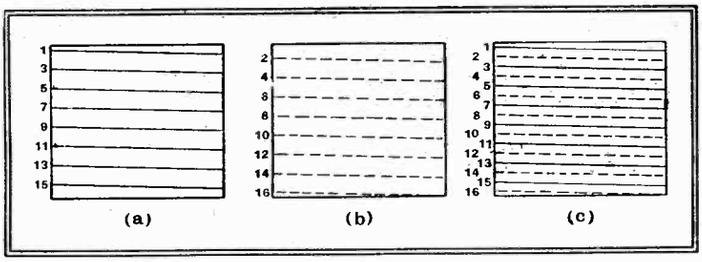


Fig. 1.—The way in which interlacing is carried out can be seen in this diagram. At (a) is shown one of the odd frames and at (b) one of the even; these mesh in the manner depicted at (c).

On examining a picture which is properly interlaced a slight interline flicker may be noticeable, but is not prominent at normal brilliance. If the eyes are kept quite steady it is usually difficult to detect how the raster is built up and the lines appear equally spaced and of equal brilliance. If the eyes are moved vertically, however, one set of lines momentarily disappears and the raster seems quite coarse.

This effect appears only on close inspection of the screen and cannot be observed at a normal viewing distance. This regular spacing of the lines with the apparent disappearance of one set on moving the eyes, however, shows that good interlacing is being secured.

There are many cases, however, in which imperfect interlacing is obtained. Sometimes the lines appear in pairs instead of being evenly spaced, at others the two sets of lines may lock in on top of one another giving no interlacing at all. The usual defect is for the successive frames to be very nearly superimposed. This gives a raster in which no signs of interlacing can be observed and in which the lines are very broad.

Interlacing is secured by providing in the transmission frame-synchronising pulses which start half a line earlier for the even frames than for the odd frames. If proper interlacing is to be secured it is necessary that the frame time-base be tripped only by the frame sync pulses and at the precise moment of their occurrence, or a time later than this by the same amount for both even and odd frames.

The two commonest causes of trouble are mains hum and interaction between the line and frame time-bases. The frame time-base is easily locked by mains hum, for it is operating at the same or one-half the frequency of the hum, depending on whether half-wave or full-wave rectification is used in the time-base HT supply. The hum is perfectly regular and will consequently trip the time-base regularly and prevent interlacing. In practice, there will be a mixture of hum and sync pulses, and it is consequently possible to get any stage between no interlace and perfect interlace, depending on their relative magnitudes. Too strong a sync pulse is undesirable, however, and it is consequently necessary to take great care to smooth the time-base HT supply adequately. In this connection the HT supply of the receiver and sync separator should not be overlooked, for hum here will find its way with the sync pulse to the time-bases.

Time-Base Interaction

The second common cause of trouble is interaction between the line and frame time-bases. The saw-tooth wave form generated is rich in harmonics, and if there is coupling between the two it is easy to lock the frame time-base to a harmonic of the line time-base. Normally, the frame frequency is not an exact sub-multiple of the line frequency. A large amount of interaction will consequently lock the time-base at the nearest sub-multiple to 50 c/s and the picture will not be steady, but will fly vertically across the screen.

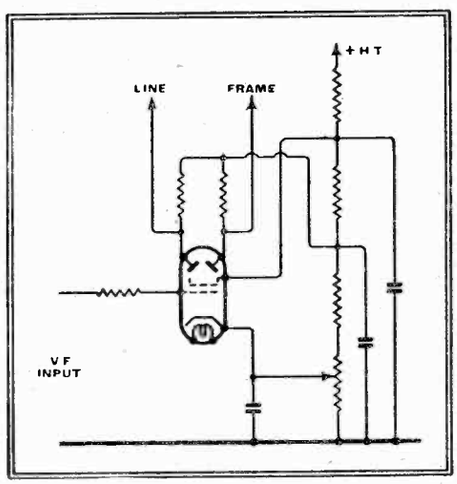


Fig. 2.—One sync separation circuit in which isolation of the line and frame time-bases is obtained.

If the interaction is small, the sync pulses will lock the frame at the right frequency, but the presence of small amounts of harmonics of the line scanning voltages may upset the interlacing. One effect which may occur is a continual shifting of the odd and even frames so that the lines appear on close inspection to be weaving in and out.

Care in the layout of components and wiring in the time-bases is necessary to avoid interaction, but quite a large amount can occur in the grid circuits of the gas-triode saw-tooth generators. These pass grid current on each sync pulse and interaction may consequently occur in the grid circuits if these are common.

Cossor makes a special valve for sync separation which enables complete separation of the grid circuits to be obtained. This valve is the 41MTS and is a tetrode with a split anode; when used with the circuit of Fig. 2, little interaction can occur between the grid circuits of the time-bases. It is, however, still necessary to insert the usual resistance-capacity filter in the feed to the frame time-base in order to prevent its being tripped by the line sync pulses.

INTERLACING

RANDOM RADIATIONS

By "DIALLIST"

Band-Spreading

LATELY I have been using with real joy a set whose short-wave tuning arrangements include wide band-spreading. The scale is semicircular and a full 6 inches in diameter. To cover the short waves between 13 and 50 metres the pointer has to traverse it no fewer than six times. Allowing for overlaps, this means that the pointer travels about 45 inches between one end and the other of the short-wave range of the set. Tuning naturally becomes a delightfully simple business, and you are relieved of all those fiddling hairbreadth adjustments that are so trying to your patience when you use the set which has only one short-wave range and a small cramped dial. But even with the amount of band-spreading indicated it must not be imagined that there are big gaps between the stations. Until you come to work it out you might fancy that with a total pointer travel of 45 inches you would have to turn some little way to pass from, say, W2XAD on 15.33 megacycles to W2XE on 15.27. Actually the angular movement is only 2½ degrees, whilst a further 2½ degrees takes you from W2XE to W8XK on 15.21 megacycles. The whole 19-metre band from 15.37 to 15.04 megacycles occupies 16 degrees, which means approximately thirteen-sixteenths of an inch of pointer travel.

What Cramping Means

Now within that space of thirteen-sixteenths inch there are no fewer than 21 channels in regular use by broadcasting stations—nearly all of them stations well heard in this country when conditions are at all favourable. There's no great separation between them on the dial, as you will see, even when the degree of band-spreading mentioned is present. It is pretty clear, then, that tuning must be terribly difficult when one small scale has to suffice for the whole band of short wavelengths covered by the receiver. It is true that many of the sets with only one short-wave range don't take in the 13-metre and the 16-metre bands. Nevertheless, on a scale of 6 inches in length which takes in the 19-metre, 25-metre, 31-metre and 49-metre bands a pointer movement of the order of one-hundredth of an inch may take you from DJQ to W2XE, or from W8XK to DJB. On a 9-inch scale the pointer movement between one station and the next is only 50 per cent. greater. It seems pretty clear that, if short-wave listening is to achieve the popularity that it deserves, band-spreading will have to become much more widely used in "all-wave" receivers. In too many of them, as matters now are, tuning is at least ten times as difficult as it is on the medium waves.

Towards Valve Standardisation?

THOUGH valves of a diversity of types and with a diversity of bases still continue to appear, one goes on hoping that eventually wiser counsels will prevail, bringing us the benefits of standardisation and of a much shortened list of British valves. There are, I think, signs, though small ones as yet, that the general feeling amongst those who make valves and sets is gradually veering round towards standardisation. I see, for instance, two announcements that may be the straws which show how the wind is blowing. First of all, the Pye people are using octal-base valves in two out of three of their newest receiving sets. Secondly, the firm of Mullard, which has hitherto pinned its faith to the Continental technique of valve manufacture, is shortly to give us a full range of octal-base valves with numbers and characteristics exactly similar to the American equivalents. It may be that my wishes are fathering my thoughts and that I am rather jumping to conclusions when I regard these things as propitious signs. Still, I shall go on hoping.

The Medium Waves . . .

IT is rather interesting to think out how completely contrasting is the behaviour of wireless waves of widely different frequencies. If you take the medium-wave band, for example, ranging roughly from 500 to 1,500 kilocycles, the ground wave is of the greatest value since it provides a reliable service over an area depending upon the output power of the transmitter both by day and by night, and at all seasons of the year. The reflected wave, however, is of comparatively little value. Just outside the service area there is a fairly wide belt in which the reflected wave plays a bigger part than the ground wave. After dark or under specially favourable conditions in daylight good reception may be obtained here. But the sky wave cannot be depended upon for all-round service, even though at times it may enable some low-powered medium-wave station to be heard at ranges of thousands of miles.

. . . And the Short

When you come to frequencies measured in megacycles the waves behave in exactly the opposite way. The ground wave is virtually worthless owing to the extremely rapid attenuation that it suffers. But if the frequency is carefully chosen to suit the time and the season long-distance communication can be maintained by means of the sky wave with something like certainty, except during periods of widespread magnetic disturbances. On the short waves, then, it's a case of the reflected wave first, the ground wave nowhere. Going still further up the scale of frequencies into the ultra-short waves, we find another complete reversal of behaviour. When we come to frequencies of the order of 30 megacycles and above, the distance at which reliable reception can be guaranteed is quasi-visual. Only quite recently it was believed that the sky wave of ultra-high frequency transmitters was not reflected at all by any layer of the earth's atmosphere; but now we know that this is not so, for "below ten" transmissions from all parts of the world are received in this country.

A Query

One great difference in the behaviour of medium-wave and short-wave transmissions is that the latter are affected by the skip-distance effect. After dark, for example, there may be a belt several hundred miles in width round the transmitting station in which nothing is heard of, say, 31-metre or 19-metre signals. But there is no appreciable skip distance, at any rate in the neighbourhood of the transmitter, for either medium-wave or ultra-short wave transmissions. What I have been trying to find out lately, though I can't put my finger on it in any text book, is the frequency at which medium waves lose their own special characteristics, whilst those of the short waves are first observed. What

Television Programmes

Vision	Sound
45 Mc/s	41.5 Mc/s

THURSDAY, MARCH 24th.

3, "Spring's in the Air"—scenes from W. Johnstone-Douglas and Amherst Webber's Chanticleer Theatre Revue. **3.20,** Gaumont-British News. **3.30,** 131st edition of Picture Page.

9, "A Valuable Rival," a Scottish Comedy by Neil F. Grant. **9.20,** British Movietonews. **9.30,** 132nd edition of Picture Page.

FRIDAY, MARCH 25th.

3, Swedish Gymnastics Demonstration. The programme will be interrupted at approximately 3.15 for part of the National commentary on the Grand National. **3.25,** Friends from the Zoo. **3.35,** The Mercury Ballet. **3.40,** British Movietonews. **3.50,** The Mercury Ballet. **4.10,** Preview.

9, Friends from the Zoo. **9.15,** "100% Broadway"—an all-American Cabaret. **9.55,** Gaumont-British News. **10.5,** Preview.

SATURDAY, MARCH 26th.

2.40, Head of the River Race. Viewers will see the progress of the 133 crews taking part in the race and the commentary will be given by George Drinkwater. **3,** Talk by C. H. Middleton. **3.10,** "A Valuable Rival" (as on Thursday at 9 p.m.). **3.30,** Gaumont-British News. **3.40-4.10,** Cabaret, including Reine Paulet in songs, and Syd Walker, comedian.

9, "Spring's in the Air" (as on Thursday at 3 p.m.). **9.25,** British Movietonews. **9.35,** Wyndham Goldie as Prince Charles Edward Stewart in "Count Albany," an historical invention by Donald Carswell.

MONDAY, MARCH 28th.

3, Starlight. **3.10,** Gaumont-British News. **3.20,** Theatre Parade.

9, Frances Day. **9.5,** "Henry IV"—a play by Luigi Pirandello. Cast includes Ernest Milton and Valerie Hobson.

TUESDAY, MARCH 29th.

3, "Through the Year"—Elizabethan Songs about the Four Seasons, compèred by Roger Quilter, choreography by Quentin Tod. **3.25,** British Movietonews. **3.35,** Jack Jackson and his Band.

9, Speaking Personally. **9.10,** "Have you Brought Your Music"—a play by Quentin Tod. Cast includes Queenie Leonard and Margaret Rutherford. **9.35,** Gaumont-British News. **9.45,** Bridge Demonstration by Hubert Phillips.

WEDNESDAY, MARCH 30th.

3, Programme of Spontaneous Swing Music. **3.20,** Cartoon Film. **3.25,** "Count Albany" (as on Saturday at 9.35).

9, Starlight. **9.10,** "Merry Peasants"—National dances from Hungary, Poland and Russia. **9.40,** British Movietonews. **9.50,** Musicmakers.

again, is the frequency—I know it's about 30 megacycles, but I want something less vague than that—at which short waves cease to skip and take on the quasi-visual properties of the ultra-shorts? Are there critical frequencies at which these enormous differences are found to occur? Or is there a widish band of frequencies in which it is difficult to differentiate between medium-wave and short-wave behaviour and another where the short waves merge by degrees into ultra-shorts? Or, again, are the points of division between the three classes quite sharp? Hitherto we have been content to class medium waves as those between 100 and 1,000 metres, short waves those between 10 and 100 metres, and ultra-shorts as those below 10 metres. I feel, though, that we want something rather less vague than this.

A Memorable Broadcast

IF you go in at all for short-wave work it's most interesting to keep some kind of record of the distances at which skip areas apparently begin and end under varying conditions of daylight and darkness, not to mention those introduced by the seasons of the year and by the prevailing sun-spot cycle. A friend of mine who served for some years as a wireless operator both afloat and ashore has told me that some particularly marked instances of variation of skip distance in daylight and darkness have come his way. At one time he was stationed at a place just within the area reached by the daylight-reflected waves of a particular station. Towards sunset signals from this station would still be coming in with their accustomed good strength. Then, quite suddenly, they might change from R9 to R3 and in a few minutes the station would become completely inaudible. I wonder if you remember a twenty-four-hour broadcast conducted about ten years ago by PCJ, the Dutch station which was then working exclusively on a little over 31 metres? I can't claim (being but human) to have listened to the whole of it, but I did tune it in at quite frequent intervals.

Daylight and Darkness

Conditions from the sunspot point of view were not then quite what they are now, so that what was observed in those days would not necessarily be true to-day. It almost certainly would not, in fact, for there have been great changes since then in the ranges and in the skip distances of the 31-metre transmissions. What I found was that whilst it was still daylight (the transmission began in the late afternoon) I could obtain very fair reception from PCJ. But with the approach of darkness signals deteriorated rapidly, and when I went to bed in the small hours PCJ had become a weak and wavering transmission. At breakfast-time the next morning PCJ was an enormous signal. And so it continued for many hours. Then, a little before sunset, there was a marked falling off. My locality had just begun to be within the skip area. There was no sudden change from great strength to weakness or inaudibility; but the effects of approaching darkness were very clearly marked.

Automatic Band-width Variation

PUSH-BUTTON tuning seems to be bringing up many new problems, or at any rate, it makes us consider old problems in a new light. Frequency shift of the circuits controlled by a push-button system is always a difficulty, and from this point of view it is desirable that the band-width of the IF amplifier should be as great as possible when push-button control is actually in use. It has been suggested that means should be provided for introducing this change automatically, similar provision being made for the IF amplifier to revert to normal when manual tuning is in use.

Club News

Barnsley and District Wireless Association

Headquarters: Lecture Hall, Barnsley Corp. Elect. Dept.
Hon. Sec.: Mr. W. Peacock, 12, Locke Avenue, Barnsley.

A lecture and demonstration on his loud speaker equipment will be given by Mr. P. G. A. H. Voigt at 7.30 p.m. on March 30th.

National Radio Society

Headquarters: 86, Lordship Lane, London, N.17.
Hon. Sec.: Mr. C. F. Biggs, 86, Lordship Lane, London, N.17.

This Society is now completing its first year of existence and during this period has organised district meetings, issued local news sheets and promoted the interest of SW listening in many ways. There are 502 members. From 10 p.m. to midnight G.M.T. on March 26th CT1AA (Lisbon) is giving a special programme for the Society.

West Sussex Short-wave and Television Club

Headquarters: Tangmere, Sussex.
Meetings: Wednesdays at 8 p.m.
Hon. Sec.: Leading Aircraftman J. Williams, H.Q. Flight, 43 (F) Squadron, R.A.F., Tangmere, Sussex.

At the General Meeting held on March 8th at "The Tangmere Café," Mr. D. Ashby, of the Westinghouse Co., gave an illustrated lecture on "The All-metal Way," in which he dealt with almost every possible application of the metal rectifier.

The date of the lecture by the Weston Electrical Instrument Co. is May 11th at 7.30 p.m.

Exeter and District Wireless Society

Headquarters: 3, Dix's Field, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

At his recent lecture entitled "The Electrical Conception of the Hammond Organ," Mr. Lawes explained that although the cost of the instrument was less than half that of a church organ, its output was considerably greater. There are 20 contacts to each of the 61 keys.

Kingston and District Amateur Radio Society

Headquarters: The Three Fishes Hotel, Richmond Road.
Meetings: Alternate Wednesdays at 8 p.m.
Hon. Sec.: Mr. D. N. Biggs, 44, Pooley Green Road, Egham.

Mr. Bowen, of Mullard's, recently gave a lantern lecture on "Valve Application in Television Receivers." At a later date Mr. J. F. S. Williams gave a lecture and demonstration of the cathode-ray oscilloscope.

Mr. B. J. Applin has undertaken the managership of the 56-megacycle Group.

Croydon Radio Society

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

A very successful evening was had recently when Mr. G. A. Hoskins presented a recorded musical programme.

Derby Short-Wave Radio and Experimental Society

Headquarters: Nunsfield House, Boulton Lane, Alvaston, Derby.
Meetings: Tuesdays at 8 p.m.
Hon. Sec.: Mr. H. Turner (same address as above).

There was a very good attendance of members at the lecture on aerials given by Mr. E. V. R. Martin, the President.

The Society will appreciate reports from any readers who receive the five-metre transmissions being sent out by G2TL.

Letters to the Editor

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

Standard Symbols

I WISH to add a very hearty "Hear! Hear!" to your editorial dealing with "standard" symbols for circuit diagrams. Terms and symbols proposed for standardisation, though they cannot be expected to please everybody, should at least have very good reasons for departing from general usage. But when they depart not only from general usage, but also from common sense, even the most conscientious conformist can feel quite happy to ignore the would-be standard. While the sponsorship of official bodies is desirable for establishing standards, these bodies, in their somewhat rarified and artificial atmosphere, are not necessarily self-sufficient in judging of practical affairs. For example, circuit diagrams almost invariably contain a high proportion of resistors. Nobody, except a person in a department where time is no object, would favour the castellated symbol for a resistor, which is quite hopeless for rapid drawing, and, moreover, is an alien product. The official symbol for a screened lead lacks the important indication of where the screening starts and finishes. And so on.

I, as a consulting engineer, will continue to use the symbols familiarised by *The Wireless World* to professional and amateur workers everywhere.

M. G. SCROGGIE, B.Sc., A.M.I.E.E.
Bromley, Kent.

High-Quality Recordings

IN joining the discussion upon quality recordings, may I express the opinion that it is extremely difficult to pass an "objective" judgment upon the excellence or otherwise of a recording owing to the "subjective" effect of the reproducing apparatus. This is evidenced by the conflicting opinions expressed by independent critics, e.g., the contributors to the gramophone and music journals and the firm of gramophone dealers who issue the monthly letter mentioned by R. F. B. I hope I am not treading too heavily upon the corns of the correspondents who have contributed lists of records, but I make this observation in order that other readers accepting these recommendations too trustingly as a guide in their purchasing may not be disappointed.

I would suggest that for the quality gramophonist a comprehensive tone control (two or three of which have been described in your journal during the past few months) is essential and sound economy—often amazing improvements can be effected by boosting bass, removing stridency, etc., in mediocre recordings. Thus, the range of available records which can be reproduced with satisfying quality is greatly widened—quite often one reads of a recording, for which maybe one has waited for years, as being excellent in every way except for its scantiness of bass, lack of brilliance or some other easily corrected fault. I have Koussevitzky's recording of Beethoven's 5th Symphony played by the London Philharmonic Orchestra (H.M.V. 2338-42), which has a splendidly firm bass, but under normal conditions of reproduction is rather lacking in the higher frequencies. With judicious top boost this recording becomes really first-class—and the boosted top is *not* strident

My own suggestions to swell the lists are:—

La Boutique Fantasque, Rossini-Respighi, H.M.V. C.2846-8, London Philharmonic Orchestra, Eugene Goossens. Velvety depth of bass, brilliant transients and splendid performance of this popular ballet suite.

Symphony No. 40 in G Minor, Mozart, Columbia LX.656-8, London Philharmonic Orchestra, Sir Thomas Beecham. The most perspicuous recording I have ever heard; impeccable performance of a great work.

William Tell Overture, Rossini, Columbia LX.339-40, London Philharmonic Orchestra, Sir Thomas Beecham. All sections of the orchestra recorded with remarkable fidelity, even in the fortissimo passages.

I could name many others, but I must not trespass further upon your space. One final observation, however. Why are the best orchestral recordings superior to the best chamber music ditto? Prima facie, a quartet should present fewer problems to the recording engineers.

Canons Park. C. A. JOHNSON.

NOTING the correspondence in your columns concerning gramophone recordings which are claimed to be of outstanding quality, I thought it might be of interest to those wishing to obtain the full benefit of the Contrast Expander Unit recently described in your pages to have a note of certain recordings which are particularly applicable to Contrast Expansion. In demonstrating such a unit the following records, among others, have been found exceedingly useful:—

"La Boutique Fantasque," London Philharmonic Orchestra, H.M.V. C.2846, Parts I and II.

Symphony No. 6 in F Major, Beethoven, B.B.C. Symphony Orchestra, H.M.V. DB3336 (side No. 8).

Enigma Variations, Op. 36, Elgar, B.B.C. Symphony Orchestra, H.M.V. DB2801 (No. 3). F. E. HENDERSON.

London, W.C.2.

Condenser Breakdown

MAY I first of all say, in reply to Mr. C. F. N. Leahy in your issue of March 3rd, that it is not beyond our British condenser manufacturers to make reliable and reasonably priced components. The fault lies with the radio set maker who, when ordering his bulk supply for the season or part thereof, does not allow a large enough margin of safety between the maximum working limit and the manufacturers' peak voltage statement.

So much for the root of the evil, and now for some explanation and experiences.

When a mains smoothing or filter condenser fails, it can seriously injure the loud speaker field winding, the rectifier valve and mains transformer, and nearly always does to some extent, as HT fuses, and very often input mains fuses, are not fitted as they should be, even in highly priced equipment.

As the cost for fitting new condensers forms the main cause for complaint, I will, as an engineer with 13 years of pure radio experience, try to account for some of the charges mentioned.

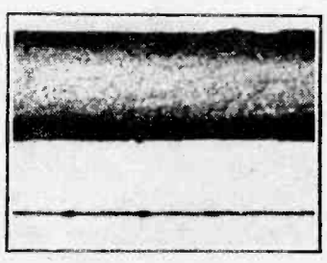
A condenser pack as used in the set in question usually contains about 8 units of from 8 mfd down to 0.1 or even less, and experience shows that in no case do they ever all go down at once.

An experienced engineer with a good test set and capacity bridge could soon find the defective unit, isolate it and, from experience, he could fit just the correct capacity new small unit somewhere on the chassis, making a neat and cheap job. Providing the speaker and mains transformer were at least 20 megohms to earth on insulation test at 500 volts he would then return the chassis, the whole job costing about £1.

The account for this job, if the firm I work for (employing four engineers all the year round) did it would be as follows: One 8-mfd. unit, 7s. 6d. max.; four hours' time at 2s. 6d. hour; collection and delivery, 2s. 6d. approx. The period of eight hours' test on the bench would not be charged unless the engineer had tests to make.

It is my earnest wish that the above details should clear the air a little, as radio engineering and service work is often looked upon as the next best thing to felony, while actually it is a highly skilled trade calling for good judgment, complete stocks for speed, and expensive and elaborate test equipment. DENNIS MOORE.

Nottingham.



PLATINUM FUSE WIRE, as used in American 10-milliamp. fuses, is shown in this micro-photograph in comparison with a human hair, which has a diameter about 30 times greater. The irregularities on the surface of the wire are due to soldering flux, used in mounting it in its holder. The diameter is given as 0·000075 in.; No. 50 S.W.G., the finest wire shown in standard British lists, measures 0·001 in.

YOUR postbag will assuredly be full of replies to your correspondent, Mr. C. F. N. Leahy, *re* "condenser breakdowns," for his letter reveals "information" that must have been denied to most of your readers.

I have read your excellent periodical for some years, and remember no reference to a limit of life for a condenser provided that it is of proper rating, is used in accordance with the maker's directions, and is not placed in too warm a position. I have used the same paper condensers in the power pack of my set on both DC and AC mains of 220-240 volts in various districts over the past 15 years, and have *never* had a breakdown. In fact, I take it for granted that the condensers will never break down! I might add that the set to-day has eight valves including two PX4's, in the push-pull output stage.

I have no interest whatever in the firm that produced the condensers, and I may add that I should expect the same excellent results from any condenser made by a firm of repute. E. G. B.

Kenton, Middlesex.

Relays

THE consternation of the trade in Southampton, coupled with your editorial, calls for a suggestion I have not seen in print as yet.

Why should the G.P.O. waste public money in showing that they can do what private companies have already done.

May I suggest that instead of attempting to provide programmes to a number of subscribers in one district, the real problem is, can they provide programmes by 'phone to people in Scotland and Cornwall at the same time?

By co-operating with the Ministry of Education perhaps all "Schools Broadcasts" could be taken from the telephone simply by dialling "School."

This again would remove the dilemma experienced during the summer.

Birmingham. W. M. DALTON.

Reception in Scotland

AS consultant to the radio trade in Scotland on the subject of electrical interference, I visit Dundee at regular intervals, and should like to supplement "WAC's" statements regarding reception of the "local" station.

Using a small four-valve portable receiver attached to an aerial in the roof of my car, I have been able to test signal strengths of the nearest stations in every part of the country from Brighton to Inverness, and in Dundee have never been able to obtain even the Regional at decent volume.

I should like to correct the impression that "WAC" leaves, however, that electrical interference in Dundee is solely due to the large number of industries using electricity. This is only half the truth.

I venture to state that there are more outside aerials in Dundee than in any other town of its size in the country, and that this is the cause of much of the poor reception complained of!

To explain this seeming paradox I should state that the Dundee people have a unique method of airing the family linen. The greater part of the town is composed of tenements, a style of building peculiar to Scotland, in which three or four flats share a common stair and entrance. The families also share a common drying green at the rear, in which is planted a full sized ship's mast with two or three pulleys at intervals of about 10 feet all the way up. Attached to these pulleys are ropes radiating to the kitchen windows on each flat, and the family washing can be slung out without the labour of trudging up and down stairs.

It needs no effort of the imagination to see that the Dundonians have no excuse for not having an outside aerial, and the criss-cross of wires and ropes, particularly in the Hilltown area, has to be seen to be believed.

It follows from all this that if A at the top of the street is picking up interference from tramway wires, telephone lines, etc., the interference is induced from aerial to aerial, where they are only a few feet apart at the poles, and eventually reaches Z at the further end of the street. The remedy is obvious.

One point which may not be so obvious to service men in this area when erecting anti-static aerials in such locations is the length of top span required. The shielded down-lead of an anti-interference aerial has, of course, no signal pick-up, and it is therefore imperative that the top span be at least forty feet in length to provide the receiver with sufficient load, and this should be nearer seventy feet where signal strength is known to be weak.

As the poles mentioned are, in most cases, only thirty to thirty-five feet distant from the building it will be seen that this is not enough, and a more suitable anchorage can generally be obtained on the roof of the building opposite.

There are other problems peculiar to Dundee which space does not allow me to enumerate here, but I should appreciate the opportunity of discussing the subject with "WAC" or other interested readers, and am always prepared to lecture at any club or association meeting on electrical interference. A. D. MILNE.

(Interference Suppression Engineer; Coatbridge. Belling and Lee, Ltd.)

Interference

APROPOS Man-made Interference, may I compare two cases.

"A" lives in the country. By carelessly putting a copper wire between two available trees, with what seems to be scant insulation, he is able to rope-in ample stations on his 8-guinea set to satisfy him and his friends. His outlay is easily covered by a tenner, including 10s. for the licence.

Now let us look at "B." He lives in the suburbs of a fast expanding town; trolley buses pass the door, on the corner nearby there are traffic lights, opposite is a hairdressers, fitted with all the latest electric hair clippers, massage and violet-ray gadgets. The street lighting is of the gas-discharge type, but as the electricity supply is overhead the leads cannot be screened. Although all the houses round about are new, "B's" is fairly old, and the lighting installation is carried out in cab-tyre (rubber) cable.

His radio reception was horrible, so he did what he could. He bought poles (they are cheap in the country!) and had them erected on the top of the house (they looked wicked, and one of the workmen knocked a slate out which resulted in a ruined ceiling). Then he paid about £2 10s. for a special aerial, and 25s. for a really pukka mains lead suppressor. Even then he could not listen to "Scottish," and his wife was Scotch. So he bought a set with a bit more kick in it; 18 guineas he paid for it. Now then, what has he paid for his entertainment as compared with "A"? And yet he still pays 10s. for the licence. Something's wrong.

Alton. "WIRELESS WHIRLED."

Next Week's Issue

Will contain articles on various aspects of the portable receiver and its design, together with a guide giving all essential information regarding portables on the British market.

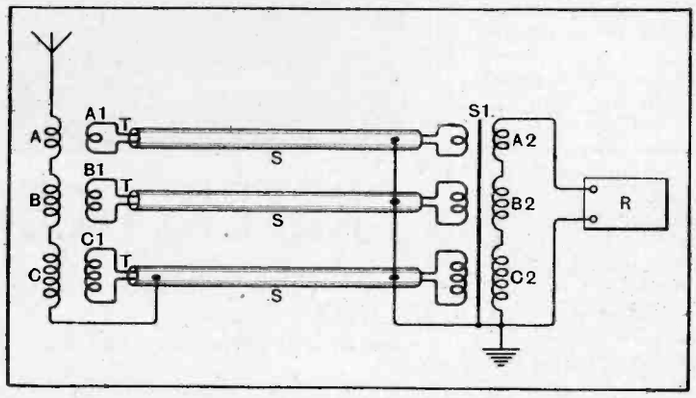
Recent Inventions

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

AERIAL COUPLINGS

THE figure shows a method of coupling a single aerial to one or more remotely-situated receivers through a multiple transmission line, which is capable of handling a very wide band of signalling frequencies.

The aerial includes a number of primary windings A, B, C, which are coupled to a similar number of secondaries A1, B1, C1, each operating efficiently on a limited frequency band, and each being matched for impedance. At the far end, the transmission lines T are coupled to similar "matched" secondaries A2, B2, C2, all wound in series with the receiver R.



Aerial coupling system capable of handling a wide band of frequencies.

Each of the two-wire transmission lines is protected from local interference by a screen S, which is earthed. An electrostatic screen S1 between the output transformers is similarly earthed. The three lines T may be wound around a common core and embedded in gutta-percha.

F. R. W. Strafford and Belling and Lee. Ltd. Application date May 16th, 1936. No. 477031.

o o o o

NAVIGATIONAL WIRELESS

A CONSTANTLY rotating frame aerial, carried on an aeroplane or other moving craft, receives the signals from one or more fixed beacons (whose geographical position is known) and utilises them through amplifiers and a differential gear box to align two separate indicators or pointers which are mounted over a chart so that their intersection marks the position from time to time of the moving craft.

The effect of any turning movement by the craft is automatically compensated by gearing which is controlled by the action of a compass needle on two light-sensitive cells. As the craft turns or yaws away from the direct course, a mirror on the compass needle deflects the light from a nearby lamp on to one or the other of the sensitive cells, and so operates a relay which, in turn, controls a reversing motor, and so applies the necessary correction to the movement of the pointers over the chart.

H. E. Sjostrand. Application date March 9th, 1936. No. 475027.

o o o o

SCANNING SYSTEMS

IN a time-base circuit for generating synchronising impulses for a television receiver, a feed-back link, consisting of a variable resistance in series with a rectifier, is connected between the deflecting coils of the cathode-ray tube and the input amplifier to which the original synchronising-impulses are applied. A negative bias is thus applied to the input valve, after the arrival of each synchronising impulse, so that the valve is kept "blocked" until the arrival of the next synchronising impulse.

This prevents the saw-toothed oscillator from being accidentally "trigged" into action by the impact of static or other interference, during the interval between successive synchronising impulses.

The overall time-constant of the circuits is such that the back-stroke of the scanning spot is kept constant irrespective of the duration of the synchronising signal. Means are also provided for cutting off the electron stream through the cathode-ray tube if, for any reason, the timing circuit is not in action. This prevents the fluorescent screen from being accidentally burnt out.

Philco Radio and Television Corpn. Convention date (U.S.A.) June 7th, 1935. No. 477038.

o o o o

TELEVISION IN COLOURS

IN television receivers of the so-called "projection" type the usual fluorescent screen of the cathode-ray tube is replaced by a thin screen of tungsten or molybdenum foil, not more than 20 microns thick, upon which an incandescent image of the picture is produced by the impact of the electron stream.

It is pointed out that an incandescent picture, unlike that produced on a fluorescent screen, contains all the primary colours, and that it is, therefore, possible by using different coloured filters to throw on to the viewing screen a reproduction of the original picture in natural colours. For instance, two or more projection tubes fitted with different filters can be focused simultaneously on the same viewing screen. Or different coloured filters can be interposed in rapid succession between the same projection tube and the viewing screen, so that the consecutive images overlap or "merge" into a coloured picture. The greater brightness of the incandescent image is an additional advantage.

N. V. Phillips Gloeilampenfabrieken. Convention date (Holland) July 20th, 1935. No. 477612.

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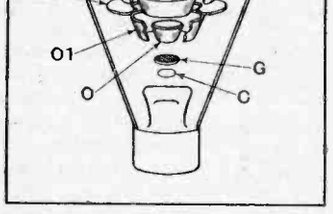
ELECTRON MULTIPLIERS

THE figure shows the electrode arrangement of a discharge device designed to amplify by secondary emission. The electron stream from a cathode C passes through a control grid G, and then impacts against a series of target electrodes of conical form. Secondary electrons are emitted from the central target O and are deflected on to a surface O1, to produce further secondary emission. From here they pass on to other surfaces, one only, O_3, being shown until the output is collected by the anode A. The electrodes O-O_3 are biased by progressively increasing voltages. A screen S prevents undesirable reaction between the electron streams.

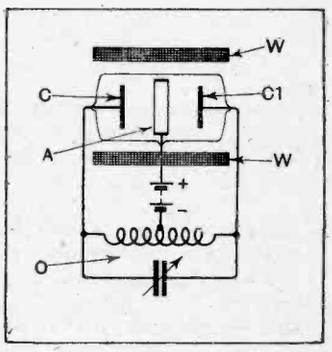


Electron multiplier operating on the principle of secondary emission.

Ferranti, Ltd. and J. C. Wilson. Application date June 17th, 1936. No. 476815.

o o o o

THE figure shows an amplifier of the type in which electrons emitted from one cathode C are forced, by the magnetic field from an external winding W, to pass through a ring-shaped anode, carrying a positive voltage, on to a second cathode or target C1, where they produce secondary electrons. The latter are then attracted back towards the first cathode C, and so the process goes on, until sustained oscillations are built up in the external high-frequency circuit O. Each cathode in turn acquires a momentary positive charge, when it releases more (secondary) electrons than the primary electrons it receives, during the building-up process. Afterwards the anode A acts as a collector.



Electron multiplier having a primary element coated with radio-active material.

According to the invention, a radio-active substance, such as a uranium salt, is used on one of the cathodes as a source of primary electrons, instead of the more usual photo-electric material. The cathode is stated to be more robust electrically, and to be capable of standing-up to a more intense electronic bombardment without damage than, say, the ordinary type of cathode coated with caesium on silver.

Marconi's Wireless Telegraph Co., Ltd., and G. B. Banks. Application date July 13th, 1936. No. 478001.

o o o o

MOVING-COIL SPEAKERS

ONE method of energising a moving-coil speaker is to include the field windings in series with the HT supply, so that it serves also as a smoothing choke. This, however, produces an undesirable drop in the available anode voltage, particularly in the case of DC mains. An alternative method is to use a separate choke for smoothing, and to connect the field winding of the speaker in parallel with the receiver.

According to the invention the field coil of the speaker is wound in two parts, one connected in series with the receiver and the other in shunt. Each coil is provided with a separate magnetic core, and the arrangement is such that the coupling between the two windings is insufficient to affect the AC impedance of the series coil to any appreciable extent.

E. K. Cole, Ltd., and A. E. Falkus. Application date June 27th, 1936. No. 476753.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Portables

High Standard of Modern Types

AS the prospects of warmer weather advance attention is naturally directed more and more towards outdoor life, and if broadcasting is to accompany us away from home a portable set becomes an obvious necessity.

In this issue we have, therefore, devoted a number of pages to wireless out-of-doors and have given readers a guide to the many types of battery portables which are available to-day.

The problem confronting the designer of a portable set differs very much from that of producing the type of receiver intended for permanent installation in the home. The portable set designer has to consider bulk, weight and battery consumption, and he has literally to juggle with these three to reach a satisfactory compromise which will produce an efficient set acceptable to a critical public.

Considerations of battery consumption control the number of valves and the output of the set, and consequently one must not expect to meet with refinements such as can be incorporated in fixed-location sets by the employment of additional valves and other current-demanding features. The portable set has to be reduced to the minimum in valves, both in consideration of battery consumption and the weight and size of the batteries themselves. Where extreme lightness and compactness is aimed at the size and weight of batteries has to be reduced, with attendant disadvantages.

Judged by the standards of earlier years, remarkable improvements have been made in the general efficiency of the portable set, and to-day it can be regarded as a reliable companion for holidays and all other outdoor occasions.

It is a curious thing that nowhere else in the world has the portable set remained as popular as here. No doubt this is partly accounted for by the week-end habit and also by the fact that the portable here is still favoured rather than the car radio set permanently installed which has made such headway in America. A self-contained portable has that important advantage over a car radio set that it can be used away from the car and carried indoors on holiday occasions to serve the purpose of an indoor, as well as an outdoor, receiver. Wherever the idea of owning a second set is entertained, the approach of summer must surely be a powerful inducement to make a portable the choice for the second receiver.

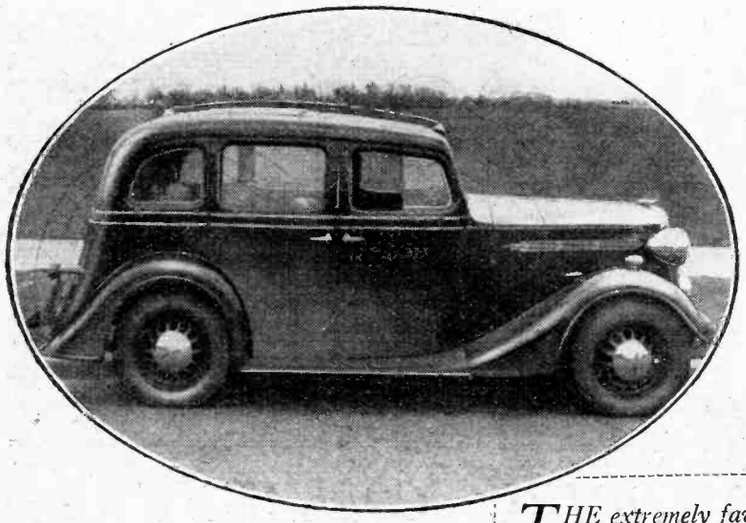
Television

The Big Screen Problem

THERE has recently been much discussion on the subject of big screen television in relation to its use in cinemas and other places of entertainment. The B.B.C. have a monopoly of television broadcasting and the conditions under which the B.B.C. obtain material for programmes frequently precludes them from allowing broadcasting either of sound or television programmes to be reproduced in places of entertainment. As matters stand at present it would almost certainly result in a wholesale curtailment of B.B.C. facilities for programme matter if the television programmes were to be reproduced on the cinema screen. If the cinemas desire television programmes it would seem to us that the only line for them to adopt at present is to establish their own programmes and devise means of feeding their cinemas by wires, for which no doubt the necessary permission from the Post Office would be forthcoming.

Car Radio

PROBLEMS OF SIGNAL PICK-UP AN



An inconspicuous type of external aerial.

THE extremely favourable signal-noise ratio to be expected from the modern car radio receiver can only be attained if due care is taken in the work of installation; the nature of the precautions to be observed are described in this article.

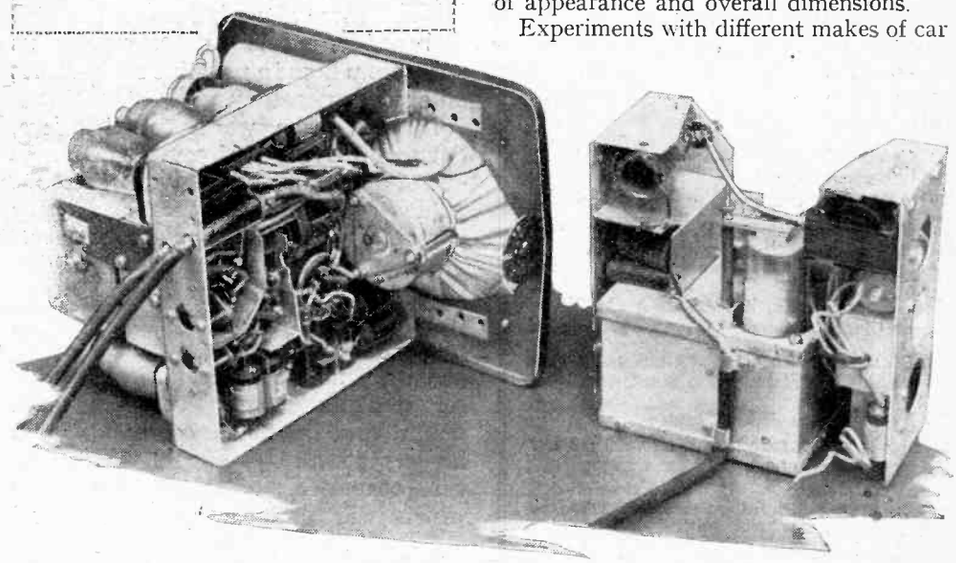
IN past years there have been many attempts to produce car radio receivers which would be satisfactory from the standpoints of compactness, sensitivity, and power consumption, but, so far as this country was concerned, the above requirements had not been convincingly fulfilled until the last year or two. In the United States the absence of the long waveband simplified the problem, whilst the public attitude towards car radio gave greater impetus to development.

The most obvious difference between a car radio receiver and a domestic receiver is, of course, that the power supply of the former is limited to a 6- or 12-volt accumulator. The majority of car receivers obtain their high-tension supply by means of a vibratory interrupter, which, in effect, creates an alternating current in the primary of a transformer where it is brought up to the required voltage and then rectified and filtered in the normal manner. Owing to the limitations of space, the vibrator has to be mounted close to the other components of the set, and this has necessitated considerable care in screening and filtering in order to prevent interference within the set or between the supply leads and the aerial system.

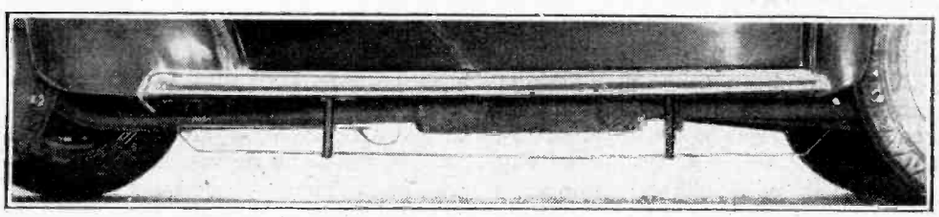
Furthermore, the car radio set has to be highly sensitive, first in order to make the most of the small aerial in use, and secondly to provide a wide margin of sensitivity to enable the automatic volume control system to cope with the great fluctuations of signal strength which are encountered.

The maximum sensitivity of a car receiver has to be approximately twenty times that of a good domestic receiver, and anyone who has experienced electrical interference with the latter will appreciate the magnitude of the problems which confront the designers and installers of car receivers.

The total power consumption of a modern car radio receiver is usually between 30 and 40 watts, and the circuit is preferably arranged so that, regardless of the polarity of the car wiring, connection is made simply by the contact between the receiver case and the car chassis and by a single lead running to the output terminal of the dashboard ammeter.



Chassis of a Philips car radio set; on the right is the vibrator and filter unit.



Under certain conditions (described in the text) an under-chassis aerial may prove to be the most practicable type.

When installing a car receiver one of the first decisions to be made is the choice of an aerial, and the problem here is to obtain the maximum of signal with a minimum of interference pick-up. Three types of aerial are in general use, the horizontal roof aerial, the telescopic vertical aerial, and the under-car aerial; the former is, of course, applicable only to saloon cars, whilst the two latter can be used on any type of car. It is, however, impossible to set out rules governing the selection of a particular type, as much depends upon the make of car.

As the receiver is earthed to the chassis it is desirable to keep the aerial as far away as possible from the body of the car, but this, naturally, is limited by questions of appearance and overall dimensions.

Experiments with different makes of car indicate that, running more or less longitudinally through the structure, there is an imaginary line corresponding to the earth in an ordinary receiver installation and that the farther the aerial can be placed away from this line the greater will be the signal pick-up.

Thus in one type of car this line was found to be well below the geometric centre of the car, and the horizontal roof aerial gave better results than the under-car aerial; in another type the line was above the geometric centre, and the under-car aerial was the better of the two, despite its closeness to the ground. The vertical aerial, which can be mounted against the side of the scuttle, generally has a good signal pick-up, with the additional advantage of being fairly clear of the interference zone, but is not very popular owing to its appearance.

The roof aerial has to be fixed symmetrically on the roof, but the under-car aerial is fixed to one of the main longi-

Installation

ERFERENCE SUPPRESSION

By S. DANIEL and J. B. KAYE, M.A., A.M.I.E.E.

(Technical Dept., Philips Lamps Ltd.)

tudinal members of the chassis and, in general, is placed on the side farthest away from the ignition wiring, although even here it is impossible to be explicit, as the exhaust pipe may also be radiating interference and each side of the chassis should be tried.

The most usual position for the set is inside the car against the bulkhead, just below the dashboard, arranged so as to avoid an excessive length of control cables between the set and the control head, which can be attached to the underside of the dashboard, to the dashboard itself, or on the steering column.

Loud Speaker Position

If the set has an independent loud speaker the exact angle at which the set is placed does not matter, but with built-in speakers the set should, as far as possible, be arranged to point the speaker into the body of the car. The independent speaker can, of course, be mounted in any suitable position on the bulkhead.

It will thus be seen that the connecting lead between the set and the aerial has to pass close to the interference field created by the electrical equipment associated with the engine and dynamo, and, unless protected against this, would pick up a considerable amount of interference.

This connecting lead must be screened, and two methods of connection are possible, one being to use a low-impedance line consisting of a screened pair of wires with an impedance-matching transformer at the aerial end. The other method is to use a high-impedance line consisting of a single conductor passing concentrically through a screen. In both instances the input to the receiver is specifically designed to match the impedance of the incoming line. The first method is, of course, common practice with domestic receiving systems, whilst the second method is rendered possible in the case of car radio by the shortness of the connection and the use of specially designed cable.

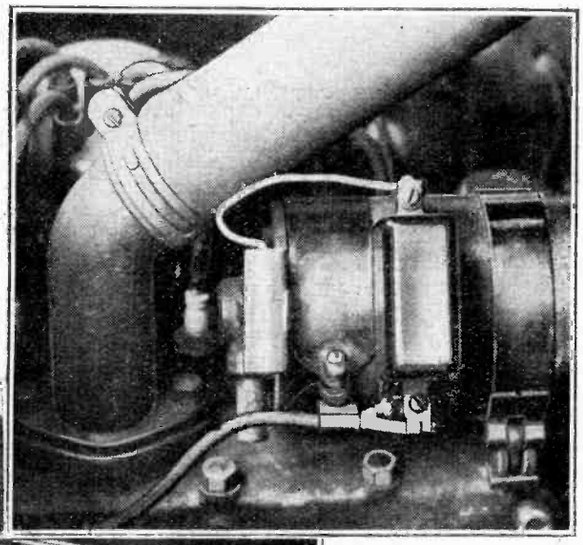
In addition to the advantage of the screening, with both of the above connecting systems it is possible to design them in such a way as to achieve a band-pass effect whereby the higher frequencies, outside the broadcast range, can be greatly attenuated, thus reducing much of the interference which may be picked up on the aerial.

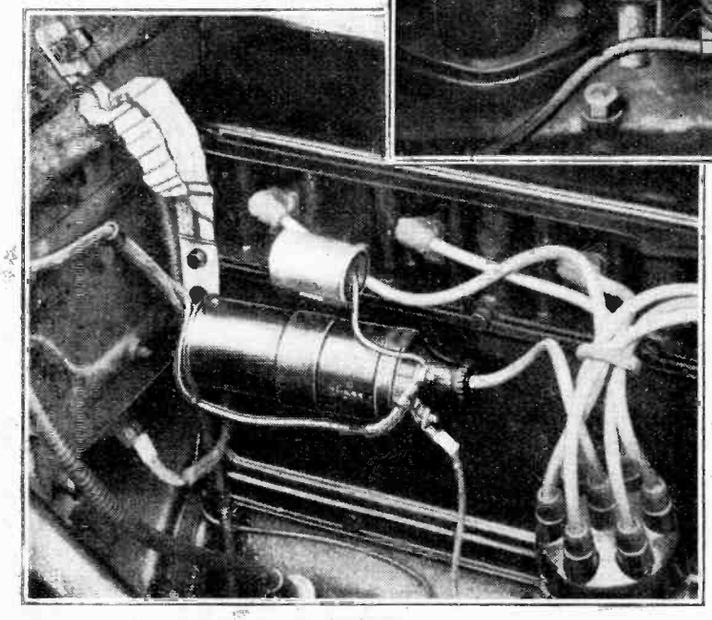
Assuming that the foregoing requirements have been effectively satisfied, it will be seen that any interference entering the set will be that picked up by the aerial itself, and thus this must be attacked at the source.

The initial causes of such interference can be divided broadly into the following main classes:—

(*a*) Ignition, comprising all points in the high-voltage system at which sparking occurs.
(*b*) Dynamo; sparking at the brushes.
(*c*) Electric petrol pumps; sparking at contacts.
(*d*) Intermittent sources, such as windscreen wipers, etc.
(*e*) Frictional sources, such as brakes and tyres.

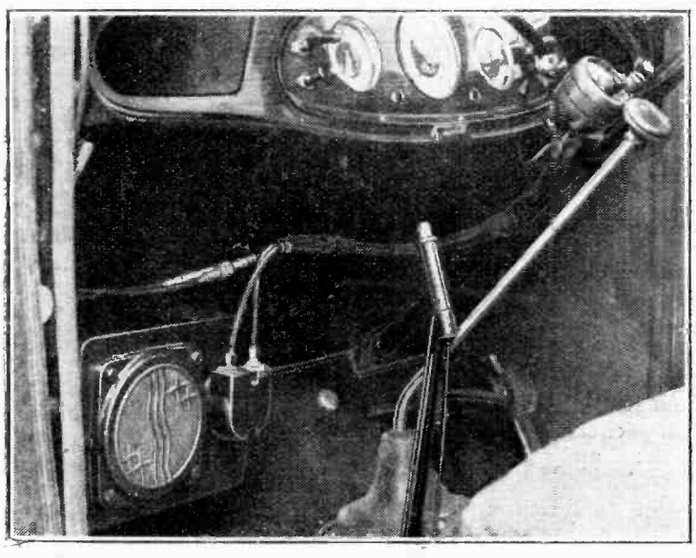
The first four categories cover sparking in closed circuits, and can be compared directly with the oscillatory circuit originally used by Hertz to demonstrate electric radiation. Moreover, the radiation is not restricted to the primary circuit, but it can shock-excite other near-by metallic bodies which may be insulated, or partly insulated, and they in turn will radiate energy. Thus, radiation may occur from wiring not associated with the sparking circuit, and from such components as the steering column, cardan shaft, gear box or exhaust pipe.





(Above) Condenser suppressor on the dynamo of a Ford Eight.

(Left) Ignition coil suppressor condenser and earthing strap.



A Philips set installed in a Vauxhall Fourteen.

Anti-interference Measures

The desirability of keeping the aerial away from other wiring has already been emphasised, and this also applies to the aerial connecting line, as even the screening may not be entirely effective in a severe interference zone. The neighbourhood of the high-tension ignition circuit is, of course, obviously to be avoided, as oscillation due to the spark at the plug points is inevitable, and so far the only really complete means of treating such a

Car Radio Installation—

circuit has been to apply complete screening to all the leads, which method is generally applied in aircraft. In car radio, however, such a comprehensive method is economically impracticable, and in cases where the anti-interference devices associated with the receiver have not been effective, a considerable reduction in interference has been attained by the use of a resistance of the order of 20,000 ohms placed close to the sparking plug, in series with each ignition lead. This resistance damps down the oscillation in the ignition circuit, thus reducing radiation.

Extra Earthing

The search for the components radiating interference is carried out by making temporary connections between possible radiators and the main frame of the car. The most likely points for such treatment are between the engine block and the chassis, between the cylinder head and the bulkhead, between the gear box and the chassis, and between the exhaust pipe and the chassis. If there is a reduction in interference, then a copper bonding strap is bolted permanently between the points indicated.

For interference arising from the electrical circuits in the car, condensers are used between the offending component and the chassis or some near-by mass of metal which is already connected to the chassis. Condensers are generally connected, as a matter of course, between the casing of the dynamo and the live brush terminal, also between the live terminal of the ignition coil primary and the engine block or bulkhead, depending on where the coil is mounted. Interference from windscreen wipers and electric petrol pumps can usually be cleared by the use of condensers, but it should be kept in mind that all connections must be extremely short, otherwise the connecting lead to the condenser may serve as an additional radiator of interference.

It is not within the scope of this article to draw up a detailed routine for interference detection and elimination, but anyone having experience of such a process as applied to domestic receivers should have no difficulty in developing a system based on the general principles outlined above. Disconnecting the aerial from the lead-in will, of course, show which of the two is collecting the interference, and at the same time the lead-in can be moved about to explore the interference zone.

The type of interference in category (*e*) is of a somewhat different character from that due to a specific spark discharge, and appears to be caused by the dissipation of static charges created by friction. It is almost invariably associated with the front wheels and picked up only on under-car aerials.

The interference is heard as a rhythmic swishing noise, and, if present, is most likely to be heard when the car is travelling over a dry concrete road at speeds exceeding 25 m.p.h.

That caused by the brake may be continuous when the brake is off and cease when it is operated, or it may occur only when the brake is operated. It may disappear entirely, or be greatly reduced, on a wet road. Tyre static varies considerably with the road surface, and will disappear completely on a wet road.

Both types, if present, will naturally be heard when the engine is cut off and the car is coasting. As only one wheel may be offending, it can be identified by drenching each wheel successively with water.

Permanent cures can sometimes be obtained by the use of a wiping contact between the wheel hub and the end of the axle shaft, or by the use of graphite grease in that position, although some car manufacturers deprecate the latter method. If neither of these two methods is practicable, the only solution is to evade the interference by using a roof or vertical aerial.

External interference from tramways, trolley buses and other cars is beyond the reach of the car radio engineer, but the two former are localised in extent, and it is hoped that in the future there will be a reduction of the latter.

A most unusual and rare form of external interference which was once encountered appeared to be associated with an iron grid forming part of the structure of a concrete road, as the interference was rhythmically connected with the passage of the car over the surface.

In conclusion, it can be stated that, although the above description of interference possibilities may appear rather formidable, in practice very few of them are likely to occur simultaneously, and they are generally amenable to simple treatment.

Variable AVC

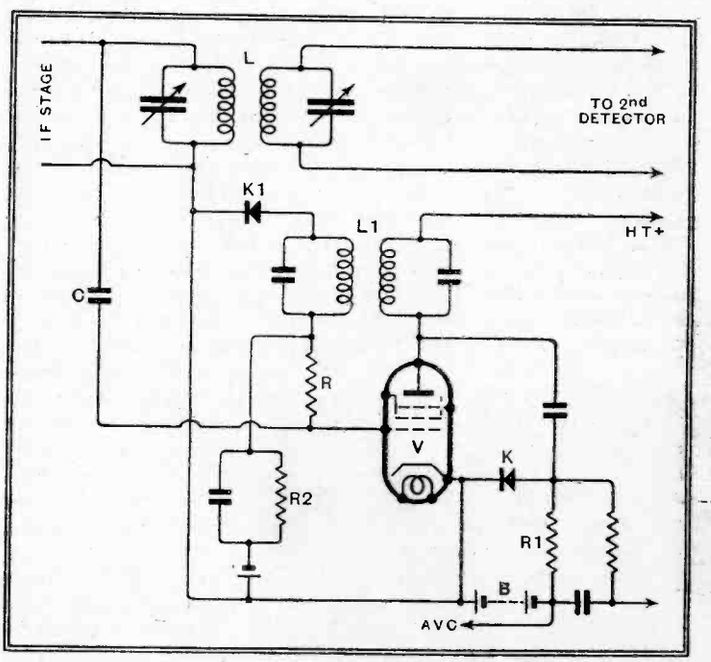
ACCURATE TUNING BY EAR

WITH AVC in operation it is difficult to tune a set accurately by ear, since there is no immediate falling-off in volume as the circuits go slightly "off resonance." Hence the popularity of visual-tuning indicators.

The figure shows a circuit (Patent No. 440494) in which the possibility of aural tuning is restored by introducing a sudden change in the intensity of the normal AVC effect. The change occurs automatically as soon as a worth-while signal comes in. The intermediate-frequency circuit L is coupled through a condenser C and resistance R to the pentode V, and a rectifier K feeds the resulting biasing voltage developed across a resistance R1 to the grids of preceding valves. This is the ordinary AVC control which is combined with a source B of "delay" voltage to cut out interstation noise and ensure quiet tuning.

The extra control is derived from a "discriminating" circuit L1, which is coupled to the anode circuit of the pentode and is very sharply tuned to the intermediate frequency. As soon as a worth-while signal is tuned in a considerable voltage is rapidly built up in the circuit L1, and is rectified by K1 to produce an opposing bias across R2 on the grid of the pentode V.

This increases the gain of that valve to an extent which depends upon the peak response of the resonant circuit L1. The effect is, in any case, so pronounced that any detuning to an extent likely to set up distortion is at once made manifest by a falling-off in the volume of sound. The extra "control" bias must not, of course, be made so sharp as to render it difficult to find a given station, but otherwise the arrangement should prove a convenient aid to accurate tuning by ear, particularly acceptable to those whose sets are of the pre-AVC era.



Substitute for a tuning indicator: circuit arrangement for avoiding the apparent "flatness" of tuning in sets with AVC.

Portables—NOW AND THEN

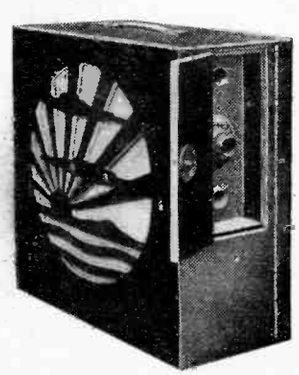
By "CATHODE RAY"

1938 . . .

Pye "Baby" Q. 4-valve straight set. 17½ lb. £8.8.

SELF-CONTAINED radio is an essentially British product. When I took one over to America in 1929 it was as much of a curiosity there as an English skylark. Here, the number of portables sold in that year probably exceeded all other types together, for it was the heyday of the species. The reason for the extraordinary demand that developed about ten years ago was not so much that people wanted portables as such, but that they wanted a change from the mess of boxes, wires, batteries, tin trumpets, masts, and other paraphernalia that comprised the only sort of "wireless" commonly known. The appearance of an entirely self-contained affair that played anywhere directly it was switched on was bound to stir the popular imagination.

A considerable amount of disillusionment followed when the expense of upkeep began to be experienced. And the portability always was a joke, except for those people who essayed to carry one more than a few yards. When mains-driven sets appeared, retaining the principal merit of the portable—tidiness—without its vices of upkeep expense, and poor reproduction, the portable suffered a severe setback, but it was never entirely eclipsed, and has continued to this day in a more subdued frame of mind. Except for a few special types embodying superhet circuits, the modern portables are remarkably similar in design to those of ten years ago. Most of the technical developments during that time have passed them by. Now, as then, they can be divided into "upright" and suitcase (*attaché case*, as the advertiser likes to call them) types.



. . . 1928

Pye Transportable. 5-valve straight set. 30 lb. £30.12.6.

Certainly they have become cheaper and more portable. In 1928 a suitcase portable cost and weighed about thirty pounds. The cost has been got down to a small fraction of that amount. Weight reduction has not been quite so successful, but there are sets with a fairly useful performance that can be carried a mile or two without discomfort.

But as regards the circuit—well, time yourself to pick out which of the three reproduced on the next page are 1928 and which are 1938.

I suppose the valves give them away. There were no RF pentodes or beam output valves in 1928. And the 1928 moving-coil speakers were much heavier than the whole of a 1938 portable! So moving-iron speakers were used. As it happens, there are still portables with moving-iron speakers sold in this year of grace, and if there are no triode output valves—well, so much the worse for 1938! On the other hand, more sound is obtainable now for a given battery consumption. With this possible exception there is hardly a feature of any significance that has definitely altered in these ten years.

Detail Improvements, But the Same Basic Circuit as in 1928

But the examples I have picked out, which are outstanding representatives of their periods, do show a few tendencies in detail. There is an unmistakable and commendable tendency to reduce the number of pretty colours to play about with when connecting up the batteries. Trimmers are now fitted for matching the tuning to the scale (in the 1928 model each scale was individually calibrated to fit the tuning). To get smooth reaction with modern valves the detector grid leak is returned to a point between LT− and +. Although I have played quite fair in sticking strictly to the diagrams of standard commercial sets, I must confess that only a minority of the 1928 example were actually produced with resistance coupling; it was tried for a while and abandoned. Two transformer couplings were more usual, and with a little care in arranging the components it was just possible to avoid howling. Of course, now, with pentodes and higher amplification valves generally, the step-up of a second transformer is unnecessary. Phone sockets were obtainable in this particular 1928 model, but only to special order; in both the 1938 models they appear to be compulsory. Nothing very exciting about that. The 1928 waveband switching looks a bit odd; switch design has made some progress since then, and the types now in vogue are more conveniently connected in other ways. The circuits are basically the same, however. Have I missed anything? . . . Change from RF choke to resistors, probably for cheapness. . . . A by-pass condenser to supplement the reaction condenser. . . . That is about all, I think. Oh! and LT switching is in the negative side instead of the positive, to give one a better chance of finding out from experience that a neat fuse is now fitted to take care of haphazard use of battery leads.

Leaving aside these details, all three examples—and many others that could be quoted—can be conventionally described as self-contained battery-driven receivers, comprising one tuned-anode RF stage employing a screen-grid valve, a leaky-grid detector valve with reaction, and an AF stage leading to the output valve. The aerial and earth terminals provided on all the sets are just for fun. I used them once (strictly unofficially) on a liner's aerial in mid-Atlantic. It certainly was fun, too. Almost every station on both sides of the pond came in together, loudly.

Amplification to the Limit

The guiding principle in portable design is to keep the thing stable. Everything else conspires to make it unstable. Amplification, both radio and audio, must be pressed to the limit to receive as many stations on its little frame as a respectable mains-driven superhet does with an outdoor aerial. The said little frame generally embraces all the other components in the set, including the anode coils, and it is generally quite amusing trying to stop them from coupling, especially if it is a design for the market, for not only has the lab. model to be stable, but also every one produced by the factory. There is far more audio amplification than would be considered prudent in any other sort of set. And, to make matters worse, all the components must be crowded together and put one inside another to get them into a small space. And, finally, one is not allowed a profusion of decoupling components to help stabilise it, because of their space and cost.

Sometimes the designer of a portable recovers and is able to resume a useful part in life's affairs.

Not only the man (or woman) in the street, the ordinary newspapers' wonder-fodder, but even "Cathode Ray" himself, must admit that being able to carry a portable around playing merrily without any connections has not yet lost all its fascination. In 1928 only a Spartan could retain for long a Kruschen-like expression of face while showing it off to his wondering friends, but now it is possible not only to look at ease while trotting around with

Portables—Now and Then

the music, but also to feel at ease. At least, that is so with the diminutive specimen I have used occasionally during the last year or so. Some of the so-called portables on the market look suspiciously like the shoulder-breakers of old, but, of course, appearances may be deceptive. And the unhygienic habit of secreting acid over themselves, to which the earlier types were addicted, seems definitely to have been eradicated. Another thing I have just remembered about my 1928 portable is that HT battery replacements cost £1 8s. apiece, and were prone to internal short-circuits when quite new, which caused them to behave like a rather sluggish type of incendiary bomb.

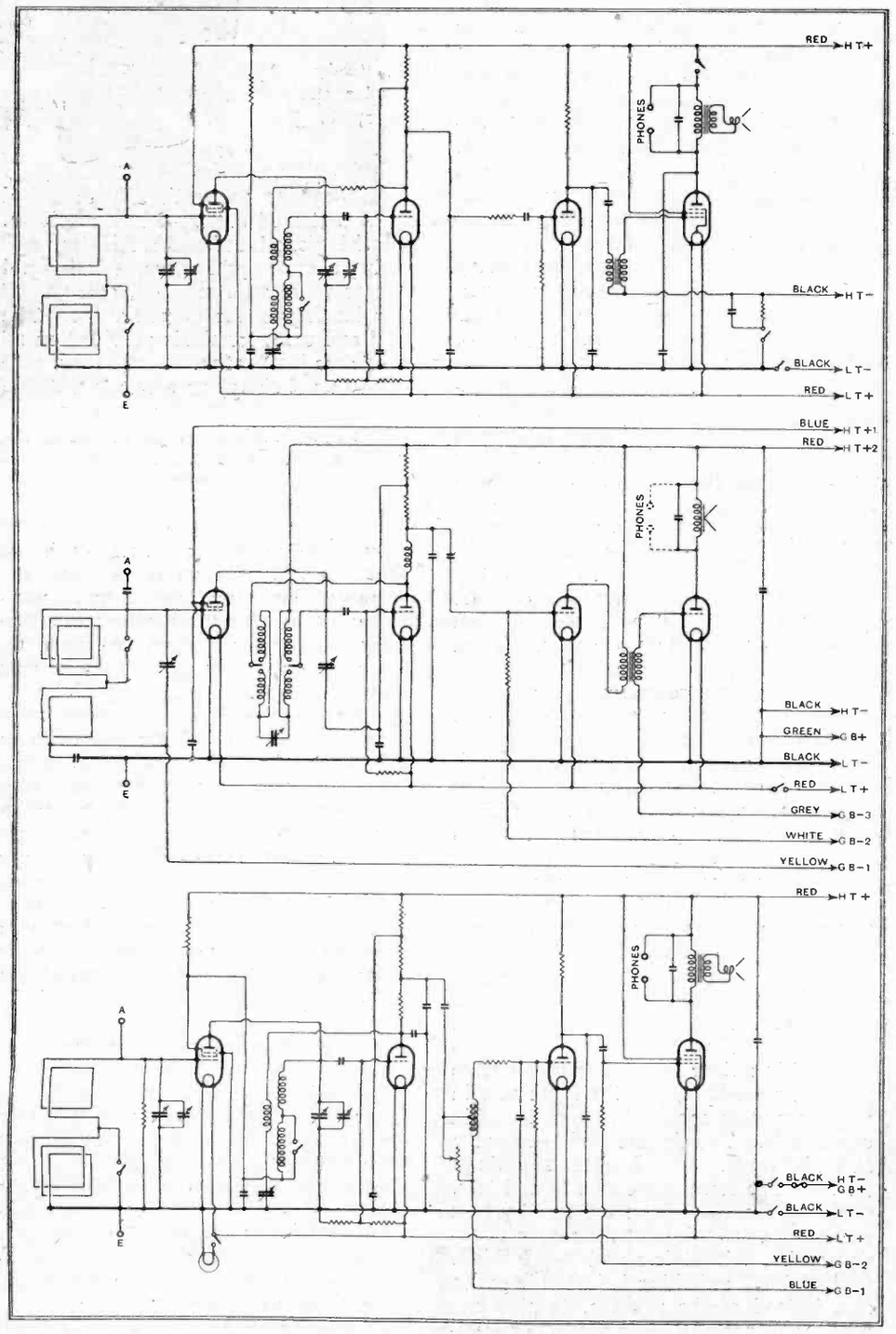
So perhaps to-day's portables have something to be said for them after all.

News from the Clubs

Radio, Physical and Television Society

Headquarters: 72a, North End Road, London, W.14.
Meetings: Fridays at 8.15 p.m.
Hon. Sec.: Mr. C. W. Edmans, 72a, North End Road, London, W.14.

At his recent lecture entitled "The Design of Antennæ for Radio Transmitters and Receivers, Dr. C. G. Lemon explained that all aerials were derivatives of three main types, the Marconi, the Hertz and the Terminated Aerial. The lecturer described thirty subsidiary types of aerial and also the Collins Coupler. In addition, he demonstrated an aerial of his own design which is unidirectional and is only half the normal size. Members were able to hear G2GL in contact with several VE and W stations.



Can you tell which of these circuits are of 1938 models and which 1928?

McMICHAEL MODEL 389. Three separate tuning scales are provided in this new 4-valve battery super-het. which has a short-wave tuning down to 18.5 metres. The price, including batteries, is 9½ guineas.

Robert Blair Radio Society

Headquarters: Islington Men's Institute, Blundell Street, London, N.7.
Meetings: Wednesdays at 8 p.m. (Practical); Thursdays at 8 p.m. (Theoretical).
Hon. Sec.: Mr. A. R. Richardson, 24, Mercers Road, London, N.19.

Recently a debate took place on the relative merits of the superheterodyne and the straight set, and at the conclusion Mr. E. W. A. De Kretser, the Society's technical adviser, dealt with the points missed by both sides. A 10-watt transmitter is now being built and a transmitting licence has been applied for.

This evening (Thursday) the Society will hear a lecturer from the Radio, Physical and Television Society. He will give a talk entitled, "The Design, Construction and Testing of Transformers. On April 2nd the Society is visiting the B.B.C. station at Brookman's Park.

Edgware Short-Wave Society

Headquarters: Constitutional Club, Edgware.
Meetings: Wednesdays at 8 p.m.
Hon. Sec.: Mr. F. Bell, 118, Colin Crescent, London, N.W.9.

Mr. L. Gregory lectured recently on the best type of transmitting aerials for long-distance work. Future activities include a visit to a power station and lectures by Mr. K. Jowers, and Erie Resistors. A junk sale will be held on April 6th.

Exeter and District Wireless Society

Headquarters: 3, Dix's Field, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

Mr. W. S. Pyrah gave a cine and lantern lecture on a recent occasion entitled "Industrial Rectification." A very interesting film of the E.C.C. works was shown.

Croydon Radio Society

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

Great interest was shown at the recent demonstration given by Mr. R. P. Jonas of his adaptation of *The Wireless World* Quality Amplifier used in conjunction with *The Wireless World* Monodial and the Voigt loud speaker. Mr. Voigt was present and made some very helpful comments.

On April 5th the season will be concluded by a loud speaker night.

Field Days

The Use of Portable Equipment for DF and Other Experiments During the Summer

By H. B. DENT

SOME may think it a little premature to discuss outdoor wireless experiments, but actually there is not a great deal of time available in which to construct any special apparatus that may be needed during the summer months.

Those who have not hitherto taken an active part in field days might well give the matter serious consideration, for some very enjoyable days can be spent in this way, provided the events are properly organised. Early notification is essential.

Obviously, there is little to be gained by taking a portable wireless set out into the country and merely sitting down to listen for stations, excepting, of course, when a set is part of the picnic paraphernalia, and is taken along solely for entertainment purposes. We are concerned here with the experimental aspect of radio, so that there must be some definite object in view.

HOW the competitive element is introduced into amateur radio : a running commentary describing the steps taken to locate a "hidden" transmitter with the help of wireless bearings, together with notes on the organisation of similar activities

During the past few years many radio societies have made a point of holding competitions during the summer, the general idea being to locate a hidden short-wave transmitter by means of direction-finding apparatus.

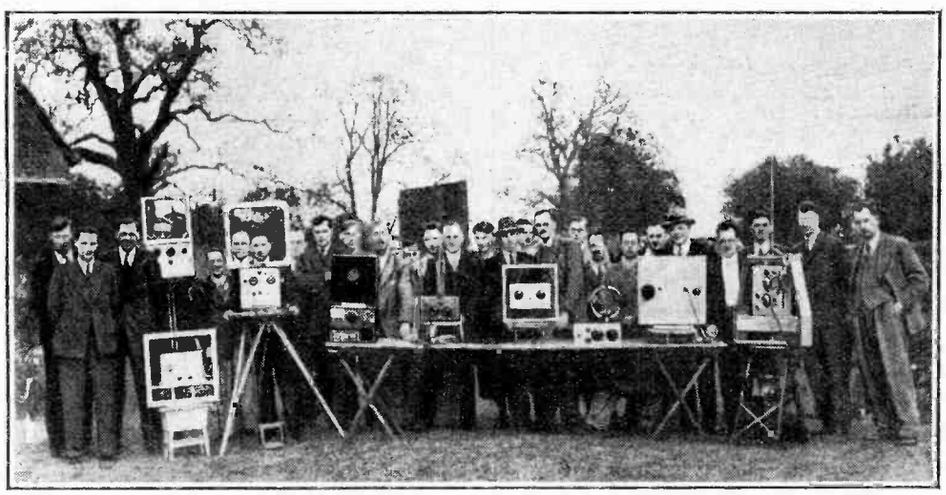
An orthodox short-wave receiving circuit can be used, and the main difference is that a frame replaces the usual elevated aerial. Special care has to be given to the mechanical construction, for the set must be capable of taking a reading of direction with an accuracy of one degree or better.

Needless to say, the set and batteries have to be enclosed in a metal box, and the frame should also be screened, though in this case a small gap is left in the screening. Though the design of the apparatus contributes largely to the success of the venture, it is not the purpose of this article to go farther into technical details, but to deal with what is of equal, or perhaps of more, importance, namely, the procedure.

As accurate bearings have to be taken a good compass is necessary. It can either be built into the set or used separately, but the former arrangement generally gives more reliable readings. Then there is the map, which must cover the tract of country in which the day's work will be undertaken.

The society organising the event should state on the field day schedule the correct map to use and it is always advisable to comply with this recommendation.

A protractor, for marking of the radio bearings on the map, and a straight-edge engraved in inches and tenths of an inch, so that distances can be scaled off, will about complete the equipment.



Members of the Golders Green, Southall and other Radio Societies photographed with their apparatus after taking part in a successful 40-metre DF competition.

Camouflaged field transmitter operated by D. N. Corfield (G5CD) at a field day last summer.

If the map is secured to a large board with drawing pins, marking off the bearings will be facilitated, as out in the country one cannot always find a flat surface for this work. Furthermore, time is saved as the map does not have to be opened and folded again at every halting place.

Now a matter that may easily be overlooked. The radio bearings will be magnetic, for they are taken with a compass, so that when plotting them on the map due allowance must be made for the magnetic variation. On Ordnance survey maps the right- and left-hand border lines run true north and south, and so also do the corresponding lines forming the squared divisions. These can be used as reference lines when plotting the true bearing obtained from the compass reading.

Allocation of Duties

Let us now follow in our mind's eye a receiving group setting out by car one fine morning in the summer to take part in a direction-finding competition. Duties have been allocated, for everything must run like clockwork, or much valuable time will be wasted, and time is important, especially if the points awarded are in any way dependent on the time taken to find the concealed transmitter.

One member of the party is navigator, his job being to study the map and pick out the best receiving positions, having regard to the likely location of the transmitter as indicated by the bearings.

Field Days—

If there is a forbidden area in which reception must not be undertaken it is his job to see that the rules are complied with. Another member should be made responsible for plotting the bearings, though this might also be the navigator's responsibility where a party of three only is concerned.

The receiver should be in the care of one individual, his duties being to see that the set is erected correctly and always switched off before leaving the last receiving position. As the set must be really portable only a small LT battery will be included and no waste of current can be permitted.

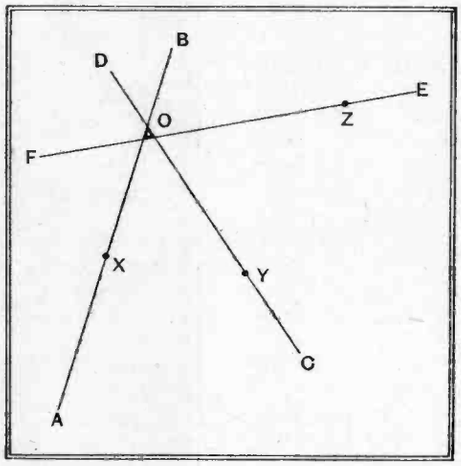


Fig. 1.—Successive steps in the location, by means of a direction-finder, of a hidden transmitter.

Now fully equipped, and not forgetting the luncheon basket, all speed is made to the scene of operations, for the first receiving position has, or should have been, previously fixed. The subsequent ones depend on the results obtained by the first receiving test.

If the navigator has done his job properly the party should halt in fairly open country and on comparatively high ground, for it is a waste of time trying to take radio bearings on short waves in the middle of a wood.

Consulting the schedule of transmissions and finding that about ten minutes has still to elapse before the first transmission starts, the set can be erected and a test made to ensure that everything is in order. When zero hour approaches attention can be concentrated on tuning in the field transmitter. For the benefit of those who do not know morse, an identification signal, such as an easily recognised combination of dots and/or dashes, should be sent out as well as the station call-sign.

Plotting the Bearings

When the station is heard the frame aerial is rotated until the signal falls to a minimum, or if the apparatus is sufficiently well designed, actually becomes inaudible. As a rule only a reduction to a minimum will be possible. Exploring with the frame, and, if one is fortunate, finding that this minimum position is quite sharp and well defined, a bearing can then be taken. The direction of the transmitter will be at right angles to the plane of the frame, but a simple frame aerial set will only indicate the line along which the signals are travelling, not the actual direction in relation to the receiver's position.

This bearing should be plotted on the map with the protractor and extended in both directions from the receiving point.

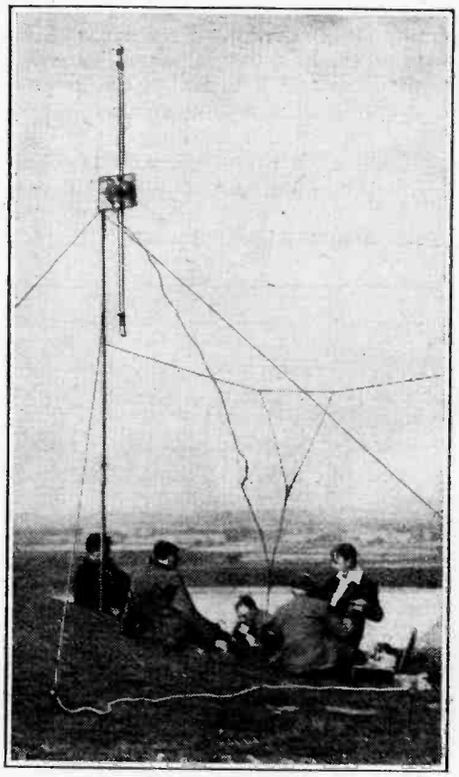
The next move is to proceed roughly at right angles to the bearing just plotted, for a distance of, say, five miles and make another test.

When plotting the bearing taken at the second position the line drawn will, or at least it should, intersect the first bearing. The lines plotted on the map will probably be as shown by AB and CD in Fig. 1, these relating to bearings taken from receiving positions X and Y respectively.

This second test gives a reasonably good indication of the location of the transmitter, for if the bearings are accurate it will be at the point O where the two lines cross.

However, more conclusive evidence is needed so that another reading must be made and the best position to take up for this would be one from which the bearing will cross either of the other two at very nearly a right angle. To reach a suitable position may entail a journey of several miles, but, as will be shown later, it will be worth the trouble.

The next, and possibly the final, position should accordingly be taken up in the vicinity of the point marked Z in Fig. 1. Unless something very extraordinary has been achieved in amateur direction-finding the third bearing indicated by the line EF will not pass through the point of intersection O, but to one side of it, making a small triangle as shown. The transmitter is, therefore, somewhere in this area.



A five-metre transmitter set up on the summit of Ivinghoe Beacon.

The size of this triangle will give an indication of the accuracy of all the bearings taken. If quite small those concerned might well be pleased with themselves, but a large triangle need not give rise to despondency, for maybe only one of the bearings is widely out.

Another receiving test from, say, somewhere between Y and Z, or north of Z, i.e., to the top of Fig. 1, will show whether all or only one bearing is inaccurate.

The accuracy of the first three bearings will determine the time taken to actually locate the transmitter.

There are, of course, many variations of this idea that can be worked into a field day. Points may be awarded based on a graduated scale for the accuracy of all bearings, distance also being taken into account, the finding of the transmitter being a secondary consideration. But the satisfaction that will always be derived by those successful enough to run it to earth is a factor that should not be overlooked by organisers of these events.

Field days offer an excellent opportunity for experiments on five metres. Even direction-finding might be attempted on these very high frequencies, and it lends itself to the exercise of much individual ingenuity in the design and construction of aerials for the purpose. This suggestion is by no means a flight of imagination, for a society well known in the South of England for its activities in this matter, namely, the Golders Green and Hendon Radio and Scientific Society, held a very successful DF competition on five metres last summer. Two groups actually succeeded in locating the transmitter by a combination of radio bearings and clever deduction, though without the help of wireless there would have been no possible chance of finding it.

Amateurs keenly interested in this aspect of outdoor wireless will find their local radio societies willing and ready to give them assistance and advice on suitable equipment. Now is the time to think about the matter, as portable receivers cannot be built, tested and made ready for DF work in a few weeks of spare time.

The Wireless Industry

A WELL-PREPARED and highly informative catalogue of public-address equipment and accessories has just been issued by Grampian Reproducers, Ltd., Kew Gardens, Surrey.

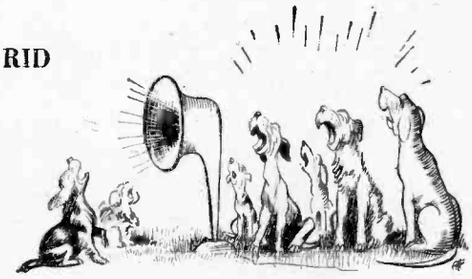
Gamages, of Holborn, London, E.C.1, have introduced a 120-watt wind-driven battery charger at £8 19s. 6d.

Trix Electrical Co., Ltd., manufacturers of sound equipment, have moved to 218, Great Portland Street, London, W.1.

A leaflet containing a description and specification of the Type TF430 Standard Signal Generator is now available from Marconi-Ekco Instruments, Ltd., Electra House, Victoria Embankment, London, W.C.2.

UNBIASED

By FREE GRID

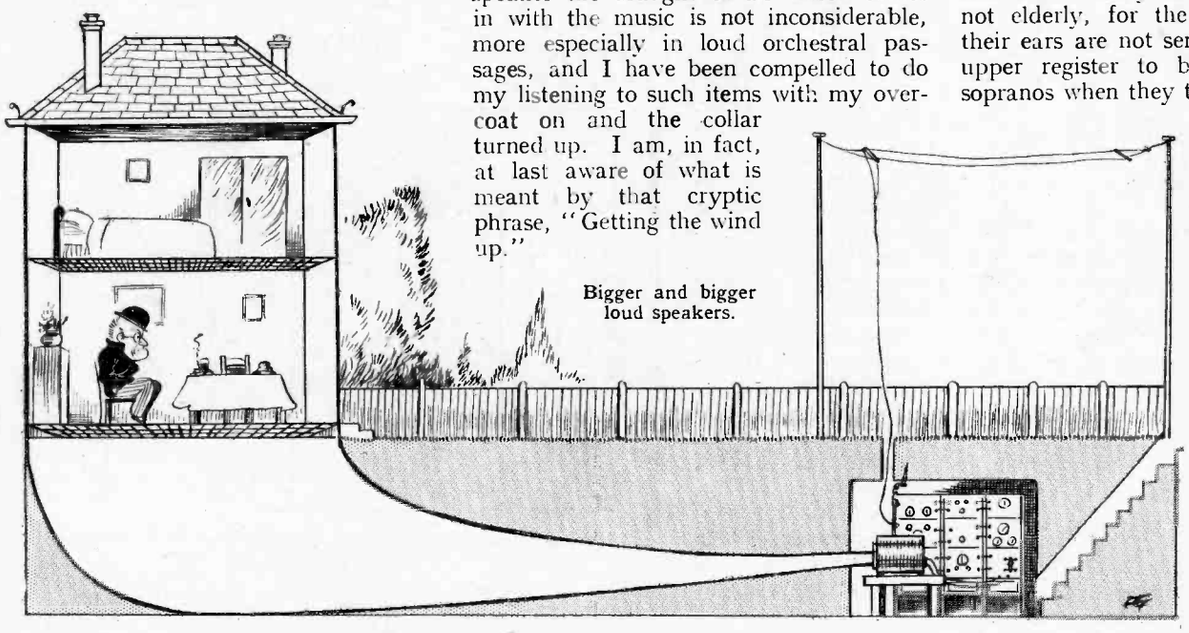


Special concerts for dogs.

Radio Reception Revolutionised

IT has long been apparent to me that some drastic revolution was needed in our listening arrangements if radio apparatus was not to take complete possession of our homes to the exclusion of everything else. Under the orders of the high-fidelity experts, our loud speakers and our amplifiers have been getting bigger and bigger during the past years and already there is very little room for other furniture in the house when they have been installed, more especially if the loud speaker be of the exponential horn type, as it so often is nowadays.

As I have already said, I have long thought that something drastic would have to be done but I was at a complete loss to know what until fortune smiled on me and provided me with a solution, as it so often does when we feel that we have touched the rock bottom of despair. Actually the solution is not mine at all, but is due to a reader, Mr. R. C. Pike, of Leigh-on-Sea, who kindly sent in a suggestion concerning another difficulty I was in some time ago and I have adapted it to this particular case. I think that a study of the accompanying illustration will make things far clearer than I can hope to do by words alone. Already I have made considerable headway in my preliminary experimental work.



Bigger and bigger loud speakers.

The underground chamber which contains the receiver is situated at the extreme end of the back garden. Incidentally this will also serve the purpose of an air-raid shelter in the case of need. There is also the added advantage that the aerial is well away from the house, so minimising the risk of electrical interference without the necessity of an expensive anti-static arrangement. The set is of the modern remotely controlled motor-driven type and so no difficulty arises in the matter of tuning it from the house.

It will be seen that the mouth of the exponential horn is formed by the whole of the house flooring, this being covered by a grid in order to support the furniture. In this manner wireless is made available in every room in the house, including the top storey, which also has a gridded floor, thus doing away with the necessity of expensive extension loud speakers and their accompanying wiring.

I have been compelled to carry out my initial experimental work on a new housing estate which is being built, this being due to the early Victorian notions of Mrs. Free Grid, who, in this twentieth century, still believes in carpets and other germ-collecting death-traps. So far only one serious difficulty has arisen and that is in connection with temperature control. Owing to the powerful output of the loud speaker the draught of air which comes in with the music is not inconsiderable, more especially in loud orchestral passages, and I have been compelled to do my listening to such items with my overcoat on and the collar turned up. I am, in fact, at last aware of what is meant by that cryptic phrase, "Getting the wind up."

This is completely counteracted, however, by the hot air emanating from the loud speaker when certain of the B.B.C. talks are being given, and on these occasions the temperature frequently rises to an oppressive level. What is needed, therefore, in order to make the invention a complete success is some method of balancing the two extremes in temperature so that the scheme can be adapted to the ordinary home. At present I am frankly stuck. Can you help me?

What Is the Reason?

IN spite of the fact that some little time ago I drew attention in these notes to the physiological fact that the response of our hearing organs to high notes falls off rapidly with advancing age, certain manufacturers seem to be pursuing the even tenor of their way as though such facts did not exist; as though, in fact, they were the idle vapourings of my imagination, instead of scientific data which any up-to-date medico-acoustic textbook will confirm.

It appears to be a well-established fact that the response of our ears to high notes is at its best at about twenty years of age, and that, after that, a fairly slow falling-off occurs until the middle thirties, when a much more rapid decline sets in. There are many happenings in everyday life which aptly illustrate the truth of this scientific fact.

We notice, for instance, that opera lovers are nearly always middle-aged, if not elderly, for the simple reason that their ears are not sensitive enough in the upper register to be disturbed by the sopranos when they touch their top notes.

Again, the average age of sea-going wireless operators is well below forty, for the simple reason that long before that age they have either profited by the pile of stock-brokers' telegrams they handle and have made enough to retire on or have been compulsorily retired through inability to hear the high notes which appear to be such a feature of modern mercantile marine morse.

Since, as I have just shown, the lack of high-note appreciation by any save callow youth is such a well-established fact, I cannot imagine why it is that makers of certain wireless components, more especially output transformers, continue to publish curves and other data to prove that the frequency response of their products goes well up towards the 20,000-cycle mark. What can be the object of producing such output transformers.

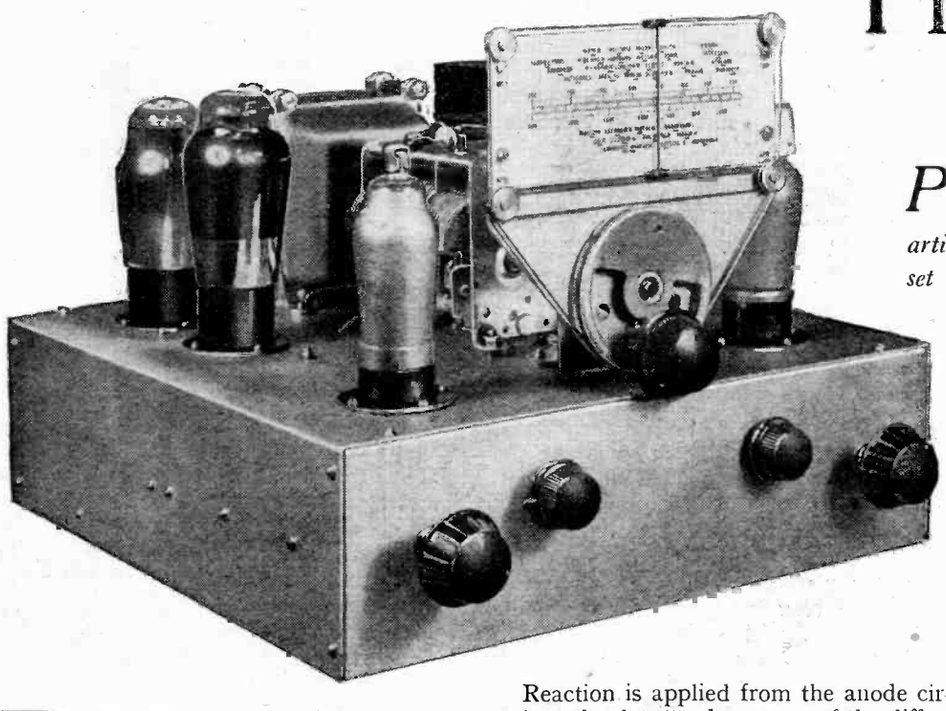
Yet there must be some reason for it, as I have seldom known wireless manufacturers do anything without a pretty good reason. I can only think that they must be preparing to provide special concerts for dogs, which are about the only normal domestic creatures able to appreciate such high notes. The whole thing is a puzzle to me, however, and I should be glad to have some enlightenment.

How a Receiver is Designed.—X.

Three-Valve

CONSTRUCTIONAL DETA

PRECEDING articles in this series have deal the details of the design of this receiver, and article the construction and operation are treated. set as described is for AC operation and is RF-det.-pentode type.



DETAILS of the radio frequency side of this receiver have been dealt with in the preceding articles of this series, as also has the design of the essential part of the AF side. It now remains, therefore, to put these together and to give details of the apparatus as a whole.

The complete circuit diagram is shown in Fig. 6. It will be seen that the aerial circuit is tuned to a frequency somewhat lower than any within the tuning range by the coils L1 and L2. On the medium waveband L2 is short-circuited and L1 only is in operation, but on the long waveband the total inductance is that of L1 and L2 in series.

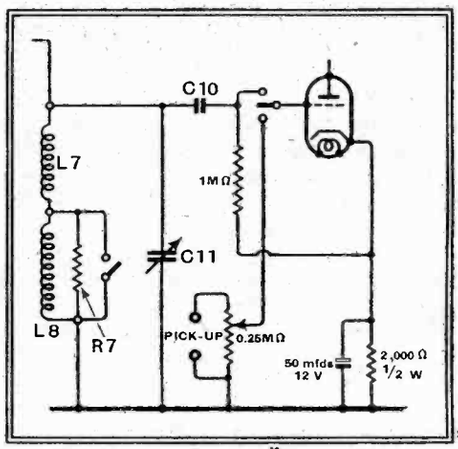
The first tuned circuit comprises L3 and L4, with C2, and again L4 is short-circuited for the medium wavelength. The coupling to the aerial circuit is by means of the 10 $\mu\mu$F condenser C1. The second tuned circuit comprises L5, L6 and C5, and on the medium waveband the coupling between these circuits is obtained by the condenser C3 of 1 $\mu\mu$F. On the long waveband, however, the condenser C4 of 3 $\mu\mu$F gives additional coupling. The RF valve is one of high mutual conductance and is coupled to the grid detector with the tuned grid circuit. The tuned circuit comprises L7 and L8, with C11. The coupling condenser, C9, is given the unusually small value of 10 $\mu\mu$F, and, in effect, the anode of the RF valve is tapped down the circuit by means of a capacity potentiometer, of which C9 forms the upper member, the lower being provided by the valve output capacity and the various stray circuit capacities. The detector is also tapped down the circuit to some degree by means of a capacity potentiometer, for the grid condenser is only 25 $\mu\mu$F and there is the input capacity of the valve for the lower limb of the potentiometer.

Reaction is applied from the anode circuit to the detector by means of the differential condenser, C12, in conjunction with L9. On the long waveband, as explained in last week's issue, the tuning tends to be too sharp and the stage gain increases to such a degree that a tendency to instability occurs. To offset this, L8 has a 50,000-ohm resistance, R7, connected across it. Following the detector there is the usual RF filter, comprising C13, R10 and C14, and the coupling to the output valve is by means of a resistance-capacity fed AF transformer. The coupling resistance, R9, has a value of 40,000 ohms and the coupling condenser, C16, a capacity of 0.5 mfd. Decoupling is provided by R8 and C15, of 20,000 ohms and 8 mfds. respectively.

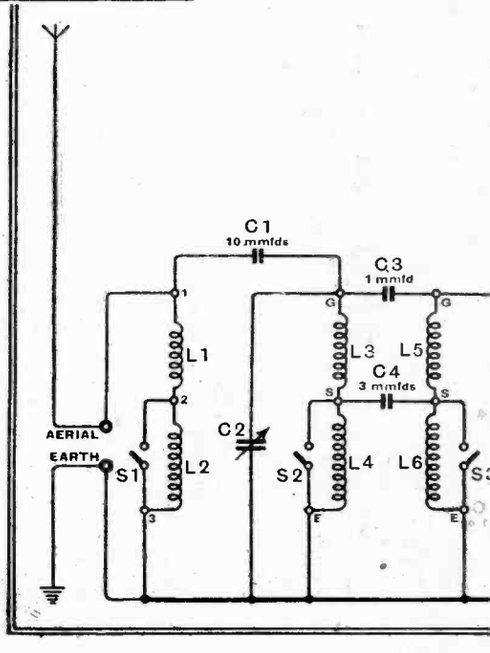
The circuit of the output valve is conventional, with the usual grid stopping resistance, R12, of 5,000 ohms and anode resistance, R15, of 50 ohms. Grid bias is obtained by the drop across R14, and this resistance is shunted by a 50-mfd. condenser, C17. It should be noted that as the value required for R14 is a non-standard value, 175 ohms, actually, this component consists of two 350-ohm resistances in parallel. Variable negative feedback is obtained by interposing the resistance, R13, in the grid circuit of the valve and feeding a portion of the anode voltage into the grid circuit through C18 and R16. With the particular transformer employed a damping resistance is necessary on the secondary to avoid unwanted phase shifts at high frequencies. This is the resistance, R11, of 200,000 ohms.

The mains equipment is of a simple nature and consists of a mains transformer carrying windings for the rectifier filament and for the valve heaters, and also the high voltage winding for the HT supply. An 8-mfd. reservoir condenser, C20, is employed and a single stage of smoothing, comprising Ch and C19, is adequate.

Little need be said about the



(*Left*) Fig. 7.—Details are shown here of the modifications needed to the detector circuit if it is required to use a gramophone pick-up.

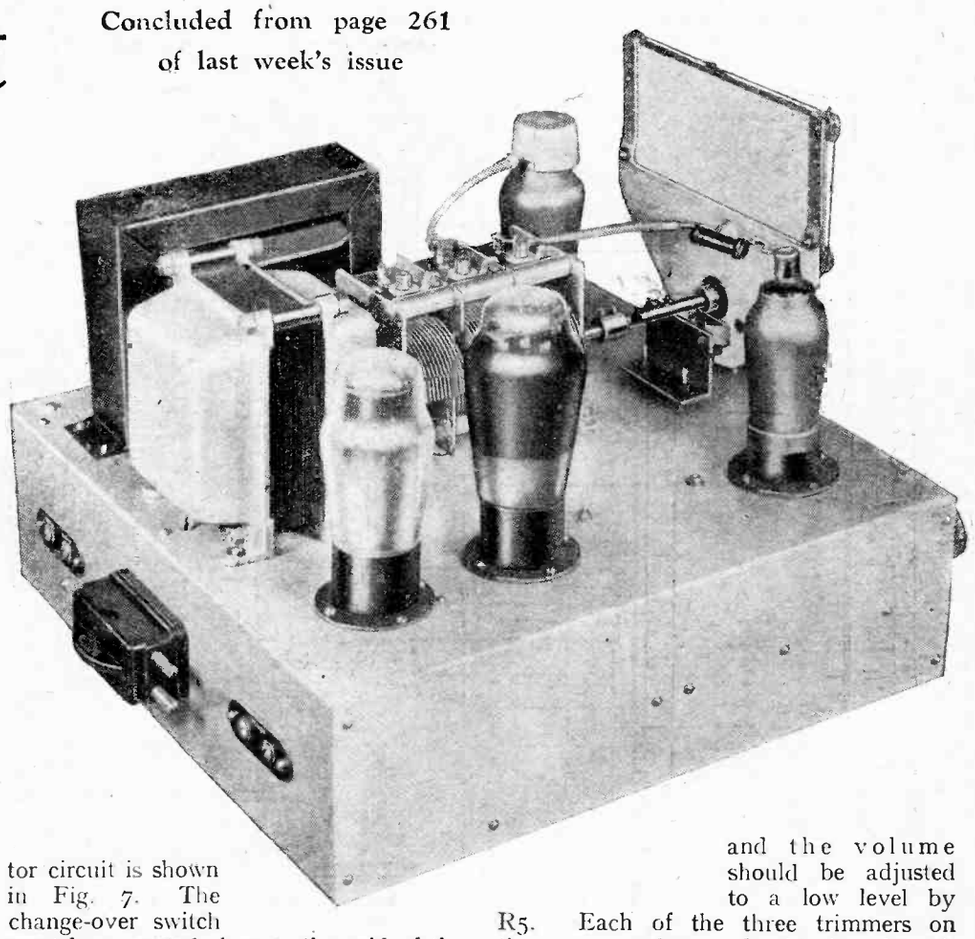


(*Right*) Fig. 6.—The complete circuit diagram of the receiver is shown here. Capacity couplings are used throughout the RF circuits.

Straight Set

D OPERATION

Concluded from page 261 of last week's issue



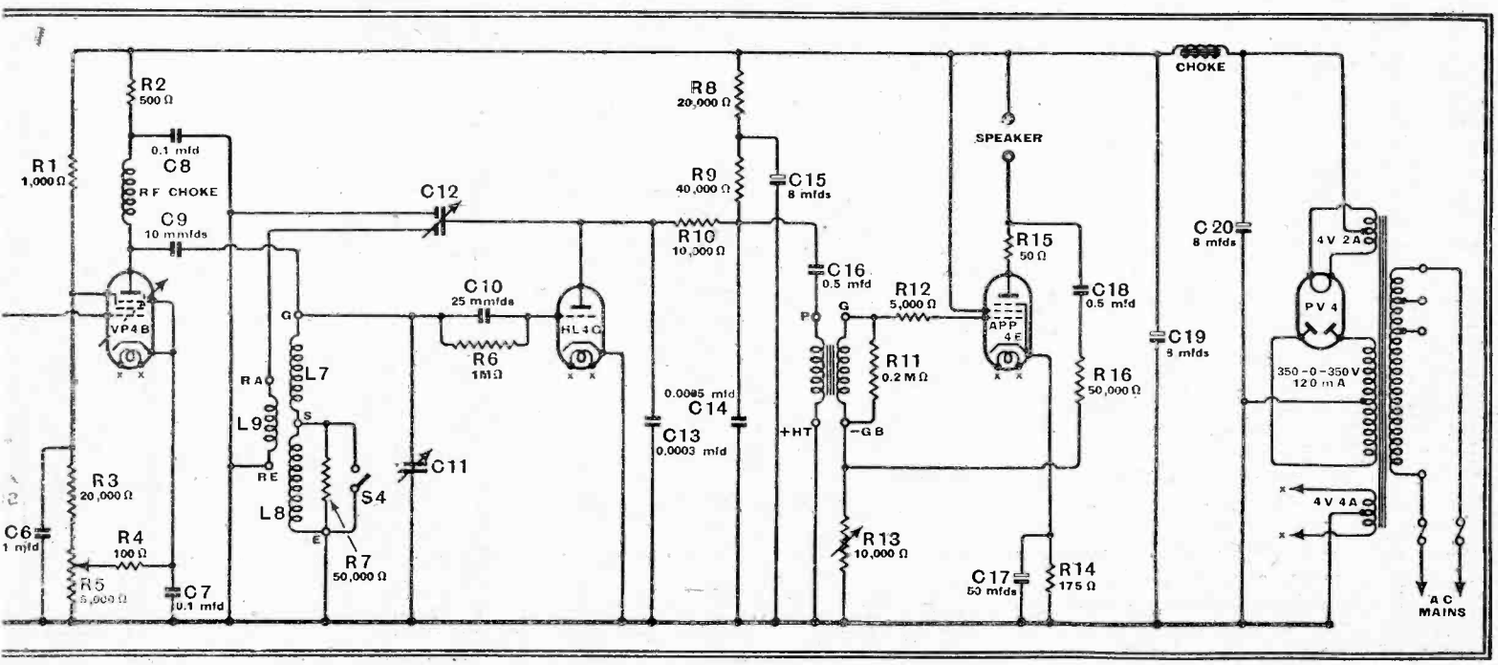
actual construction of the receiver, since this will be clear from the drawings which accompany this article. It may be remarked, however, that it is necessary to place the mounting bolts for the gang condenser through the chassis from the underside before the coils are mounted. These bolts should each have a nut run on and tightened up and the condenser can then be placed over the bolts afterwards, so that it is spaced from the chassis by the thickness of one nut. This is necessary because the heads of the fixing bolts actually come underneath some of the coils.

Adjustment and Operation

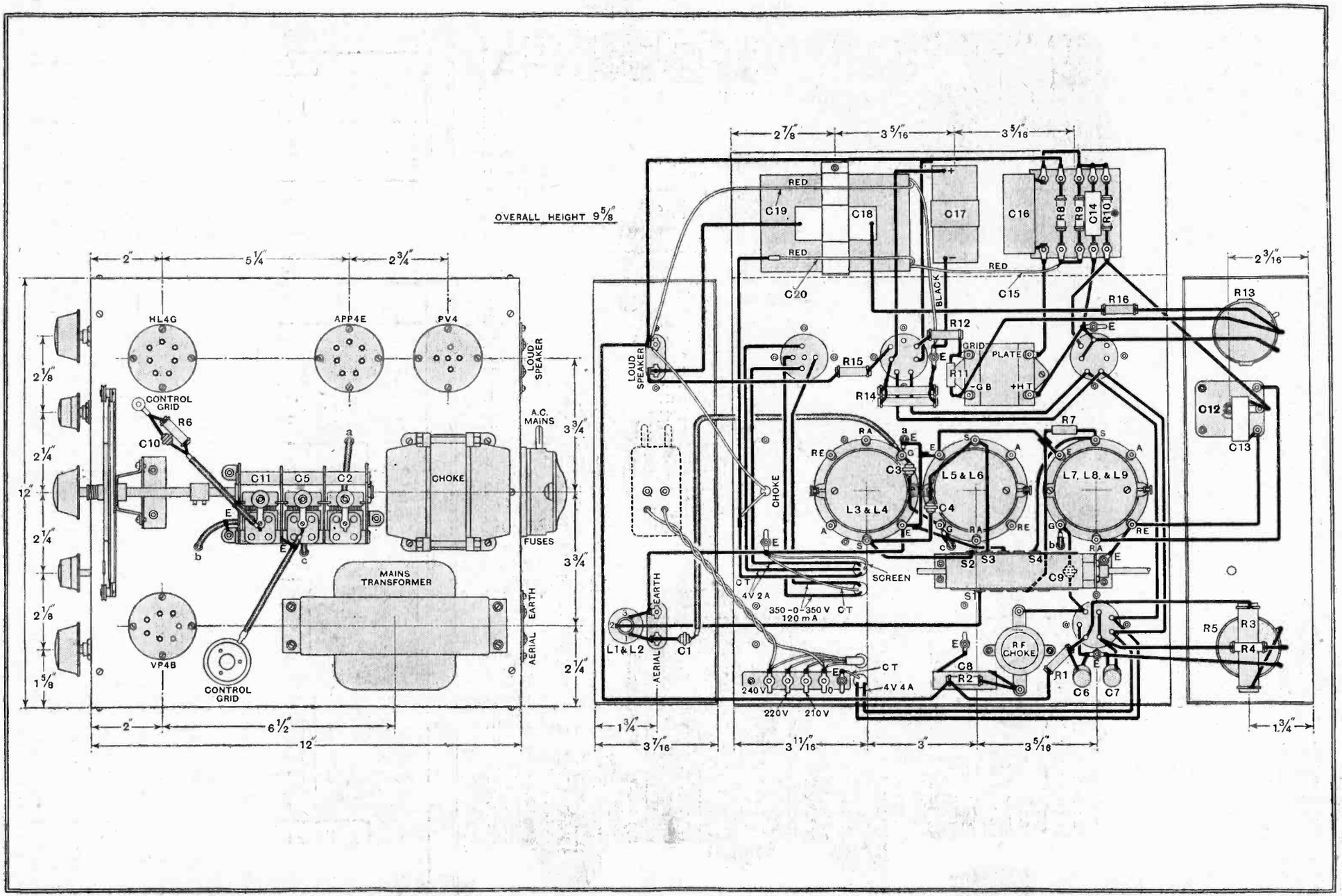
The layout of components has been carefully chosen to give a minimum of feedback effects and it is not advisable to alter it. Particular care should be taken to see that only low-capacity screened cable is used in the RF circuits. The material employed should be large-diameter Systoflex with a braided metal cover, and the internal wire should be of moderate gauge only, say No. 22. Care must also be taken to see that the frame of the gang condenser is earthed in several places. If the first point is not attended to correct ganging may not be possible, and if the second is not carried out correctly instability may be found.

No provision has been made for the use of a gramophone pick-up, in view of the complication which would result in the detector circuits. This can be done, if desired, however, and the modified detector circuit is shown in Fig. 7. The change-over switch must be mounted close to the grid of the valve so that very short leads can be employed in the RF circuit.

When setting up the receiver the feedback control, R13, should be set for maximum gain, which occurs when the resistance is a minimum. The volume control, R5, should also be set nearly at maximum and reaction, C12, at minimum. With the wave-change switch set for the medium waveband it should be possible to tune in the local station and the volume should be adjusted to a low level by R5. Each of the three trimmers on the gang condenser should then be adjusted in turn for maximum signal strength, reducing volume by R5, so that only small volume is obtained. With the circuits thus roughly adjusted it should be possible to find a station towards the bottom of the tuning scale upon which the trimmers can be adjusted accurately. If a sufficiently weak signal can be found it is best to work with the volume control, R5, at maximum and with a certain amount of reaction applied by C12. Each



CONSTRUCTION, ASSEMBLY AND WIRING DETAILS OF THE THREE-VALVE STRAIGHT SET



As explained in the text, the fixing bolts for the gang condenser must be placed in position before the coils are mounted

Three-Valve Straight Set—

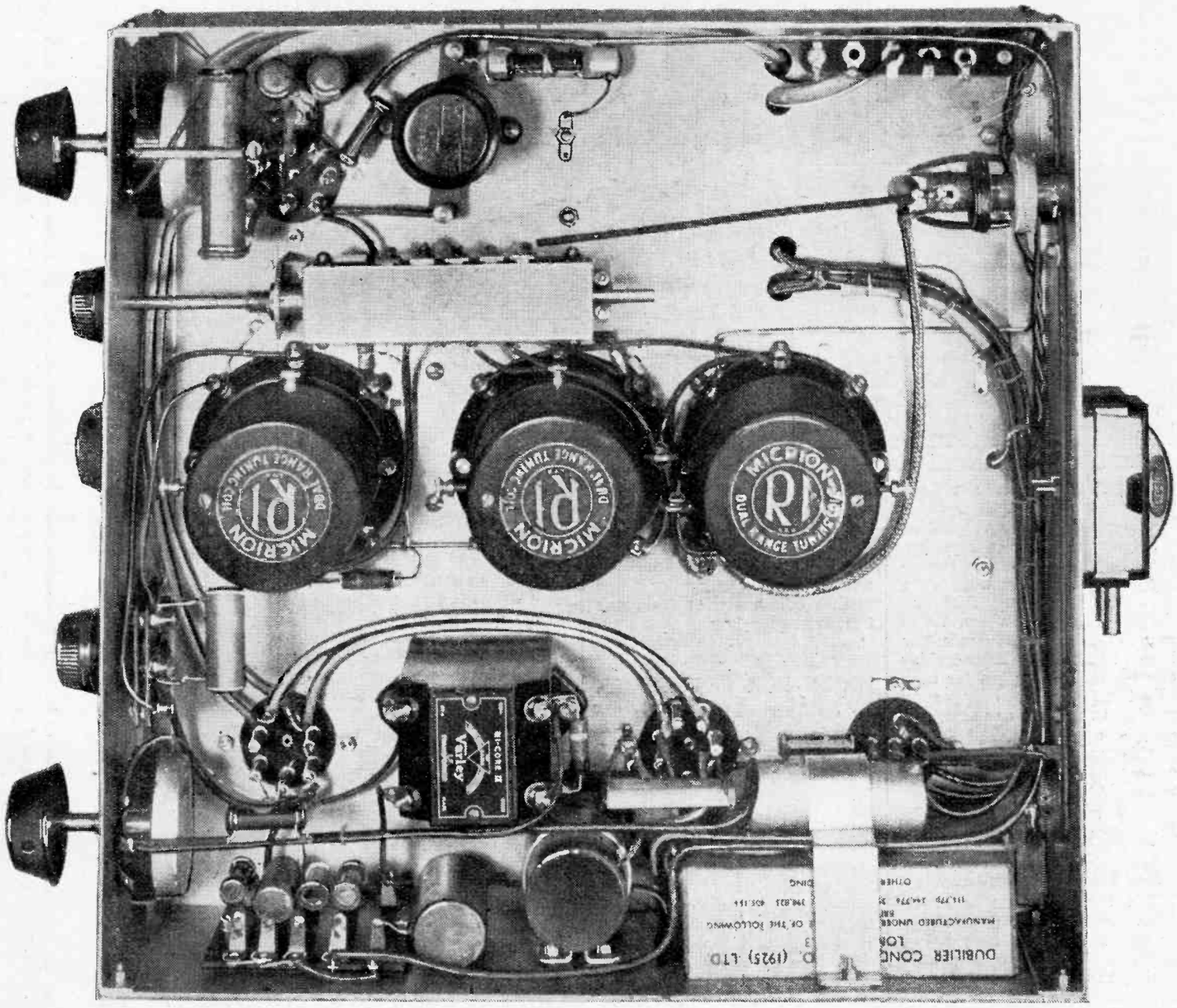
trimmer should be adjusted in turn, commencing with that of C11 and working backwards towards the aerial. Then tune in a station towards the upper end of the band and similarly adjust the three inductance trimmers for the medium-wave coils. A return should then be made to the low wavelength station and the capacity trimmers readjusted. On the medium waveband the wavelength calibration scale on the tuning condenser should hold with reasonable accuracy, and if it is found, for instance, that dial readings are consistently high, it means that the receiver has been trimmed with too little capacity in the trimmers. All three trimmers should, therefore, be screwed up a little and the station retuned at a lower setting.

On the long waveband wavelength calibration will not hold because the coils have a different inductance value from that assumed by the condenser makers in preparing their dial. The only adjustment necessary on the long waveband is to the inductance trimmers on the long-wave coils. A station towards the middle of the band should be tuned in and these trimmers adjusted for maximum response.

On test the receiver gave a very good account of itself and proved free from mains hum and on local reception gave large volume at high quality. The sensitivity and selectivity were both adequate for the reception of a large number of Continental stations, but, actually, the standard of quality was somewhat lower than in the case of local reception, partly because it is necessary to use a certain amount of reaction in the interests of selectivity and partly because one cannot employ so much negative feedback on account of the loss of signal strength which it entails. The spread of the local station proved exceedingly small and it was easily possible to obtain stations between the locals while both were working. When the utmost in selectivity is required from the set it is necessary to use critical reaction. Signal strength is then often too great and so the best course when maximum selectivity is required is to keep R5 away from the position of maximum volume and to rely upon reaction to bring back the sensitivity. That is to say, if a station is found to be suffering from interference, the best course is to reduce the volume with R5 and then bring it back again to normal by increasing C12 while retuning slightly.

So far, no mention has been made of the loud speaker. A permanent magnet type is advised, since it is not possible readily to energise the field winding of a speaker from the mains equipment; in fact, a substantial increase in the mains transformer output and rating of the smoothing condensers would be necessary if an attempt were made to energise a field. Any good quality speaker can be employed and the transformer feeding it should have such a ratio that it will give a load of 3,500 ohms on the output valve. The transformer should, of course, be capable of carrying 70 mA. in the primary.

The complete list of parts necessary for building this receiver will be found on page 299



Underside of the chassis.

NEWS OF

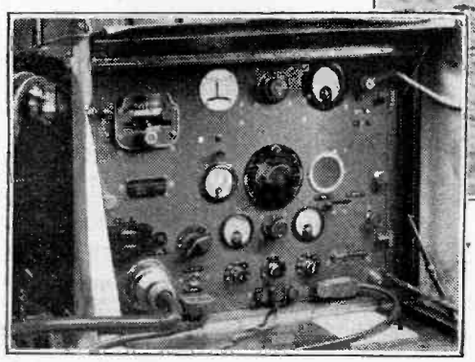
PORTABLE RECEIVERS

What the Home Licence Covers

READERS of *The Wireless World* will doubtless know that a wireless receiving licence permits the use of any number of sets in one household and that the same licence also covers the use of a portable receiver. It may not, however, be known that a separate licence is necessary for a receiver *installed* in a car, although if the owner takes his portable set with him into his car instead of installing car-radio he is covered by the home licence. The reason for this apparent inconsistency is that a portable set does not, according to the Act, constitute a fixed wireless receiving station.

What is the position regarding a receiver installed in a yacht? Here, again, a separate receiving licence is required.

In the same way that one licence permits the operation of any number of receivers in the home, so on board British ships one licence will suffice for each vessel no matter how many receivers the crew or passengers may be operating. The licence in this case is only obtainable at certain head post offices or at the G.P.O., London.



THE B.B.C. LAUNCH *Magician*, which is used for boat-race commentaries and descriptive broadcasts from the Thames, is equipped with a 100-watt Marconi transmitter (inset) designed to work on the 40-120 metre waveband. The engineers experiment until they find the frequency best suited to the local conditions and the transmissions are picked up by a receiving station located near-by.

TEST MATCH BROADCASTS

Dual Programmes for Australia

FOR the first time in short-wave history, a double programme service will be supplied by the B.B.C. to Australia during the coming summer. A transmitter working on one of the five frequencies which are normally used by Daventry for Australian transmissions will be devoted exclusively to ball-by-ball descriptions of play in the cricket Test matches each day from 2.0 p.m., B.S.T., to close of play. These hours are outside the ordinary Empire service hours to Australia, which are round about 6.0 to 8.0 a.m., and the additional service will not necessitate any revision of ordinary programme arrangements.

Experimental transmissions have proved that while reception in Australia of the Daventry transmissions can be quite satisfactory during the English afternoon hours, it is less reliable during the English morning hours; hence the decision not to use Daventry for these cricket commentaries from the time that play begins each day.

UNION FOR SERVICEMEN

An American Organisation

SKILLED wireless servicemen have always worked under the difficulty of competing with "quacks" who, during the brief period of their wireless activity, succeed in lending to the profession a reputation of inefficiency linked with "daylight robbery."

It has been advocated from time to time in *The Wireless World* that some protection should be available to qualified servicemen, and a similar recommendation has been advanced by our American contemporaries, with the result that a national organisation, Radio Service Men of America, Inc., has been formed in the United States. This organisation admits only members of local servicemen's associations, so that unqualified individuals are excluded from membership.

The radio public should soon be alive to the fact that the sign of the Association means effective attention for them, and the trouble of "dabblers" in the profession may be eventually removed.

PRESS v. RADIO

France Finds a Settlement?

THE conflict between the Press and Radio in France will soon be settled if the agreement drawn up by the National Federation of French Newspapers and the French Union of Journalists is accepted by the broadcasting authorities. It is proposed that broadcast news should be more condensed, that a brief analysis of the contents of the daily Press should be broadcast, and that the maximum time allocation should be 45 minutes of news and 15 minutes of Press reviews, divided up into six specified periods each day, beginning at 6.45 a.m. and ending at 10 p.m.

WITHOUT COMMENT

Observations from America

WE quote the following extracts, without comment, from an article entitled "The Status of Television," which appears in the April issue of our American contemporary, *American Exporter*:—

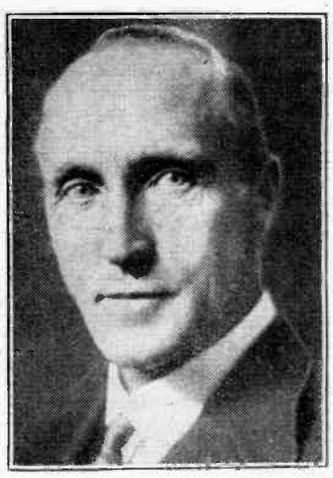
"Notwithstanding the periodic rumours that popular television is just around the corner, this problem child of the radio industry is still eluding its would-be masters in a perplexing game of hide-and-seek that is expected to continue for a long time. . . . According to most laboratory experts, television is no further advanced at the present time than was radio broadcasting in 1907.

"Subsidised by the British Government television in England, despite its public showing, is no further advanced than the American laboratory brand. Programmes are broadcast from studios in Alexandra Palace, in London, and can be picked up only in London and its immediate vicinity as the range of the transmitter is limited. The programmes themselves are very crude compared to those heard on regular radio sets or seen in the cinema. . . . As one of the British studio hands expressed it, 'We're not working; we're being paid for a hobby.'"

AMATEURS' FUTURE AT STAKE

A BATTLE over the status of the radio amateur is developing in intensity at the Cairo Conference. It is understood that Italian delegates are seeking to restrict the activities of amateur transmitters to the 7- and 14-megacycle bands, and other countries are rallying in support of this proposal.

Great Britain, on the other hand, is not forgetful of the debt which the services and commercial radio owe to the amateur, particularly in the short-wave field, and delegates from the Post Office and the B.B.C. are insisting that the amateur should receive fair treatment.



SIR CHARLES CARPENDALE, deputy Director-General of the B.B.C., who has served British broadcasting since 1923, will bid farewell to the staff at Broadcasting House on his retirement at an informal tea-party in the Concert Hall on April 1st. He will be succeeded by Mr. Cecil Graves, who is at present Controller of Programmes.

THE WEEK

SHORT WAVES AT THE RACES

NEW YORK bookmakers have sustained heavy losses as the result of the nefarious application of wireless. Racketeers equipped with short-wave transmitters have flashed the results of races from the tracks, and their confederates on receiving the information have been able to place money on the winner before the bookmakers knew the race was over.

Eight of these stations have been traced by the police, and the offenders are charged with operating wireless stations without a licence. They are liable to a maximum penalty of two years' imprisonment and a fine of £2,000 each.

ENCOURAGING LISTENING

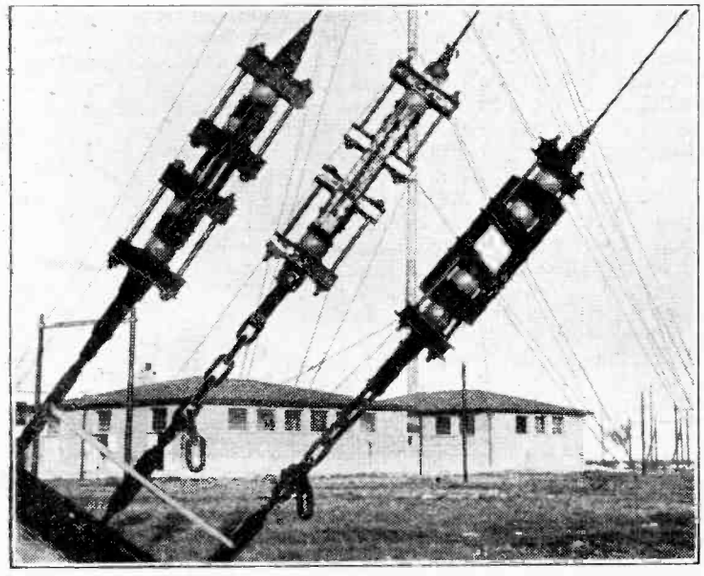
IN Switzerland the postmark on letters is being used to encourage listening. It exhorts people to "become listeners."

A competition has been started in Italy with a view to increasing the number of listeners. Licence-holders who introduce new listeners in their own districts are given a coupon which will entitle them to one of many prizes, which vary according to the number of coupons obtained. For one, a book or gramophone record will be given, while 100 coupons entitles the holder to a five-valve set or a nine-day first-class trip to Tripoli.

FROM ALL QUARTERS

Car Radio in America

OUR American contemporary, *Radio Retailing*, has been investigating the possible sales of car radio receivers in the U.S.A. during this year. It is estimated that of the three million new cars likely to be sold at least 2,225,000 will be fitted with radio. It is also pointed out that of the ten million cars in use which are over seven years old the majority are not fitted with car radio, and here is, therefore, another big market.



PARIS-ONDES COURTES, the new 25kW station at Essarts-le-Roi, near Paris, is designed to work on the 16, 19, 25, 31 and 50-metre wavebands. The directional aerial array is carried on wooden masts, and the station, which was opened by the French P.M.G. on March 23rd, will begin its regular transmissions on April 1st. The insulators in the foreground of the picture are part of the Radio Paris aerial system.

The Best Station in America

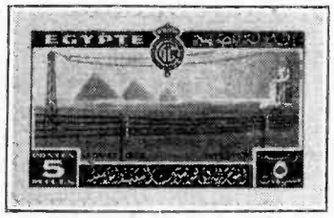
DURING WEAF's 6,380 hours on the air in 1937, for only three minutes twenty-nine seconds was the station silent due to breakdowns. For this excellent record the station has been awarded the General Electric Plaque, which is given annually to the American station which shows the best technical performance.

No Interference

SUPPRESSOR condensers have been fitted to the electric trolley-buses plying along the 2½-mile route between Hartlepool and West Hartlepool.

Seeking Parliamentary Aid

THE Paddington Borough Council Improvements Committee has suggested that the problem of dealing with electrical interference should be brought before the Metropolitan Boroughs' Standing Joint Committee with a view to obtaining Parliamentary jurisdiction on the matter.



CAIRO, 1938, is written in Arabic and French on the recently issued Egyptian stamp commemorating the Telecommunications Conference. Superimposed on the design, which depicts the Pyramids of Gizeh and the Sphinx, are a wireless aerial and telegraph lines.

A Short-wave Link

IMMEDIATELY behind Herr Hitler's car during his drive through Austria was another car, equipped with a short-wave transmitter, which carried the broadcast commentators. When they spoke no extraneous noises were heard, as they were using the new German lip microphones. The cheering and the crowd noises were picked up by two ordinary microphones mounted close to the headlights of the car.

Coast Wireless at Glasgow

A REPLICA of a Post Office Coast Wireless Station will be set up at the Glasgow Exhibition, which the King will open on May 3rd. Operators from the North of Scotland will be in charge of it, and visitors will be allowed to speak to the masters of trawlers at sea.

Austrian Delegation at Cairo

CONSEQUENT upon the announcement made on March 19th by the German Post Office that it had taken over the former Austrian Postal and Telegraph Administration, the Austrian delegation at the Cairo Telecommunications Conference were instructed to join the German delegation and act as one.

No C.B.S. Television Yet

THE experimental television transmissions which the Columbia Broadcasting System had hoped to start early this year will not begin until the late summer, if then. The R.C.A. have not finished the transmitter, owing to changes in specifications, and its installation in the Chrysler Tower and testing period will occupy some months.

Another Marconi Memorial

IT is proposed by Rotarians of Cardiff, Penarth and Barry to erect a memorial to the late Marchese Marconi at Lavernock, between Penarth and Barry, at the spot where he first transmitted signals across the Bristol Channel.

Police Wireless

THE police wireless station at West Wickham, described in *The Wireless World* of October 29th, 1937, cost roughly £43,000, according to a recent estimate in *The Police Review*.

New F.R.S.

AT the recent election of Fellows of the Royal Society, Mr. T. L. Eckersley, the well-known research physicist, who is with Marconi's Wireless Telegraph Company, was elected.

German-Austrian Listeners

WITH the annexation of Austria, German radio listeners now number more than 10,000,000. At the end of January Austria had only 590,000 licences in force. Listeners in Austria who have until now paid roughly £1 per annum for a licence, will in future have to pay the German fee, which under the new valuation of the Austrian currency, will cost about 10s. more.

Free Receivers in Austria

TWENTY thousand receivers, mostly Volksempfangers, have been sent to Austria by the Party authorities for distribution among needy Austrians.

New B.B.C. Cables

IN the recently issued report for the Birmingham Postal Area of the Postal, Telegraph and Telephone Services, it is disclosed that the laying of two cables in the district, specially for the use of the B.B.C., has cost £50,000.

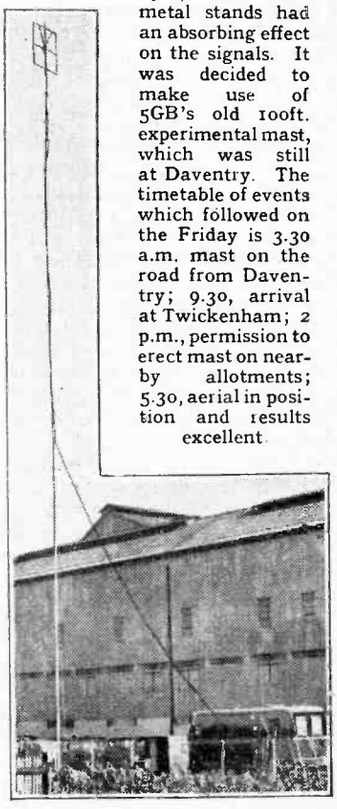
French Propaganda

RADIO will play an important part in the French Ministry of Propaganda which has just been formed under the control of M. Frossard, a journalist.

I.E.E.

THE monthly meeting of the I.E.E. Wireless Section will be held on Wednesday, April 6th, at 6 p.m. at Savoy Place, London, W.C.2, when a paper by Messrs. A. J. Gill, B.Sc.(Eng.), and S. Whitehead, M.A., Ph.D., on "Electrical Interference with Radio Reception" will be read.

QUICK WORK was necessary by the Television O.B. engineers when it was found, during tests on the Thursday prior to the International Rugger Match at Twickenham on March 19th, that the metal stands had an absorbing effect on the signals. It was decided to make use of 5GB's old 100ft. experimental mast, which was still at Daventry. The timetable of events which followed on the Friday is 3.30 a.m. mast on the road from Daventry; 9.30, arrival at Twickenham; 2 p.m., permission to erect mast on nearby allotments; 5.30, aerial in position and results excellent.



Letters to the Editor

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

High-quality Recordings

THE recent correspondence which has appeared in the columns of your paper about the variable standard of quality which apparently exists amongst recording companies is very interesting, and my own experiences fully substantiate those already printed.

It seems to me, however, that a very important link in the reproducing chain has been overlooked by the contributors—namely the needle. What kind of needle do most readers use? The "once only" type, the permanent (50 sides) or the semi-permanent (10 sides)? The writer, after many trials of various kinds, has arrived at the conclusion that the "once only" needle gives the best performance and has the least harmful effect on the surface, but it would be very interesting to hear the verdicts of other readers on this matter.

Plymouth. S. W. AMOS, B.Sc.

Electrical Interference

AS a regular reader of your journal and one who has never written you before, may I ask for attention to be given to this letter, as it refers to a question that is interesting to all those who follow the developments of radio and television closely, viz., Interference. By the term I mean the electrical radiation from vacuum cleaners, car ignition, hair dryers, etc., etc., and would like to relate a personal experience.

A salesman from a well-known vacuum cleaner firm demonstrated a "super" model costing over 20 guineas, and when asked if it was fitted with suppressors, gave the reply "Who wants to listen to the radio when working; in any case, our firm believe in giving you the maximum motor efficiency, and this cannot be done when suppressors are fitted." When asked to explain how he accounted for this, he could not give a "technical explanation," and went on to say that his firm would not be prepared to fit anything to cut out radiation further. In the event of the machine being touched the guarantee becomes void—this, of course, we would realise. Of course, everyone has his own opinion as to whether radio and work mix, but to my mind the outstanding point is that one of the leading manufacturers of these domestic appliances should be producing equipment that causes poisonous interference. I do not expect the small producer who puts a cheaper machine on the market to take the lead in this field; it is up to the larger firms to do so.

Are the manufacturers of the various electrical equipment waiting until it becomes compulsory by law to fit suppressors? The present efforts to "sell" television to the public can hardly succeed while such circumstances exist.

It is bad enough operating a short-wave receiver even when a screened down lead and transformer are fitted; cleaners, cars, refrigerators, violet-ray equipment, all destroy the pleasures that radio could afford, and I have attended more television demonstrations than I care to mention. When the public learn that "snow effect" or "flashes" are due to cars, trolley buses, or trains (electric), they immediately lose interest in the apparatus.

When thousands of such machines are being released to the public daily, cannot the B.B.C., the Post Office, the R.M.A. and others, get together and put some pressure on the manufacturers concerned?

ARTHUR WARRINER.

Orpington, Kent.

"Why Not Two Sets?"

IN connection with the article by Mr. Wallace, "Why Not Two Sets?" we think that our latest dual circuit, that is to say, the straight and superhet circuit combined in one set, is the very thing Mr. Wallace is looking for.

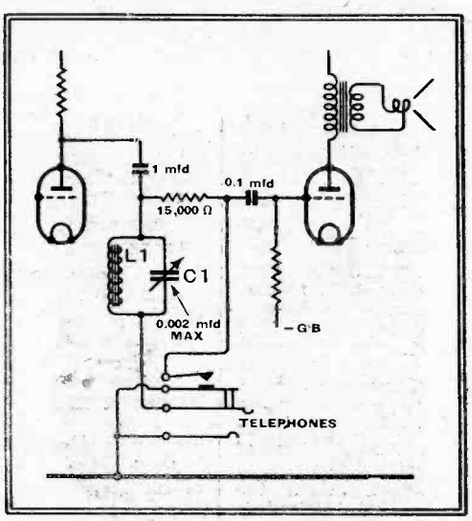
Also, with regard to the latter part of Mr. Moody's letter in your issue of March 17th, we would point out that every set we manufacture has a switch for cutting out the main speaker, a switch for cutting out the external speaker, and also provision for connecting headphones if required.

B. HALFORD, Halford Radio.

London, W.1.

Satisfactory Headphone Reception

AS one possessing neighbours who object to loud speakers running in the "small hours" I have very often had recourse to headphones. My first effective impressions were that the "tone" of the headphones was, to say the least of it, somewhat horrid. As most of this distortion seemed to be due to a peak at about 3,000 cycles, I tried a tuned rejector circuit which was such a success that I have now built it into my receiver permanently.



Tuned rejector circuit to remove headphone peak resonance.

The circuit is illustrated herewith, little comment being required regarding its action beyond the fact that the setting of C1 is fairly critical for the best reproduction; L1 is the primary of an old transformer of about 15 henries.

The method of switching is a little unusual, but is adopted in order to avoid leaving the grid of the output valve "up in the air," and also to make the switching automatic by using a 'phone jack (the headphones should in any case be disconnected when not in use). The 'phone jack, incidentally, is home-made, being a two-pin plug, the sockets being arranged with an additional springy contact to do the switching.

Wimbledon. R. G. YOUNG.

Down to Earth

IN these days when we are continually being reminded of the necessity to keep our aerials well above earth and above earthed objects, it is rather "refreshing" to know that I am using an aerial of 100 feet in length which is *laid along the ground* in an approximate direction west to east from the house.

We have so often heard that "Necessity is the Mother of Invention," and it certainly was the Mother (or Father) of my earth aerial! My aerial mast having blown down, it occurred to me to try my luck along the ground, and I am now getting nearly as good results on the broadcast wavelengths as I previously did with my shorter aerial "up the pole."

It is much too early to give more detailed particulars except to say that during the first experiments the aerial *would not function in other directions* in which it was tried. I am apparently picking up wireless waves along the surface of the earth in an approximate west-to-east, or east-to-west direction. As stated, it is much too early to give any definite detailed particulars.

I have not yet tried it on the short wavelengths.

I must say that there is no question of re-radiation from an outdoor aerial or from the electric light mains, because there are none. Some distance away runs a railway line, but this hardly seems likely to have any bearing on the subject. In any case, I cannot remove it to find out!

I should also say that the stations can be tuned in the usual manner, and when the ordinary earth tube was disconnected the reception ceased. D'ARCY FORD.

Exeter.

Dry-cell LT

THE following little tip may be useful to those of your readers who use your excellent little "Radio Companion." I find the only snag with this set is the jelly-acid accumulator. This is usually either run down or deteriorated when the set is required in a hurry. I am afraid few of us are careful enough to keep this little accumulator charged. The three little valves require about 0.2 amp. to run. A 5-ohm resistor and a small standard two-cell dry battery (similar to that used in some deaf-aid appliances) make an excellent and satisfactory substitute for the accumulator. The batteries can be obtained anywhere and renewed at short notice. With intermittent use their life is quite long.

Derby. W. HUBERT WILLIAMS.

Battery Portables of 1938

BRIEF SPECIFICATIONS OF THE LEADING MAKES

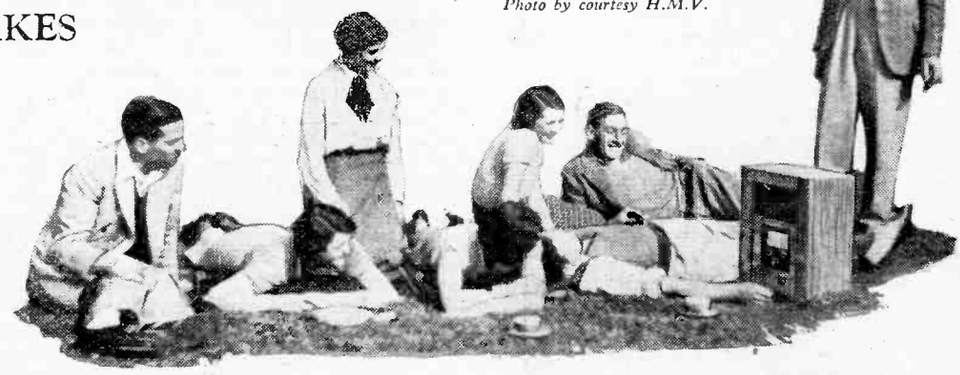


Photo by courtesy H.M.V.

IN preparing this list of battery portables we have tried to emulate the set designers in condensing as much material as possible into the space available. It is intended primarily as a reminder of the makes and types in the market at the present time and gives the essential information necessary in order to make a preliminary selection.

The weights given include batteries which in many cases are of the same size as are used in ordinary broadcast receivers. Although there are some notable examples of superheterodyne portables, the majority rely on a three- or four-valve straight circuit with reaction in the detector stage to give the requisite sensitivity.

For the sake of completeness, battery transportables intended primarily for indoor use have been included, as also are some examples of car radio sets which are essentially battery-operated portables.

AERODYNE

MODEL 296.—Waveranges: (1) 200-550 metres. (2) 800-2000 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; pentode output valve. Automatic grid bias. **Weight:** 26lb. **Dimensions:** 11½in. by 9½in. by 7½ in. **Price:** £5 19s. 6d.

A VERTICAL-TYPE cabinet is used to house this receiver. The control panel is recessed, and slopes at a convenient angle for tuning. The loud speaker is of the permanent magnet moving-coil type, and the specification includes a 108-volt HT battery.

Aerodyne, Ltd., Platina Street, London, E.C.2.

ALBA

MODEL 25.—Waveranges: (1) 200-550 metres. (2) 800-2000 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; pentode output valve. Automatic grid bias. **Weight:** 28lb. **Dimensions:** 11½in. by 9½in. by 7½in. **Price:** £5 19s. 6d.

THE cabinet is of the vertical type with a sloping control panel immediately above permanent magnet moving-coil loud speaker grille. A 108-volt battery supplies HT current,and there is provision for an external aerial and earth.

A. J. Balcombe, Ltd., 52-58, Tabernacle Street, London, E.C.2.

BEETHOVEN

MODEL P202.—Waveranges: (1) 200-550 metres; (2) 950-2000 metres. **Circuit:** Screen grid RF amplifier; triode detector with reaction; triode first AF amplifier; pentode output valve. Automatic grid bias. **Weight** 12¾lb. **Dimensions:** 9in. by 8½in. by 5in **Price:** 7 guineas.

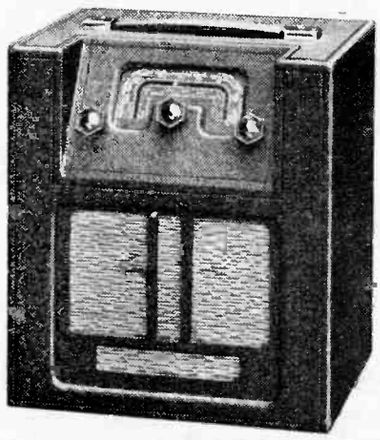
THE controls are placed at the top of the black leather-cloth case which is mounted on a ball-bearing turntable. Tuning is by means of a rubber-mounted air-dielectric condenser the scale of which is station calibrated. Dial illumination is optional. The loud speaker is of the moving-coil type, but another model (P101) with balanced armature speaker is available at 6 guineas.

MODEL P107.—Waveranges: (1) 200-500 metres. (2) 900-2000 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; triode first AF amplifier; pentode output valve. Battery grid bias. **Weight:** 24¼lb. **Dimensions:** (Closed) 8in. by 11in. by 12in. **Price:** 8½ guineas.

This receiver is of the suitcase type, and can be locked when not in use. The exterior finish is black leather-cloth, and the interior walnut with sycamore inlays. A turntable is provided, and the loud speaker, which is mounted in the lid, is of the moving-coil type. As in the Model P202, the tuning scale is station calibrated, and is provided with an optional indicator light.

MODEL AD303.—Waveranges: (1) 16-50 metres; (2) 200-550 metres. (3) 900-2000 metres. **Circuit:** Triode-hexode frequency changer; pentode IF amplifier; double diode triode second detector; AVC rectifier and first AF amplifier; pentode output valve. Half-wave valve rectifier. **Weight:** 15lb. **Dimensions:** 10½in by 10½in. by 6in. **Price:** (Receiver) £10 17s. 6d. (Converter unit) £5 15s.

Although this receiver is primarily for universal mains operation, its compact size and the fact that it can be operated through the medium of a converter unit from a car battery justifies its inclusion in this series. The specification is unusually complete having regard to the small dimensions of the set, and includes wet electrolytic condensers for smoothing, a 2½-watt output stage and a steel chassis specially designed to give uniform temperature distribution under working conditions. The converter unit, which is of the vibrator type, may be obtained for 6- or 12-volt systems, and the power consumption is approximately 75 watts.



Alba Model 25.

Beethoven Radio, Ltd., Chase Road, North Acton, London, N.W.10.

B.T.S.

"LITTLE PRINCESS" PORTABLE.—Waveranges: (1) 200-550 metres; (2) 1000-2100 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; triode first AF amplifier; tetrode output valve. Battery grid bias. **Weight:** 18½lb. **Price:** 8 guineas.

THE provision of a telephone jack makes this receiver suitable for the sick-room or bedroom as well as for out of doors when the permanent magnet moving-coil loud speaker would be used. The output valve is a Hivac-Harries tetrode, and another interesting feature of the circuit is the combined reaction and AF volume control, which consists of a solid dielectric condenser with 90-degree vanes coupled to a carbon track resistance with triple-contact brush arm.

British Television Supplies, Ltd., 8-10, Charing Cross Road, London, W.C.2.

BURNDEPT

MODEL 247.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Pentode RF amplifier; pentode detector with reaction; pentode output valve. Battery grid bias. **Weight:** 17lb. **Dimensions:** 11in. by 7in. by 9in. **Price:** £7 2s. 6d.

THE carrying case is of the suitcase type with a moving-coil loud speaker in the lid. The receiver unit is compact, and is mounted to the right of the lower compartment, leaving ample room for batteries of adequate capacity. Optional tuning-dial illumination is provided.

MODEL 292.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Octode frequency changer; pentode IF amplifier; double diode triode second detector pentode output valve. Battery grid bias. **Weight:** 20lb. **Dimensions:** 11½in. by 7in. by 11in. **Price:** Not yet announced.

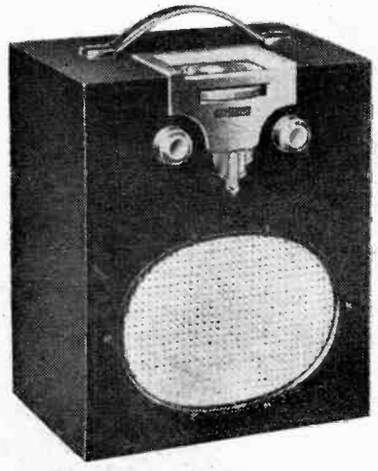
A well-designed cabinet with rounded corners and a lid to protect the control panel has been developed for this latest addition to the range of Burndept receivers. The superheterodyne circuit brings the advantages of high sensitivity and automatic volume control, and other special features include a 20-AH accumulator and press-button control for the scale illumination.

Burndept, Ltd., Light Gun Factory, Erith, Kent.

COSSOR

MODEL P44.—Waveranges: (1) 200-550 metres; (2) 850-2000 metres. **Circuit:** Pentode RF amplifier; pentode detector with reaction; triode first AF amplifier; tetrode or pentode output valve. Automatic grid bias. **Weight:** 22lb. **Dimensions:** 12⅜in. by 10¼in by 7⅞in. **Price:** £6 19s.

A NEAT edgewise knurled control actuates the station-calibrated dial at the top of the black leather-finished case. The HT battery has a voltage of 120, and an item



Cossor Model P44.

of unusual technical interest is the inclusion of an indirectly heated 2-volt valve in the detector stage to avoid microphonic troubles. Headphones may be used with the set, and a jack switch is arranged to cut out the internal loud speaker as required.

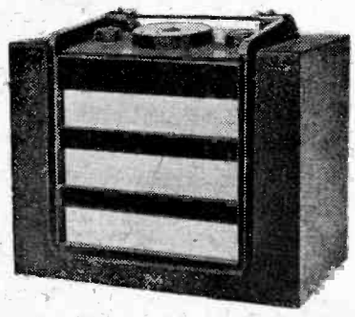
A. C. Cossor, Ltd., Highbury Grove, London, N.5.

EKCO

MODEL P148.—Waveranges: (1) 200-550 metres. (2) 1000-2000 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; triode first AF amplifier; pentode output valve. Automatic grid bias. **Weight:** 17lb. **Dimensions:** 11½in. by 9¼in. by 7in. **Price:** £7 19s. 6d.

THE carrying handle is neatly incorporated in the moulded inset forming the control panel and loud speaker fret. The tuning scale is mounted inside the main tuning knob, and is traversed by a hair line engraved in a transparent disc. Sockets are provided for headphones, and the internal loud speaker may be disconnected. The black rexine-covered case is available with either a green or maroon moulded inset.

E. K. Cole, Ltd., Southend-on-Sea, Essex.



Ekco Model P148.

EVER READY

MODEL 5041.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; triode first AF amplifier; pentode output valve. **Weight:** 18½lb. **Dimensions:** 11½in. by 9½in. by 7½in. **Price:** £6 19s. 6d.

THIS receiver is the very latest addition to the Ever Ready range, and deliveries will begin in a few days' time. It is housed in a mottled navy-blue leatherette case with the tuning dials and controls at the top.

MODEL 5010. — Waveranges: 200-570 metres; (2) 900-2000 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; triode first AF valve; pentode output valve. Battery grid bias. **Weight:** 31lb. **Dimensions:** (Closed) 13in. by 8½in. by 15in. **Price:** 9 guineas.

The mounting of the loud speaker in this suitcase model is unusual. Instead of being housed in the lid, it is contained in a box baffle in the lower compartment, and is automatically tilted upwards when the lid is opened.

MODEL 5035.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Screen grid RF amplifier; triode detector with reaction; triode driver valve. Class B output stage. Battery grid bias. **Weight:** 38lb. **Dimensions:** 16½in. by 19in. by 9in. **Price:** 10 guineas.

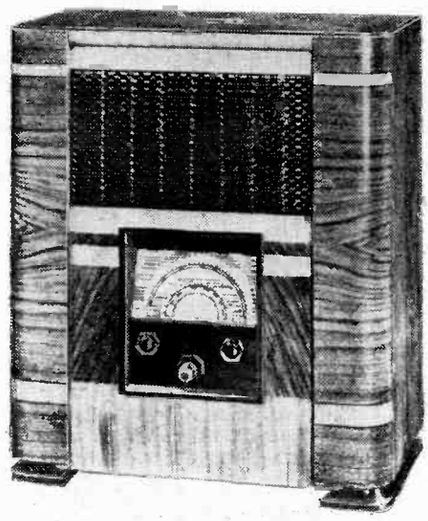
The polished walnut cabinet inlaid with sycamore specially fits this instrument for indoor broadcast reception as well as for outdoor use. The push-pull output stage is in itself an important qualification for the former role, and it is worthy of note that there is also provision for a gramophone pick-up.

Ever Ready Radio, Ltd., Hercules Place, Holloway, London, N.7.

H.M.V.

MODEL 464.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Pentode RF amplifier; heptode frequency changer; pentode IF amplifier; double diode triode second detector; separate beam tetrode or pentode output valves in QPP. Automatic grid bias. **Dimensions:** 20¾in. by 17¾in. by 9¾in. **Price:** 12½ guineas.

THIS receiver is intended primarily as an indoor transportable and with less restriction on weight HT batteries totalling



H.M.V. Model 464

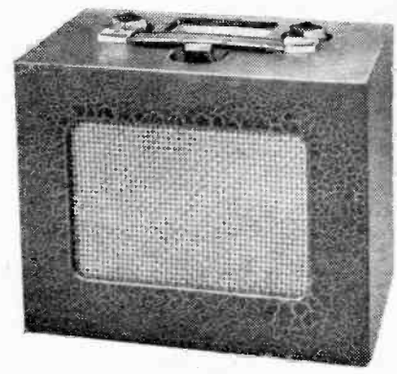
168 volts are used. These are divided into two units to give even weight distribution, since a turntable is fitted on the underside of the walnut cabinet. The undistorted power output is 1 watt, and a three-position tone control is provided.

The Gramophone Co., Ltd., 98-108, Clerkenwell Road, London, E.C.1.

LISSEN

MODEL 8409.—Waveranges: (1) 220-550 metres; (2) 850-2000 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; triode first AF amplifier; pentode output valve. Automatic grid bias. **Weight:** 18½lb. **Dimensions:** 11½in. by 9½in. by 7½in. **Price:** £6 19s. 6d.

THE cabinet lines are simple, and a special claim is made for the durability of the finish, which includes silver-plated fittings.



Lissen Model 8409.

The tuning control is of the slow-motion type, and the volume control is effected by varying the bias on the variable-mu RF amplifier.

Lissen, Ltd., Angel Road, Edmonton, London, N.18.

McCARTHY

MODEL PB4.—Waveranges: (1) 190-510 metres; (2) 900-1900 metres. **Circuit:** Pentode RF and AF amplifier; pentode detector with reaction; pentode output valve. **Weight:** 16½lb. **Dimensions:** 10¾in. by 7⅝in. by 13⅜in. **Price:** 6 guineas.

McCarthy Model PB4.

THE circuit of this receiver is interesting for the fact that the first valve is reflexed and functions both as an RF and AF amplifier. The specification includes a 7in. moving-coil loud speaker, and the case, which is fitted with a turntable, is available with red, blue or green weatherproof finish.

McCarthy Radio, Ltd., 44a, Westbourne Grove, London, W.2.

McMICHAEL

MODEL 367.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Screen grid RF amplifier; triode detector with reaction; triode first AF amplifier; pentode output valve. Automatic grid bias. **Weight:** 22½lb. **Dimensions:** 13½in. by 13½in. by 7½in. **Price:** £8 18s. 6d.

THE permanent magnet moving-coil loud speaker is contained in the lid of this suitcase model, and there is also provision for the use of headphones. The tuning arrangements are unusually lucid, and consist of three separate scales showing medium- and long-wave station names and wavelengths.

A de luxe version, the Model SMC, with furniture hide finish and polished ebonite panels is available at 15 guineas. It is fitted with the McMichael semi-circular "Duplex" dial in which the length of the

Battery Portables of 1938—

pointer is automatically adjusted by the wave-range switch.

MODEL 373.—Waveranges: (1) 19-50 metres; (2) 200-550 metres; (3) 900-2000 metres. **Circuit:** Pentode RF amplifier; triode-pentode frequency changer; pentode IF amplifier; double diode triode second detector; QPP output valve. Automatic grid bias. **Dimensions:** 22¼in. by 17in. by 11½in. **Price:** 14 guineas.

Designed primarily as a transportable for the flat-dweller, this instrument is capable of receiving short as well as medium and long waves on self-contained frame aerials. The output power is 600 milliwatts, and

McMichael Model 367.

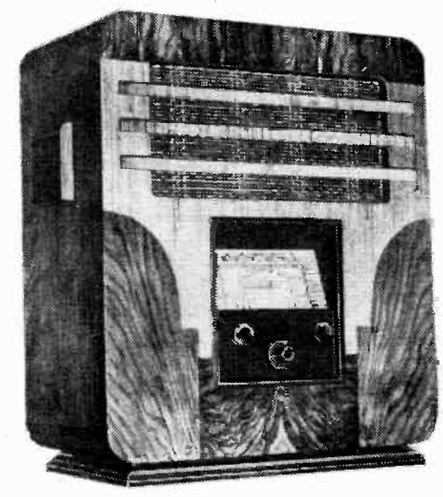
pick-up sockets are provided as well as external speaker sockets arranged to cut out the internal speaker if desired. The fly-wheel system of tuning has been adopted, and the coloured tuning scale is selectively illuminated on each of the three wavebands.

McMichael Radio, Ltd., Slough, Bucks.

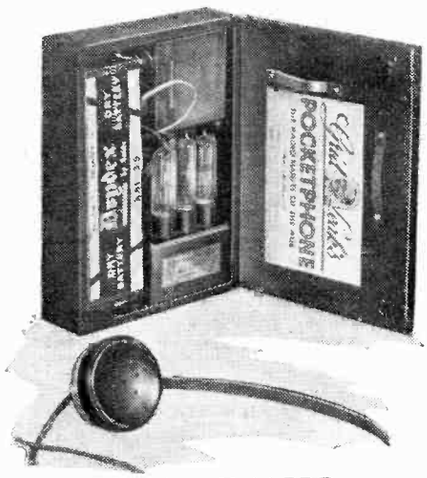
MARCONIPHONE

MODEL 562.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Pentode RF amplifier; heptode frequency changer; pentode IF amplifier; double diode triode second detector; separate beam tetrode or pentode output valves in QPP. Automatic grid bias. **Dimensions:** 20⅝in. by 18¼in. by 9½in. **Price:** 12½ guineas.

A SUPERHETERODYNE circuit with signal frequency RF stage is employed in this battery transportable. The figured walnut cabinet is mounted on a turntable and provided with side carrying handles. To obtain even weight distribution the HT battery is divided into two 84-volt units. The tuning scale is illuminated, and there is provision for using a gramophone pick-up and external loud speaker.



Marconiphone Model 562.



Pocketphone Model DB/P.

POCKETPHONE

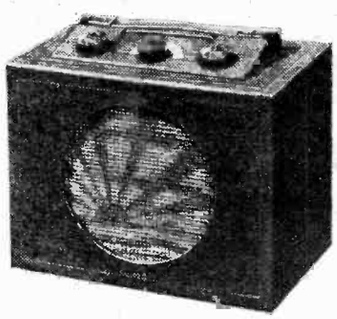
Waverange: Medium waves (not calibrated). **Circuit:** Triode RF amplifier (resistance-coupled); triode detector with reaction; triode output valve. **Weight:** 2½lb. **Dimensions:** 5¼in. by 7½in. by 1¾in. **Price:** £3 19s. 6d.

THIS compact little receiver is designed for headphone reception of B.B.C. (50 kW) stations up to 50 miles, and may be obtained to be operated from an accumulator or a cycle lamp dry battery for filament current. The latter model, which is known as the Type DB/P, costs £3 8s. 6d. complete with lightweight phones.

A. Reid Manufacturing Co., Ltd., 14a, Clerkenwell Green, London, E.C.1.

PYE

"BABY Q."—Waveranges: (1) 200-554 metres; (2) 900-2080 metres. **Circuit:** Pentode RF amplifier; triode second detector; triode first AF amplifier; pentode output valve. Automatic grid bias. **Weight:** 17½lb. **Dimensions:** 9in. by 11in. by 7in. **Price:** 8 guineas.



Pye "Baby Q."

THIS compact little instrument has a sloping bakelite control panel, which is also adapted to take the flexible carrying handle. Headphones may be used with this receiver, and the jack is arranged automatically to cut out the internal moving-coil loud speaker.

MODEL QPB.—Waveranges: (1) 18.3-52 metres; (2) 196-567 metres; (3) 900-2000 metres. **Circuit:** Pentode RF amplifier; octode frequency changer; pentode IF amplifier; double diode triode second detector; QPP output stage. Battery grid bias. **Dimensions:** 18¼in. by 17in. by 10in. **Price:** 15 guineas.

Reception of short waves in addition to medium and long on self-contained aerials is by no means the only special feature of this transportable. On the two latter waveranges inter-station noise suppression is available, and in one position of the tone-control switch reverse feed-back is introduced into the AF circuits. The loud speaker is of the oval diaphragm type, and is stated to have a frequency response to more than 10,000 cycles.

Pye, Ltd., Radio Works, Cambridge.

ROBERTS

MODEL M4B.—Waveranges: (1) 200-550 metres; (2) 1000-2000 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; triode driver valve; Class B output stage. Battery grid bias. **Weight:** 23lb. **Dimensions:** 11½in. by 11¾in. by 8in. **Price:** 9 guineas.

A COMPACT receiver chassis enables a standard type HT battery and 20-AH accumulator to be used in this suitcase

Roberts Model M4B

portable. The tuning scale is calibrated both in wavelengths and stations, and the 6½in. diameter loud speaker is mounted in the lid of the cabinet.

Roberts Radio Co., Ltd., 41, Rathbone Place, London, W.1.

SPENCER

"MIDGET FOUR."—Waveranges: (1) 200-580 metres; (2) 900-2000 metres. **Circuit:** Octode frequency changer; pentode IF amplifier; double diode triode second detector; QPP output stage. Automatic grid bias. **Weight:** 23½lb. **Dimensions:** 13in. by 11¾in. by 7½in. **Price:** 10 guineas.

Spencer "Midget Four"

Battery Portables of 1938—

THE cabinet is of the suitcase type and is designed to take HT batteries of standard size. The circuit includes iron-cored IF transformers and delayed AVC is provided. There is a continuously variable tone control and a manually operated frame aerial trimmer to ensure the maximum performance at all parts of the tuning range.

Gordon Elf, Ltd., 17a, Hanover Square, London, W.1.

Vidor Model 283

VIDOR

MODEL 272.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres **Circuit:** Pentode RF amplifier; pentode detector with reaction; pentode output valve. Battery grid bias. **Weight:** 16lb. **Dimensions:** 11in. by 7in. by 10½in. **Price:** £6 19s. 6d.

THE tuning dial in this model is illuminated, but the pilot-light may be switched off if desired. Black leatherette covering is used for the case, which opens and has a lightweight moving-coil loud speaker mounted in the lid.

Wayfarer "Major"

MODEL 288.—Waveranges: (1) 200-500 metres; (2) 900-2000 metres **Circuit:** Octode frequency changer; pentode IF amplifier; double diode triode second detector; pentode output valve. Battery grid bias. **Weight:** 20lb. **Dimensions:** 11½in. by 7in. by 11in. **Price:** Not yet announced.

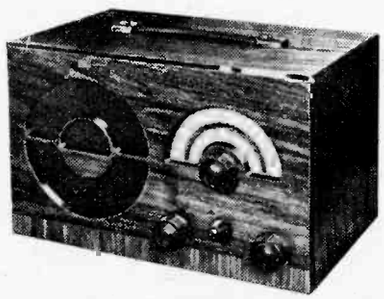
This latest addition to the Vidor range is a superheterodyne housed in a neat case with rounded corners and a detachable carrying strap. The moulded control panel is available in a variety of colours and is totally enclosed when the set is not in use. Scale illumination is obtained by pressing a button incorporated with one of the main controls.

WAYFARER

"MAJOR" MODEL.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Screen grid RF amplifier; triode detector with reaction; triode first AF amplifier; tetrode output valve. Battery grid bias. **Weight:** 14lb. **Dimensions:** 12½in. by 8½in. by 6¾ in. **Price:** 7 guineas.

A LARGE-DIAMETER circular tuning scale is incorporated in the main tuning control and a transparent cursor bridges the dial. The control panel is covered by a lid, the closing and locking of which also prevent the back panel from being removed. An interesting feature of the circuit is the employment of a Hivac-Harries tetrode valve in the output stage.

Gambrell Radio Communications, Ltd., Broomhill Road, Wandsworth, London, S.W.18.



W.B. Senior Stentorian

W.B.

JUNIOR STENTORIAN.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Pentode RF amplifier; pentode detector with reaction; pentode output valve. Automatic grid bias. **Weight:** 22lb. **Dimensions:** 13in. by 8in. by 7in. **Price:** 6 guineas.

THE cabinet is of the horizontal type with the loud speaker to the left of the controls. A flexible carrying-handle is fitted to the top of the case. Iron-cored litz-wound coils are employed in the circuit, and there is provision for the use of headphones. Space is allowed for a standard size 120-volt HT battery.

SENIOR STENTORIAN.—Waveranges: (1) 200-550 metres; (2) 900-2000 metres. **Circuit:** Pentode RF amplifier; triode detector with reaction; triode first AF amplifier; tetrode output valve. Automatic grid bias. **Weight:** 25lb. **Dimensions:** 14in. by 8½in. by 7½in. **Price:** 7½ guineas.

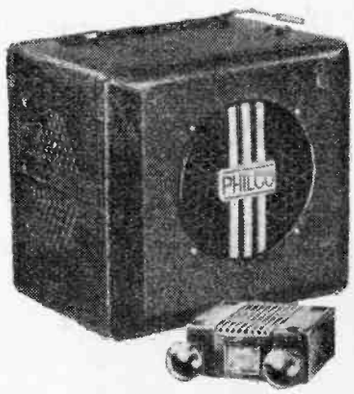
As in the case of the "Junior" model, a horizontal cabinet is used, but the tuning scale is of a more open type. The circuit includes an additional stage of AF amplification and the output valve is a tetrode fed through a transformer instead of resistance-capacity coupling as in the smaller model.

Whiteley Electrical Radio Co., Ltd., Victoria Street, Mansfield.

CAR RADIO

PHILCO

MODEL K628.—Waveranges: (1) 197-566 metres; (2) 950-2000 metres. **Circuit:** Pentode RF amplifier; heptode frequency changer; pentode IF amplifier; double diode triode second detector and AVC rectifier; pentode output valve. Vibratory converter and full-wave rectifier. **Weight:** 18½lb. **Dimensions** (approx.): 8½in. by 9in. by 7in. **Current consumption:** 6-volt model, 4.5 amp.; 12-volt model, 2.3 amp. **Price:** 15 guineas.



Philco Model K628 Car Set.

IN this model the loud speaker is incorporated in the cabinet, but in the Model L628 at 17 guineas a separate loud speaker unit is employed. In both models the controls are operated through flexible cables and filter circuits are included, which obviate the necessity for plug suppressors. For use on yachts the Model L628 may be supplied with a waverange (113.2-300 metres) covering the ship-to-shore telephony band.

MODEL K728.—This is a de luxe version of the K628, with chromium fittings and a push-pull output stage. **Price:** 18 guineas.

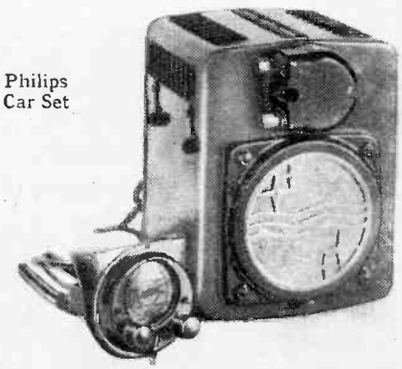
Delco-Remy and Hyatt, Ltd., 111, Grosvenor Road, London, S.W.1.

PHILIPS

MODELS 247B (6-volt) and 248B (12-volt).—Waveranges: (1) 195-580 metres; (2) 710-2000 metres. **Circuit:** Pentode RF amplifier; octode frequency changer; pentode IF amplifier; double diode triode second detector and AVC rectifier; pentode output valve. Vibratory converter and full-valve rectifier. **Weight:** 30-32lb., including separate loud speaker. **Dimensions:** 9½in. by 8in. by 7in. **Power consumption:** 33 watts. **Price:** 14½ guineas.

A LOCKING device on the remote control unit prevents unauthorised use of the set in the absence of the owner. Waverange switching is by means of a magnetically operated relay. No plug suppressors are required, and interference is eliminated by a dipole aerial in conjunction with a built-in low-pass filter.

Philips Car Set

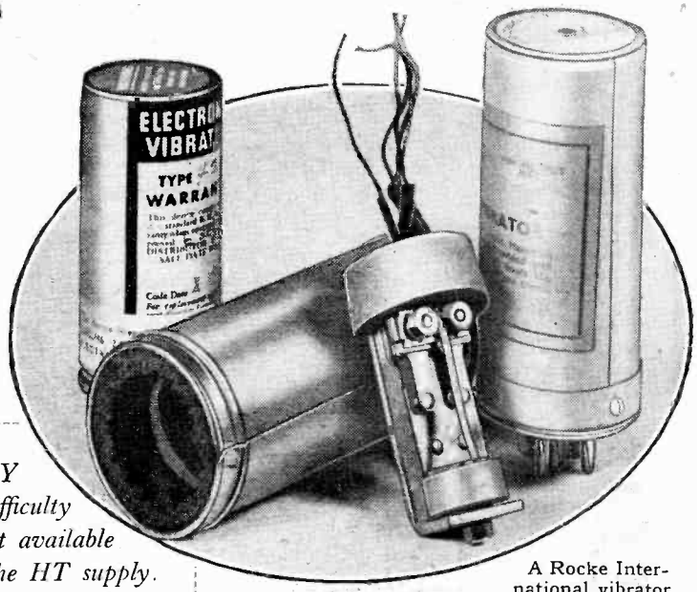


Models 249B (6-volt) and 250B (12-volt), at 16½ guineas, are de luxe versions of the above, with high-fidelity loud speakers and increased output.

Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2.

Vibratory HT Generators

HOW THE SYSTEM WORKS



A Rocke International vibrator is shown on the left and a Bulgin on the right. The interior of a Bulgin unit can be seen in the centre

A COMMONLY encountered difficulty when mains are not available is how to obtain the HT supply. Dry batteries form the most widely used source of power, but of recent years the use of a vibrator supply unit run from an accumulator has come to the fore. Developed chiefly for car radio, the vibrator lends itself well to use in home equipment and makes it possible to obtain a really high standard of quality from battery-operated apparatus.

THE well-known limitations of dry batteries for HT supply in cases where more than a small current is required have led to the development of vibrator systems which can operate from the LT accumulator. In general, such vibrators are not very suitable for operation from a 2-volt accumulator owing to the very heavy current drain. They are usually designed for use with 6-volt or 12-volt accumulators.

Even then the current is several amperes in most cases, and it is usual to use a car-type battery. Indeed, one of the widest uses of vibrator HT supplies is for car sets, and then the ordinary car battery is pressed into service. The ease with which an output similar to that found in the smaller mains sets can be obtained, however, makes the system one which also commends itself for the home set. Its use for the first time enables a high standard of quality to be secured with reasonable economy from a battery-operated set.

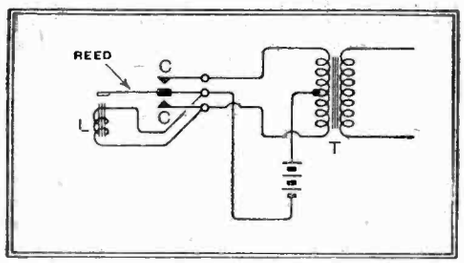


Fig. 1.—The basic circuit of the simplest vibrator is shown here. An AC output of any required voltage is obtained on the transformer secondary.

It is clear, therefore, that the system merits serious consideration by all those interested in high-quality reproduction who are unfortunate enough to have no mains supply. Essentially a vibrator HT supply is extremely simple and the details are shown in Fig. 1. The vibrating reed is fixed at one end and carries two contacts as shown. When at rest the reed contact rests against the upper of the two fixed contacts C. A current from the battery then flows through the upper half of the primary of the transformer T *via* the upper contacts. At the same time there is another much smaller current flowing through the lower half of the primary and the coil L.

The magnetisation of the core of L attracts the reed and it moves over, breaking the upper contacts and making the lower ones. The current from the battery now flows through the lower half of the primary and the coil L is short-circuited. As a result, the magnetic field collapses and the reed goes back to the original position, breaking the lower contacts and making the upper. The whole cycle is then repeated indefinitely.

In this way the battery delivers current in pulses, and these pulses flow alternately in opposite directions through the two halves of the transformer. Such a current produces a magnetic field in the transformer core, which is continually varying, and hence a form of alternating current in the secondary. The waveform, of course, is by no means a sine wave, but it is nevertheless alternating current.

By converting the DC output of the battery into alternating current by the vibrator we have the great advantage that we can obtain any voltage we like on the secondary merely by choosing the transformer ratio of primary to secondary turns suitably.

For an HT supply the voltage on the transformer secondary must be rectified and smoothed just as if AC mains were used. With the larger types of vibrator it is usual to employ a rectifier valve, but the smaller units are generally self-rectifying or synchronous. These have an extra pair of contacts connected as in Fig. 2, where the connections to the HT contacts are shown in heavy lines.

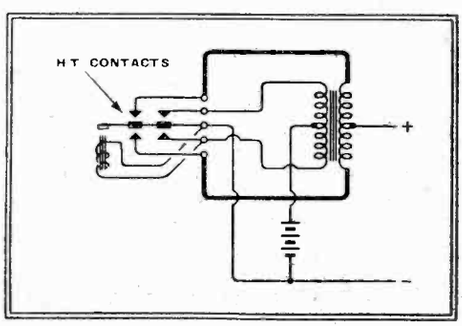


Fig. 2.—When a second pair of contacts is fitted to the vibrator it can also rectify the output voltage.

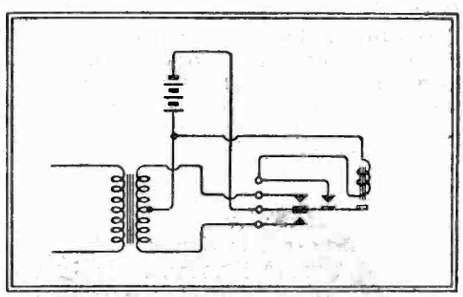


Fig. 3.—The larger vibrators often have a special contact for the coil circuit as shown in this diagram.

The rest of the circuit operates in exactly the way described for the rectifier of Fig. 1, but the output is now taken alternately from the two halves of the secondary. Consequently the output consists of unidirectional pulses of current instead of alternating current. In other words, the two HT contacts act as a full-wave rectifier. The output then only needs smoothing before it is used for operating a receiver.

Vibrators are obtainable giving outputs of 7.5 watts to several hundred watts. As already stated, the large ones are usually non-synchronous, and they also generally have a separate contact for controlling the coil current. With the arrangements

Vibratory HT Generators—

already discussed, the two half primary currents are not quite equal. Referring to Fig. 1, when the lower contacts are closed there is a certain current through the lower half of the primary and none through the upper. When the upper contacts are closed, however, there is the normal current through the upper half of the primary and, in addition, the coil current is flowing in opposition through the lower half.

This asymmetry is not very important with small vibrators, but with large types it is overcome by using the arrangement shown in Fig. 3, the action of which is self-explanatory.

The action of a vibrator is such that quite high peak voltages are generated, and there are extremely rapid changes of amplitude of current. As a result, vibrators can cause radio-frequency interference, which is naturally greatly increased if there is any sparking at the contacts. It is, therefore, usual to screen the vibrator and to include an RF filter in some part of the circuit.

The life of a vibrator cannot be taken as indefinite and is similar to that of a valve. Constructionally, therefore, a vibrator is usually fitted to a valve base so that it can be replaced as easily. The end of the useful life is usually set by erratic operation and a fluctuating output.

The complete circuit of a vibrator HT supply unit using a synchronous vibrator is shown in Fig. 4. An RF filter is included in the negative battery lead and a normal type smoothing circuit in the positive HT lead. A 0.01-μF. condenser is connected across the transformer secondary and must be of high voltage rating on account of the high peak voltages occurring. Some 1,000 volts AC working is not unusual in a unit giving about 250 volts smoothed output.

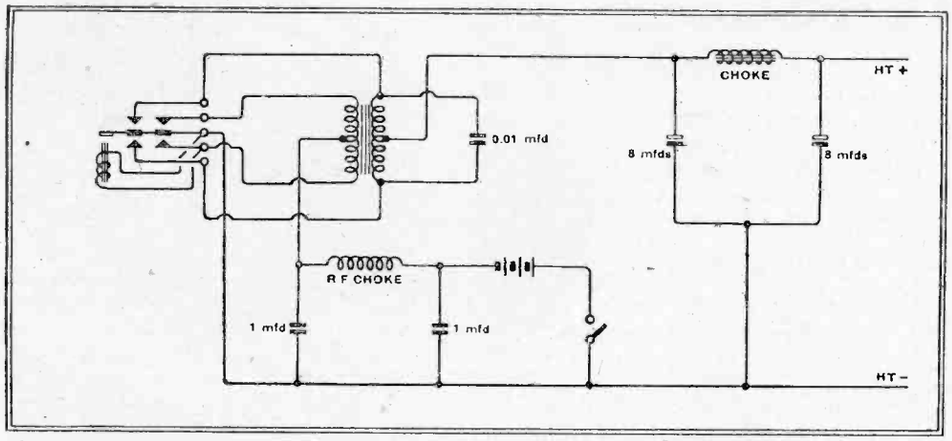


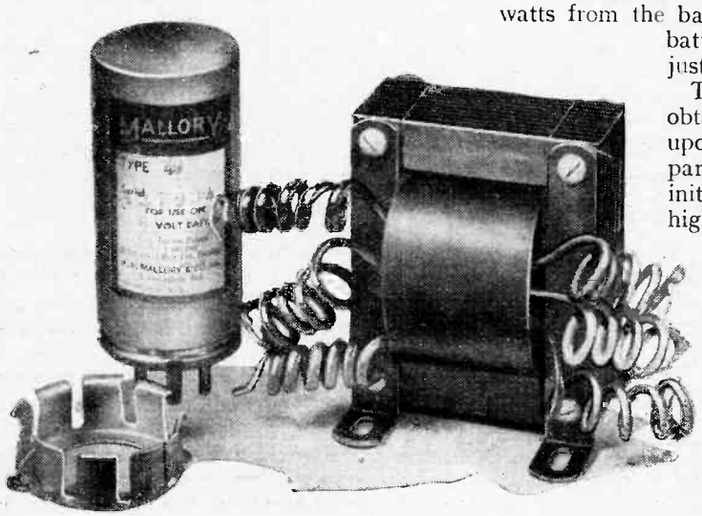
Fig. 4.—The complete circuit diagram of a vibrator HT supply unit is shown here. It is the one recommended for the Rocke International Vibrator, Type 335, which gives an output of 250 volts at 50 mA.

The efficiency of equipment of this nature is very important, for all losses mean an increase in the current drain on the battery. The actual overall efficiency depends on many factors, including the vibrator, the transformer and the smoothing choke. The requirement in the choke is a low DC resistance, and the importance of this naturally increases with the current output of the unit.

A good transformer is especially important, and its design must be much better than that of a mains transformer if good results are to be secured. The chief requirements are an adequate core section to reduce iron losses and an adequate size of wire to reduce copper losses.

The efficiency obtained varies with different apparatus, but in the absence of precise figures it is usually safe to take it as about 50 per cent. A unit giving 50 mA. at 250 volts has an output of 12.5 watts and will take something like 25 watts from the battery. With a 12-volt battery this is a current of just over 2 amperes.

The efficiency actually obtained depends largely upon how much one is prepared to spend on the initial apparatus. With a high quality transformer the initial cost will be greater than with a poor one, but the current drain on the battery will be smaller. The running costs, represented by battery charging and occasional renewals, will consequently be lower.



The Rothermel-Mallory Vibrator is shown here, together with the recommended transformer.

The uses of HT supplies of this nature are obvious, fixed or portable equipment for use in a car or high-quality amplifiers for home use. They do not appeal greatly for general portable work, however, on account of the weight of the battery, but they are widely used in portable P.A. apparatus, where weight is little drawback.

To many their greatest appeal will lie in the possibility of obtaining really high-quality reproduction from battery-operated equipment with reasonable running costs. If the full advantage in economy is to be secured, however, specially designed apparatus is really necessary. It is perfectly possible to take a standard AC design and operate it from a car battery by substituting a vibrator HT unit for the normal mains equipment. It is not usually economical to do so, however, for AC power is so cheap that a designer rarely considers efficiency with ordinary small apparatus. With careful design, however, the efficiency can often be improved considerably, and it is well worth while to make this attempt when a single battery supplies the whole power for operating the receiver.

Fundamentals of Radio. By Frederick Emmons Terman. 458 pages + viii. Published by McGraw Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price 21s.

IN his preface, the author states that this book is essentially an abridged version of his previously-published "Radio Engineering" and that it presents the subject with the same organisation, the same viewpoint, and the same style, but with a simplified treatment. Whereas his earlier book "Radio Engineering" is primarily intended as a text book for advanced students, and as a reference book for the engineer, "Fundamentals of Radio" is intended as a text book of a more elementary character.

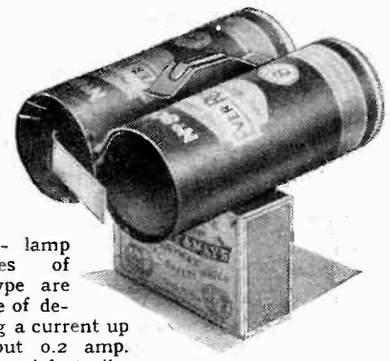
The book covers the whole ground of circuit and valve theory in a concise manner and yet without any incompleteness. The descriptions are clear and, with but few exceptions, the mathematics is confined to ordinary vectorial algebra. The book is up-to-date and in the treatment of AF amplifiers negative feedback is included.

In dealing with power amplifiers, class A, class AB, class B, and class C amplifiers are dealt with from a practical viewpoint, and one of the especially good features is the description not only of the calculation, but of the practical adjustment of a class C amplifier. Modulation and detection both find a place and there are chapters on mains equipment, transmitters, receivers, the propagation of radio waves, and aerials. Direction-finding is also dealt with in a descriptive manner and there is a chapter on television. Some of these later chapters are more of a descriptive nature than a complete explanation of the subject, but their inclusion is justified by the more complete view of the subject which the student will obtain.

The book is clearly written and accurate and can be confidently recommended to those desiring a sound grounding in the elements of wireless theory. W. T. C.

Dry-Cell LT

ITS ADVANTAGES FOR INTERMITTENT USE IN PORTABLES



Cycle - lamp batteries of this type are capable of delivering a current up to about 0.2 amp. quite satisfactorily.

By H. F. SMITH

IT is a typical instance of human perversity that the portable set was first used in entirely the wrong way, more often than not by those to whom portability was by no means an essential requirement. Since those early days we have become rather more reasonable; the typical portable, now weighing well under 20 lb., is generally used for the purposes for which it was designed, and—here is the real point—intermittently and with long periods of idleness.

But the sets still retain, in the form of an LT accumulator, a legacy from the days when their forerunners were consistently used for prolonged periods of continuous listening at home. The trouble about an accumulator is that it has to be periodically recharged whether it is used or not; it implies a degree of almost inhuman perfection in the owner of a set used only during the summer to remember the need of recharging during the long months of winter.

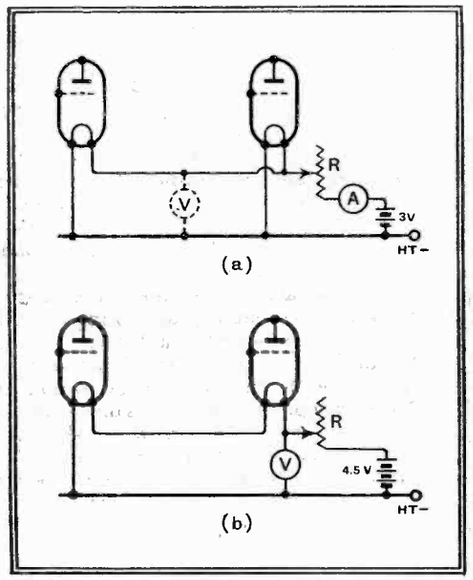


Fig. 1.—Parallel and series connection of valve filaments for dry-cell supply. Connections of indicating meters are shown.

In spite of these remarks, it is not the purpose of this article to urge that the LT accumulator might be abandoned entirely for every type of portable, including those intended for the unskilled user and multi-valve transportables. The dry battery as a source of filament current is at its best in one-, two- and three-valve sets of the truly portable type (that in itself implies intermittent use). If the set is to be handled by someone who understands something of its working, such a form of supply is entirely practical, economical and trouble-free. The writer has used a single eightpenny cycle-lamp battery to feed the filaments of two Hivac midget valves (total 0.12 amp.) throughout a whole summer season of intermittent use at week-ends and holidays. Had his set been more extravagant, it would have been no trouble to slip in the occasional replacement that would have been needed. Such cells are obtainable, generally in fairly fresh condition, almost everywhere, and in any case it would be no hardship to carry a spare or two.

As compared with accumulators, dry cells suffer from the admitted shortcoming of inconstant voltage, and so it becomes necessary to provide a variable resistance or rheostat whereby the voltage actually applied to the valve may be regulated. In the writer's submission, some form of meter is virtually essential as an aid to the adjustment of this rheostat. Failure to provide such a meter is responsible for most cases of disappointment with dry-cell LT; the matter is partly a psychological one, as without some form of indicator one always tends to ascribe poor reception to insufficient filament voltage. Consequently, the rheostat is turned too far, and both valves and battery suffer.

Choice of a meter requires some care, but a cheap moving-iron instrument costing about 10s. will generally serve the purpose. The best type of meter depends on the consumption of the valves and the manner in which they are connected. For a lightweight or "pocket" set with one or two valves each consuming 0.06 or 0.1 amp. at 2 volts and connected in parallel as in Fig. 1(a) a cheap ammeter is generally better than a cheap voltmeter. As there is voltage to spare, a certain amount of loss in the meter does not matter, but the extra current taken by a voltmeter (connections shown in dotted lines) represents so much extra load on the battery.

If a cheap ammeter is used, it will generally be necessary to keep the resistance down by choosing an instrument with a higher maximum reading than would otherwise be required. A 0.5-amp. or 1-amp. meter with a resistance of 0.5 to 1.5 ohms will generally permit sufficiently accurate readings of currents of respectively 0.12 and 0.2 amp.

With a series connection of the valves, as in Fig. 1(b) a $4\frac{1}{2}$-volt battery is required, and there will be only half a volt surplus; consequently it will be practically essential, if an indicating instrument is to be fitted, that it should be a voltmeter. Incidentally, this is perhaps the best arrangement when no meter is to be employed, as the half-volt surplus, distributed over two valves in series, can do little harm even if the rheostat is mishandled. But from other points of view it is not so good; both valves must take the same current, and the full capacity of the battery is not usefully employed.

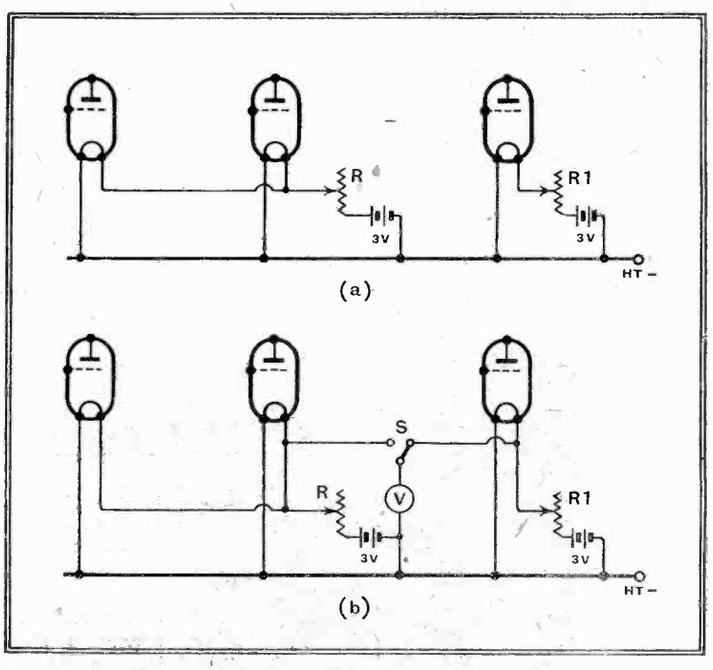


Fig. 2.—Diagram (a) shows the use of separate batteries in cases where total filament consumption is too high for a single battery. The same arrangement with the addition of switch connections for a voltmeter is shown at (b). In Figs. 1 and 2 the rheostats R, R1 will generally have maximum values between 5 and 10 ohms.

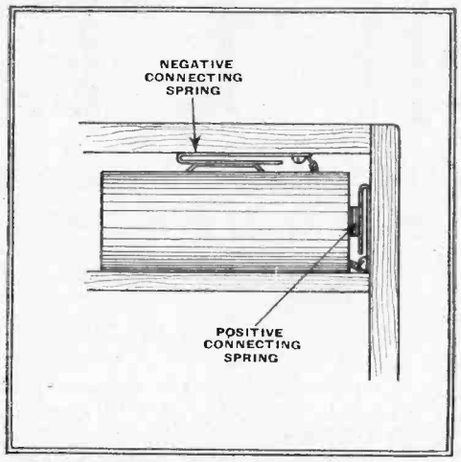
When dealing with more ambitious sets than those we have so far considered, it may be desirable to divide up the work of

Dry-Cell LT—

heating the filament between two or even more batteries. This method is shown in Fig. 2 (a), which might represent the filament currents of a three-valve set with an output valve taking 0.2 amp. Two rheostats will be required; R controls the first two valves, while R1 serves the output valve only.

With more than one battery, the connection of a meter becomes rather more difficult. An ammeter is virtually ruled out, and it is best to use a voltmeter connected as in Fig. 2(b) with a switch arranged so that the voltage of either "group" may be read at will. In this case the meter should be of reasonably high resistance, in order that its disconnection (by means of the switch) will not greatly increase the filament voltage.

Finally, it may be pointed out that the advantages of the dry-cell LT battery are not confined to receivers. Its uses for heating valve filaments of certain test instruments must be obvious. The writer knows of a *Wireless World* Resistance and Capacity Bridge that has been working for over two years without any replacement of the original Ever Ready Type 800 battery used to heat the valve.



The provision of spring contacts for dry LT batteries facilitates replacement.

On the Short Waves

MOST readers who have followed these notes during the past months will remember that I have endeavoured to show that a moderate degree of sunspot activity is essential for good short-wave conditions.

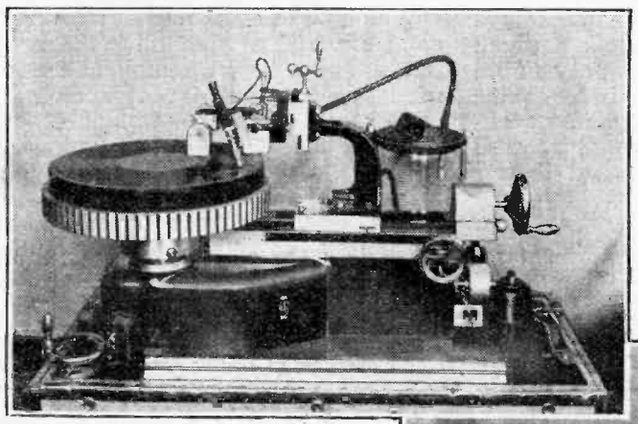
It has also been demonstrated that lack (or an excess) of sunspot activity causes poor conditions and results in moving the useful frequencies to a narrow band at the low-frequency end of the spectrum.

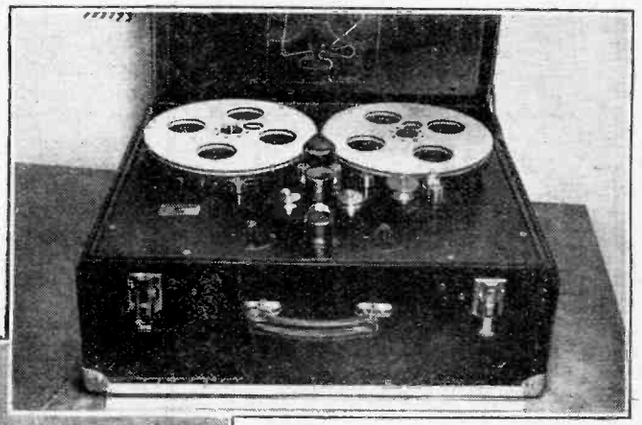
A similar view is also held, I believe, by those B.B.C. engineers responsible for operating the Daventry short-wave service.

The following statement in a contemporary is therefore of more than usual interest, and shows the lack of understanding of this problem generally:—

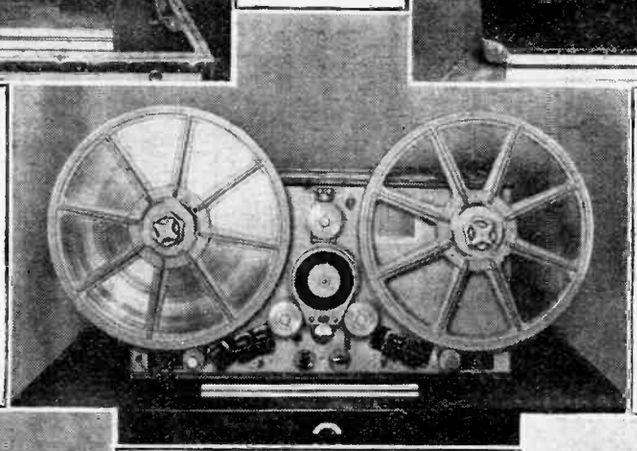
"Although further sunspot activity was expected on February 21st (*27 days after*

RECORDING FOR RE-BROADCASTING IN GERMANY

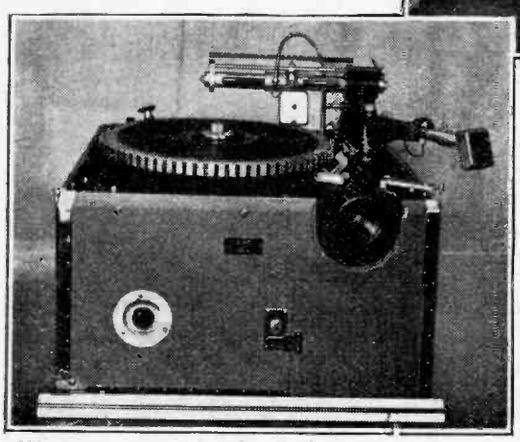




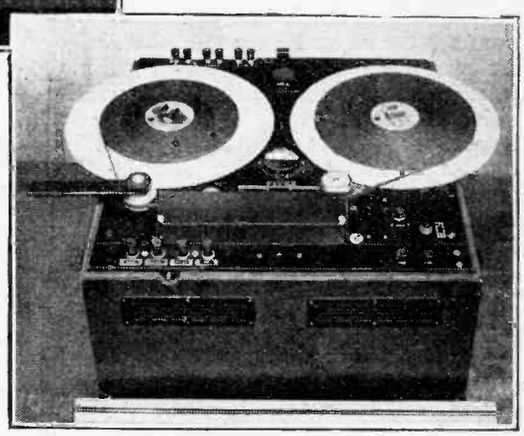
A MACHINE of massive construction is used for recording programmes in the German broadcast stations. Immediate playback is possible despite the fact that the disc is made of comparatively soft wax. As shown in the illustration above a thick disc is employed which, when not required as a matrix for the making of pressings, can be refaced by turning off the old grooves. When



require cutting and editing before re-broadcast. The Magnetophone recorder recently introduced by the R.R.G. is shown below. It makes use of a non-inflammable film 6.5 mm. wide which is coated with a thin layer of powdered metal. The recorded film can be stored and transported, being unaffected by jolts in moving vehicles. Considerable use is made of recordings in Germany.



recordings have to be made in a train or in a car on the roads, the steel-tape machine illustrated here (centre) is generally employed as the recorder is unaffected by the motion of the vehicle. For portable work a machine of the type seen on the left is used by the R.R.G. of Berlin. Flexible recording blanks are employed, which provide up to 100 playings. The sound-on-film machine (top right) uses 6 mm. film, and is designed for recording radio drama and other programme matter that may



On the Short Waves—

the Aurora of January 25th), little difference was noticed by short-wave listeners.

"The conditions did not seem to fall off, although some of the more distant stations were not quite so strong as usual.

"On the contrary, despite the fact that this year short-wave reception should be more difficult than ever, listeners are finding conditions quite satisfactory."

In fact, until March 22nd conditions, in spite of a sustained high degree of activity, had been excellent for about five weeks.

On March 21st a pair of rather large intensely black spots were observed—in contrast to the more distributed small spots of the past weeks—and a remark at the time that they might well produce poor conditions was certainly borne out.

The accompanying drop in optimum frequency may result in better signals from Bombay during the afternoons (until 5.30 p.m.) on 3.31 Mc/s, but Delhi is now believed to be working near to 4 Mc/s at this time of the day.

From 2 a.m., however, both Delhi on 9.59 Mc/s and Bombay on 9.55 Mc/s may be heard in the 31-metre band, providing both stations are clear of interference.

It is announced that WIXK on 9.57 Mc/s is now using a rhombic aerial directional on South Africa from 11 a.m. to 10 p.m. The final stock market report is, however, broadcast on an omni-directional aerial between 10 and 10.15 p.m. G.M.T.

To turn from short waves to television it is of interest to note that a sync-less system of television has been demonstrated by the Du Mont Company in the U.S.A.

In this new system no line and frame pulses are transmitted on the vision carrier for the purpose of synchronising the frame and line saw-tooth generators in the receiver, for the simple reason that such generators (thyratrons, etc.) are not employed. Masking pulses below the black level, however, may still be transmitted if desired. The movement of the cathode-ray spot in this new system is obtained by a novel method, which in its simplest form is this:—

The camera line and frame deflecting potentials are fed to the sound transmitter, are picked up by the sound receiver, and after "detection" and magnification fed to the deflecting plates, or coils (after suitable shaping in some cases) of the receiver cathode-ray tube.

Although additional equipment is required to separate out and magnify the scanning waveforms, it will be seen that such devices as sync-separators, line and frame oscillators and variable time-constant networks are abolished in the receiver. It is claimed by the inventors that quadruple interlacing is possible in this way, since it is impossible for the receiver to get out of step with the transmitter.

It will be interesting to see if there are any practical objections to such a system. In the remote possibility of it being adopted by Alexandra Palace, it is most useful to remark that it would not in any way, apart from the necessity of fitting a very simple filter to the sound receiver, make an existing television receiver obsolete. Alexandra Palace could continue to send sync-pulses just as it does now, but the "Du Mont system" receiver would only use them for blacking out the flyback lines.

In a full Du Mont system, however balanced line scanning is employed, i.e., both the forward and backward trace of the line are used.

Finally, a word about valves. Now, in addition to the Tungsram triode-hexode 6TH8, in the octal series, we have the Marconi-Osram International Range X65 triode-hexode, and now the U.S.A. produces a valve of this type for the first time—the Sylvania triode-heptode 6J8G.

An octal triode-hexode is also being produced by R.C.A., the 6K8.

Provided a high intermediate frequency is used, not lower than 2 Mc/s, and preferably 3-4 Mc/s, it has been found that these "mixers" give excellent results down to 5 metres when a simple Hartley oscillator circuit is used. ETHACOMBER.

Television Programmes

Sound	Vision
41.5 Mc/s	45 Mc/s.

THURSDAY, MARCH 31st.

3, Cabaret, including Talbot O'Farrell, the Irish entertainer. **3.25,** British Movietonews. **3.35,** 133rd edition of Picture Page.

9, Starlight. **9.10,** Hogarth Puppet Grotesques. **9.20,** Gaumont-British News. **9.30,** 134th edition of Picture Page. **10,** News Bulletin.

FRIDAY, APRIL 1st.

3, Comedy Film—"Old Fashioned Movie." **3.10,** "Nice Work"—miscellaneous programme, including C. H. Middleton, Charles Heslop, Cyril Fletcher and Joan Miller.

9, Comedy Film—"Old Fashioned Movie." **9.10,** "If You Can Get It"—the miscellaneous programme of the afternoon continued. **10,** News Bulletin.

SATURDAY, APRIL 2nd.

1.30–2 (approx.), The Oxford and Cambridge Boat Race—viewers will follow the progress of the crews with the help of an animated chart and a commentary by John Snagge. The finish of the race will be televised direct from Chiswick. **3,** The Hogarth Puppets. **3.15,** Darts Match between a B.B.C. team and the *News of the World* Champions. **3.25,** British Movietonews. **3.35,** "Have You Brought Your Music?" a play devised by Quentin Tod, written by Eleanor Fargeon.

9, Cabaret (as on Thursday at 3 p.m.). **9.25,** Cartoon Film. **9.35,** Through the Year—Elizabethan Songs about the Four Seasons, compered by Roger Quilter. **10,** News Bulletin.

SUNDAY, APRIL 3rd.

3–3.30, "Boat Races of the Past," a reminiscent programme, relayed from the river at Chiswick. **8.50,** News from National. **9.5,** Speaking Personally. **9.10,** Lisa Perli, with Television Orchestra. **9.25,** Cartoon Film. **9.40–10.40,** "Will Sheakespeare," a special version of Clemence Dane's great biographical play, with Henry Oscar in the name part.

MONDAY, APRIL 4th.

3, Ord Hamilton, songs at the piano. **3.10,** Gaumont-British News. **3.20,** "Christopher Wren"—play.

9, Spontaneous Swing Music. **9.20,** British Movietonews. **9.30,** "Powder and Pipe-clay"—a military version of the nautical musical "Mizzen Cross Trees." **10,** News Bulletin.

TUESDAY, APRIL 5th.

3, Gillie Potter. **3.10,** Talk. **3.20,** British Movietonews. **3.30,** Viennese Music.

9, Ord Hamilton, songs at the piano. **9.5,** Cartoons by Low. **9.15,** Gaumont-British News. **9.25,** "The End of the Beginning," a comedy in one act by Sean O'Casey. **10,** News Bulletin.

WEDNESDAY, APRIL 6th.

3, Starlight. **3.10,** Craftsmen at Work—the Slater. **3.20,** Gaumont-British News. **3.30,** "Will Shakespeare" (as on Sunday at 9.40 p.m.)

9, Cabaret. **9.30,** Repetition of 3.10 p.m. programme. **9.40,** British Movietonews. **9.50,** Indian Music. **10,** News Bulletin.

Random Radiations

By "DIALLIST"

Finding the Weak Spots

IT was rather unkind of Radio-Normandie to make the big change in its wavelength that took place recently. Many people hadn't seen or heard the announcement and, failing to find the French station on 269.5 metres, concluded that it had broken down. It didn't occur to them to try for it right down near the bottom of the medium-wave range. But those who had the worst time of all were the owners of certain sets with automatic tuning which aren't designed to go down to 212.6 metres. Many makes will do so, but some won't. Designers have never expected that there would be a worth-while station working on a wavelength below 220 metres. This is, perhaps, rather surprising, since the Bournemouth and Plymouth relays operate on 203.5 metres, and one would have expected provision to be made for reception of the local stations in those towns. In any event the 203.5-metre wavelength will probably have to be used for a much bigger station as the B.B.C.'s scheme nears completion. It is just in these ways that weak spots in receiving sets are discovered; let us hope that designers make a note for future reference. Luckily, the sets in question are fairly easily altered, though some parts have to be replaced.

Inefficient AVC

A GOOD many sets that I have tried from time to time are not too happy in their automatic volume control arrangements, particularly when it comes to reception on the short-wave range. Naturally, when a set is working all out to bring in a station at all you can't expect AVC to be of much help in counteracting fading, for you are already using all the available amplification, and the best AVC in the world can't supply what is not there. But what does annoy me is to find that a strong transmission which is suffering from slow fading of a not very violent type cannot be kept more or less steady by the AVC, though you can maintain it at almost level strength by keeping your fingers on the knob of the manual volume control. This means simply that the AVC arrangements in the set are not up to their job. You can get a pretty good idea of what AVC is or is not doing by putting a milliameter into the plate circuit of the IF valve, or the second of them if there are two. A steady signal from the loud speaker combined with considerable activity on the part of the instrument's needle indicates that AVC is doing its work well; fading is there but the set is able to take charge of it.

Television Going Ahead

THOSE in charge of the television programmes are displaying real enterprise just now. The studio shows certainly seem much improved, and I am glad to see that such ambitious outside broadcasts are being undertaken. When you look at the list for the last few weeks you must agree that it is a pretty good one, including, as it does, such good things as a ladies' international hockey match, the University athletic sports and the England *v.* Scotland rugger match. The Grand National was, unfortunately, too far away to be televised, though it was a great idea to show that plan of the course and to indicate the positions of the horses as they were named in the description of the race. It was hard lines that part of the rugger match television broadcast was spoilt by interference with the radio link between Twickenham and the Alexandra Palace. An enormous amount of work was put into the preliminary preparations, and it wasn't the fault of anyone concerned with the televising that the images were wobbly and jumpy at times. Anyhow, thanks to the use of the telephoto lens with the emitron camera, the operators gave us some of the best close-ups of the King that have ever been obtained by any means.

The Green Marias

The B.B.C.'s trio of vans for the television broadcasts make a most imposing array. I had a good look at them when they were drawn up outside the White City Stadium for televising the Oxford and Cambridge sports. Their outward appearance is rather grim, and I think that when you see them you will agree that the name I coined for them—the Green Marias—fits rather well. But if their outsides suggest the marias of another colour, so familiar to "Free Grid" that on entering one of them he automatically murmurs, "Home, George," their insides are vastly attractive. One of them contains the power supply unit, the second houses the control room, and the third the ultra-short-wave transmitter. The trio are known officially as the B.B.C. Mobile Television Unit. There will soon be a fourth van carrying a complete aerial outfit which can be racked up to a height of 80ft. The engineers of the television department are certainly proving themselves to be live wires.

Waking Up

BEFORE now I've tilted good and hard against our radio manufacturers because they wouldn't realise the potentialities of the Empire markets for receivers and made no signs of proposing to cater for them. It has always been a shrewd blow to my national pride to hear British folk on leave from this or that outpost of Empire declare, "It's no good thinking about British sets. There's nothing suitable for our

BROADCAST PROGRAMMES

Features of the Week

Abroad.
Rome No. I, 7, "Siegfried," opera (Wagner).
Eiffel Tower, 7.30, Ravel Concert.

SATURDAY, APRIL 2nd.

Nat., 1.30, Commentary on the Oxford and Cambridge Boat Race. 3.40, 4.20 and 5.45, Commentary on Motor-racing at the Crystal Palace for the Coronation Trophy. 8, Palace of Varieties. 9.20, American Commentary.
Reg., 7.30, Nikolai Lopatnikoff, pianoforte. 8, The Brighton Society of Symphonic Players. 9, Cabaret.
Abroad.
Milan, I, 8, "Aida," opera (Verdi).

SUNDAY, APRIL 3rd.

Nat., 11 a.m. and 2.30, J. S. Bach's St. Matthew Passion, relayed from the Queen's Hall. 9.5, Spelling Bee—Men *v.* Women. 9.45, B.B.C. Theatre Organ.
Reg., 4.30, Children's Service from the Royal Infant Orphanage, Wanstead. 5, Falkman and his Band with Tessa Deane. 6, Frank Titterton (tenor) with the B.B.C. Military Band. 9.5, Dorothy Manley and Myers Foggin, pianofortes, in Sunday Orchestral Concert, conducted by Sir Henry Wood.
Abroad.
Frankfurt, 7, "Cosi fan Tutte"—opera (Mozart).

MONDAY, APRIL 4th.

Nat., 6.20, John Wills, pianoforte. 7, Monday at Seven. 8.45, "The Gang Smasher"—episode 1. Adapted from the novel by Hugh Clevely. 9.20, World Affairs.
Reg., 8, "Sailors Return"—the true record of an uneventful voyage. 8.15, The Berlin Philharmonic Orchestra from Berlin. 9.30, Strange to Relate.
Abroad.
Lille, 7.10, English talk on Artificial Textiles in France," by Professor Savage.
Radio Paris, 7.30, "Euryanthe," opera (Weber).

TUESDAY, APRIL 5th.

Nat., 7.40, Talk on "Exercise," by a Harley Street Physician. 8, "The Cousin from Nowhere"—musical play. 9.20, America Speaks. 9.40, The London Film Symphony Orchestra.
Reg., 7.30, Swift Serenade. 8.45, "Down on the Farm"—a review of country life, relayed from Evesham.
Abroad.
Leipzig, 7, Selections from famous European Operas.
Strasbourg, 8.30, Part II of the Ravel and Roussel Festival Concert.

WEDNESDAY, APRIL 6th.

Nat., 7.5, Mario de Pietro and his Estudiantina. 7.45, Malcolm Sargent conducts a B.B.C. Symphony Concert. 9.20, "Hail Variety," No. 1—traditional music-hall acts.
Reg., 7.30, "The World Goes By." 8, "Band Waggon." 9, "We Are Not Alone," a play by James Hilton and Barbara Burnham.
Abroad.
Lille, 7.10, English Talk on "The Students," by Professor Connes.

needs; we just have to buy foreign-made sets, whose makers know exactly what we need." It is good to find that some of our manufacturing firms are now taking the Empire's requirements seriously. They are, for instance, no longer sending out sets with tuning dials plastered with the names of European long-wave and medium-wave stations that are unreceivable locally. They have realised that receiving sets for Empire use must take in the 13-metre band, and that those intended for listeners in India must tune up to 100 metres on the short-wave range. They have come, too, to appreciate that wooden cabinets are not ideal in the realms of the white ant and other pests; that coils, condensers and resistances must be able to stand up to extremes of cold, heat, damp and dryness that we don't know in this country. All of these things are good, ; but I have still to find the battery-operated set intended for Empire use, whose designer understands that the HT current supply is one of the biggest problems facing those whose nearest town of any size may be hundreds of miles away. What is the use of offering them a battery set with Class B output whose *quiescent* HT drain is 15-20 milliamps? Even the largest dry HTBs can't stand up to this for long, and it may be a matter of extreme difficulty to obtain replacements.

Scotland is Dissatisfied

RECEPTION of the home programmes is none too good in that part of Scotland which lies within a radius of some 25 miles from Dundee. So poorly, in fact, are the programmes received in this important area that a petition is being sent to the B.B.C. asking that something shall be done about it. What exactly they can do I don't quite know, for there certainly isn't an independent wavelength available for a new relay station. But since Bournemouth and Plymouth are rated at only 1 kilowatt and 0.3 respectively, and are right away in the south and south-west of England, it might be possible to run a third relay, situated, say, at Dundee on this wavelength. Or, again, it might be feasible to synchronise a relay of greater power with the three Nationals that are already working on 261.1 metres. Let's hope, anyhow, that some solution will be found, for it won't do to leave an important part of Scotland with a poor service from the home stations.

Why Not Short Waves?

There are a good many parts of both England and Scotland certainly, and possibly of Wales, which still aren't too well served by either Regional or National transmitters. Some time ago I suggested in these notes the possibility of using short-wave relays to ease the position. Nothing of the kind has been done in this country so far, but short-wave broadcasting is meeting with considerable success in India, where it is used to cover parts of the country that cannot be served by the small number of medium-wave stations at present in operation. A short-wave transmitter working at Rutherglen could quite possibly serve those easterly parts of Scotland where reception of the B.B.C.'s programmes is now poor and patchy. A similar transmitter at Washford Cross might be a great help to dwellers in the more southerly and westerly parts of Devon and Cornwall. Different wavelengths for the day and night transmissions might be needed owing to skip effect; but this should present no great difficulty, and as so many listeners now have "all-wave" receivers there would be no trouble so far as they were concerned.

Three-valve Straight Set

Constructional details of this receiver are given on pages 282-285 of this issue.

LIST OF PARTS

1 Variable condenser, 3-gang, **C2, C5, C11** — **Polar "Bar"**
1 Dial — **Polar VP horizontal drive**
1 Reaction condenser, differential, 0.0003 mfd. **C12** — **Bulgin N24**
3 Coils — **R.I. "Micrion" BY36**
1 Aerial coil, L1, L2 — **B.T.S. type ML/FTA**
1 RF choke — **"Kinva" standard type**
1 Choke, 25H., 300 ohms, 120 m/A — **Vortexion CH 300**
1 Mains transformer; Primary, 200-250 volts 50 c/s; Secondaries, 4 volts 2 amps. CT, 4 volts 4 amps. CT; 350-0-350 volts, 120 mA — **Scientific Supply Stores**
1 LF transformer, ratio 4:1 — **Varley "Nicore II" DP2**

Fixed condensers:
1 0.0003 mfd., tubular, **C13** — **Dubilier 4601/S**
1 0.0005 mfd., tubular, **C14** — **Dubilier 4601/S**
3 0.1 mfd., tubular, **C6, C7, C8** — **Dubilier 4603/S**
2 0.5 mfd., tubular, **C16, C18** — **Dubilier 4608/S**
1 50 mfds., 50 volts, electrolytic, **C17** — **Dubilier 3004**
1 8-8-8 mfd., 500 volts, electrolytic, **C15, C19, C20** — **Dubilier 312**
1 1 mmfd., ceramic, ± 0.5 mmfd., **C3** — **Dubilier CDE**
1 3 mmfds., ceramic, ± 0.5 mmfd., **C4** — **Dubilier CDE**
2 10 mmfds., ceramic, ± 10 per cent., **C1, C9** — **Dubilier CDS3**
1 25 mmfds., ceramic, ± 5 per cent., **C10** — **Dubilier CDS3**

Resistances:
1 50 ohms, ½ watt, **R15** — **Erie**
1 100 ohms, ½ watt, **R4** — **Erie**
1 500 ohms, ½ watt, **R2** — **Erie**
1 1,000 ohms, ½ watt, **R1** — **Erie**
1 5,000 ohms, ½ watt, **R12** — **Erie**
1 10,000 ohms, ½ watt, **R10** — **Erie**
1 20,000 ohms, ½ watt, **R8** — **Erie**
1 40,000 ohms, ½ watt, **R9** — **Erie**
2 50,000 ohms, ½ watt, **R7, R16** — **Erie**
1 200,000 ohms, ½ watt, **R11** — **Erie**
1 1 megohm, ½ watt, **R6** — **Erie**
2 350 ohms, 1 watt, **R14** — **Erie**
1 20,000 ohms, 3 watts, **R3** — **Erie**

1 Potentiometer, wire-wound, 5,000 ohms, tapered, **R5** — **Reliance SG**
1 Potentiometer, wire-wound, 10,000 ohms, non-tapered, **R13** — **Reliance SG**
3 Valve holders, 7-pin (without terminals) — **Clix Chassis Mounting Standard Type V2**
1 Valve holder, 5-pin (without terminals) — **Clix Chassis Mounting Standard Type V1**
1 Switch, QMB Two-position Wavechange — **Bulgin S121**
1 Fused mains input connector, with 1 amp fuses — **Belling-Lee 1114**
1 Plug-top valve connector — **Belling-Lee 1175**
1 Screened-top connector — **Bulgin P64**
2 Lengths screened sleeving — **Goltone**
2 Skeleton captive screw strips, "Aerial-Earth" and "Speaker" — **Bulgin T10**
1 Coupler, ¼in. bore — **Bulgin**
1 2½in. length ¼in. rod — **Bulgin 2005**
Chassis — **B.T.S.**
Miscellaneous: — **Peto-Scott**
8 lengths systoflex, 4oz. No. 18 tinned copper wire, 3 aluminium clips for holding condensers, 1 angle bracket for holding dial, etc. **Screws:** 42 ¼in. 6BA R/hd., 12 ½in. 6BA R/hd., 8 ¾in. 6BA C/sk., all with nuts and washers; 4 1in. 6BA with three nuts to each, 5 ¾in. 4BA with two nuts to each.

Valves:
1 PV4, 1 APP4E, 1 HL4g, 1 VP4B — **Tungsram**

Recent Inventions

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

SECONDARY-EMISSION AMPLIFIERS

THE light from a picture is focused by a lens L on to a photo-sensitive surface P, and the emitted electrons pass first through a perforated anode A and then through a bundle of metallic tubes M (shown separately in cross section at the right-hand side of the figure). During the passage through this tubular system secondary emission takes place, so that an intensified image of the original picture appears on the fluorescent screen F.

The primary electrons strike the tubes M obliquely, but the secondary electrons are "canalised" so that there is no necessity to provide any focusing device

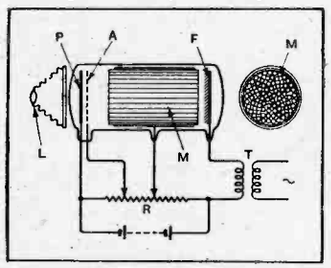


Image intensification by means of secondary emission of electrons.

between the end of the tubular electrodes and the final viewing-screen F. The surface P, anode A, and secondary-emission tubes M carry increasingly positive voltages derived from a potentiometer R. The intensification is stated to be favourably influenced by superposing an alternating component from a transformer T on to the potentiometer voltage.

V. Zeitline, A. Zeitline, and V. Khiatchko (associated with R. Barthelemy). Convention date (France) July 30th, 1935. No. 478426.

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TELEVISION SYSTEMS

TELEVISION signals transmitted from a cathode-ray tube of the iconoscope type are found to be subject to a kind of interference which is described as a "false brightness." In other words patches of high light occur, which have no relation to the actual illumination of the picture.

In order to remove them a second cathode-ray tube is run in synchronism with the transmitter proper, and is used solely for the purpose of producing a compensating effect. The auxiliary tube is provided with a secondary-emission screen which is divided into squares, each of which can be differently biased relatively to a collecting-anode. The "false" patches of light produce secondary emission from the various squares on the screen, and the resulting currents (which vary with the distribution of the bright patches) are passed through a load resistance in the "collector" or output circuit, from which the required "correcting" voltages for the transmitter tube are derived.

Telefunken Ges. fur drahtlose Telegraphie m.b.h. Convention date (Germany) April 28th, 1936. No. 475473.

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A METHOD of scanning is based upon the movement of an electrostatic field of force. If, for instance, two plates are oppositely charged, and a third, carrying an intermediate voltage, is placed between them, then the resulting electrostatic field is such, or can be made such, that on the surface of the intermediate plate there will be a line of "zero" field. Moreover, as the voltage on one or other of the outer plates is varied, the "zero" line on the intermediate plate will be moved to and fro at a speed proportional to the applied voltage variation.

Now if the place of the intermediate "plate" is taken by a photo-electric cathode, on which a line of picture signals has been projected, then the position of the "zero" line will determine the boundary between the part of the cathode which can "emit" electrons on to a collecting electrode and the part from which such emission cannot occur. This arrangement is utilised to provide a basis for high-speed scanning.

H. Browde. Application date December 18th, 1936. No. 476714.

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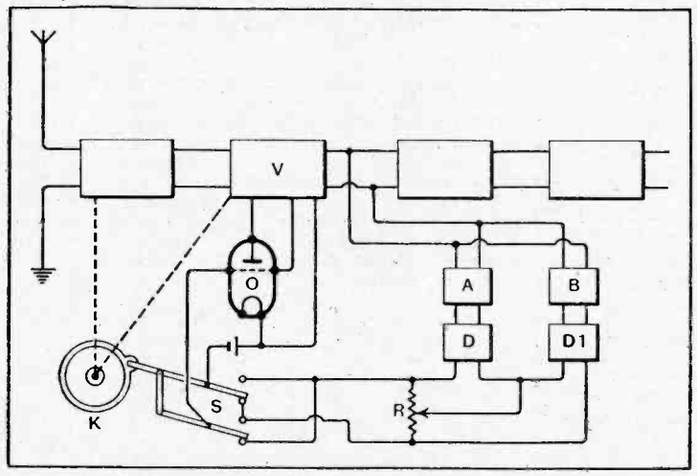
AUTOMATIC TUNING CONTROL

THE correcting voltage applied to bring the mistuned circuits of a superhet set into accurate step with the signal is derived from two circuits A, B, one broadly tuned and the other finely tuned, both being coupled to one of the intermediate-frequency stages V. For instance, the circuit A may include a piezo-electric crystal with a resonance "peak" lying inside that of the circuit B.

The currents built up in both circuits are rectified at D and D1, and are applied in opposition across a resistance R, the resulting EMF being used to bias the control grid of the oscillator valve O, or to correct its frequency in any known way. A reversing switch S serves to change the polarity of the control voltage according to the direction in which the knob K is rotated.

J. Robinson. Application date May 29th, 1936. No. 475900.



Schematic arrangement for automatic correction of tuning.

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DISTRIBUTING BROADCAST AND OTHER SIGNALS

THE invention describes a wired-wireless system for distributing broadcast or other programmes at high frequency, say, to the cabins (and other points) on board a ship, so that the passengers can exercise a choice by tuning. In addition the network will carry voice-frequency currents for issuing orders, say, from the bridge of the ship to the officers and crew.

Provision is made so that, in an emergency, an officer can issue instructions, say, to the engine room staff alone, excluding all others. The arrangement is designed to prevent the issue of such special orders from creating a possible panic or any premature uneasiness amongst the passengers.

Guided Radio Corporation. Convention date (U.S.A.) April 29th, 1936. No. 476022.

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SUPERHET RECEIVERS

IN a superhet set, "whistle interference" caused by a signal having the same frequency as the fixed intermediate stages is usually prevented by the use of rejector circuits or wave-traps. These naturally add to the prime cost of manufacture.

According to the invention, the same result is secured by using a two-circuit band-pass input, with a coupling link resonant to the "fixed" intermediate frequency on which the set works. For an incoming signal of this frequency, the effective coupling between the band-pass circuits will depend upon the impedance (or resistance) of the coupling link, and this can be made of such small value as to be negligible for the signals which it is desired to exclude.

E. S. V. Truefitt. Application date, June 25th, 1936. No. 477048.

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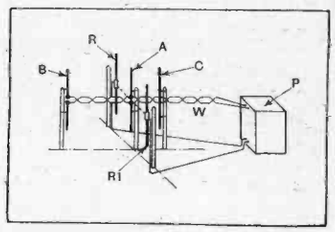
RADIO NAVIGATIONAL SYSTEMS

THE Figure shows an aerial system for producing a short-wave navigational "beam" designed to guide a pilot to an aerodrome and to assist him to land in conditions of poor visibility. The main dipole A and an "advance" or "director" dipole B are both fed by cross-over wires



Aerial system for a short-wave beacon transmitter.

from the power unit P. A reflecting antenna C is placed behind the main aerial A at a distance of a quarter of the working wavelength, and serves to cut-off back radiation. Two side dipoles R, R1 are keyed in alternation, so as to "swing" the radiated beam from side to side. This produces a "guiding line" formed by the overlapping portions of the radiated energy.

For producing a landing beam the main aerial A is arranged horizontally and co-operates with similar reflecting and "directing" aerials to produce a vertical beam, which is distorted by one side reflector so that the pilot is guided tangentially to ground by flying along a line of constant field-strength.

Standard Telephones and Cables, Ltd. (assignees of Le Matériel Téléphonique Soc. Anon). Convention date (France) April 9th, 1936. No. 478470.

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HIGH-FREQUENCY INDUCTANCES

IN the construction of short-wave transmitters, particularly for television where the carrier wave is modulated with a very wide frequency-band, it is sometimes desirable to use inductances of high resistance, i.e., of high damping. For instance, a copper-tube inductance, sprayed with a coating of soft iron, has been used to produce the desired effect.

According to the invention the inductance is made of a half-turn or more of copper tubing, to which a separate steel rib or strip is attached. The thickness of the latter can be chosen according to the amount of "loss" required.

Baird Television, Ltd., and D. W. Pugh. Application date June 6th, 1936. No. 476256.