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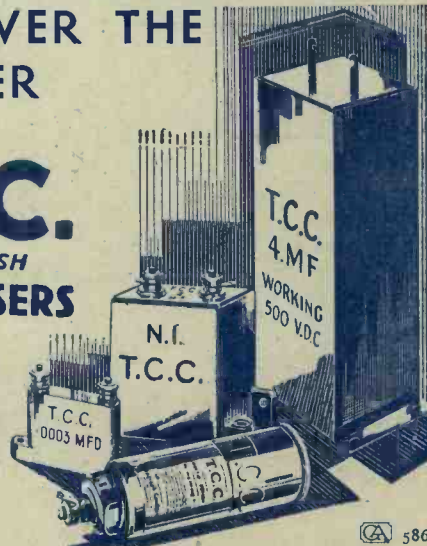
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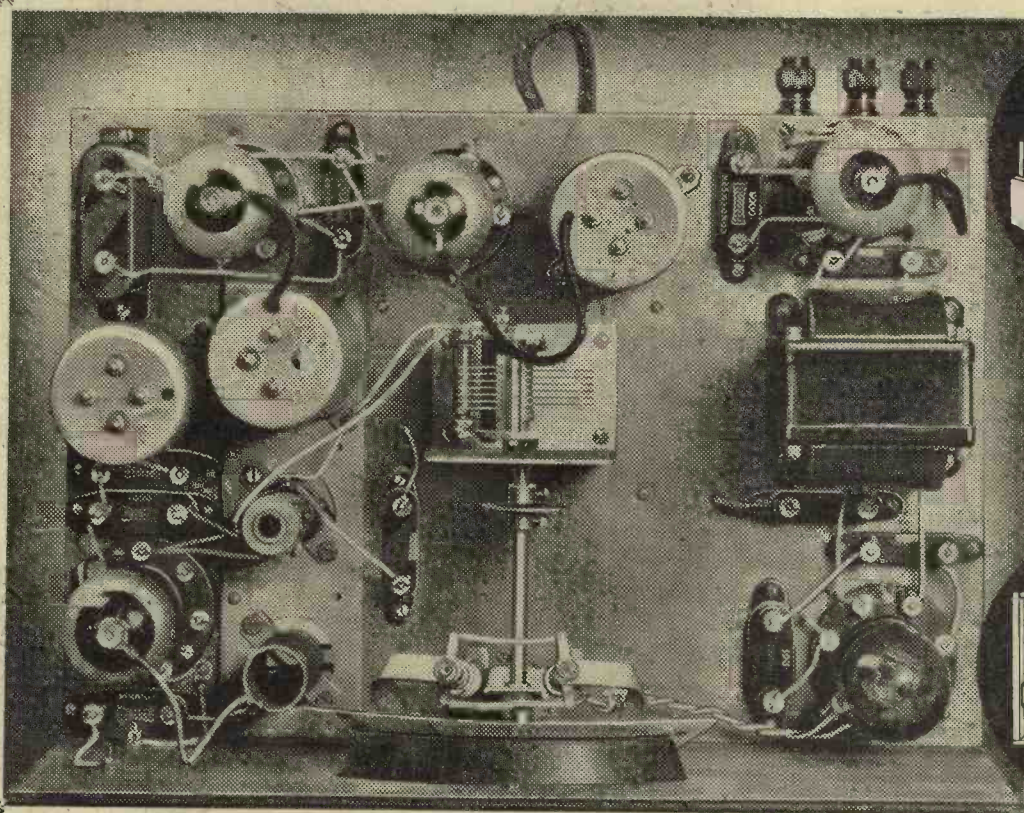
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The Wireless World

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

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EDITORIAL COMMENT

To Our Readers

An Important Announcement

AN important change in *The Wireless World* is to take effect with next week's issue, and we therefore take this opportunity of advising our readers of it. We have made note of frequent expressions of regret on the part of our readers that we are not able to devote more pages to technical and practical matter, and it must be conceded that considerations of space frequently make it necessary for us to hold over articles of this nature and to forgo the inclusion of new features.

The suggestion has often been put to us that we should reduce the number of pages devoted to foreign programmes in order to be able to accommodate other matter. But to reduce the foreign programme section would, in our opinion, result in this section becoming of little value, for already we find that a position has arisen where it is impossible to accommodate full details of the ever-increasing number of foreign programmes, especially as so many stations have augmented their power and lengthened the hours of their transmissions.

We have, therefore, had to decide which road we should follow, and we are confident that our readers will endorse our view that *The Wireless World*, which has built up a reputation for sound technical and practical information, should continue along these lines at the expense of the foreign programme pages.

With next week's issue, therefore, the foreign programme supplement will disappear, and in its place additional pages will be included to extend the technical and practical part, whilst other features will be added to make the journal more than ever a complete wireless newspaper. At the same time,

arrangements have been made to increase the facilities for research and for the development of new designs in the fully equipped and up-to-date laboratory of *The Wireless World* at our offices in Dorset House.

We shall continue to devote pages to the requirements of the general listener who takes a practical interest in his set, and will deal with manufacturers' receivers and components, both by the extension of our present series of critical reviews and by articles giving practical advice and assistance. Technical news concerning new apparatus and developments will be a strong feature.

Our efforts will constantly be directed towards enhancing the value of the paper to our readers, to whom we hope we may look for real co-operation, both by bringing *The Wireless World* in its new form to the notice of their friends, and by giving us the advantage of their views on the contents, or by suggestions for any new features which might appeal to them.

All-wave Receivers

Performance and Cost

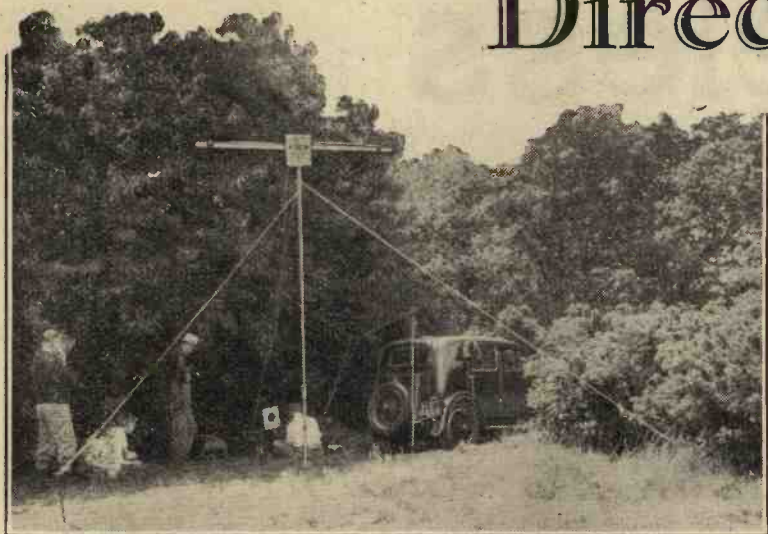
IT seems likely that the next major step in the development of receivers in this country will be the production of all-wave models. This change will not be such a radical departure as it has been in America, as British sets will require only the addition of the short-wave ranges. Nevertheless, considerable care, both in design and construction, will be required to provide for a performance on the short waves comparable with what is now available on other ranges. The public should be prepared for all-wave receivers to cost proportionally more if the essentials of reliability and good performance are to be maintained.

Direction-Finding

with

Ultra-Short Waves

By D. A. BELL, B.A.



When Loop or Dipole Receiving Aerial Gives Best Results

IT is only the arrival of some new development, such as communication on ultra-short wavelengths, which makes us realise the extent to which we have grown accustomed to conventional methods of working and forgotten the principles which govern them. In fact, it has come to be regarded as so inevitable that the longer waves should be radiated with their electric field in a vertical plane (i.e., the radiation is polarised in a vertical plane) that the ordinary listener forgets the very existence of a plane of polarisation. Now in any kind of electromagnetic wave, of which wireless waves are a particular example, there must always be an alternating magnetic field H and an alternating electric field E (Fig. 1), which are at right angles to each other and to the direction in which the wave is travelling (the direction of propagation). If the directions of E and H remain constant, the wave is said to be

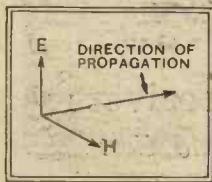


Fig. 1.—The two components of a wireless wave, the magnetic field (H) and electric field (E) are always at right angles to each other and to the direction of propagation.

plane polarised in the plane which contains E . Now let us consider the radiation from a vertical aerial; the radiated field will bear some resemblance to the static field, so that the magnetic component is in a horizontal plane (Fig. 2, a) since the lines of force due to a current flowing along the wire are circles around it. As there is a potential difference between the ends of the wire, there must also be an electric field parallel to its length, so that the wave is radiated with its electric field parallel to the length of the wire carrying the current. The reader might object at this point that a long-wave aerial frequently has a horizontal length greater than its height, so that the aerial current is flowing in both vertical and horizontal

wires; but if proper allowance is made for the effect of the earth in such cases, it will be found that the horizontal part or "roof" merely corresponds to the plate shown at the top of the aerial in Fig. 2, and serves to increase the capacity so that a larger current flows through the vertical portion. The horizontal portion does not therefore result in the radiation of any horizontally polarised wave.

When the wavelength is long it is desirable to use the earth as an electrical mirror, so that the effective size of aerial-earth system is double that of the aerial alone; hence the transmitter necessarily has its aerial current flowing in a vertical wire, and radiates a vertically polarised wave. But with short waves it becomes practicable to use self-contained aerial systems, such as the dipole type, which require no earth connection, for there is

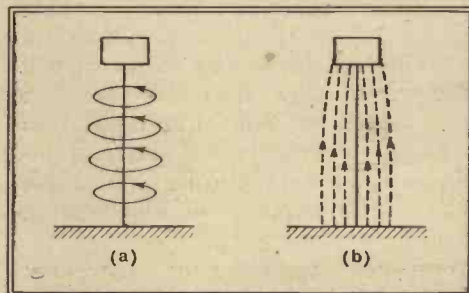


Fig. 2.—The concentric circles depict the lines of force in a vertical aerial (a) the electric field is parallel to the wire (b) and so is the field of the radiated wave. Adding a horizontal portion to the aerial has the effect only of increasing the capacity at the top and does not affect the polarisation of the wave.

A RECENT article, "Are Ultra-Shorts Directional?" recorded some practical observations on a 5-metre field-day organised with the view to investigating the directional properties of aerials at very high frequencies. Here are some theoretical aspects of the question.

now no difficulty in making the length of the aerial system as large as a half wavelength. There is consequently no need for the length of the system to be placed in a vertical plane, and in fact the horizontal dipole (Fig. 3) has been a popular aerial with amateur transmitters. This will radiate a wave which is polarised in the horizontal plane, and as such should not be well received on a vertical aerial; but long-distance reception depends upon reflection from the Heavi-

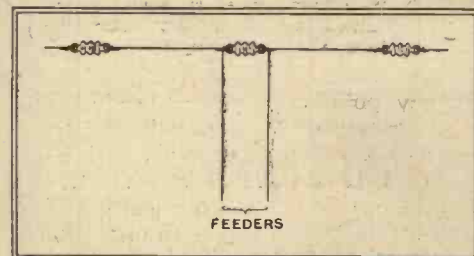


Fig. 3.—Typical horizontal dipole aerial used for ultra-short wave transmission.

side layer, which confuses the plane of polarisation so much that whatever it may be at the transmitter the reflected wave is likely to have components polarised in both horizontal and vertical planes. (The reflected wave is usually elliptically polarised.) Accordingly it is impossible to tell from the receiving end which type of transmission was employed.

Receiving Aerials

With ultra-short waves, however, we know that it is the direct wave, not a reflected wave, that is received, so that it must be polarised in the same plane

Direction-Finding with Ultra-Short Waves— when it arrives at the receiver as it was at the transmitter. The simplest case occurs when both transmitter and receiver use the same type of aerial, both dipoles or both loops; the aeri- als should then be arranged in the same plane for best reception. If a loop aerial is used for reception it should always be set up in the plane of polarisation, i.e., a vertical loop for receiving a vertically polarised transmission, but a horizontal loop if the transmitter uses a horizontal dipole or loop. For it is only possible for an EMF to be induced in the loop if, first, some parts of its circumference are parallel to the electric field, and, secondly, there is a difference in either phase or magnitude between the EMFs induced in opposite sides. Thus for a

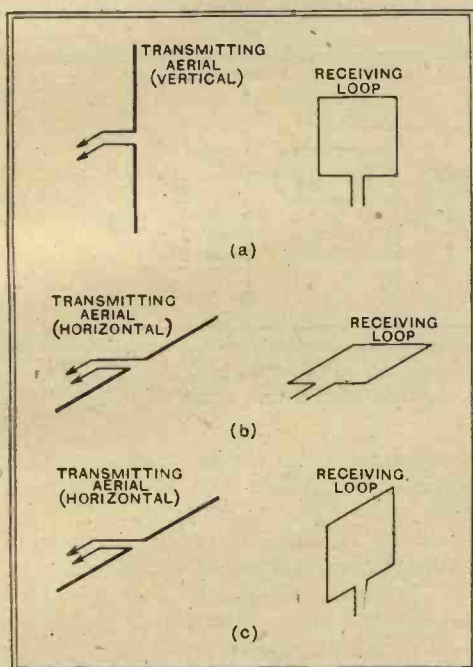
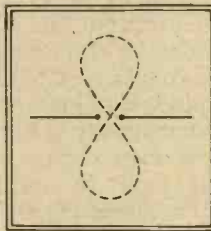


Fig. 4.—If a loop aerial is used for reception it should be set up in the plane of polarisation as shown above.

vertically polarised transmission we get maximum signal strength with the loop pointing towards the transmitter as in Fig. 4, a, there being EMFs of equal magnitude induced in the two vertical sides of the frame; these are acting in opposition, but there is a difference in phase between them owing to the greater distance from the transmitter of the second side of the frame, so that there is a resultant EMF around the loop. With a horizontal dipole at the transmitter a receiving loop will behave in the manner just described if placed in a horizontal plane (Fig. 4, b), but is obviously non-directional. We have now to explain Mr. Dent's observations, which showed that with a horizontally polarised transmission a vertical loop can be used at the receiver (Fig. 4, c), but with its plane at right angles to the direction of the transmitter. It will be realised that if the loop is set pointing towards the transmitter, as in Fig. 4, a, but with the electric field now in the horizontal plane, the field is everywhere at

right angles to the winding of the loop, and therefore produces no EMF in it: as observed, this position gives minimum signal strength. But if the loop is set as in Fig. 4, c the electric field will be parallel to its top and bottom, and will induce in

Fig. 5.—With horizontally polarised waves a horizontal dipole can be used for direction finding for the polar curve relating signal strength to direction as is shown here.



these two sides EMFs which are opposed to each other around the loop. Since all parts of the loop are now equidistant from the transmitter, the two EMFs should ideally have the same magnitude and phase, so that the resultant EMF round the loop would be zero. But if for any reason the field is non-uniform in the vertical plane so that the EMF, say, in the top of the loop is greater than that in the bottom, there will be a resultant EMF around the circuit. In practice the presence of the receiver just below the loop will probably cause sufficient distortion of the field, while there is also the effect of the earth to be considered, so that reception in this way becomes possible.

Dipole Aerial

It is not anticipated that the plane of polarisation of ultra-shorts will show any change during propagation, but it would be as well to have practical observations of its constancy, especially when long distances are covered. Since the vertical loop responds to vertically polarised signals when pointed towards the transmitter, and to horizontally polarised ones when at right-angles to the direction of the transmitter, the accuracy of the bearings obtained in either case will be a measure of the extent to which the received wave is polarised exactly in the horizontal or vertical plane.

A better method is the use of a dipole

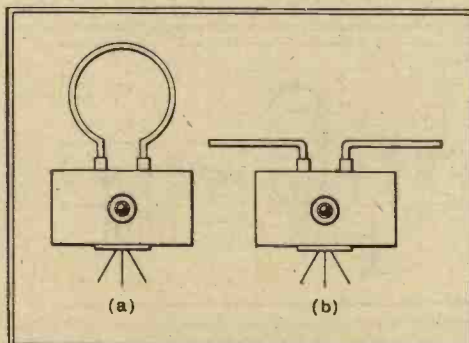
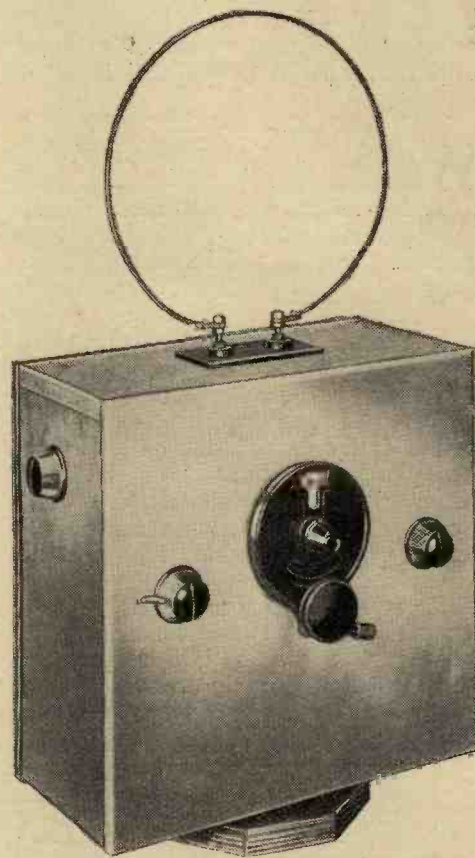


Fig. 6.—A horizontal dipole should be mounted on top of the receiver and if sockets are fitted a quick change to a loop can be made for vertically polarised transmissions.

receiving aerial, for if this be oriented for maximum signal strength it must then lie in the plane of polarisation and perpen-

dicular to the direction of the transmitter. If the plane of polarisation is horizontal the dipole can be used for direction-finding, for it has a curve as shown in Fig. 5 relating the signal strength to the direction of the signal received. (This polar curve can be understood from the fact that the electric field in a radio wave is always perpendicular to its direction of propagation, so that if the wave is travelling end-on to the aerial its electric field is at right angles to the wire and therefore ineffective.) Maximum signal strength will therefore occur when the dipole is perpendicular to the direction of the transmitter, but sharper bearings can be obtained by using instead the minimum which occurs when the dipole points towards the station received. To avoid pick-up on the leads between the dipole and the receiver, these should be arranged in a vertical position, i.e., a horizontal dipole aerial should always be mounted on top of the receiver, not at one side.

If reaction and tuning arrangements do not preclude the change from loop to



Self-contained receiver in metal case and surmounted by a loop which was designed for DF experiments with ultra-short waves.

dipole aerial, a receiver for direction-finding on ultra-shorts might be arranged as shown in Fig. 6. Mounted on top of the receiver are a pair of sockets which can take either the two ends of a vertical loop or the two halves of a horizontal dipole, for direction-finding on vertically or horizontally polarised waves. The positions of the receiver for minimum signal strength would, of course, be at right-angles in the two cases.

HINTS and TIPS

Practical Aids to Better Reception

A NUMBER of components are fitted with earthing terminals, through which metal frames, shrouds or cores may be connected to earth. In perhaps the majority of cases it will be found that it makes no detectable difference whether these terminals be earthed or not; in spite of this, it is wise to cultivate the habit of connecting to earth all large masses of metal whenever possible, even though terminals for the purpose are not actually provided.

Masses of Metal.

Although those who ignore such precautions often escape the consequences, inconsistent and erratic behaviour of receivers has often been traced to metal-work that is not properly "tied down" to earth.

WHEN a superheterodyne receiver is considered to be lacking in sensitivity and selectivity, the most obvious thing to do is to add a stage of IF amplification. With regard to selectivity, this statement should perhaps be qualified by saying that the susceptibility of the receiver to interference from stations occupying channels adjacent to that of the desired transmitter will be greatly improved by such an addition; certain other forms of interference to which the superheterodyne is liable can only be avoided by attention to the signal-frequency circuits.

Improving a Superhet

It is especially easy to make alterations or additions to an IF amplifier of normal design without running into instability or other troubles, for the reason that it usually operates at a comparatively low

at least a commensurate increase in true selectivity as well is made. Now this can most easily be done by using plenty of tuned circuits, and it is recommended when adding an extra stage that at least one of the couplings should be in the form of a double band-pass filter, as shown diagrammatically in Fig. 1. Such an arrangement may consist of a pair of ordinary band-pass IF transformers, IFT₁ and IFT₂, linked together by a small coupling condenser C, which may have a maximum capacity of some 20 micro-mfd. or so; it should be variable or semi-variable in order that the best coupling may be determined experimentally. This condenser is joined between the high-potential ends of, respectively, the secondary and primary windings of the two IF transformers. The appropriate terminals are usually lettered as shown in the diagram.

Almost invariably the best position for the double filter is that shown—immediately succeeding the frequency changer—but where this plan is inconvenient it might be used as an intervalve coupling between the two IF valves.

When adding an IF valve to an existing receiver it will generally be found distinctly beneficial to use a screened pentode in the second position, as shown in the diagram, which deals only with the essentials of the amplifier.

IT is a matter of some importance that the frequency of an IF amplifier should be adjusted, within reasonably close limits, to the value at which the receiver is designed to operate. Fortunately this is a detail that is normally not responsible for much trouble, for the reason that a certain amount of latitude is permissible, and also because the range covered by the ordinary IF trimming condenser is not wide.

IF Amplifier Frequency

are satisfactorily covered, it can be assumed that the intermediate frequency is correct—and vice versa.

are satisfactorily covered, it can be assumed that the intermediate frequency is correct—and vice versa.

EVERYONE knows that interaction between grid and anode circuits of an HF amplifying valve must be avoided; the penalty for failure to observe this precaution is uncontrollable self-oscillation or instability. A good deal of trouble on this score seems to be due to failure to classify the various components and sections of the wiring into their proper circuits. In particular, the fact that a component may, from our present

Separating the Circuits

proper circuits. In particular, the fact that a component may, from our present

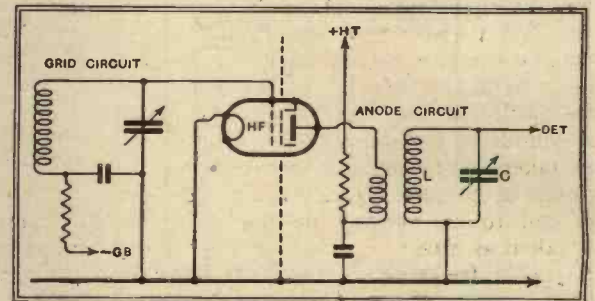


Fig. 2.—Instability in an HF amplifier is prevented by isolation of grid and anode circuits.

point of view, be common to the anode circuit of one valve and the grid circuit of the next, often causes confusion.

For the sake of illustration, let us refer to the simple skeleton diagram given in Fig. 2, which represents a simple HF amplifying stage. Here the grid and anode circuits, which must at all costs be isolated both magnetically and electrostatically, are separated by a dotted line, the valve being disposed horizontally very much as it was in practice in the past, when inadequate internal shielding had to be supplemented by an external screen.

The secondary circuit of the HF transformer, comprising the inductance L and the condenser C, though not metallically connected to the anode circuit of the valve is very much a part of it, being comparatively tightly coupled, and in spite of the fact that it is in the grid circuit of the succeeding valve (in this case the detector), it must be rigorously isolated from the preceding grid circuit.

There are one or two other points about circuit isolation that are apt to be puzzling. For instance, the valve screening grid, or, rather, its by-pass condenser, decoupling resistance (if used), and the connecting wires, seem to belong to no particular circuit. It will, indeed, be convenient to regard this circuit as a sort of "no man's land," and to isolate it from everything else. The aerial, as many of us have found to our cost, is, from the point of view of undesirable interaction, a part of the input grid circuit.

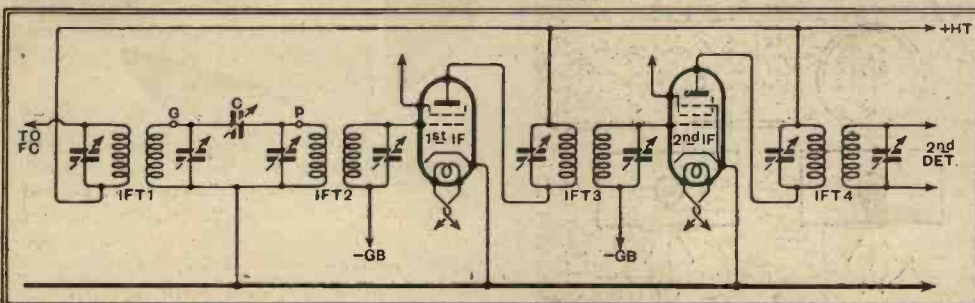


Fig. 1.—A highly selective 2-stage IF amplifier. Details such as volume control, AVC, by-pass condensers, etc., are omitted.

frequency, and, most important of all, the tuning is fixed, and so no provision need be made for external adjustments.

The object of this paragraph is to point out that if extra IF amplification is to be provided, care must be taken to see that

The wave-range coverage of any superheterodyne is to some extent affected by the frequency at which the IF amplifier is operated, and this provides a useful clue as to whether the IF amplifier is correctly adjusted. If the normal broadcast bands

Single-Sideband Working

Practical Methods and Future Possibilities

EVEN though there is no immediate prospect that single-sideband broadcasting will displace existing methods, the matter is of considerable importance. Adoption of the system would make it possible greatly to improve quality of reproduction, or, alternatively, to double the number of stations without impairing existing standards of quality

A RECENT article on sidebands gave a synthetic demonstration which showed how a radio frequency F modulated by an audio frequency N was the equivalent of three simultaneous radio frequencies F , $F+N$ and $F-N$ respectively. In the more general case of telephonic modulation, especially for high-quality broadcast, the modulating frequency N may consist of any frequency or of any number of simultaneous frequencies comprised in the audio-frequency spectrum, according to the nature of the sound or combination of sounds to be transmitted. Thus, if N be taken as meaning a whole band or group of frequencies anywhere between 30 and 10,000 cycles, and the carrier F be taken as 1,000 kc/s (300 metres), then the upper frequency sideband $F+N$ will consist of a whole group of frequencies between 1,000,030 and 1,010,000 cycles, and the lower frequency sideband $F-N$ will consist of a whole group running down from 999,970 to 990,000 cycles. This condition is shown in Fig. 1, reproduced from the previous article, and represents the very practical case of what occurs when a 300-metre wave in the medium broadcasting band is modulated.

It is most important to be perfectly clear about the rôle of the carrier. The carrier itself conveys no intelligence. Even if you rectify it (in the absence of modulation), you cannot, and indeed do not, hear it. Its presence may be detectable in the form of a "mushy" background; this is not the carrier itself,

but parasitic and general background noises which are "riding in," as it were, due chiefly to the increased sensitivity of the detector under the influence of the carrier.

The intelligence is conveyed *entirely* by the *sidebands*. For example, in Fig. 1 (c) the intelligence is conveyed entirely in the sideband groups mentioned above. The function of the carrier in reception is merely to beat against or to *heterodyne* the various frequencies in the sidebands and give beat notes which restore the resultant to the correct position in the audio-frequency spectrum which it occupies in Fig. 1 (a). If by any chance we failed to receive the carrier but did receive the sidebands we could still do exactly the same thing by supplying locally an oscillation of exactly 1,000 kilocycles. This would fulfil the rôle of the original carrier and give beats restoring the sideband components, conveying the intelligence, to their correct position in the audio spectrum. Even if we omitted the carrier and one sideband, but did receive the other sideband, we could still get our intelligence from it and from a local oscillation of exactly the frequency of the carrier which is con-

veniently assumed to have been mislaid.

This important fact, indeed, is being utilised daily in the long-wave transatlantic telephony service between Rugby and America. To the person accustomed to think in terms of broadcast telephony, with carrier and both sidebands, this, at first sight, appears almost irregular and

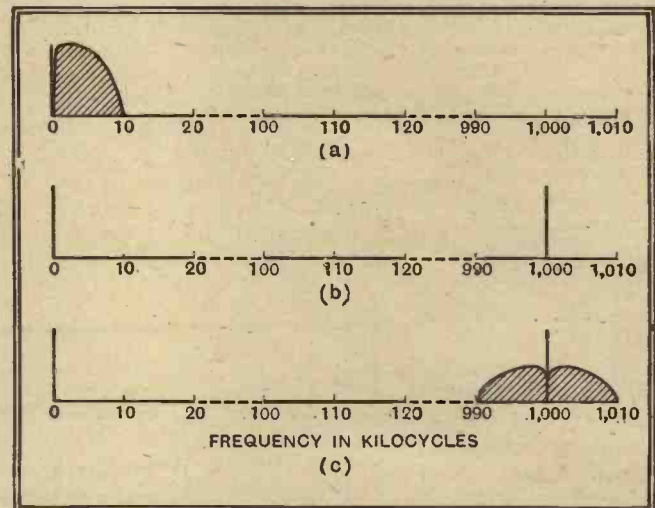


Fig. 1.—This diagram, repeated from last week's article, shows the normal process of broadcast modulation.

untidy, but it is a most important technical and economic feature of the long-distance long-wave service.

Alternative Methods

The position as regards the conveyance of intelligence by radio-telephony can, therefore, be summed up as follows. The intelligence can be conveyed by:—

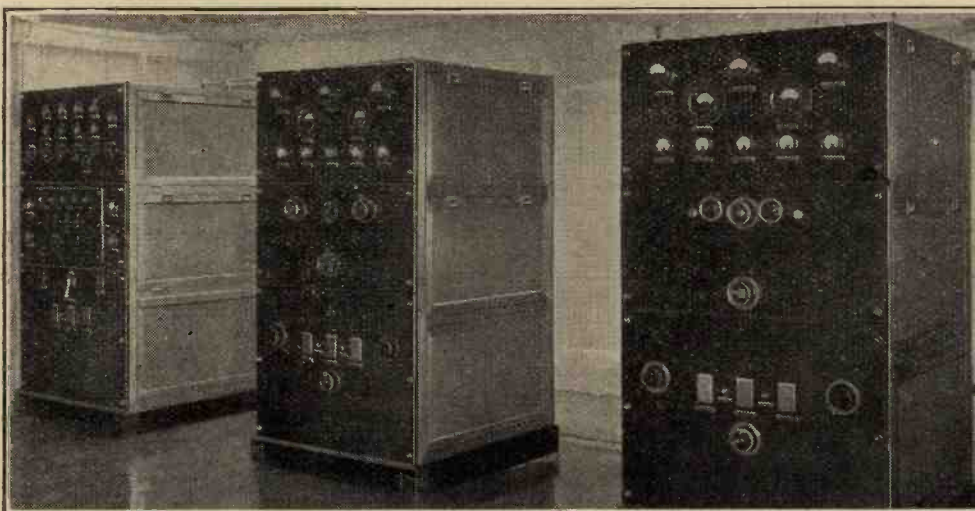
(a) The transmission and reception of carrier and both sidebands (present normal broadcast practice).

(b) The transmission and reception of carrier and one sideband (possible broadcast development).

(c) The transmission and reception of both sidebands with the correct carrier replaced at the receiver (not actively envisaged for any purpose).

(d) The transmission and reception of one sideband with the correct carrier replaced at the receiver (in practical use in long-wave transatlantic telephony).

The methods mentioned in (b) and (d) above constitute what are described as single-sideband systems, and it is an open secret that the broadcasting authorities of



The units of a single-sideband transmitter built by Standard Telephones and Cables for use on short wavelengths.

Single-Sideband Working—

Europe are at least interested in their possibilities. It is quite impossible, at present, to state what future developments may occur. Certainly, a good deal of

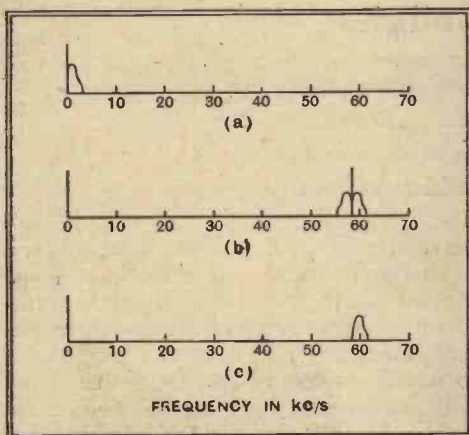


Fig. 2.—Principles of single-sideband emission as used for transatlantic telephony. (a) Speech band of 3 kc/s. (b) Speech band used to modulate a carrier of 58.5 kc/s. (c) Carrier and lower sideband suppressed, leaving only sideband of 58.5 to 61.5 kc/s.

technical development is necessary before any system of single-sideband working could be regarded as a practical proposition for broadcasting purposes. In addition to purely technical difficulties, any rearrangement to single-sideband working would require to be arranged on an international basis and would doubtless be accompanied by international wavelength reallocations. At the same time there appears no obvious and fundamental objection to the method given in (b) as a practical broadcasting system. Some of the advantages accruing from it were discussed in *The Wireless World* of June 15th.

On the other hand, the system mentioned in (d) has many advantages which have been the cause of its adoption for the long-wave telephony channel. From the broadcasting point of view it certainly appears less attractive. The technique of transmission is well developed for the case of commercial communication channels using a speech band of 250 or 300 to 2,700 or 3,000 cycles, but offers much greater difficulty in the case of broadcast transmission, which demands a lower limit of 30 or 50 cycles. In addition, the inherent need for replacement of the carrier at the receiver is a serious difficulty in the case of broadcasting.

The system is so interesting, however, as a piece of technical work that a brief description of it may not be out of place. In particular it gives the most complete impression that can be gained of the

manner in which bands of frequency can be moved about at will in the spectrum. The essential operation is shown in Fig. 2. An audio-frequency band of 0-3,000 cycles is used, this being found sufficient for good-quality commercial speech, but not good broadcast quality, of course. (Actually the speech band is only 250-2,700 cycles, but the above figure is convenient to consider.) This is shown in its spectrum position in Fig. 2 (a), while Fig. 2 (b) shows it when used to modulate a carrier of 58.5 kc/s. By methods to be described later, however, the carrier and the lower frequency sideband are both suppressed so that the final band of frequencies passed on to the power amplifiers and radiated from the aerial is the upper frequency sideband of 58.5 to 61.5 kc/s.

Radiating One Sideband Only

The manner in which this is actually done is illustrated in Figs. 3 and 4. The speech band of Fig. 3 (a) is used to modulate a carrier frequency of 33 kc/s, using a particular type of balanced modulator that passes the sideband frequencies but not the carrier. Sidebands of 33 to 30 and of 33 to 36 kc/s are thus set up as shown in Fig. 3 (b), but the upper frequency sideband of 33 to 36 kc/s is suppressed by a filter as suggested by its dotted outline in Fig. 3 (b). The band

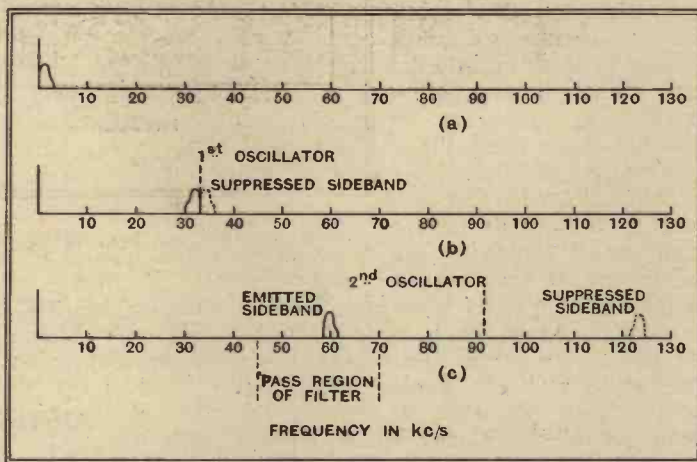


Fig. 3.—Practical method of producing single-sideband.

of 33 to 30 kc/s passed by the filter is then applied to modulate a second carrier of 91.5 kc/s by means of a similar balanced modulator. From what has been said about sidebands and modulation it will be seen that this gives rise to

sidebands of 58.5 to 61.5 kc/s and of 121.5 to 124.5 kc/s respectively. Now these sidebands are very well separated from each other. The band of 58.5 to 61.5 kc/s falls within the pass-region of a wide band-pass filter, passing 45 to 70 kc/s (the figures here given throughout may not be exactly those actually employed, but are very nearly so and are certainly near enough to illustrate the method). Thus only the 58.5 to 61.5 kc/s band is passed, and we are left with this group of frequencies occupying the position in the ether spectrum which it would occupy if it were the upper sideband of a 58.5 kc/s carrier which is not really there.

These processes can also be traced in the block schematic diagram of Fig. 4. This method has the advantage of being very flexible, since the actual band finally passed can be varied within the pass region of the second filter by changing the frequency of the second oscillator. For example, if the second oscillator is 85 kc/s the sideband resulting and falling within the filter will be 52-55 kc/s.

The type of balanced modulator used is shown in Fig. 5. In the case of this, when used as the first modulator, it can be shown theoretically that, with the speech and oscillator inputs arranged as shown, the output consists of sidebands without carrier, the actual response to the sidebands depending, of course, on the response characteristics of the circuits. From the point of view of the long-wave telephony channel this system has notable advantages. The actual band sent out is the minimum necessary for intelligible communication and all the radiated energy delivered from the power amplifiers goes into useful intelligence. It is estimated that the carrier contains not less than two-thirds of the total energy, and it has already been seen that the radiation and reception of this is not essential to the conveyance of intelligence.

An Artificial Carrier

At the receiver it is necessary to introduce locally the carrier of 58.5 kc/s in order to restore the sideband components to their proper position in the spectrum, as in Fig. 3 (a). Moreover, it will readily be seen that this involves the replacement of the carrier frequency with very great accuracy, otherwise all the components will be displaced and speech distorted. For commercial speech a latitude of 15 to 20 cycles in the carrier replacement has

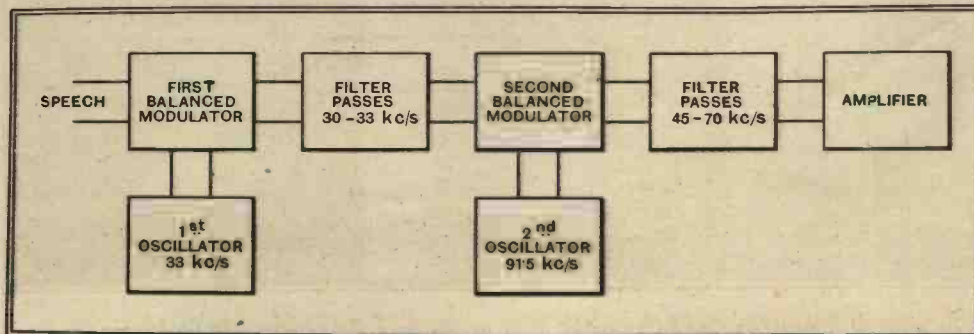


Fig. 4.—Schematic diagram of apparatus for producing single sideband.

Single-Sideband Working—

been found permissible, but for good broadcast reception this accuracy would have to be very much better. This is the greatest difficulty of this type of single-

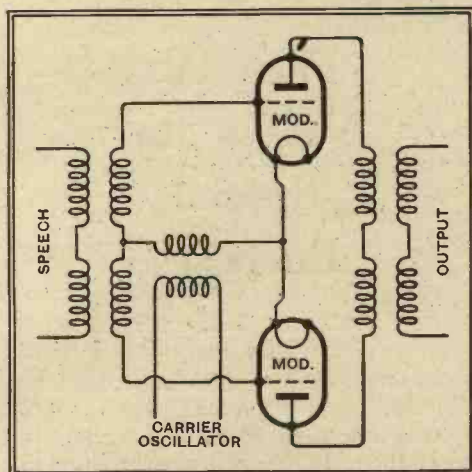


Fig. 5.—Balanced modulator as used in single-sideband apparatus.

sideband operation for broadcast use, since it puts such very exacting requirements upon the receiver. Whether oscillators can ever be good enough (at least at reasonable cost) to provide this stability is quite uncertain, but wonderful things have already happened in wireless. For example, six years ago even the boldest of us would have had difficulty in envisaging mass-produced superheterodynes which had their oscillators ganged to the tuning controls. Yet these are now selling in their hundreds of thousands and being used by quite unskilled people.

A further great advantage of this type of single-sideband operation is the improvement which it gives with fading. This is because the carrier is supplied locally at the receiver and is not concerned in a general fade. Generally, therefore, the effect of fading in the sidebands is felt much less than if the carrier were also concerned.

Future Possibilities

As stated already, however, it is very doubtful indeed if this system can be regarded as ever becoming a starter in the broadcast field. Broadcasting authorities who are thinking of single-sideband transmission are considering much more seriously the method originally given in (b), where the carrier and one sideband are transmitted and received. This can be done, more or less, by modulating in the ordinary way at a low power-level, and suppressing the undesired sideband by means of suitable filters. This is by no means a simple technical feat, but experiments on these lines are definitely proceeding both in England and abroad. After all, this is not the first problem that radio has set us to solve, and it will be agreed that any solution is well worth seeking if it has as its main object the lessening of interference between stations, with, at the same time, an improvement

of the audio-frequency band that can be usefully employed without interference.

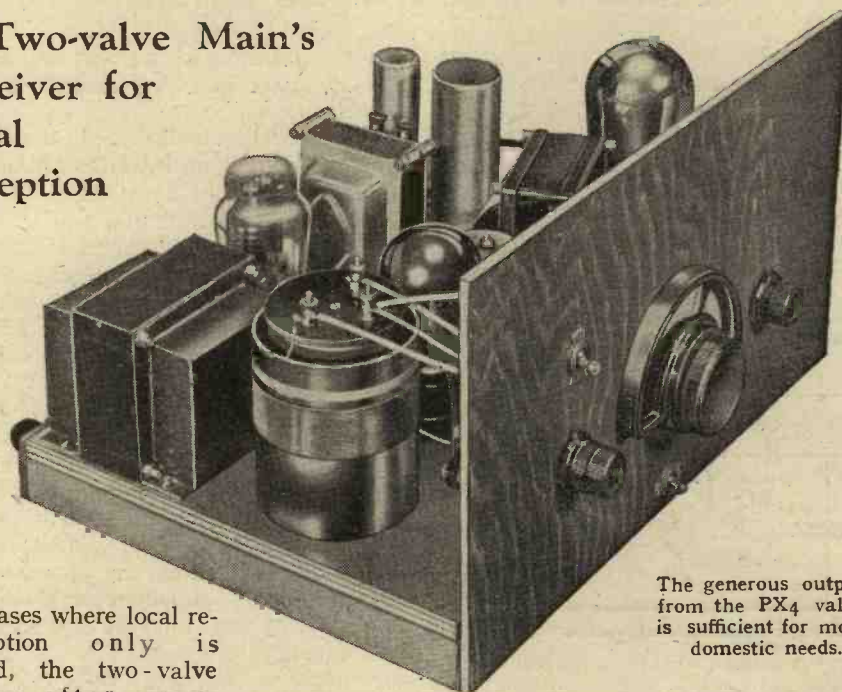
An experimental transmission of this kind was recently made from a Dutch station, chiefly for the information and benefit of interested authorities in various countries. It is understood that the results were not very satisfactory. Whether this was due to inherent faults or to faults avoidable in further experi-

ments is not very clear, but from what can be gathered, faults of the latter class were not absent. There is no obvious reason why, with suitable transmitters and receivers, the arrangement should not be quite satisfactory, although some changes of receiver design would be inevitable. This subject is, however, of sufficient importance to merit an article by itself, and this will appear at an early date.

In Next Week's Issue:—

THE STANDARD AC TWO

A Two-valve Main's Receiver for Local Reception



The generous output from the PX4 valve is sufficient for most domestic needs.

IN cases where local reception only is needed, the two-valve receiver often proves sufficiently sensitive and it can provide high-quality reproduction. The Standard AC Two consists of a power grid detector transformer-coupled to a triode output valve rated for 2.5 watts output. A single tuned aerial circuit is employed with reaction and the selectivity is sufficient to separate the local transmissions with ease; in fact, a few continental stations are

receivable at good volume in most areas. On the long waveband Droitwich can be relied upon to provide large volume and Radio-Paris is often available.

The mains equipment is self-contained and full-wave rectification is used, while the use of electrolytic condensers enables hum-free operation to be secured with only a single smoothing choke.

LIST OF PARTS

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

- | | | | |
|---|---|---|---|
| 1 Variable condenser, 0.0005 mfd. | Formo SU5 | 1 Fixed condenser, 0.0001 mfd. | Dubilier 665 |
| 1 Dial for above | Formo Mystic Drive | 1 Fixed condenser, 0.0002 mfd. | Dubilier 665 |
| 1 Reaction condenser, 0.0003 mfd. | Ormond R508 | (Graham Farish, T.C.C., T.M.C.-Hydra, Telsen.) | |
| 1 Knob for above | Ormond R355 | Resistances: | |
| 1 Midget condenser, 0.0001 mfd. slow motion | Ormond R149 | 1, 100 ohms, 1.5 watts | Graham Farish "Ohmite" |
| 1 Tuning coil, two-range | Scientific Supply Stores, Standard Two Type | 1, 1,000 ohms, 1.5 watts | Graham Farish "Ohmite" |
| 1 Mains transformer, with screened primary, 200-250 volts, 50 cycles; secondaries, 300-0-300 volts, 60 mA.; 4 volts, 2.5 amps., centre-tapped; 4 volts, 2 amps, centre-tapped | Savage | 1, 20,000 ohms, 1.5 watts | Graham Farish "Ohmite" |
| (All Power Transformers, Davenset, Heayherd, Partridge, Rich and Bundy, Sound Sales, Vortexion, Wearite) | | 1, 500,000 ohms, 1.5 watts | Graham Farish "Ohmite" |
| 1 LF choke, 20 henry 75 mA. | Wearite HT12 | 1, 700 ohms, 3 watts | Graham Farish "Ohmite" |
| (Bulgin, Davenset, Heayherd, Partridge, Rich and Bundy, Sound Sales, Vortexion) | | (Bryce, Dubilier, Erie, Ferranti, Claude Lyons, Polar-N.S.F., Watmel) | |
| 1 LF Transformer, 1.7 ratio. | Ferranti AF6 | 3 Valve holders, 5-pin, chassis mounting type | |
| 1 HF choke, screened | Coltone SHF | Goltone R20/521 | |
| 2 Microfuses, 100 mA., 750 volts, with holders | Microfuses F4 | 1 Toggle switch, 3-point, wave-change | Bulgin S87 |
| Electrolytic condensers: | | 1 Toggle switch, SPDT, radio-gram | Bulgin S81 |
| 2, 8 mfd., high voltage type | Dubilier 0281 | 1 Toggle Switch, on-off | Bulgin S80T |
| 1, 4 mfd., high voltage type | Dubilier 0283 | 6 Terminals, A, E, 2 PU, 2 LS | Belling Lee |
| 1, 50 mfd., 12 volts working | Dubilier 3001 | 1 Connector block, 6-way | Bryce |
| 1, 50 mfd., 50 volts working | T.C.C. 521 | 1 Dial lamp, 6 volts | Bulgin |
| | | Cabinet: | Peto-Scott |
| | | Loud speaker with triode or universal transformer | Wharfedale New Bronze Universal Chassis |
| | | Valves:—1, 41MHL, Cossor; 1, PX4, Marconi; 1, 442BU, Cossor. | |

From TRIODE to DOUBLE-DIODE-PENTODE

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

THE modern valve and its applications: this, the concluding instalment, deals with superheterodyne frequency-changers, and describes practical methods of "mixing" the incoming signal with locally generated oscillations. Diode detectors and multiple valves are also treated.

(Concluded from page 301, October 12th issue)

Part IV. Valves for Special Purposes

IN the preceding articles of this series we have discussed types of valve used simply for amplification. There still remain other functions which are performed in the set by valves.

In a superheterodyne receiver the signal, with or without preliminary amplification, has its frequency changed from that at which it is received to another for

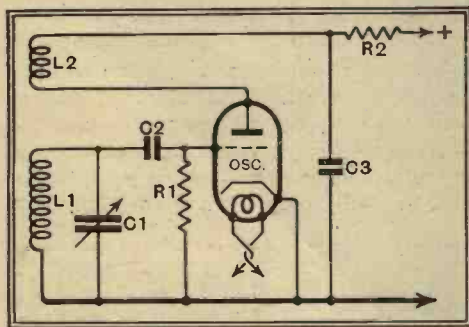


Fig. 17.—A simple generator of oscillations.

which the amplifying portion of the set is designed. It is not proposed, since we are dealing with valves, to discuss at any length the process of frequency-changing, but it is a necessary preliminary to remind readers that the new frequency is built up by combining the original signal current or voltage with a second high-frequency current or voltage generated locally. The results of the combination include new currents whose frequency is equal to the sum, and to the difference, of the two original ones. Of these two the succeeding amplifier is designed to accept and amplify one, that usually chosen being the difference-frequency.

Two stages are essential in this process; first, the generation of the local oscillation, and, secondly, the mixing of the two. This mixing cannot be carried out simply by passing the two currents through the same circuit, for then, though both are present, they are *independently* present in the sense that neither is the least affected by the other. The mixing required before the new frequency is formed is more intimate than this; the one current must so modify the circuit that the other is differently amplified as a result of its presence. Such modifications of circuit conditions can only take place in a valve, which is

known, according to the way in which it is used, either as a *first detector* or as a *modulator*.

The generation of the local oscillation is generally carried out by a triode connected in some such way as shown in Fig. 17. The coupling between the tuned coil L1 in the grid circuit and the untuned coil L2 in the anode circuit is so adjusted that the energy fed back from L2 into L1 is always in phase with that already there. As a result, if any trifling disturbance in the valve or tuned circuit puts a momentary positive voltage on the grid, this voltage is amplified by the valve and fed back from L2 into L1 in such a way as to increase at that instant the positive voltage already there. Owing to the fact that any kind of disturbance in a tuned circuit shocks it into momentary oscillation, the positive voltage accidentally evoked must always be followed at a time interval depending on the frequency to which L1 is tuned by a corresponding negative voltage. This, in its turn, is enhanced by energy fed back from the reaction coil L2.

If the energy so introduced into L1 is greater than that lost owing to its resistance, the momentary oscillation, instead of dying away, will grow. Its growth will continue as long as more energy is fed back in each second than is lost in that time. In practice the grid current flowing during the positive half-cycle develops

across R1, a voltage which biases back the valve and reduces its amplification, until at some amplitude of oscillation, depending on the resistance of L1, the mutual inductance between it and L2, and the characteristics of the valve, an equilibrium is reached and the amplitude of the oscillation remains unchanged.

Fig. 18 shows one of the many ways of combining signal and local oscillation. The latter, generated by the triode V2, is directly applied to the suppressor-grid of the pentode V1, the signals meanwhile being applied to its ordinary control-grid. The characteristics of a screened pentode can be varied by altering the voltage on its suppressor; in the frequency-changer shown the characteristics of V1 are being varied at the frequency of the local oscillation. The required new difference-frequency is thus produced, and is selected from the many currents of various frequencies present in the anode circuit of V1 by the tuned intermediate transformer T.

Combined Detector-oscillators

The *pentagrid* has been developed to provide a single valve that will combine the functions of local oscillator (V2) and mixer valve or first detector (V1). As its name implies, it contains five grids, in addition to the normal anode and cathode. These grids are disposed and used in the

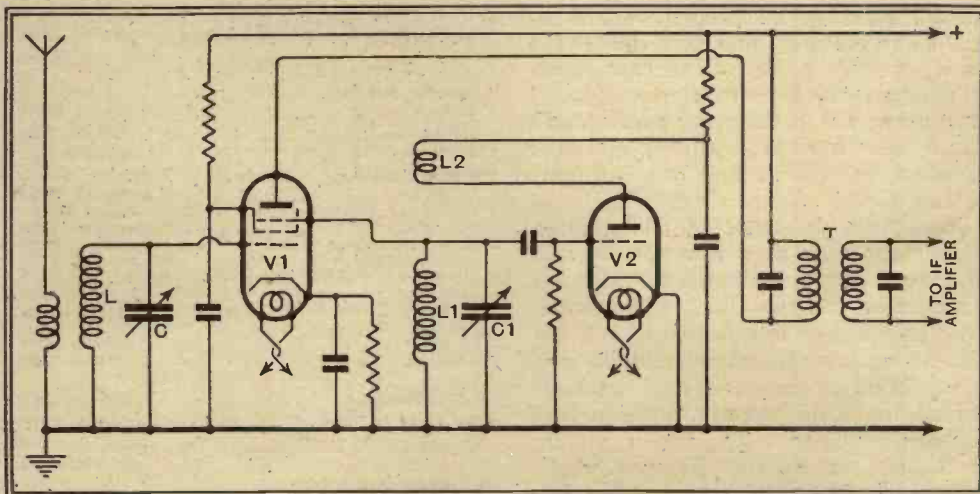


Fig. 18.—A two-valve frequency-changer, in which oscillator voltages are applied to the suppressor grid of a screened pentode detector.

From Triode to Double-Diode-Pentode—manner shown in Fig. 19, it being understood that the whole structure is cylindrical, with a central cathode round which the grids are arranged in the order shown.

It is simplest to regard this rather complex valve as a triode (two innermost grids) surrounded by a screen-grid valve (two outermost grids and anode) with an electrostatic screen (central or third grid) between the two valves. In use, the innermost grid and the one next to it are connected exactly as the grid and anode of the oscillator valve already discussed in connection with Figs. 17 and 18; these two electrodes are, in consequence, usually referred to as oscillator grid and oscillator anode.

Since all the electrons reaching the anode and the other electrodes of the outer or modulator valve have to pass through the triode, it is evident that when the latter is made to oscillate, as in Fig. 20, the total current of the modulator portion will rise and fall in time with the oscillation. As the slope of any valve depends largely upon the current through it, this means that the alternating anode current produced by the signal applied to the modulator grid will rise and fall at the frequency of the oscillation. In this way the intimate mixing of signal and oscilla-

assume that the oscillation of the triode is such as to produce a total grid-swing of 16 volts, then, since the valve will bias itself back by grid current through R (Fig. 20) until only the extreme positive

it would overload and distort on strong signals. No serious inconvenience was caused by this, because sufficient LF amplification was provided in the set—usually by the detector itself—to ensure

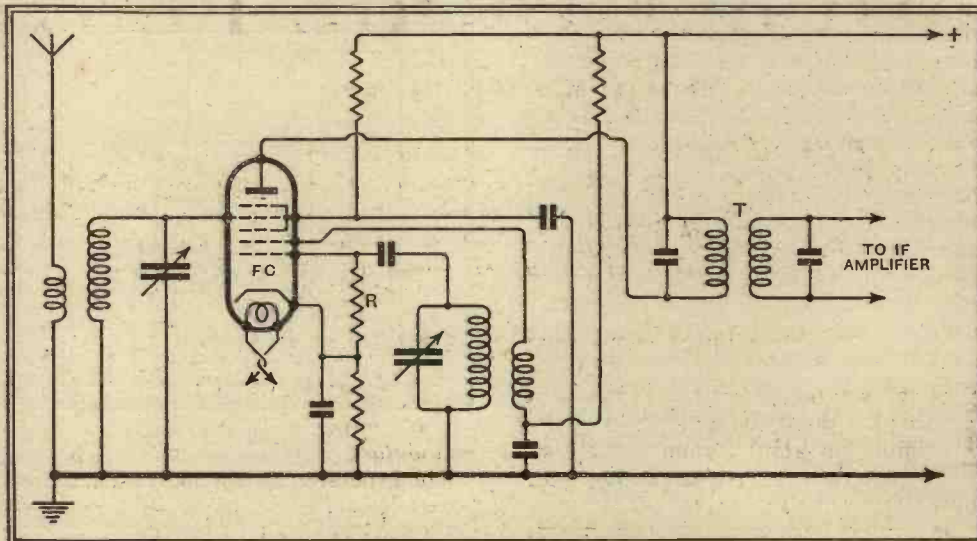


Fig. 20.—A pentagrid valve and its circuits.

peaks draw grid current, the oscillator grid will have a mean bias of approximately 8 volts. If the modulator grid is biased to -2 volts, the characteristics of this valve will be swung by the oscillation through all the values symbolised by points on the line AB in Fig. 21.

The inclination of the curves shows very clearly that at moments when the oscillator grid is most negative the modulator slope is practically zero, while when the oscillator grid approaches zero potential the modulator slope is high. Thus the amplification given by the valve to the signal applied to the modulator grid will increase and decrease rhythmically with the rise and fall of the oscillator grid voltage caused by the oscillation itself, and the difference-frequency required is formed in the anode circuit.

that adequate output could be had from a signal small enough to be handled without distortion by the detector.

But if automatic volume control is desired, it becomes desirable to be in a position to rectify a signal large enough to produce a DC voltage that, when fed back as bias to variable- μ valves used as high- and intermediate-frequency amplifiers, will reduce their amplification

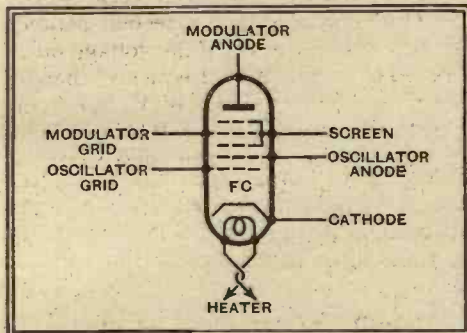


Fig. 19.—Arrangement and functions of the various electrodes in a pentagrid frequency-changer.

tion is achieved, and the difference-frequency current makes its appearance, and is selected by the intermediate transformer T of Fig. 20.

Except for the fact that in the case of the pentagrid the oscillation can control the electron-stream through the mixer-valve directly, while in the case of the two-valve frequency-changer of Fig. 18 the control had to be done via the pentode's suppressor grid, the operation of the two circuits of Figs. 18 and 20 is much the same.

The way in which the oscillator controls the modulator portion of the pentagrid is well shown in Fig. 21. All these curves, which show the variation of modulator anode current with modulator grid voltage, were taken with the same operating voltages on the modulator itself. Each, however, refers to a different fixed bias on the oscillator grid. Comparison of the curves thus shows the influence of the oscillator portion upon the outer tetrode.

The operation of the valve can be followed quite well from the curves. If we

The Diode Detector

The diode is the oldest and simplest type of thermionic tube, consisting simply of a cathode and an anode. The term "valve," which so ineptly describes the modern amplifying tube, was originally invented for the diode in view of the fact that current can only pass through it in one direction.

The diode cannot amplify, but it can detect; this, indeed, was its original use when it was the only kind of valve known. The later introduction of the triode, which can both detect and amplify in one operation, caused the diode (except as a mains rectifier) to disappear entirely for a time. Modern conditions, however, are bringing it back into favour.

Until automatic volume control was demanded by the user of the set, no great advantage was to be had by amplifying the received signal to more than a volt or so at most before rectifying it. The triode, first as grid detector and later as "power" grid detector, therefore fulfilled all possible needs, in spite of the fact that

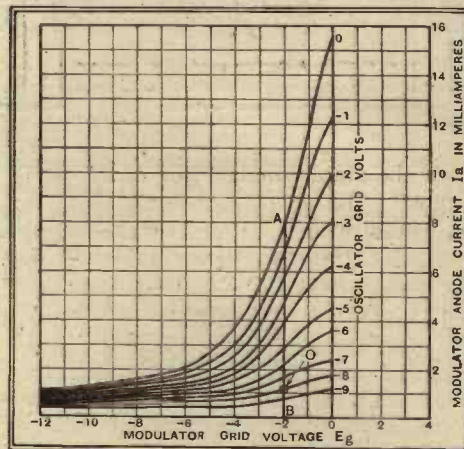


Fig. 21.—Pentagrid characteristics; curves for different values of oscillator grid bias. Typical operating point marked O.

almost to zero. For this the DC voltage needed is about 15 volts or more, which requires for its production a peak HF voltage of about the same, or a modulated HF voltage up to double this value.

No ordinary detector will stand up, without distortion, to an input of this magnitude on account of the enormous anode current swings at high frequency that are produced in response to such a signal. The low-frequency component, which even at 100 per cent. modulation only has half the amplitude of the modulated carrier, is more readily dealt with; in any case, the question of handling it is an ordinary problem of LF amplification.

From Triode to Double-Diode-Pentode—

It becomes necessary, therefore, to take steps to remove the high-frequency component from the anode circuit of the detector; this can be done, as suggested in these pages more than three years ago,¹ by transferring the low-frequency component, through a filter to remove high-frequency currents, from the grid of the valve used as grid detector to the grid of a second valve used as a pure LF amplifier. Such a circuit is shown in Fig. 22b, in contrast to the simple grid detector of Fig. 22a. The two-valve system will handle a much larger input voltage than its single-valve counterpart; in fact, the limit is set entirely by the overloading of the second valve, for the first has so high a grid resistance that it takes quite a small current even when given an enormous signal. With the interposition of a volume control between the two valves to control the LF input reaching the second, we are in possession of a system that will handle faithfully signal inputs up to 100 volts at least without any signs of distortion.

From Fig. 22b it is easy to develop the simple AVC circuit of Fig. 23. In this the

fairly strong by taking its leak to a point negative with respect to the cathode. This "delayed AVC" has the advantage that the full sensitivity of the receiver is maintained until the peak value of the signal

diodes to that of the succeeding valve, and since, further, the emission required from the cathode for adequate performance on the part of the diodes is only a few milliamperes, it is possible to sacrifice a small

portion of the cathode of V₂ and to use this for the diodes. Thus are born double-diode-triodes, double-diode-tetrodes, and double-diode-pentodes, with their bewildering seven-pin bases and grids connected to top caps.

Of these the only one that is anything more than a combination of two diodes in the same bulb as a more or less standard valve is the

double-diode-pentode. This has been designed for the specific purpose of providing correction, on the audio-frequency side, for the small differences in volume between station and station that remain even in a set fitted with AVC of normal type.

AVC in LF Circuits

If, with the circuit of Fig. 24, a 3-volt signal is required at the diodes to give full loud-speaker strength, and if, further, a bias of 15 volts is required to reduce the gain of the variable- μ valves preceding the diode to a suitable level for handling the signals of the local station, the signal voltage arriving at the diodes when the local station is tuned in will be 18 volts, or six times that necessary for full output. Either a volume-control will have to be used, or there will be overloading.

In the DD/Pen the pentode used as LF amplifier after the diodes has a variable- μ characteristic on the lines of those discussed in connection with screened valves for high-frequency amplification,

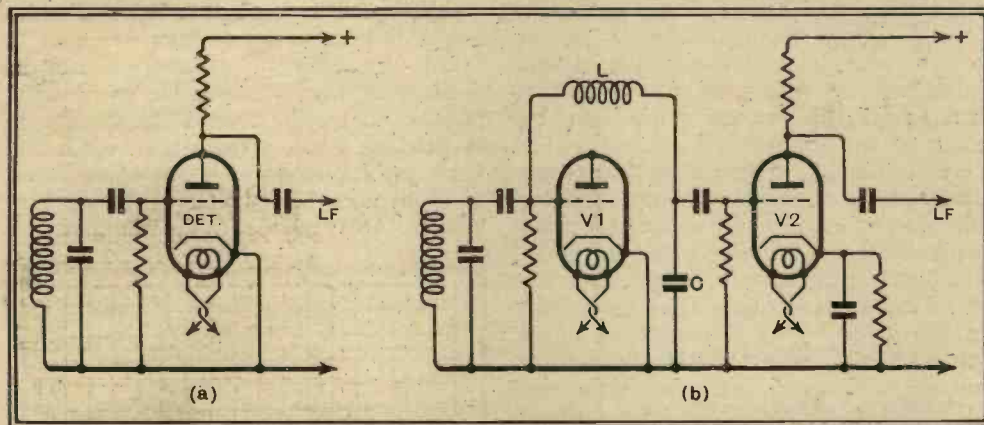


Fig. 22.—In diagram (a) the grid rectifies and also controls anode current to provide LF amplification. In diagram (b) rectification and amplification are effected by separate valves; the grid of V₁ rectifies, whilst that of V₂, isolated from LF voltages by the filter LC, controls LF amplification.

detector valve, of which only the grid was used in Fig. 22b, is replaced by a diode, and, while the modulation-frequency component of its output is fed forwards to the LF amplifier V₂, the direct-current component, in the form of the rectified voltage across the "grid" leak, is fed back to bias earlier valves. The disadvantage of this simple circuit is that the earlier valves begin to receive a bias as soon as any signal reaches the diode D, so that by the time the signal is powerful enough to operate the loud speaker, the sensitivity of the set as a whole has been very appreciably reduced.

Delayed AVC

A better scheme is that in which, by the use of two diode valves (usually in the form of a double diode, the two diode anodes having a common cathode), the functions of signal rectification and provision of AVC voltage are separated, as in Fig. 24. Here the AVC diode D₂ is prevented from rectifying until the signal is

the cathode of the succeeding valve, since it has no constant current of its own from which to derive the bias. In general, the magnitude of this bias is adjusted to make it equal to the signal voltage required at the detector to provide, with average modulation, full output at the speaker.

This and other AVC circuits are possible by using a double diode in conjunction with any desired LF amplifier; if strong enough signals are available at the diodes V₂ may even be the output valve.

Since it is usual to connect the cathode of the

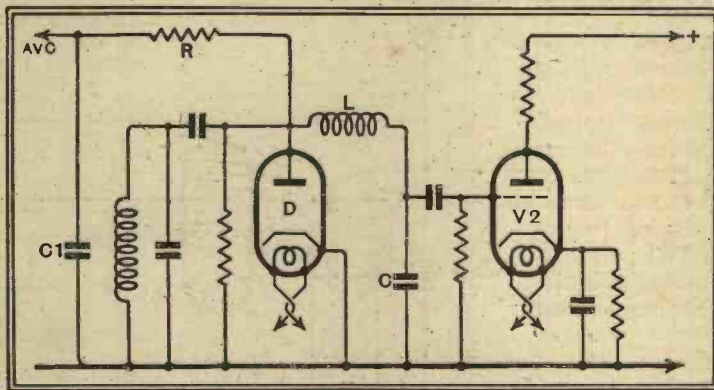


Fig. 23.—Essentially the same circuit as that of Fig. 22b, but modified to provide simple AVC. The extra components R and C₁ act merely as a filter, barring both HF and LF energy from the AVC line.

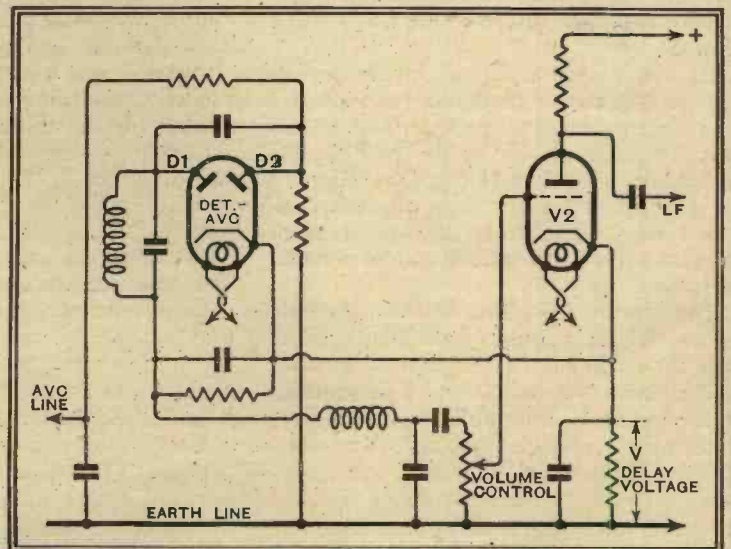


Fig. 24.—Delayed AVC circuit. If the bias voltage of V₂ is suitable also as delay voltage both valves may be combined as a double-diode-triode with common cathode. But a separate double diode is needed when different cathode potentials are desired.

¹ Colebrook, *The Wireless World*, June 10th, 1931, p. 625.

From Triode to Double-Diode-Pentode— and this characteristic is so computed that by applying the AVC voltage to the pentode portion of the valve the LF gain is reduced to compensate for the rising signal input. The circuit used for this valve is shown in Fig. 25, where the grid-leak of the pentode is taken to the AVC line.

Like this valve, all the double-diode composite valves have no general applicability in the sense that they can be used as raw material for the design of a stage to suit our needs. They are essentially combinations built up to fill a definite place in a receiver of particular design. Their consideration at any length—as even the

trend of the present article must have shown any observant reader—would lead us away from valves into the most intimate details of receiver design—with which we are not at present concerned.

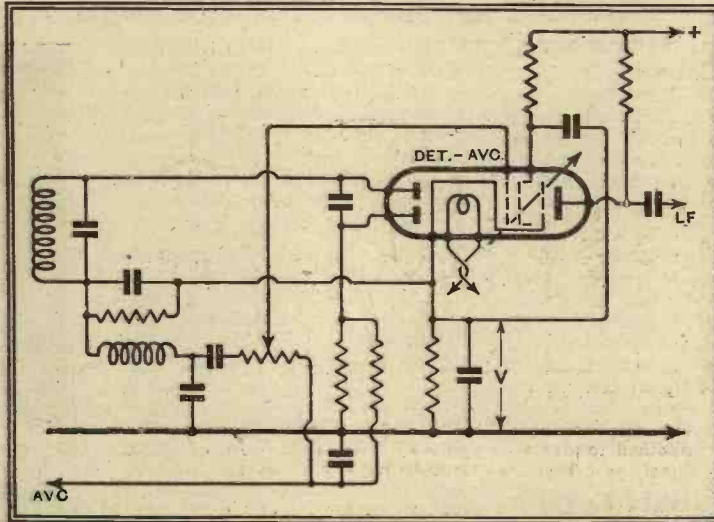


Fig. 25.—Double-diode-pentode used for delayed and corrected AVC. The pentode LF amplifier has a special variable-mu characteristic, and is biased from the AVC line. Its amplification falls as the rectified signal rises, providing an LF output that is independent of HF input.

FERRANTI
Constructors' Short-wave
Charts

FOR some time past it has been evident that the short waves are attracting many listeners who hitherto have not considered it worth while looking below 200 metres for broadcast programmes. Yet it is only on those wavelengths that real distant reception is possible, and the success of the all too few relays from America and Australia has shown that this field is quite worth exploring.

A special set or a converter unit is, of course, necessary, and some new designs have been developed by Ferranti, Ltd., Hollinwood, Lancs. Three constructor's charts are available; one gives full constructional details of a battery and of an AC mains short-wave converter, while the other two are of a five-valve superheterodyne, one a battery and the other an AC mains model.

Each chart contains a theoretical circuit, wiring diagram, photographs of the complete receiver, list of parts needed, and, indeed, everything the constructor wishes to know.

Any of these charts can be obtained on request from Ferranti for the cost of postage only, this being 1½d. in each case.

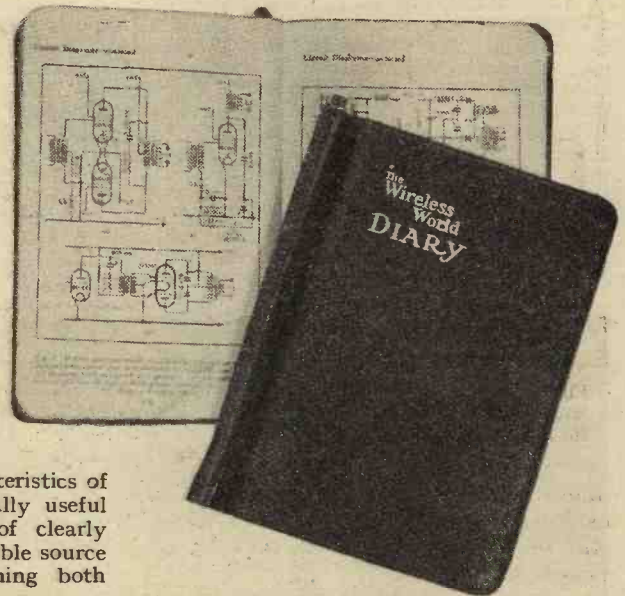
The Wireless World Diary
for 1935

IN every field of activity there is a great deal of vital quantitative and other information that, under the stress of modern life, cannot possibly be memorised. It will be admitted that the next best thing to possessing full knowledge of a subject is to know where the knowledge can be obtained. So far as amateur radio activities are concerned, there is no reason why one's memory should be overburdened by formulæ, valve characteristics, uncommon symbols, or coil-winding data, for all this information, and a great deal more besides, has been compressed into the pages of *The Wireless World Diary*, of which the 1935 edition has just been issued by our publishers.

A Pocket Guide and Reference Book for Every Wireless Amateur

short-wave) and tabulated characteristics of valves in general use are especially useful sections, while fourteen pages of clearly drawn diagrams constitute a valuable source of practical information concerning both receivers and circuit details.

Several new sections, including one dealing with the suppression of electrical interference, have been added, and the remainder have been revised where necessary. The Diary, which costs 1s. 6d. (by post 1s. 7d.), is of just the right size for the pocket, and is obtainable from booksellers or direct from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1. Companion diaries are also issued by our sister journals, *The Autocar* and *The Motor Cycle*.



Essential Wireless Data

The diary section proper has been arranged with space for a full week at an opening, and there are some eighty pages of technical and general information of precisely that kind which is most often needed by amateurs, and indeed by all wireless users.

Lists of broadcasting stations (including

The Olympic SS Six

IT will be remembered that a triode-pentode is employed in this receiver as a combined buffer and first IF valve, and the mazda ACTP was specified. Valves of this type are marketed by few firms, but one has now been added to the Mullard range, the TP4. This valve has characteristics similar to the one specified, and it forms a satisfactory alternative in the Olympic SS Six.

NEXT WEEK'S ISSUE

As announced elsewhere in this issue, commencing next week, an enlarged technical and practical section will replace the Programme Supplement. With every copy of next week's number will also be included a useful

STATION FINDER CARD

News of the Week

Current Events in Brief Review

Maths. at the Mike

TAKING its courage in both hands, the Australian Broadcasting Commission is giving a short experimental series of five talks on elementary mathematics.

Japan Joins Up

THE Japanese Amateur Radio League has been elected to membership in the International Amateur Radio Union. The Union now embodies amateur societies of twenty-five nations, representing 60,000 amateur stations.

Police Air Radio

LEICESTERSHIRE may continue to lead the way in experiments in the use of aeroplanes and wireless in the capture of criminals. The bandit chase described in *The Wireless World* of July 20th last has been the subject of a report to the Leicestershire County Council and facilities are to be afforded for further tests.

Doctors and Wireless

A PHYSICIAN in a French rural area recently petitioned the Government for permission to instal a wireless transmitter at his home which would enable him to be summoned very quickly while on his rounds in his radio-equipped motor car. The official reply was that such permission could only be granted if it was shown to be quite impossible for him to communicate with his surgery by wire or 'phone. An annual tax of £40 would be levied.

Three-year Microphone Course

A BROADCASTING school has been opened by the Soviet radio organisation for the benefit of authors, lecturers and artists. The complete course of studies lasts three years.

Voices Everywhere

THE City of Brussels is to be one huge loud speaker during next year's Universal Exhibition in the suburb of Heysel. Loud speakers are to be installed all over the city, giving a stream of announcements descriptive of the exhibition, informing tourists how to get there, outlining hotel charges, taxi fares and other information.

Have You Heard Egypt?

YESTERDAY, November 1st, saw the inauguration of an alternative programme service in Egypt. Two temporary stations are at present operating on wavelengths of 222.6 metres (Cairo) and 209.9 metres (Alexandria), and these transmissions will be continued by the Egyptian State Broadcasting Service until the high-power stations are opened.

The stations transmit a five-minutes' tuning signal each day at 4.55 p.m. (G.M.T.), followed by an announcement at 5 p.m. and an hour's music. The times of other test transmissions will be announced daily on the main service transmissions at Abu Zabal (483.9 metres) and Ras el Tin (267.4 metres) at 7 p.m.

A Notable Birthday

PROFESSOR EDOUARD BRANLEY, inventor of the coherer method of detecting wireless signals, has just celebrated his ninetieth birthday.

The Professor is reported to be still busy in his radio laboratory.

Brighter "Blurbs"

TO discover whether microphone publicity can be made entertaining, Radio Algiers has inaugurated a competition in which listeners will be asked to vote for the most pleasing, or, perhaps, the least objectionable, advertising announcement at the microphone. The prizes, to the value of 2,000 francs, take the form of cash, furniture, a trip in the Algeria-Metropole hydroplane, and other inducements.

Broadcasting Trial

THE most sensational legal trial in the history of broadcasting opens in Berlin on Monday, November 5th. Persons who helped to found and organise the German broadcasting system will be charged with breach of trust and of the laws against unfair competition.

The defendants, who have been awaiting trial in internment camps for many months, include Dr. Magnus, former Managing Director of the Broadcasting Company; Dr. Bredow, a former Secretary of State and the official Post Office Commissioner for Broadcasting until 1933, and Ernst Hardt, former Director of the Cologne station.

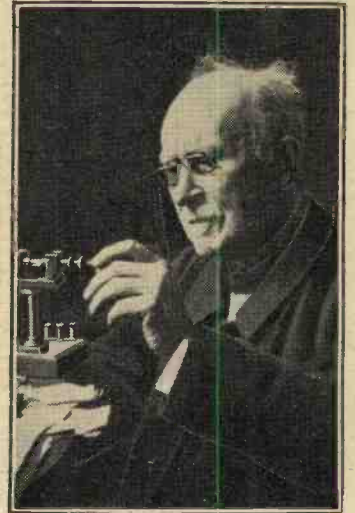
Politics naturally play a large part in the affair, for without the change of régime last year events might not have taken their present turn.

Records in Public

MANY readers are probably aware that certain restrictions now exist with regard to the playing of gramophone records in public. In order to clarify the position, it seems advisable to publish the gist of a statement recently issued by Phonographic Performances, Ltd., an organisation formed by the principal recording companies to protect their interests in this and similar matters.

It has been decided to demand fees for the public performance of records of the member-companies in cinemas, hotels, public houses, restaurants, cafés, boarding houses, etc., and a scale of fees has been prepared. It is stated that these fees are in every case moderate, and in the case of cinemas are based on the monetary seating capacity of the building; hotels, etc., are assessed on either the rateable value or seating accommodation of the premises.

It is gratifying to record that after having successfully established its claim to fees for public performances, the organisation has offered gratuitously to put aside part of the total revenue thus obtained for distribution to artists whose work has been recorded.



PROFESSOR EDOUARD BRANLEY at work in his laboratory. The inventor of the coherer has just celebrated his ninetieth birthday.

What the Microphone Heard

THE mischievous "mike" is blamed for a *contretemps* in a French broadcasting studio a few days ago. According to a correspondent, an author was being interviewed. His interlocutor began with a breezy request to the author: "Tell me about your new book." The author, pretending to be non-plussed, protested: "Alas! you find me unprepared, but I will do my best." Unfortunately, the microphone picked up the rustle of the paper on which the author's "unprepared" remarks were neatly typed.

St. Dunstan's and Radio

NO institution realises more keenly than St. Dunstan's the value of a wireless set to a blind man. The 19th Annual Report discloses that every St. Dunstan has been presented with a Braille watch, a wireless set and a typewriter, and one of the minor services of this vast and varied organisation is the responsibility of keeping all three in good repair and replacing them as need arises.

In addition to the 2,000 war-blinded men on its rôle, the organisation looks after about 5,000 of their dependants.

The Standard AC Three

IN the constructional article describing this receiver it was stated that the Polar tuning dial is calibrated for long-wave coils of different inductance from those specified, so that the calibration would not hold on this waveband. We understand, however, that this is not the case with the dials now being supplied, which are designed for use with coils of 157 μ H and 2,200 μ H for the medium and long wavebands respectively. The calibration, therefore, should be accurate on both wave ranges.



FILMS BY WIRELESS. Two frames from the Gaumont British News film of Scott's arrival in Australia as transmitted by Cable and Wireless from Melbourne to Moorgate, London. Each picture, measuring 10 x 8 in., took just over half an hour to send and each had to be re-photographed and reduced for projection at 20 frames per second.

BROADCAST BREVITIES

Is it the Luxembourg Effect?

IS Droitwich evincing the "Luxembourg effect" in this country? Dr. Van der Pol has already reported Droitwich as an offender so far as Holland is concerned; now letters have reached the B.B.C. from Cornwall stating that the British Regional transmissions are flavoured with a faint trace of National programme, which seems to emanate from the new station.

But is this the Luxembourg effect? It is significant that the engineers are being troubled with induction effects on the Droitwich transmissions, which they attribute to crossing of the Droitwich and Daventry lines.

An Unforgivable Crime

I hope the B.B.C. realises that to permit induction effects between transmitters is the almost unforgivable crime in broadcasting to-day. The luckless listener is powerless when faced with interference of this kind, and the saddest part about it is that he seldom recognises the cause. Consequently he tears his receiver to pieces in search of selectivity, and the only person who can possibly gain is the manufacturer of selectivity gadgets.

A Perfect Transmission?

SET testers and others may be glad to know that to-night's orchestral concert from 9.5 to 10 o'clock (London Regional) will be given with ribbon microphones in the new Maida Vale studio.

The engineers first installed standard moving-coil microphones in the new building, but these were found to emphasise the bass unduly. Ribbon "mikes" are now the standard in the skating rink.

By the way, the reverberation period of the studio over most of the audio frequency range is estimated at 2 seconds.

Invisible Microphones at the Abbey

MR. GERALD COCK, "O.B." chief, is confronting one of the most ticklish propositions in his long career. It concerns the broadcast of the Royal Wedding in Westminster Abbey on November 29th.

He tells me that the main problem, after finding a viewpoint for Mr. Howard Marshall, the commentator, on the roof of Westminster Hospital, has been to devise a means of making the installation in the Abbey entirely invisible. The job is complicated because, owing to the considerable amount of movement during the service, a great many microphones are necessary.

Swinging Over

"I am using the swing-over system," said Mr. Cock. "It will be smooth, and listeners will be unable to detect the transfer from one microphone to another. We have had plenty of experience with the method, which incidentally is always used in broadcasting of the Ceremony of the Keys at the Tower of London."

"Are you satisfied that the Abbey acoustics will be suitable?" I asked, and Mr. Cock laughed.

"That problem has long been solved," he said. "Listeners may rest assured that there will be no echo effects to mar the broadcast."

By Our Special Correspondent

Those P.O. Landlines

THE Post Office has refused to be stampeded by suggestions that the B.B.C. should have first claim on the telephone lines in this country. (Strange that no one should have thought how a "bob a call" service after 7 p.m. would affect the wireless programmes!) The effect was first felt last week when the Belfast Wireless Orchestra, tabled for a National broadcast, was replaced by gramophone records in the London studio.

£100,000

One wonders whether the Post Office will maintain its adamant attitude, for lack of B.B.C. patronage would mean the loss of at least £100,000 per annum.

Electrical Recording as Solution?

As the present congestion on the telephone lines is not likely to be relieved before the middle of next year the B.B.C. engineers are seriously considering the possibilities of more electrical recording.

And why not? The "Microphone at Large" series of broadcasts could be quite easily handled by means of a mobile recording van which would not only obviate the use of long telephone lines, but secure the material at a time of day when the "artistes" are less likely to be in a state of dangerous inebriation.

Ultra Short-wave Links?

Again, the Corporation could use that split, if not broken, reed—the wireless link. Let the engineers perambulate the country with a mobile transmitter connected to the nearest B.B.C. receiving station.

Better still, if a network of ultra short-

wave stations could be employed, the results, having regard to the wide frequency band available, might seriously challenge those obtained with land lines. When the land lines were once more available the ultra short-wave transmitters would be *in situ* at just the right moment for high definition television.

Good for Daventry

THE Duke of Kent's informal visit to Daventry on Tuesday last, October 30th, was one more reminder that the closure of 5XX was not the end of all things for Daventry. Whatever the ordinary listener may think, the Government considers the short-wave station as one of the most important departments of the B.B.C.

True, the biggest audience is in the United States, but the official feeling is that if British exiles get good programmes from home it matters not how many other people also pick up these crumbs of goodwill.

Why Did He?

WHY did Weber write "Invitation to the Waltz"? No one knows, but Holt Marvell and George Posford will supply a very plausible and romantic reason in "Invitation to the Waltz," which is to be broadcast on November 14th (Regional) and 15th (National). Tessa Deane will play the heroine and John Hendrik the hero. Carleton Hobbs will appear as Weber.

I understand that a film of the radio show is to be made at Elstree.

The Prime Minister's Broadcast

THE speech of the Prime Minister, the Rt. Hon. J. Ramsay MacDonald, at the Lord Mayor's banquet at the Guildhall will be broadcast on November 9th. This year a new feature is being introduced into the manner of this broadcast. Mr. Howard Marshall will describe the scene just before the Prime Minister's speech. It is thought that the sounds from this great pageant will become more real by the hearing of this description of the background to the broadcast.

Scots Wha Hae

A ST. ANDREW'S DAY programme will be relayed from Edinburgh to National programme listeners on November 30th. The basic idea is to tell Scotsmen the world over what Scotland has been doing during the past year. The new Cunarder, the Gaelic Mod, the unemployed, the moors, the arts—all these will be described and reflected in the programme which has been devised by George Blake, who did the commentary on the Cunarder. Two contrasting voices, each showing different sides of the Scotland of 1934, will carry on a conversation. This dialogue will be supported by music, drama, and effects. Recorded broadcasts of events which have occurred in the past year will be incorporated in the programme.

The Man Who Lives Next Door

THE most embarrassed member of the B.B.C. staff at the moment is a player in the Symphony Orchestra. His flat adjoins the new Maida Vale studio, and in an unguarded moment he intimated the fact to his colleagues. Now his home has become a port of call for those permanently thirsty people, the brass section.



INVISIBLE MICROPHONES. B.B.C. engineers preparing the elaborate chain of microphones for the Royal Wedding in Westminster Abbey on November 29th. All the microphones must be concealed.

Receiver Performance Data

IV. Miscellaneous Characteristics

THE previous articles in this series have dealt with the chief characteristics of receivers which are susceptible to measurement, and in this concluding instalment a résumé is given of the less important attributes, including the AVC characteristics and the noise level

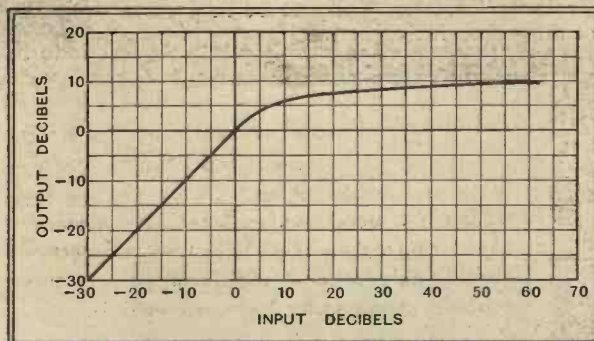
A PART from the main characteristics of a receiver—sensitivity, selectivity, fidelity, and second-channel ratio—which have been discussed in the earlier articles in this series, there are many minor properties which are susceptible of measurement and which it is important to know. The performance of the AVC system falls among these, and is readily measured. The receiver is tuned to the Standard Signal Generator, which is set to provide an output modulated 30 per cent. at 400 cycles. The output is then measured for a wide range of aerial input voltages up to 1 volt.

The figures obtained can be plotted in the form of a curve, but before doing so it is convenient to convert them to ratios and thence to decibels, the standard output of 50 milliwatts being taken as the zero decibel level. A typical curve is shown in Fig. 1 for a set including two controlled stages of amplification. In general, a single curve of this nature will completely specify the performance of the AVC system, but in special cases it may prove necessary to take curves at several different signal frequencies, for some AVC circuits vary in efficiency with the operating frequency.

Noise level is another factor which can usually be easily measured. With the manual volume control at maximum, the output with no applied signal is measured and expressed as so many decibels below standard output (50 milliwatts). This figure is known as the no-signal noise level, and it naturally includes both valve hiss and mains hum. Of more practical interest is the noise level on a signal, and this is measured by tuning the set to the Standard Signal Generator, which provides a carrier modulated 30 per cent. at 400 cycles. The input to the set is adjusted until standard output is obtained; the modulation is then switched off, and the output measured and expressed in decibels below standard output. The figure obtained includes valve hiss, mains hum, and any noise generated in the early circuits of the receiver, and it will usually represent a greater output than the no-signal figure. The figure obtained will be called the signal noise level, and will vary

somewhat with signal frequency since the sensitivity of the set varies with frequency.

It may be remarked that the signal noise level may be somewhat misleading, for the noise level will almost invariably increase with increasing sensitivity. The figures, therefore, are likely to give the impression that a sensitive set is noisy, whereas the noise level, when it is operated with the same signal input within the capabilities of the less sensitive set, may actually be the lower. The figure at maximum sensitivity is necessary in order to see whether the full sensitivity of the set is usable, for in highly sensitive sets requiring an input of $1 \mu\text{V}$ or so, it is not uncommon to find that the noise level equals the signal.



The AVC characteristics of a typical small receiver of modern design are shown here.

As a basis of comparison between different sets, therefore, it is suggested that a figure for noise level be quoted for an input of $1,000 \mu\text{V}$, this figure being chosen because it is within the range of the less sensitive receivers, and it roughly corresponds with the input likely to be obtained from the stronger Continental transmissions. The measuring procedure would then be to tune the receiver to the Standard Signal Generator, and to adjust the input (modulated 30 per cent. at 400 cycles) to $1,000 \mu\text{V}$. The manual volume control of the receiver would then be adjusted for an output of 50 milliwatts. The next step is to switch off the modulation and measure the remaining output, and express it as before in decibels below standard output.

It will be thus apparent that many attributes of a receiver are capable of being measured, and that the sensitivity, selectivity, second-channel ratio, fidelity, AVC characteristics, and noise level of

By W. T. COCKING

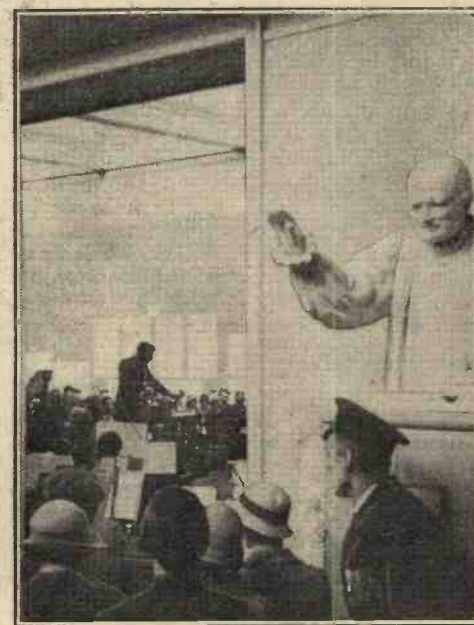
a receiver can be expressed in figures with a sufficient degree of accuracy for most practical purposes. It cannot, of course, be claimed that such measurements reveal everything about a receiver, and, because of the impossibility of reproducing practical conditions in their entirety in the laboratory, a verbal description of the performance will probably always be necessary. It is felt, however, that the receiver measurements which are now possible, although not ideal, will form a useful supplement to a description of the performance, particularly in enabling a rapid comparison of different sets to be made.

Slow Morse

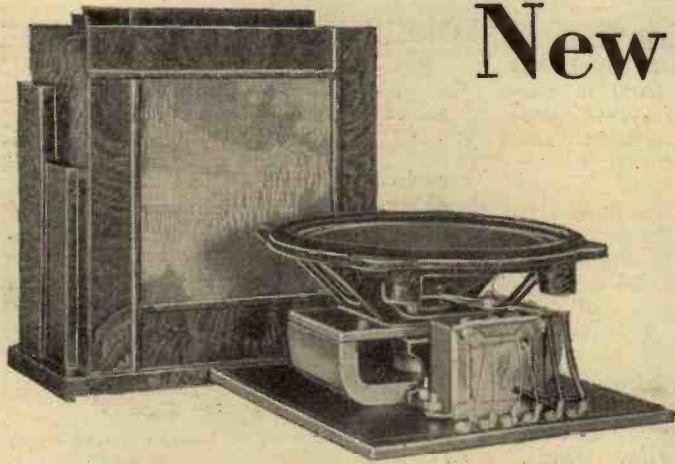
SLOW morse practice transmissions are now provided for learners by members of the Radio Society of Great Britain. The following tests are scheduled for November:—

Date.	G.M.T.	kc/s.	Station.
4th	00.30	1,820	G2OI (Manchester).
	10.00	1,815	G2DQ (Wickford, Essex).
	10.30	1,911	G2JL (Newport, Mon.).
	11.00	1,700	G2UV (Wembley, Middx.).
11th	00.30	1,820	G2OI (Manchester).
	10.00	3,630	G2DQ (Wickford, Essex).
	10.30	1,911	G2JL (Newport, Mon.).
	11.00	1,700	G2UV (Wembley, Middx.).

Reports are welcomed by the R.S.G.B., 53, Victoria Street, London, S.W.1.



A statue at the entrance to the music room of the Museum and Art Gallery in Belfast gives an impression of solemnity at a recent concert by the Wireless Orchestra.



"FYDELITONE MINOR" EXTENSION LOUD SPEAKER

ALTHOUGH of such compact size (the overall dimensions are only 8½ in. x 8 in. x 4 in.), this unit is fitted with a large and heavy permanent magnet, and its sensitivity is not less than that of the standard size loud speakers fitted to the majority of receiving sets.

The 5½ in. diaphragm gives a high note response which extends up to 9,000 cycles, and is noticeably free from resonances in the upper half of the musical scale. A full bass response is not to be expected, but the lower cut-off does not commence before 150 cycles. The only noticeable resonance was in the vicinity of 500 cycles, and although its presence could just be discerned on speech, its effect on music was negligible. The general response is clear, and instruments rich in the higher harmonics are particularly well reproduced.

The cabinet is a well-designed bakelite moulding, and the unit is fixed to a detachable back panel. A universal transformer with socket connections, giving four alternative ratios, is provided, and the unit is suitable for use with receivers requiring a low-impedance extension loud speaker.

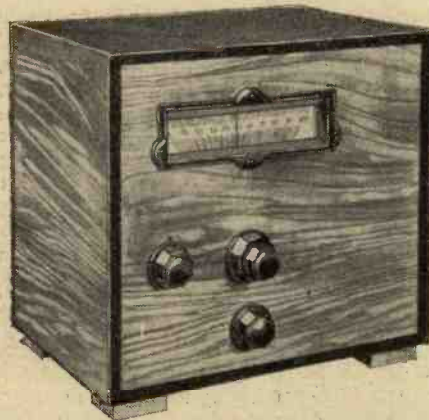
The price with transformer is 35s., and the makers are Baker's Selhurst Radio, Ltd., 75-77, Sussex Road, Croydon.

HARKEN SHORT-WAVE CONVERTER

THE HARKEN ELECTRICAL Co., Ltd., 18a, South End, Croydon, has sent in for test an AC mains-operated short-wave converter which is an attractively finished and well-made unit measuring 11½ in. x 7½ in. x 10½ in. It contains its own HT and LT supply unit, so it is entirely self-contained, and all the connections needed can be made to the existing input terminals on the broadcast set.

It embodies several novel features, such as a heptode frequency-changer with tuned input circuit ganged with the oscillator, waveband switching, giving a tuning range of from about 13.5 metres to 55 metres without changing the coils, and a tuned output circuit adjusted to approximately 500 metres, and the broadcast set must, of course, be tuned accordingly. If required, the wave-range can be extended by fitting extra coils, for which provision is made.

The unit has been tested with straight and superheterodyne receivers and very good results obtained with both types. Although when used with a superhet double frequency-changing is involved, the two oscillators do not produce heterodyne whistles at any part of the waveband covered.



Harken AC mains-operated self-contained short-wave converter.

BRYCE CONVERSION TRANSFORMER

THE conversion transformer made by W. Andrew Bryce & Co., Woodfield Works, Bury, Lancashire, is an auto-wound mains transformer for stepping down the voltage of the supply mains so that a receiver de-

New Apparatus Reviewed

Recent Products of the Manufacturers

Baker's Selhurst "Fydelitone Minor" extension loud speaker and cabinet.

Tuning is quite straightforward, for there is one control only, and although a small trimming condenser for the aerial circuit is included, the tracking of the oscillator and the input circuit is so accurate throughout that we found no need to make use of it.

Its efficiency can be gauged by the fact that American short-wave broadcast was received at good volume as early in the evening as 5.30 p.m. with the unit connected to a broadcast set of reasonable sensitivity. During one short spell of listening between 5 and 6.30 p.m., American W8XK and W2XE were well received together with two others not identified by announcement, but all below 25 metres. Two B.B.C. Empire transmissions, one Norwegian, two French and one German, were found on the 25-55-metre band, together with several unmodulated carrier waves, probably of stations about to commence their afternoon programmes.

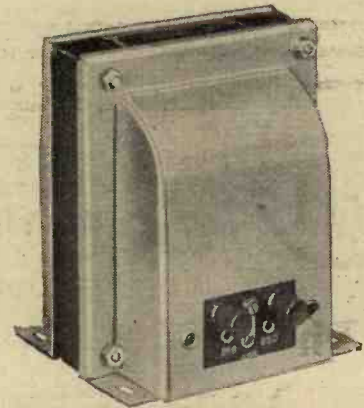
Somewhat more care is needed, of course, than when tuning in on the normal broadcast band, but the results amply repay the exercise of a little patience in this respect. There is a calibration chart with each unit which will be found a very useful guide until a few stations have been logged and identified. This calibration is quite accurate. The price is £6 10s. complete with valves.

signed for 100 or 110 volts may be operated from mains of 200 to 250 volts AC. Alternatively, by changing over the connections so that the 100-110 voltage portion of the winding becomes the primary, the mains supply can be stepped up to the higher voltages.

A single winding only is employed, but as the transformer will always be used in con-

Input Volts. RMS.	100-Volt Output.			110-Volt Output.		
	Current Amps. RMS.	Voltage. RMS.	Volt/ Amps.	Current Amps. RMS.	Voltage. RMS.	Volt/ Amps.
235 at 50 c/s.	0.1	100.4	10	0.1	110.5	11
	0.2	99.9	20	0.2	109.8	22
	0.3	99.2	29.8	0.3	109	32.7
	0.4	98.8	39.5	0.4	108.3	43.3
	0.5	98.2	49	0.5	107.4	53.7
	0.6	97.7	58.6	0.6	105.2	63

junction with an AC receiver, which will incorporate a double-wound mains transformer, it complies with the I.E.E. regulations in that the receiver is completely isolated from the electric mains.



Bryce 60-watt conversion transformer for stepping up or stepping down the mains voltage.

There are several models available ranging from 60 watts to 200 watts rating, the specimen tested being the type AB1A, the smallest in the range; this suffices for many of the smaller heterodynes and most straight sets other than radio-gramophones.

The transformer is fitted with insulated terminals, and there is a simple link-type switch for selecting tappings for the 200- to 250-voltage input, or output as the case may be. It is a well-made component, and this model costs 16s.

AVO OSCILLATOR

THIS instrument is a small portable self-contained high-frequency oscillator covering all the frequencies met with in modern broadcast sets, and although intended primarily for the service engineer, those who are keenly interested in home construction and set design as a profession or as a hobby will find it an exceedingly useful addition to their equipment.

It provides a local signal of known frequency which can be modulated by an audible note of about 500 c/s. A triode valve is used with dry batteries supplying HT and LT, while a single tuned circuit is utilised for all the radio frequencies required. This circuit covers a range of 100



The Avo oscillator, a radio signal generator which can be modulated at an audible frequency.

kc/s to 280 kc/s, and for all higher frequencies up to 1,500 kc/s harmonics of this circuit are used. Modulation of the radio signal is arranged by discharging a condenser through a high-resistance grid leak, a system often described as "squegger." A switch controls the modulation. Provision is made also for adjusting the output according to the sensitivity of the receiver under test, and either a high, medium or

a low output can be obtained from the three sockets fitted.

To one not familiar with harmonic oscillators it may at first seem a little strange that on the medium-wave band in particular a signal is obtained at several different settings of the oscillator condenser. This is explained by the fact that with the set tuned to, say, 1,000 kc/s (300 metres), the oscillator gives a signal when adjusted to 250 kc/s, 200 kc/s, 166 kc/s, and such of its fundamental frequencies having a harmonic of 1,000 kc/s; which in the example taken would be the fourth, fifth and sixth harmonic respectively of the fundamental frequencies mentioned.

For ganging and set testing generally any of the harmonics will answer and only when the calibration of a receiver is being checked need the correct frequency be ascertained. If the set is wavelength calibrated no difficulty can arise, but in other cases it is useful to remember that the mid point on the scale is approximately 400 metres on the medium- and 1,450 metres on the long-wave band.

The oscillator is hand calibrated, a series of curves being given for all the harmonics and their dial settings. These have been checked and found perfectly accurate, and the calibration of the instrument can be relied on absolutely.

The makers are The Automatic Coil Winder and Electrical Equipment Co., Ltd., Winder House, Douglas Street, London, S.W.1, and the price is £5 10s. complete including a pair of screened leads.

362 Valves

WE regret that an error occurred in our review of this firm's products in last week's issue, the address being incorrectly given. The address of the 362 Radio Valve Co., Ltd., is Stoneham Road Northwold Road, Upper Clapton, London, E.5.

The Diary of an Ordinary Listener

Vienna Singing Boys—A "Lohengrin" Night

THOUGH there has been no outstanding feature in the Continental programmes for the past week, I have found many items in the ordinary routine concerts which have proved most interesting.

On Friday evening, October 19th, the K.R.O. Orchestra, conducted by Gerritsen, first attracted my attention with a selection from Purcell's "The Gordian Knot Untied," which I do not remember having heard before. This was, of course, broadcast from Huizen, which station seems now quite back to its old form and free from heterodyne interference. Later I listened with considerable interest to the Vienna Singing Boys, whose performance was excellent as regards precision and attack, though I thought their voices had more than a suspicion of that rasp which an English choirmaster strives before all things to eradicate. However, it appears to be regarded with favour on the Continent, if I may judge from my very limited experience of Italian and German church choirs.

From Huizen I turned to Prague, where Madame Studer-Weingartner was conducting the Station Orchestra in her own—or perhaps her husband's—music and in Brahms' Symphony No. 2 in D. The station

was not at its best, so I went over to Radio-Paris for operatic selections, and heard an air from Bellini's "Les Puritans," admirably sung by M. Faniard, and the mad aria from Donizetti's "Lucia di Lammermoor," by that accomplished coloratura soprano, Mlle. Hédoine. I must confess, however, that I do not greatly admire vocal pyrotechnics with flute obligato, and it was not long before I changed over to Kalundborg and Copenhagen for the concert of French music by the Radio Orchestra, reviving memories of bygone days while listening to that once-popular march, "Le père de la Victoire," by Ganne.

A Programme Change

The V.A.R.A. orchestra, under de Groot, gave us a very good programme of popular music on Saturday evening, broadcast from Hilversum, which included the almost too familiar overture from "William Tell," a selection from Delibes' "Sylvia," and the overture from Litolv's "Maximilian Robespierre." I then went over to Radio-Paris in the expectation of hearing a part of Massenet's opera, "Manon," but the French programmes had apparently been altered on account of the death of

FOREIGN BROADCAST GUIDE

TOULOUSE (PTT)

(France)

Geographical position: 43° 36' N; 1° 26' E.

Approximate airline from London: 556 miles.

Wavelength: 386.6 metres. Frequency: 776 kilocycles. Power: 2 kw.

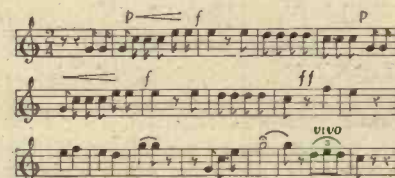
Standard Time: Greenwich Mean Time (France adopts Summer Time).

Daily Transmissions:

Mainly relays Paris PTT, Bordeaux-Lafayette, Strasbourg and Limoges.

Announcer: Man.

Interval Signal: Musical box melody: *La Tyrolienne des Pyrénées*.



Call: *Allô! Allô! Ici Poste de Radiodiffusion des P.T.T. de Toulouse-Pyrénées.*

Closes down as other French P.T.T. stations with good-night greetings followed by *La Marseillaise*, or the interval signal.

A new 120 kilowatt transmitter is under construction and will operate in 1935.

M. Poincaré, and instead there was an excellent rendering of Mozart's Symphony in D Minor.

The first item that attracted my attention on Sunday evening was Beethoven's piano-forte Concerto in C Minor, played by Wilhelm Kempff and the Opera House Orchestra, broadcast from Königsberg and relayed by Frankfurt. Brussels No. 1 was giving a concert of operatic music, in which I heard a selection from Saint-Saëns' "Déjanire," and the Meditation from Massenet's "Thaïs," played as a violin solo.

Monday evening was made pleasant for me by the concert version of "Lohengrin" from Radio Toulouse, of which I heard the Prelude to Act III, the Bridal Chorus and Lohengrin's three famous airs which, although I greatly admire the music, always rather irritates me, as Lohengrin seems unable to get away from his own supreme self-importance. All through Act III I cannot help feeling that a little touch of human sympathy for Elsa's natural curiosity would have saved the situation.

The Better Station

On Tuesday Cologne and Stuttgart broadcast a programme of "Rigoletto" by the Stuttgart Station Orchestra and choir, with soloists whose names I was unable to catch. I found it easier to pick this up from Cologne, as Mühlacker, for some reason, was not coming through as strongly as usual. After listening for a while I went over to Huizen for Dvorák's Violin Concerto in A Minor by the K.R.O. Orchestra, with Ruth Posselt as soloist, and I thoroughly enjoyed her playing. Leaving Huizen for Poste Parisien I came in for another violin solo, this time by Henry Szeryng, who gave a very sympathetic rendering of Lalo's "Symphonie Espagnole," supported by the excellent station orchestra under the baton of Theodore Mathieu.

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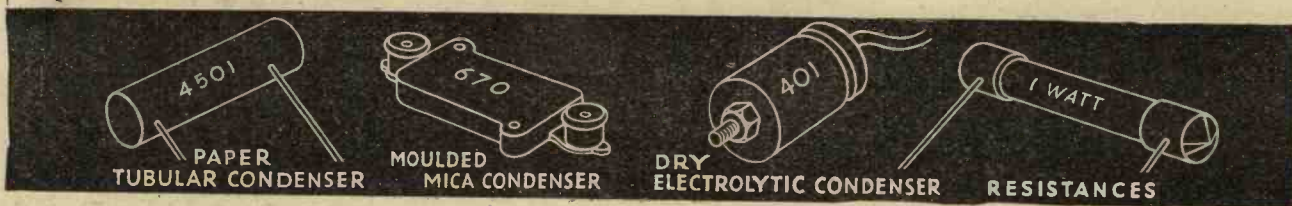
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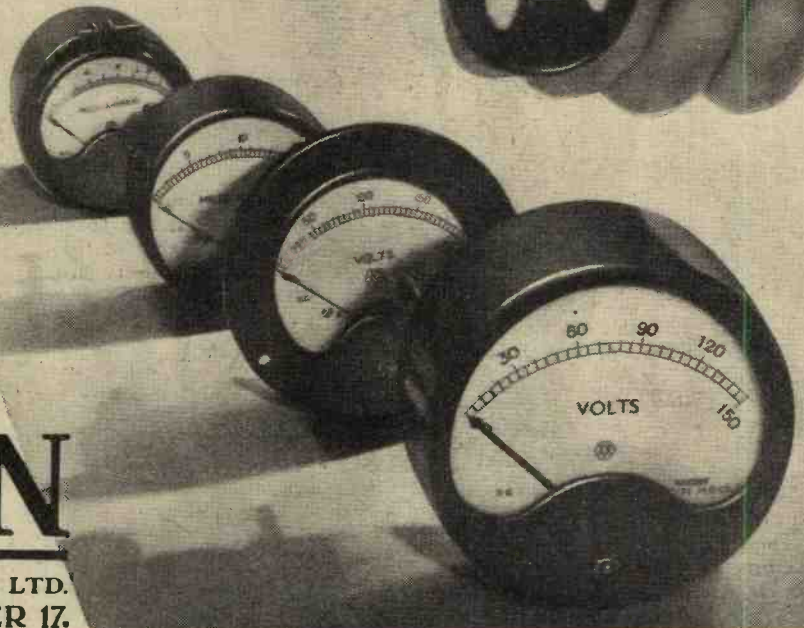
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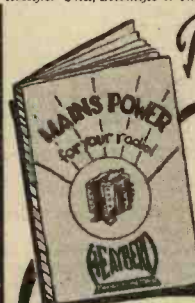
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PARTRIDGE.—See last week's detailed advertisement; delivery from stock; trade enquiries invited.

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Mains Equipment.—Contd.

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STANDARD A.C.3 Transformer, polished die cast, shroudings guaranteed 5 years; £1; chassis 6/-, choke 12/6; see also displayed advertisement on page 12, October 19th.

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HOYNE'S—Push-pull quality amplifier, complete to "W.W." specifications, wired and fully tested, less valves, £5/12/6; complete kit of components including metal chassis, £5/2/6; field replacement choke, 1,250 ohms, 13/6, post 1/-; output transformer, 12/6, post 1/-.

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HOYNE'S—400 or 450 or 500v., 120 m.a., 4v. 2 to 3a., 4v. 2 to 5a., 4v. 1 to 2a., 18/-, post 1/3.

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FEEDING

Last week, by a printer's error, we said "our sets and speakers are food enough to advertise themselves." Obviously we meant "good," but even this error means something. Our sets and speakers provide food for the thoughtful. We have been told that our advertisements do so too. If this is so, it is only because, as we said last week, we get fed up with bombastic and fantastic claims. We think that the "advertisee" gets fed up too. Our ads. are, therefore, merely honest statements of what we think and do. Their natural corollary is the literature we offer you free; this you should read, for facts only are given therein.

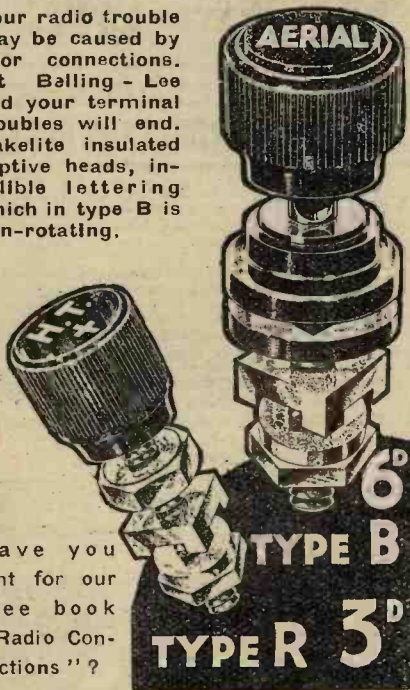
This is the last time our weekly message to you will appear on this page. We are a growing concern; our works department is just being increased six-fold to cope with the enormous increase in our orders, but increased production will take shape only gradually, as we still insist on individual craftsmanship in all our products. However, next week, we move forward to the beginning of this section of *The Wireless World*, with more space to tell you what fine fellows we are.

Hartley Turner Radio Ltd.

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Telephone: HOUnslow 1854.

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Mains Equipment.—Contd.

PARAMOUNT Mains Transformers, equal to any, and better than most; try them once and you will always use them!

PARAMOUNT Auto Transformers, 100-120v. up to 200 250 volts, or vice versa, 60 watt, 8/6; 120 watt, 10/-; shrouded 2/- extra, post 9d.

PARAMOUNT—250-0-250v. 60 m.a., 4v. 1 to 2 amp., 4v. 2 to 4a., open type, 9/6; shrouded, 11/6; post 9d.

PARAMOUNT—350-0-350v. 60 m.a., 4v. 2.5a., 4v. 3 to 5a., 13/-; shrouded, 15/-; post 9d.; 120 m.a., 4v. 5 amp., 4v. 4 amp., 4v. 2.5a., with screened primary, shrouded, 16/-; post 1/-.

PARAMOUNT—Single span model, with 1 1/2 in. x 1 1/2 in. core size, 350-0-350v. 100 m.a., 4v. 5a., 4v. 1a., 4v. 2.5a., shrouded, with screened primary, 2 1/2% regulation, 20/-.

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PARAMOUNT—Westinghouse transformers, H.T.8, 9 or 10, with 4v. 2a., 4v. 4a., shrouded, 16/-, post 1/-.

PARAMOUNT—Chokes, 30h. 60 m.a., 5/6; 20h. 120 m.a., 8/6, post 9d.

PARAMOUNT Mains Transformers are Guaranteed for 12 Months.

PARAMOUNT Products are Fitted with Neat Aluminium Frames or Shrouds, all filaments C.T., insulating paper 2 1/2 mils. thick between each layer, and tested thoroughly before leaving our works.

PARAMOUNT Transformers Made to Your Own Specifications; price according to wattage; quotations by return.

PARAMOUNT Guaranteed Electrolytic Condensers, 4+4 mid., 500v. peak, 3/6, post 3d.

PARAMOUNT Mains Transformers, manufactured by R. H. Salter, 66, Hartfield Rd., Wimbledon, S.W.19 (one minute from Wimbledon Station). Tel.: Liberty 3226. [6315]

14/11—Battery chargers, 1 amp. 2-6v., incorporating Westinghouse L.T.4 rectifier, guaranteed one year, postage 9d., list free.—Arden Agency, Wollaston Wellingborough. [6757]

CABINETS.

MANUFACTURERS' Clearances.

ULTRA "Panther," a modern cabinet, with contrasting figured walnut veneer panel, 20x17x11, 13/6; pedestal type, 35x22x12, 30/-, undrilled; photo sent on request.

SIMILAR Cabinet, 20x18x11, drilled for Polar Arcuate drive, 15/- (with Polar drive 20/-); mains chassis for same, 2/6; transformer, 5/- (Photo).

SET and Speaker Cabinets; 5/- upwards.

RADIOGRAM Cabinet; 37/6 upwards.

SPEAKER Cabinets; 4/6 upwards.

SEND Particulars of Your Requirements (giving size of set, etc.), or call and make your choice from our stocks of over 100 different types; from 3/6 to £4/10.

H. L. SMITH and Co., Ltd., 287-9, Edgware Rd., London, W.2. Tel.: Padd. 5891. [6756]

5/9—Super moving coil loud-speaker cabinets, octagonal, 18 1/2 in. x 6 in., baffle hole 7 in. diameter; manufacturer's surplus.—Easco, 18, Brixton Rd., London, S.W.9. [0440]

DYNAMOS, ETC.

75 (only) Rotary Converters, brand new, D.C. to A.C., makers' guarantee 7 years, 200-240 D.C. input, 230 A.C. output at 180 watts, list £15/10, at £4; 90 watt model (same voltages), list £10/10, at £3/13/6; carriage forward; cannot be repeated.—Degallier's, 6, Coryton House, 21, Upper Marylebone St., London, W.1. Museum 7795. [6853]

LOUD-SPEAKERS.

11/6.

SONOCHORDE Moving Coil Energised Speakers, brand new, 1934 model, Pentode output, 2,500, 6,500 ohms., exceptional offer; 11/6 post free.

MAINS RADIO DEVELOPMENT COMPANY, 4-6, Muswell Hill Road, London, N.6. [6805]

R.K. Senior D.C. (1934 type), with transformer, perfect; £3.—Verney, Rumsan, Barnstable. [6826]

"**STANDARD**" Novotone, perfect condition, seal unbroken; 25/-.—Hunt, 15, Priory Rd., N.W.6. [6845]

U.S.A. Rola Type F.6, 2,500- or 6,500-ohm field, power or pentode output transformer, 17/6; U.S.A. Rola, type F.7 P.M. and F.7, energised, with 9in. cone, 25/-.

MAGNAVOX D.C.152 (9in. cone), 22/6; Magnavox 154 (6 1/4 in. cone), 16/3; all with humbucking coils, power or pentode transformers, and 2,500- or 6,500-ohm fields; Magnavox P.M.254, 18/-; Magnavox P.M.252, 22/6.

ATTENTION to All Orders Within 24 Hours; carriage paid; cash with order or c.o.d.

WARD, 2nd Floor, 45, Farringdon St., London, E.C.4. Telephone: Holborn 9703. [6404]

B.T.H. Senior P.M. Speaker, list price £5/12/6, only £2/10; Epoch P.M.99, list £6/2, only 15/6.—Anderson, 35, Landsdowne Rd., Walthamstow, E.17. [6813]

10/6 Only!!—Brand new manufacturer's surplus moving coil speakers, by one of the best known British makers; energised, 2,500 or 6,500 ohms field, power or pentode transformer, 8in. cone; 10/6 each.

12/6 Only!!—As above, but 10in. cone; 12/6 each.

15/6 Only!!—Permanent magnet, with power or pentode transformer, 8in. cone; 15/6 each.

17/6 Only!!—As above, but with 10in. cone; 17/6 each.

CABINETS for Any of Above, 2/9 each only; secure one of these amazing bargains now; cash with order or c.o.d.—Hubert, 6, Conduit St., W.1. [6769]

Loud-Speakers.—Contd.

EPOCH 99 1/2 Energised A.C. or D.C. High Quality Speaker, new, £4/10; Epoch 99X P.M. high quality speaker, £4.—Barrow, 23, Ballour Avenue, Hanwell. [6803

VAUXHALL—Magnavox permanent magnets, universal, suitable for Class "B" power or pentode, 7in. cone 17/6, 10in. cone 23/-; mains energised, 2,500 or 6,500, 10in. cone, 22/-; 7in. cone 15/3; brand new, with humbucking coils; state power or pentode transformer.

VAUXHALL—American Rola, type F, 6, 2,500 or 6,500, 8in. cone, 16/6; large type, 9 1/2in. cone, 24/-; complete with humbucking coils, power or pentode; permanent magnets for power, super power, pentode, Q.P.P. or Class B, 8in. cone, 25/-; large type 9 1/2in. cone, 33/-; unused manufacturers' stock; immediate delivery, carriage paid, cash with order or c.o.d.—Vauxhall Utilities, 163a, Strand, W.C.2. Temple Bar 9338. [6682

MOVING-COIL Speakers, for experimenters wanting something different; hear the drums and oboe without resonance, all sealed cartons, brand new, carriage paid; cash with order or c.o.d.; state if power or pentode transformer required; energised speakers incorporate humbuckers; Rola's (American) Senior models only 9 1/2in. diameter, 100-150v. (2,000 ohms), 110-175v. (2,500 ohms), 200-250v. (6,500 ohms), list 47/6, at 23/- each; permanent magnets, same size diaphragms, 9% cobalt magnet, 7,400 lines per sq. cm., list £3, at 33/-; as sensitive as an energised speaker.—Degallier's, No. 21, Upper Marylebone St., London, W.1. [6851

TRANSMITTING APPARATUS.

TRANSMITTING Gear for Disposal, wavemeter, crystal, transformers, etc.; stamp for list.—G5CL, 9, Chestnut Rd., Birmingham. [6829

VALVES, 1,000 volt working, type M.C. 1/60 amplifier, list £8; D.C. 1/60 rectifier, list £3/10; less 50%; guaranteed.—M. Donovan, 167, City Rd., London, E.C.1. [6792

PREMIER SUPPLY STORES Offers the Following Brand New Gear: Standard Cables transmitting valves (out of limits), 4211E and 4211D, 15/- each; 4212D, £3; American 866, 20/-; T.C.C. 2 ml., 1,500v. working, 6/-; Standard Cables transformers, 1,000-0-1,000v. 250 m.a., 4v. 3a. C.T., 4v. 3a. C.T., 49/6; 1,000-0-2,000v. 150 m.a., 49/6.—Premier Supply Stores, 20, High St., Clapham, S.W.4. 'Phone: Macaulay 2188. [6861

VALVES.

ALL Types of American and Continental Valves in Stock; keenest prices; send for price list.—Anderson, 35, Lansdowne Rd., London, E.17. [6814

METROPOLITAN RADIO SERVICE Co. for American M Valves with a Guarantee; any type at keenest prices; trade supplied.—1021, Finchley Rd., Golders Green, N.W.11. Speedwell 3000. [6836

SURPLUS Valves.—All brand new; battery types, 2-volt, H.F.2, L.F.2, L.P.2, 1/9; super power, P.P.2, 2/6; screens and pentodes, 3/9; A.C. mains, 4-volt 1 amp., general purpose, 3/3; power, 4/-; screens and pentodes, 4/6; full wave rectifiers, 3/6; postage paid cash with order or c.o.d. over 10/-.—Clarion Radio Valve Co., 885, Tyburn Rd., Erdington, Birmingham. [6339

PREMIER SUPPLY STORES Announce the Purchase of the Complete Stock of a World Famous Continental valve manufacturer, all the following standard main types fully guaranteed, 4/6 each: H., H.L., L power, medium, high, low mag. and variable mu screen grids, one, three and four watt A.C. output, directly heated pentodes, 250v. 60 m.a., full wave rectifiers, D.C. types, 20v. 18 amp., filaments, screen grid H., H.L. power.

THE Following Types, 5/6 each: 350v. 120 m.a., full wave rectifier, 500v. 120 m.a., full wave rectifier, 2 1/2 watt indirectly heated pentode.

THE Following American Types, 4/6; 250, 112, 171, 210, 245, 226, 47, 46, 24, 35, 51, 57, 58, 55, 37, 80.

THE Following Sizes, 6/6 each: 42, 77, 78, 25Z5, 36, 38, 85, 39, 44, 53, 6A7, EB7, 2A5, 2A6, 2A7, 2B7, 5Z3, 6C6, 6A4, 6D6, 6F7; 43.59.

PREMIER SUPPLY STORES, 20 and 22, High St., Clapham, S.W.4. [6860

ALL Types of Brand New American Valves in Stock, all only first-class makes such as Arcturus and R.C.A. stocked, guaranteed for 6 months, 247, 235, 551, 89, 19, 19, 46, 59, 6A7, 15, 42, 41, 38, 39, 78, 75, 57, 58, 224, 44, 36, 235, 83, 43, 5Z3, 12/-; 25Z5, 12Z3, 14/6; UX171, UX199, UX280, UX245, UX226, UX227, 7/6; UX250, UX210, UX281, 17/6; UX 867 photocells, 25/-; all other types of American valves in stock; we also stock transmitting valves, post paid, cash with order or c.o.d. WARD, 45, Farringdon St., London, E.C.4. Telephone: Holborn 9703. [6517

COMPONENTS, ETC., FOR SALE.

23, Lisle St.—Ultrax Radio, Ltd., Leicester Sq., W.C.

PHILIPS A.C. Transformers, 200 volts input, output 200-0-200, 30 m.a., 4v. 1, 4v. 4a., 2/6; 200 input, output 330-0-330, 60 m.a., 4v. 2a., 4v. 4a., 4/6.

KOLSTER Brandes Battery Sets, 2-valve Pups, 27/6; 3-valve Kobra model, 45/-; above absolutely complete, with valves, speaker, batteries, etc., in oak cabinet.

G.P.O. Relays, platinum contacts; 2/6.

R.C.A. Photo-electric Tubes, type UX-868, caesium type, 90 volts, super sensitive, new; 50/-; details with each.

G.P.O. Polarised Relays, ultra sensitive, new, with points, 12/-; with mahogany stand, 14/-.

WESTON Microphones, on stand, with enclosed transformer, carbon type; 8/6.

PHILIPS Photo Cells, caesium type, has over 100 uses, new, UX base; listed at £7, few only at £3/10.

G.P.O. Selector Switches, twin-coil, spring return and ratchet action, travelling 8 lever arm contacts, all separate, making contact with 8 semicircular rows of 25 contacts, arranged so that any 8 are in circuit, new; cost 25/-, 200 only at 5/-; send for full details to

23, Lisle St.—Ultrax Radio, Leicester Sq., London, W.C. Phone: Gerrard 2969. [6858

A Complete Range MAINS SWITCHES SELECT WITH SAFETY from the largest range of British-made mains switches yet available. Each and every one is fully guaranteed to give every satisfaction. List No. Type Price S. 102 Toggle On-off 1/3 S. 103 S.P.C.O. 1/6 S. 104 D. Pole 2/- S. 80 On-off 1/6 S. 81 S.P.C.O. 1/9 S. 87 3-point 1/9 S. 88 D. Pole 2/6 S. 89 D.P.C.O. 2/3 S. 98 D.P.D.T. 2/3 S. 91 On-off 1/9 Rotary S. 92 C.O. 2/- S. 114 D.P.D.T. 2/9 S. 116 4-pt. on-off 2/3 S. 117 3-way stud switch 1/6 S. 119 5-way " " 2/- S. 121 Q.M.B. 5-way 4/6 SEND FOR 80 PAGE CATALOGUE & MANUAL No. 154 "W" Enclose 3d. Postage A. F. BULGIN & Co. Ltd. Abbey Road, Barking, Essex.

NEW! PHILCO SHADOW TUNING METER For any make of set with A.V.C. — either A.C., D.C., or Battery. Now you can put Philco Shadow Tuning on any make of A.C., D.C., or Battery set which has A.V.C. This new accessory can be fitted without adjustment and makes this exclusive Philco tuning device available to all. The Shadow Tuning Meter is complete with its own cabinet, decoupling condenser, wire, lamp and full fitting instructions. Or, if desired, can be fitted inside the set's own cabinet. Shadow Tuning shows you when you have hair-line tuning—and therefore pure, undistorted reproduction. Tuning-in is completely silent. Makes station-finding child's play. Indicates, as well, the comparative signal strength of stations.

AMERICAN TYPE VALVE REPLACEMENTS Philco valves are suitable for all makes of American Radio sets. They improve the performance of any receiver. They can be purchased from any Philco Accredited Dealer—or write to us for full price list. ONLY PHILCO VALVES HAVE A 90-DAY GUARANTEE THE PHILCO RADIO & TELEVISION CORPORATION OF G.T. BRITAIN, LTD., AINTREE RD., PERIVALE, Middlesex.

PHILCO logo and text: MADE IN U.S.A.

Components, Etc., for Sale.—Contd.

R. RYALL'S RADIO, 44, Lamb's Conduit St., London, W.C.1, callers note: we are just off Theobald's Rd., best approach from Holborn through Red Lion St.; Holborn 3529. Hours 11 to 7 p.m. Saturdays 5 p.m. Thursdays 1 o'clock.

WESTON 425 Type Thermo Ammeter, guaranteed 0-1.5a. R.F., £2; Ferranti Radio wattmeter, 0-50v. A.C., 2/10/50w., £3; Weston 301 type, 0-15 amps, 15/-; Weston 0-500 m.a., Bakelite case, 20/-; Weston pin jack, D/R, 6-200v., 20/-; Hunt's flush 0-20 m.a., 15/-; Hunt's 0-200 m.a., 15/-; Weston centre zero, Bakelite cased, 0-100 m.a., 20/-; Silam 0-300 m.a., 15/-; Turner flush 0-100 m.a., with cut-out, 2 1/2in. type, 15/-.

VARLEY 500,000 ohm Wire Wound Resistances, 9d.; Belling Lee Unit pick-up, new, 17/6; Lewcos S.W. intermediates, 4/-; pairs new Polar thumb drive 0.0005 condensers, with double escutcheon plate, 7/6 pair to clear; Garrard Junior B D./S. motor, with unit plate, etc., new, 15/-.

WIRE, new Knitfown, etc., 1/2lb. reels, 16 swg. En., 8d.; 1/2lb. 18 swg. C.C., 8d.; 1/2lb. 28 swg. En., 9d.; 1/2lb. 28 swg. En., 6d.; 1/2lb. 20 swg. En., 6d.; 1/2lb. 32 swg. En., 9d.; 2oz. 20, 30, 32, C.C., 6d. each; 1lb. 26 swg. D.C.C., 1/6; 1lb. 34 swg. D.C.C., 2/-; 1/2lb. 34 swg. D.C.C., 9d.

TO Clear.—Set cabinets, room for speaker, callers only, 5/-; Partridge 400v. transformer, 10/-; T.C.C. 500 mf. 40v. electrolytic, 4/-; T.C.C. 101 2 mf., new, 4/-; ditto, 1 mf., 3/-; Edison Bell 10,000 ohm resistances, wire wound, with base, 6d.; Varley 10w. resistances, 500, 4,000, 40,000, 50,000, 80,000, 20,000, 2/- each; Ferranti 2 1/2w. type, with holders, 3,000, 30,000, 50,000, etc., 1/-; Igranite shrouded mains transformers, input 100/220v., output 250/250v. 4v. 1/2a., 7/6, unused; Multitone B driver, 4/9.

REGENTONE S.60 Unit, 200v. 30 m.a., 4v. 6a. A.C., £25/-; New Ekco K.25 eliminators, 150v. 20 m.a., with 1/2 amp. trickle charger, 45/-; Sponchorde 2,500 ohm speakers, with tapped transformer, 10/6; Met-Vick 250v. transformers, 4v. 2a., 4v. 5a. input, 200-250v., with terminals, 11/-, new; Varley Pentode Nichokes, new, 6/-.

DECONTROLLED Sets: Columbia 4v. battery, S.G., det., Q.P.P. output, Exide and Marconi batteries, complete, £6/5; McMichael Twin Supravox receivers for A.C. mains, 2 H.F. with twin speakers, £9; Ultra Panther superhet, 6v. and rectifier, £10; Lotus D.C. 2 sets, £4/10, all new, complete, etc.

HEAYBERD Transformers, new, with leading-out wires, 350v., 120 m.a., 4v. 4a., 4v. 5a., 4v. 2 1/2a., 25/-; Heayberd 500v. 120 m.a., 4v. 4a., 4v. 6a., 4v. 2 1/2a., 32/6; both screened primary and input 200-250v.; carriage forward.

RYALL'S RADIO Offer Reliable Resistances, suitable for all sets where a 1-watt resistance is specified in values 100, 150, 250, 400, 500, 600, 1,000, 2,000, 5,000, 10,000, 15,000, 20,000, 25,000, 30,000, 40,000, 50,000, 75,000, 100,000, 150,000, 250,000, 1/4 meg., 1 meg., 2 meg., all values stated in ohms. 4d. each; also 2-3-watt type, 400, 700, 800, 1,000, 4,000, 5,000, 6,000, 10,000, 20,000, 9d. each wire ends.

RADIOPHONE Volume Controls with Switch, 5,000, 10,000, 15,000, 20,000, 100,000, 2/6; also 10,000 graded 9-1 with 3-P switch, 25,000 graded 9-1 with 2-P switch, 3/6.

NEW Garrard No. 11B D/S Motors, 12in. turntable and fully automatic unit plate, all fittings included; less than half price, 20/-.

POLAR Minor 3-gang Condensers, with "Arcuate," "Horizontal" or "Semi Circular" drive, new, list 24/6, 14/6.

RYALL'S RADIO Offer British-made Mansbridge Condensers, metal cased, brand new, fully guaranteed, 1 mf., 400 vw., 1/3; 2 mf., 400 vw., 1/6; 4 mf., 400 vw., 3/-; 4 mf., 750 vw., 6/-.

READY RADIO 0.0005 Extensor Condensers, new, 2/6; Yagerphone S.G./Det./Pen. and rectifier chassis, with valves, complete, 65/-.

WEGO, British, condenser blocks, containing 4x4 at 350 vw., also 1x1x1x0.1x0.1x0.1 at 250 vw., new, 4/-; Wearite H.F. screened chokes, 2/-; T.C.C. dry electrolytic, 8x4, 400 vw., 2/9; T.C.C., wet type, 8 mf., 3/-, 440 vw.

T.C.C. 0-1 Non-inductive Tubular Condensers, 10d. each, 350 v.; T.C.C. electrolytic 15 mfd., 50 v., 1/4 new; T.C.C. 0.01-mica, type M, 1/-; T.C.C. 0.0001, type M, 5d.; H.M.V. condenser blocks, 250v. working, 4x4x1x1 1/2 mid., 3/-; T.C.C. 0.1x0.1, 450v. working, 1/6; T.C.C. 8 mfd., electrolytic, 500 v. working, 3/9; Dubilier 2 mid., 250v. working, 1/6.

UNIKNOBS, Polar 2-gang, new, brown, 8/-, with cover, 9/-; R. and A. type output transformers, 18-23-32-1, new, 5/-; Paxolin formers, with guides, 1in., 8d.; R.I. Hypermite transformers, 4/-, second-hand; R.I. Parafeed transformers, 5/-, second-hand.

RADIOPHONE Disc Drives, less escutcheon, fit 1/4in. spindle, read 0-100 from left to right; 1/6 post free.

R. [6847

1/6—Cadmium plated chassis, 4-valve, pressed steel, 14x9; post 6d.

12/6—Conversion transformer, 20/300 A.C. input, 220v. output, 120 watt; Everett and Edgecumbe A.C. voltmeter, 0/250, with resistance block, 12/6; G.E.C. ironclad switch and fuses, 2/6; complete outfit in metal case, 25/-.

20/-—A.C. supply unit for P.A. loud-speaker, 400v., 100 m.a., suitable for amplifier mains unit.

27/6—Ediswan D.C. all-electric S.G., detector and Pentode, complete minus valves, breaks up to 50/- worth of parts or converts to A.C.; c.o.d., carriage forward.—Kay, 167, City Rd., London, E.C.1. [6726

PEARL and PEARL Bargain List A Free.—190, Bishopsgate, London, E.C.2. [0421

HARTLEY-TURNER.—Supplies obtainable from Tet. radio, 82, Tetley Rd., Hall Green, Birmingham, 11. [6843

Components, Etc., for Sale.—Contd.

PREMIER SUPPLY STORES.

ANNOUNCE a City Branch at 165 and 165a, Fleet St., E.C. (next door to Anderson's Hotel), for the convenience of callers; post orders and callers to High St., Clapham.

OFFER the Following Manufacturers' Surplus New Goods at a Fraction of the Original Cost; all goods guaranteed perfect; carriage paid over 5/- under 5/- postage 6d. extra, I.F.S. and abroad, carriage extra. Orders under 5/- cannot be sent c.o.d. Please send for illustrated catalogue post free.

STUPENDOUS Purchase of Set Manufacturers' Stock.—All electric 3-valve (S.G. det. pen.) set, in walnut cabinet, with moving coil speaker, 200-250 volt 40-60 cycles, chassis built, 200-2,000 metres, with 4 valves; £24/19/6.

AL-ELECTRIC 3-stage Amplifiers, 200-250v., 40-60 cycles, 10 watts undistorted output, complete with 5 valves, and Magnox Super 66 energised speaker; £12/10.

TYPE 4480, 9in. diameter, permanent magnet, handles 4 watts, 7 ohms speech coil, 13/6; multi ratio transformer, 4/6 extra.

ELIMINATOR Kits, including transformer, choke, Westinghouse metal rectifier condensers, resistances, and diagram, 120v. 20 m.a., 20/-; trickle charger, 8/- extra; 150v. 30 milliamps., with 4v. 2-4 amps. C.T., L.T., 25/-; trickle charger, 6/6 extra; 250v. 60 milliamps., with 4v. 3-5 amps. C.T., L.T., 30/-; 300v. 60 m.a., with 4 volts 3-5 amps., 37/6; 200v. 50 m.a., with 4v. 3-5 amps. L.T., 27/6.

PREMIER Chokes, 40 milliamps., 25 hrs., 4/-; 65 milliamps., 30 hrs., 5/6; 150 milliamps., 30 hrs., 10/6; 60 milliamps., 80 hrs., 2,500 ohms, 5/6; 25 milliamps., 20 hrs., 2/9; 250 milliamps., 30 hrs., 20/-.

ALL Premier Guaranteed Mains Transformers Have Engraved Terminal Strips, with terminal connections, input 200-250v., 40-100 cycles, all windings paper interleaved.

PREMIER H.T.7 Transformer, output 135v. 80 m.a., for voltage doubling, 8/6; 4v. 3-4a., C.T. L.T., 2/- extra; with Westinghouse rectifier, giving 200v. 30 m.a., 17/6.

PREMIER H.T.8 and 9 Transformers, 250v. 60 m.a. and 300v. 60 m.a., rectified, with 4v. 3-5a. and 4v. 1-2a., C.T. LT and screened primary, 10/-; with Westinghouse rectifier, 18/6.

PREMIER H.T.10 Transformer, 200v. 100 m.a., rectified, with 4v. 3-5a., and 4v. 1-2a., C.T. L.T., and screened primary, 10/-; with Westinghouse rectifier, 19/6.

PREMIER Mains Transformer, output 250-0-250v. 60 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

PREMIER Mains Transformers, output 350-0-350v. 120 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

PREMIER Auto Transformers, 100-110/200-250v., or vice versa, 100-watt; 10/-.

WESTERN ELECTRIC Mains Transformers, 300-0-300v. 65 m.a., 4v. 1-2a., 4v. 2-3a., 6/6; 500-0-500v. 150 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. C.T., 4v. 1a. C.T., 19/6.

SPECIAL Offer of Mains Transformers, manufactured by Phillips, input 100-200v. or 200-250v., output 180-0-180 volts 40 m.a., 4v. 1 amp. 4v. 3 amps., 4/6; 200-0-200v., 4v. 1a., 4v. 3a., 4/6.

PREMIER L.T. Charger Kits, consisting of Premier transformer and Westinghouse rectifier, input 200-250v. A.C., output 8v. 1/2 amp., 14/6; 8v. 1 amp., 17/6; 6v. 2 amp., 27/6; 30v. 1 amp., 37/6; 2v. 1/2 amp., 11/-.

B.T.H. Trused Induction Type (A.C. only) Electric Gramophone Motors, 100-250v.; 30/- complete.

SPECIAL Offer B.T.H. Gramophone Motors, A.C. and D.C. 100-250v.; 30/-; listed £3/3.

COLLARO Gramo. Unit, consisting of A.C. motor, 200-250v. high quality pick-up and volume control, 49/-; without volume control, 46/-.

EDISON BELL Double Spring Gramophone Motors, complete with turntable and all fittings, a really sound job; 15/-.

SPECIAL Offer of Wire Wound Resistances, 4 watts, any value up to 50,000 ohms, 1/-; 8 watts, any value up to 15,000 ohms, 1/6; 15 watts, any value up to 50,000 ohms, 2/-; 25 watts, any value up to 50,000 ohms, 2/6.

CENTRALAB Potentiometers, 400 ohms, 1/-; 50,000, 100,000, 1/2 meg., any value, 2/-; 200 ohms, wire wound, 1/-.

POLAR STAR, manufacturers' model, 3-gang condensers, fully screened; 7/6, with trimmers; unscreened, 5/-.

AMERICAN Triple Gang 0.0005 Condensers, with trimmers, 4/11; Utility bakelite 2-gang 0.0005, screened, with uniknob trimmer, 3/6; Polar bakelite condensers, 0.00035, 0.0003, 0.0005, 1/-.

ORMOND Condensers, 0.0005 2-gang semi-shielded, 2/6; brass vanes with trimmers, 3/6; British Radiophone 110 kc/s intermediate, 3/-.

MAGNAVOX D.C. 152, 2,500 ohms, 17/6; D.C. 144, 2,500 ohms, 12/6; D.C. 152 magna., 2,500 ohms, 37/6, all complete with humbucking coils; please state whether power or pentode required; A.C. conversion kit for above types, 10/-; Magnox P.M., 7in. cone, 16/6.

RELIABLE Canned Coils with Circuit, accurately matched, dual range, iron cored; 3/6.

RELIABLE Intervalve Transformers, 2/-; multi-ratio output transformers, 4/6.

T.C.C. Electrolytic Condensers, 8 mf. 440v. working, 3/-; 15 mf. 50v. working, 1/-; 6 mf. 50v. and 2 mf. 100v. working, 6d.; 8+4 mf., 450v. working, 4/-; 50 mf. 12v., 2/-.

UTILITY 3-gang Condensers, 0.0005, fully screened, with trimmers, ball bearing straight or superhet, 5/9, complete; with disc drive, 7/11; the best 3-gang available.

(This advertisement continued in second column.)

Components, Etc., for Sale.—Contd.

(This advertisement continued from first column.)

BRITISH Insulated Cable Condensers, 8 mf. 550v. peak working, 3/6; 50 mf. 50v., 2/9.

T.C.C. Condensers, 250v. working, 1 mf. 1/3, 2 mf. 1/9, 4 mf. 3/-; 4 mf., 450v. working, 4/-; 4 mf., 750v. working, 6/-; 2 mf., 750v. working, 3/-.

DUBILIER Condensers, 8 or 4 mfd., dry electrolytic, 450v. working, 3/-; 4+4+2+0.1, 300v. working, 3/-.

VARLEY Constant Square Peak Coils, band-pass type B.P.7, brand new, in maker's cartons, with instructions and diagrams; 2/4.

VARLEY I.F. Intervalve Coils, B.P.8, band-pass, complete with instructions, in original cartons; 2/6.

SCREENED I.F. Chokes, by one of the largest manufacturers in the country; 1/6.

PREMIER British-made Meters, moving iron, flush mounting, accurate, 0-10, 0-15, 0-50 m.a., 0-100, 0-250 m.a., 0-1, 0.5 amps.; all at 6/-.

WESTERN Electric Condensers, 250v. working, 1 mf., 6d.; 2 mf. 1/-; 4 mf., 2/-; 400v. working, 1 mf., 1/-; 2 mf., 1/6.

WIRE-WOUND Potentiometers, 1,000, 2,500, 15,000, 20,000, 50,000, 90,000, 120,000, 200,000, 500,000, 2/- each; 1,000 ohm, semi variable, carry 150 m.a., 2/-.

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CONDENSER Blocks, 350v. working, 6+4+2+1+1, 4/6; 4+2+1+1+1+0.5, 3/9; 9+3+2, 3/-.

PREMIER SUPPLY STORES,

20-22, High St., Clapham, S.W.4. 'Phone: Macaulay 2188. Nearest station: Clapham North, Underground. [6959]

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FERRANTI A.F.4, 7/6; A.F.3, 10/6; A.F.5, 18/-; A.F.6, 18/-; A.F.7, 18/6; A.F.7c, 20/-; A.F.5c, 20/-; O.P.1, 1-1 ratio, 7/6; O.P.2, 25-1 ratio, 7/6; O.P.3a, 1-1 ratio P.P., 8/6; O.P.4c, 25-1 ratio P.P., 8/6; O.P.M.1, 10/-; O.P.M.2, 10/-; O.P.M.3c, 12/6; O.P.M.4, 12/-; B.5 choke, 15/-.

WEARITE and Lewcos Superhet Coils, 4/- each; British General tuner, 5/-; British General and pass coils, 4/- each; Wearite I.F. transformers, 5/- each, 110 kc.; Ferracort F.10, F.11, F.12, F.13, 30/-.

SPECIAL Clearance Offer Telsen 40 Henry L.F. Chokes, brand new and in sealed boxes, 1/6 each; offer invited to clear stocks approximately 400.

PAIR T.C.C. Condensers, working voltage 1,500, 4 M.F., 22/6 pair; Hypercore L.F. chokes, 8/6 each; R.I. general purpose chokes, 5/- each, second-hand.

R.I. Pentonite L.F. Chokes, 6/6 each, second-hand; Ferranti B.3 chokes, 5/6 each; Lissen I.F. transformers, 126 kc, 5/6 each; set Telsen 330 superhet coils, 10/-; Wearite B.P.1, B.P.2, T.G., 16/- set; Colvern K.M.S.1, K.M.S.2, K.M.S.3, 12/- the set.

SPECIAL Offer Ferranti B L.F. Chokes, inductance 10-35 Henries, resistance 850 ohms, current 50 m/amps., offer at the very low price of 4/- each.

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13/9 Will Buy new Celestion 37/6 Energised M.C. Speaker, 2,500 ohms, 8in. cone, universal tapped transformer.—Below.

3/6 Will Buy 12 Colour Coded Resistors, wired ends, unused, 100 to 50,000 ohms, 1-watt, assorted.—Below.

EPTON, 93, New Rd., Chingford, London, E.4. [6837]

Components, Etc., for Sale.—Contd.

SOUTHERN RADIO'S Wireless Bargains.

RECEIVERS—G.E.C. Osram 4-valve (actual) sets, complete with 4 Osram valves, permanent magnet moving coil speaker, magnificent pedestal cabinet, ready to use on all voltages A.C., all Osram proprietary components in original sealed cartons; £6/15 (list £15/15); an exceptional bargain.

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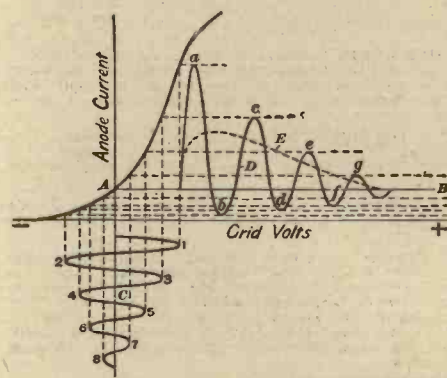
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POLAR New Type Midget Condensers, fully screened, with trimmers, 0.0005 mfd., 2-gang 6/6, 3-gang 9/9, all boxed; British Radiophone curved dial, 3/9; new Polar straight-line dial, with lights, 4/-.

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J.B. Condensers, 0.0005 mfd., with escutcheon, drive and dial light, 3/-; binocular chokes, 1/2; H.F. chokes, 10d.; Pye short wave valve holders, 4d.; S.W. H.F. chokes, 10d.; Astra 0.00015 and 0.0002 differentials, 1/3; 30 h. 40 m.a. chokes, 3/9; 40 h. 40 m.a., 3/9; 60 h. 30 m.a., 3/9; Sistofex, 7 yds., 6d.; Connectite, 10ft., 2/6d.

FORMO 2 mfd. 1,000v., 1/3; 1 mfd. 800v., 1/-; Wezo 4 mfd. 750v., 2/3; T.C.C. 8 mfd. 550v. dry electrolytics, 3/6; Dubilier 4 mfd. 500v., 3/3; Mersham wet 8 mfd. 500v., 2/9.

WESTERN ELECTRIC Microphones, boxed, 2/3; Faradex transformers for same, 85-1, 2/3; Marconi mike transformers, 100-1, 3/6; Marconi Ideal L.F. transformers, 3 1/2-1, 3/6; Eston iron-cored dual range coils, 2/6; Lucerne iron-cored canned coils, 2/6.

TRADE List Ready; enclose stamp and heading.

WOBRUN RADIO Co., 9, Sandland St., W.C.1. [6834]
Holborn 7289.

FERRANTI A.F.6, 12/-; Sound Sales driver 2-1, 6/-; Charles pentode output choke, 10/-; Grigg, 70, Peel Rd., Wealdstone, Middlesex. [6823]

FILM Industries L.S.4 unit, 50/-; 8ft. folded horn, 30/-; Ferranti M.5. speaker chassis, 20/-; O.P.M.3C., 14/-; Widdop, Electrician, Barracks, Devizes. [6832]

WESTERN ELECTRIC Condensers, I.M.F. 400v. working, 9d. each; postage 1 1/2d.; bargain list free.—Radelec, 83, Denzil Rd., London, N.W.10. [6839]

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STANDARD Telephones, mains trans., 300-0-300 60 m/a., 4v. 3a., 4v. 2a., 4/11; British 350-0-350 70 m/a., 4v. 3a., 4v. 2a., 6/11.

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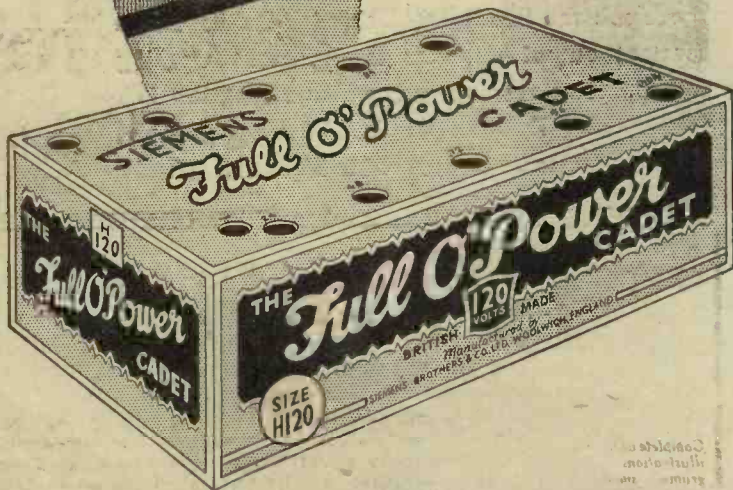
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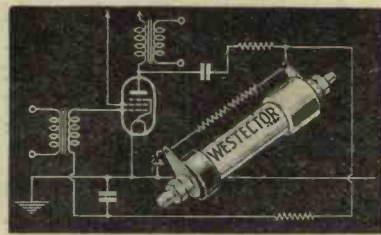


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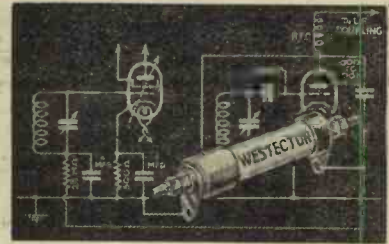
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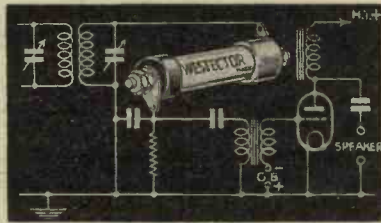
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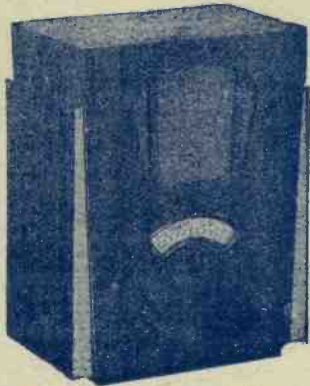
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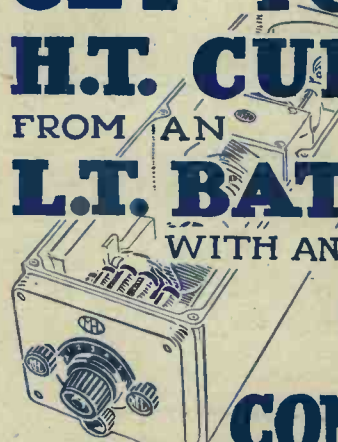
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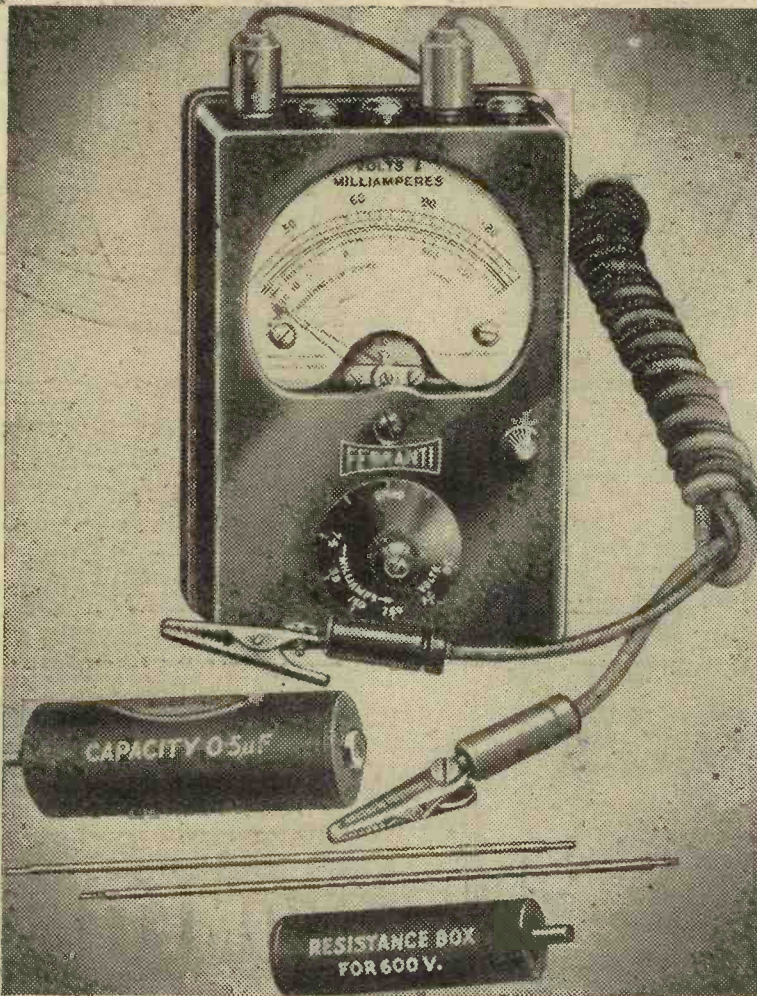
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EDITORIAL COMMENT

Electrical Interference

An Extraordinary Situation

CONSIDERABLE publicity was given recently to the attitude adopted by the Local Distribution Committee of the London and Home Counties Joint Electricity Authority, following a complaint from the Chief Engineer of the Post Office that electrical equipment at Dorking was causing interference with broadcast reception.

The Committee said that the suggestion had been made that they should adopt certain methods for removing the interference, but they declined to recognise any liability to provide a supply of electricity free from interference with broadcasting and decided to inform the Post Office that they could not see their way to effect the remedies suggested.

A Long Story

It is now just twenty-one months since the Institution of Electrical Engineers, following a suggestion by *The Wireless World*, set up a Committee to enquire into the question of electrical interference in an endeavour to obtain agreement between the many electrical interests with a view to devising means for its suppression. Twenty-one months is a long time, and as far as we can judge from what little has been made public of the deliberations of this Committee, in spite of hard work on the part of the members, nothing much has been achieved beyond making the complications of the issue doubly complicated by endeavouring to cover every conceivable eventuality, and some inconceivable ones as well.

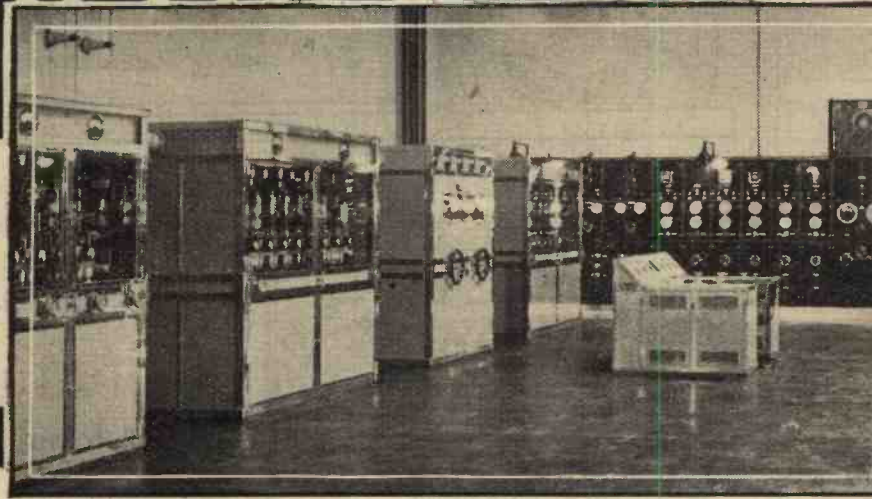
So long as a policy of perfection is aimed at we fear that we may have to wait in vain for any final settlement. We welcome every effort being made

to explore the possibilities of a perfect definition of interference and the ideal means of interference suppression, but surely something could be done to effect a partial remedy in the meantime by making it illegal in principle to produce avoidable interference. When efforts have been made by the representatives of the Postmaster-General to trace causes of interference and recommend methods for overcoming it, it can scarcely be regarded as satisfactory for those responsible for the interference to be able to say "mind your own business and leave us alone."

Listeners Would Suffer

There is before Parliament at the present time a Bill which, although we understand it has been shelved for the present session, is almost certain to come up again in the future. An endeavour is being made to include in this Bill a clause to authorise electricity suppliers to relay broadcasting to their subscribers over the electric supply wires. If this clause in the Bill is allowed to go through a most extraordinary situation will arise. The electricity supply authorities will become competitors with the suppliers of wireless sets for direct reception, and interference by the electric supply could be made to render listeners' reception of broadcasting on a wireless set practically impossible, and giving them the relay programmes as the only alternative. It would be equivalent to allowing the railways, whenever they felt the competition of road transport, to scatter broken glass and nails on the highways in order to divert traffic to themselves. Even if consideration is to be given to broadcast relaying over electric supply wires the idea should not be entertained until the production of electrical interference has been made illegal and proper steps taken to suppress it.

BROADCASTING IN



A Bird's-Eye View of Transmission and Reception : An

*N*EXT week begins a series of articles on the theme "The Foundations of Wireless," in which will be discussed the simple basic theory underlying the design and performance of wireless apparatus. It is intended to begin with the most fundamental electrical notions, and to proceed by easy stages to the complete circuit of a simple receiver. The present article, which gives a bird's-eye view of the whole process of broadcasting from studio to listener, is meant as an introduction to the coming series. Later articles will of necessity be concerned with quite small parts of the whole; it is hoped that the sketchy outline here presented will serve as a skeleton framework into which later articles can be fitted, so making the series a coherent whole in the reader's mind.

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

IN discussing the day's wireless programmes one might easily remark to a friend: "There's some good music on the air to-night." Perhaps the phrase is more American than English, but it will nevertheless serve as a text for discussion, because it suggests a point of view that must be utterly abandoned before even beginning to grasp the mechanism of wireless transmission.

"Music on the air" suggests that the transmitting station sends out music as a disturbance of the air, which is music as we understand it in every-day life. But a transmitter is not a super-megaphone bawling out music; its aerial emits no more sound than does an ordinary telephone wire. "Music" must therefore be sent out from a wireless station in some altered state, from which it can be converted back into ordinary audible music by the listener's receiving equipment.

Anyone who has watched a cricket match will recall that the smack of bat against ball is heard a moment after bat and ball are seen to meet; the sound of the impact has taken an appreciable time to travel from the pitch to the grandstand. If the pitch were 1,100 feet away from

the observer the time delay would be one second. Yet it is found that a watch may be set with apparently perfect accuracy by a wireless time signal from New York, providing, of course, that we allow for the fact that Americans do not use Greenwich Mean Time. That time signal has hurtled across the Atlantic in about a fiftieth part of a second. Comparing this with the three hours that would be required by any air-borne impulse we are driven to the conclusion that wireless transmissions are not carried by the air.

Nature of Wireless Signals

In the light of these facts "music on the air" has resolved itself into a silent substitute for music, carried by something that is not air.

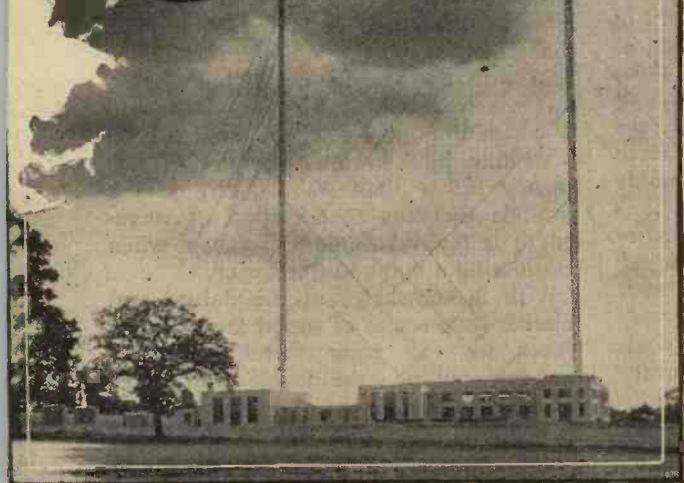
The clue to the real nature of wireless signals is given by their rate of travel, which is the same as that of light. Light is one of the many possible disturbances in a mysterious and rather debatable medium called the "ether of space"; besides light there exist both longer and shorter ether waves which do not affect the eye at all.

The shortest waves, a few millionths of an inch long, affect only the smallest things, and are used by physicists to evoke disturbances within the atoms of which matter is composed, or to peer into atomic structure. The longer waves, which may be many yards long, also act on objects of physical dimensions comparable with their own. In particular, they affect metallic objects, such as wireless aerials, for example, losing energy to them and setting up in them electric currents. All these waves, since they are all carried by the ether, travel at the same rate, which is about 186,000 miles per second.

Natural processes are mostly reversible, so that the fact that ether waves of long wavelength set up electric currents in an aerial wire at once suggests that if by any means electric currents of a suitable kind can be made to flow in an aerial, that aerial will very probably radiate waves into the ether. In actual fact it does so, and recognition of this at once makes it evident that communication can be carried out between two points, even though separated by many miles, provided that we have some means of generating the currents at the transmitting end and recognising them at the receiver.

The whole process is no more and no less wonderful than ordinary speech, during which air waves are set up by the motions of the speaker's vocal cords, transmitted over a distance of a yard or two by the intervening air, and reconverted into mechanical movements when they strike the listener's ear drum. The sequence "electric currents — electric waves — electric currents" is exactly analogous to the sequence "mechanical

OUTLINE



Introduction to a New Series of Instructive Articles

motions — air waves — mechanical motions.” Communication by air waves for which we use our own natural organs, seems merely commonplace; communication by electric waves is still something of a novelty, because it is only in this century that man has learnt to build himself transmitting and receiving stations, which are the electrical equivalents of mouth and ears.

The long distances over which wireless communication is possible is a result of the natural properties of the longer ether-waves; in communication by signal fires and heliograph the shorter (visual) waves have been used for generations for the sake of their ability to span greater distances than can conveniently be reached by waves in the air.

Of the various types of wave that we meet in daily life those formed when still water is disturbed are the nearest in character to the invisible air or ether waves. If we drop a stone into a pool and watch the resulting ripples carefully

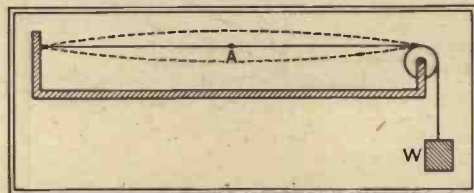


Fig. 1.—A stretched string vibrates in a regular manner when plucked or bowed, giving rise to a musical note of definite pitch. The size of the weight W controls the tension of the string, and therefore the pitch of the note.

we shall observe that as they pass a twig or other small object floating on the surface they cause it to bob up and down. But the twig is not carried along bodily by the ripples.

The waves, therefore, do not consist of

water flowing outwards from the point where the stone hit the surface, although they certainly give the impression that this is happening. As the twig shows, all that the water at any one point does is to move up and down rhythmically a few times before the wave dies away. The point is that nothing moves outwards from the centre but energy passed on from one part of the water to the next.

Air Waves

The behaviour of an air-wave is very similar. Suppose someone seated in the middle of a large room claps his hands. A listener seated against the wall will hear that hand-clap almost immediately. It is not to be imagined that the air suddenly compressed in the act of clapping has shot across the room to the listener's ear in that brief time. What has happened is that the body of air suddenly compressed by the clap has rebounded, compressing in the process the air immediately surrounding it. This, rebounding in its turn, has passed on the wave of compression in the same way until it has eventually reached the listener. All that has actually travelled across the room is energy in the form of compression of the air.

In wireless work one is more largely concerned with rhythmic waves than with irregular disturbances like that caused by a hand-clap. A stretched string, which emits a definite musical note, gives rise to a more important type of air wave.

When such a string is plucked or bowed it vibrates in the manner indicated in Fig. 1. The movement of the string is rhythmic in the sense that each complete cycle of movements, from the highest position of A to the lowest and back again, occupies the same period of time.

Moreover, each of these cycles is exactly like the last in every respect save that as the vibration dies away the amplitude of movement of the string becomes progressively less. The length of the time occupied by each cycle determines the pitch of the note heard; if it is short, so that many vibrations take place each second, the note is high, while if it is long, so that only a few cycles of the movement occur in a second, the note is low. In scientific work of all kinds it is customary to specify a note in terms of the number of complete vibrations that occur in each second, this being known, for the sake of brevity, as the frequency.

Suppose the string vibrates at the rate of 550 cycles per second; in each second it will send out 550 compressions and 550 rarefactions of the air. The rate at which the wave that these compose will travel forward depends only on the medium through which it is passing; in air the velocity is about 1,100 feet per second. If we imagine that the string has been in vibration for exactly one second the wave corresponding to the first vibration will have reached a distance of 1,100 feet from the string just as the last wave (the 550th) is leaving it. There are, therefore, in existence 550 complete waves extending over a distance of 1,100 feet, from which it is very evident (see Fig. 3) that

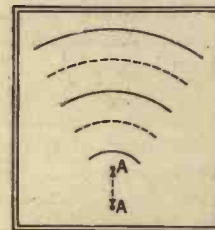


Fig. 2.—End view of the vibrating string at A in Fig. 1. As it moves up and down over the distance AA it sends out alternate waves of compression (full line) and rarefaction (dotted line), which carry some of the energy of vibration to the listener's ear.

Broadcasting in Outline—

each wave must be two feet long. If the string had executed 1,100 vibrations in the same period, the first would still have travelled 1,100 feet in the second of time occupied, and there would have been 1,100 complete waves in the

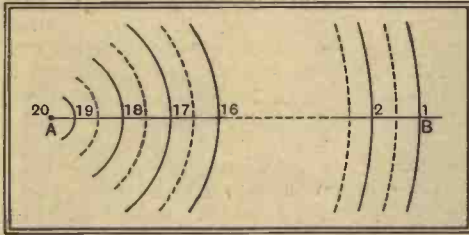


Fig. 3.—Twenty successive waves from the string. If the string is vibrating 20 times per second, the 1st wave has been travelling for one second by the time it reaches B, and the 20th is just leaving the string at A. Since sound travels 1,100ft. in one second, AB=1,100ft. and the distance between one wave and the next (wavelength) is 1/20th of 1,100ft.

series—each, therefore, one foot long. Since the velocity of sound in air is constant the higher frequencies correspond to the shorter wavelengths, and *vice versa*. It is specially to be noticed that it is the frequency of the vibration that is fundamental, and that the wavelength is a purely secondary matter depending on the velocity with which the wave travels. That it really is frequency, and not wavelength, that settles the musical note heard can be shown by sending a sound through water, in which the velocity is 4,700 feet per second; the wavelength corresponding to a 550-cycle note is much greater than in air, but the pitch, as judged by the ear, remains the same as for a 550-cycle note in air.

The range of musical sound with which a wireless engineer has to deal runs from a low note of frequency about 50 cycles per second to a high note of frequency some 8,000 cycles per second, since if this range is fully reproduced music is sufficiently natural to give real pleasure to even the most critical listener. The musical frequency-scale of Fig. 4 indicates, for reference, the frequencies corresponding to various notes.

When we turn to the production of the wireless waves, by whose aid music is transmitted from place to place, we find frequencies of a very different order. These waves, as has already been mentioned, are set up by the surging to and fro of electric current in the aerial of the transmitter. Since the flow of electric current does not involve the movement of material objects, as does the vibration of the strings and reeds used in music, there is no great barrier to the production of very high frequencies indeed. If the current in the aerial surges back and forth at such a rate as to complete the double motion a million times in a second, it is oscillating at quite an ordinary *radio-frequency*. In such a case the surging current sends out into the ether a wave which has the electrical equivalent of compressions and rarefactions, the "compressions" following each other every millionth of a second.

Being a wave in the ether, our wireless wave travels at the invariable speed of all ether waves, 300,000,000 metres, or

relationship is $\lambda = \frac{300,000,000}{f}$, where λ = wavelength in metres and f = frequency in cycles per second.

In dealing with sound, frequency is always used to specify the pitch of the note; in wireless matters both frequency and wavelength are in common use. Since in this series we shall be much less concerned with the waves themselves than with the rapidly oscillating electric currents from which they are born and to which they give rise, we shall exhibit a definite bias towards the use of frequency rather than wavelength, on the grounds that the specification of wavelength is really meaningless except when considering a wave in free space.

With a knowledge of the nature and relative frequencies of sound and wireless waves we can trace through, in the broadest outline, the whole process of broadcast transmission and reception. It is summed up, with almost ludicrous absence of detail, in the crude scheme of Fig. 5.

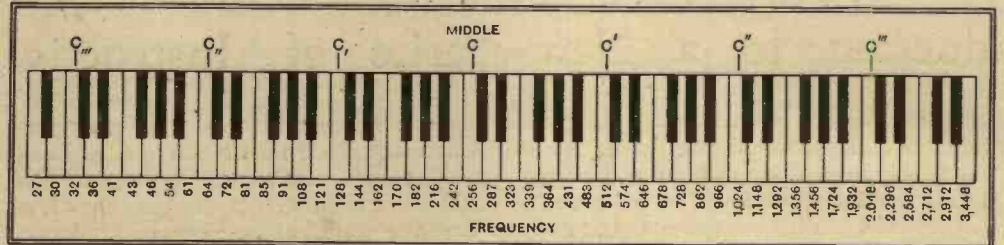


Fig. 4.—Showing the frequency corresponding to each musical note. Harmonics (multiples of the fundamental frequency shown) give notes their distinctive character; hence the need to reproduce frequencies apparently outside the range of music as written.

186,000 miles, in each second. If, during one second, one million complete waves are radiated by the aerial, then at the end of that time the first wave has travelled 300 million metres and the millionth is just leaving the aerial. Each wave, therefore, is 300 metres long. Just as in the case of sound, a lower frequency of electrical oscillation in the aerial will give rise to fewer waves each second, though the distance over which one second's-worth of emitted waves will stretch remains the same. The waves, therefore, are longer. In symbols, the

We begin in the studio, where we will imagine that an orchestra is playing a symphony. The result, brutally ignoring the aesthetic side, is a complicated mixture of air waves. These impinge on the diaphragm of a *microphone*, and this diaphragm, being thin, light and flexible, takes on exactly the movements of the air in which it stands. The task of the microphone is to convert these movements of its diaphragm into movements of electrons, just as though the wire leading from it were a pipe filled with water pushed to and fro by the diaphragm.

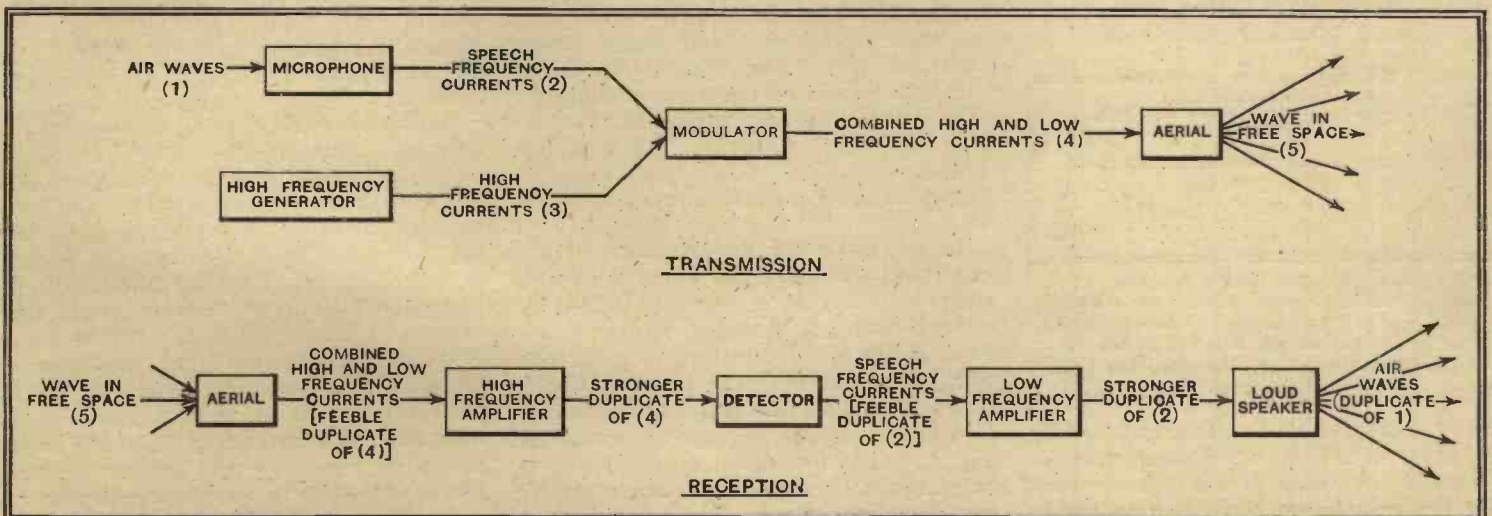


Fig. 5.—Schematic outline of broadcasting, showing how air-waves in the transmitting studio are duplicated, after many transformations, in the listener's home. Many stages of amplification have been omitted, for the sake of simplicity, from the diagram of transmission

DISTANT RECEPTION NOTES

Stations that Wander : Fewer X's

Broadcasting in Outline—

The complicated air-waves are thus eventually translated into an exactly corresponding movement of electrons, so making a complex mixture of currents at frequencies which may lie anywhere within the range 50 to 8,000 or more cycles per second. They cannot be radiated from the aerial in their present form, partly because they are too weak and partly because the frequencies they represent are far too low to radiate well.

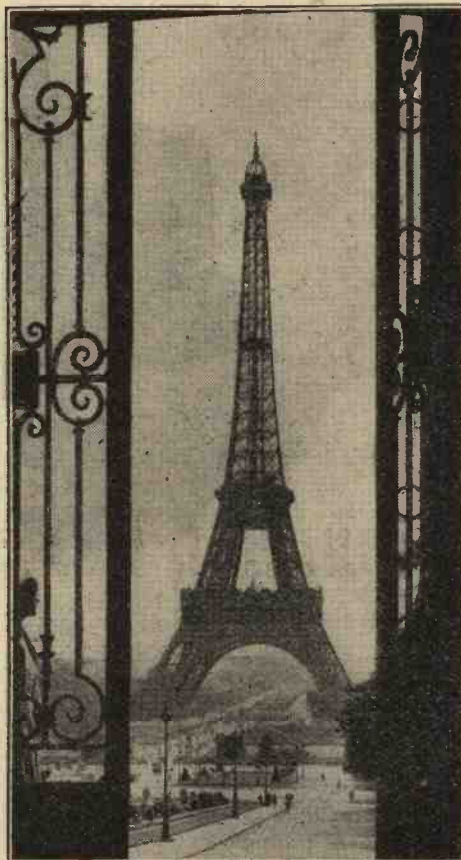
From another source a single regularly oscillating current, of a frequency suitable for wireless purposes (150,000 to 1,500,000 cycles per second) is produced, and the currents derived from the microphone are superposed on this in such a way that they render it irregular. The mixture is finally fed to the aerial, so that the final wave sent out bears upon it, in the form of variations in strength, the impress of the currents derived from the microphone. These are then carried, in their new form, to any point on the globe to which the wireless wave itself can reach.

It has already been pointed out that a transmitter sends out a silent substitute for music; this complex wave is that substitute.

On striking an aerial this wave is partially absorbed by it, the energy so abstracted from the wave serving to set up in it a current which is an exact replica in miniature of the far more powerful current surging back and forth in the aerial of the transmitter. If the received signals are very feeble, as they may be if the transmitter is distant or the aerial small, the first need is to strengthen them without changing their character. This is done by a *high-frequency amplifier*, a part of the receiving equipment in which screened valves are generally used. When sufficiently amplified the signals are *detected* by another valve, which sorts out from the complex current representing the wave as a whole those parts of it which are directly due to the original music, rejecting those more rapidly oscillating currents which, in enabling the music to be transported from transmitter to receiver on the wings of a wireless wave, have now done all that is required of them.

The currents we now have left are as exact a copy of those given by the microphone in the studio as can be had after so many transformations; they only require to be magnified up by another valve or two until they are strong enough to operate a loud speaker. To this they are accordingly passed, where they serve to push and pull a diaphragm (usually of paper) in such a way that its movements are a mechanical replica of the movements of the electric currents supplied to it. The diaphragm of the speaker thus performs the same movements as did that of the microphone a fraction of a second earlier; in doing so it sets up in the listener's home air waves which are, as nearly as may be, identical with those produced by the orchestra.

MOST long-distance enthusiasts must have noticed and regretted the heterodyne which has so persistently affected Leipzig's transmissions of late. It appears that this has been due, as I had suspected, to Barcelona, which has recently



SEEN BUT NOT HEARD. As a broadcasting station Eiffel Tower makes its last bow in the near future. At one time the famous call sign FL stood for the only broadcasting station in Europe.

had the distinction of not being exactly on its allotted wavelength of 377.4 metres on any single evening. As the station is provided with the official wavemeter of the U.I.R., the truth is probably that its plant is now so antiquated that it is incapable of maintaining its wavelength without large wobbles. It is particularly hard on Leipzig, which has always kept dead on its proper wavelength of 382.2 metres.

Many other stations, as the U.I.R. report discloses, have wandered rather badly. By far the best records are shown by the British, German, Italian, Austrian, Danish and Polish stations, most of which have kept strictly within the frequency limits allowed by the Lucerne Plan. Sweden would also figure in the list but for the antics of her smaller relay stations working below 225 metres. Many of these have been literally all over the place.

The worst offenders in the matter of wavelength wandering are the Spaniards, with the French, I am sorry to say, as a pretty close second. The only French station which has a clean record is the Poste Parisien. Many of the others have not deviated very badly, but in these days even a small wobble can have devastating effects upon neighbouring transmissions.

Actually, comparatively few stations of

Europe's large family keep precisely to their wavelengths, so that it must be a matter for surprise that the number of transmissions receivable evening after evening without noticeable interference is as great as it is.

We seem now to have left behind us the period of atmospherics that was so marked during August, September and the first week of October. Since October 6th, atmospherics have been bad enough to interfere seriously with foreign reception on only one evening, the 18th. Freedom from atmospherics always means good conditions on the long waves. Huizen, Radio-Paris, Zeesen, Warsaw and Luxembourg have all been good and Kalundborg has only been interfered with on occasional evenings. The French Government is at last definitely closing down the Eiffel Tower as a broadcasting station and in future it will be used only for occasional experiments.

Pre-War Broadcasting

Old hands will remember the days when the Eiffel Tower, then working on about 2,700 metres, was Europe's only regular broadcasting station. They will recall, too, those astonishing solenoid coils on four-inch formers with windings a foot or so in length which were used to receive its programmes. The number of turns in action was adjusted by means of a sliding contact working on a square brass rod, and fine tuning (!) was accomplished by means of a variable condenser, usually with a capacity of .001 microfarad. A favourite form of tuner in those days was the loose-coupler. Its primary was a solenoid six inches in diameter and the secondary could be moved inwards or outwards, travelling on two parallel round brass rods. The whole apparatus was mounted on a stand two feet or so in length and about a foot in width.

The number of medium-wave stations now receivable with good quality and volume is wonderfully large. Amongst the best are Prague, Lyons, Cologne, Munich, Stockholm, Brussels No. 1 and No. 2, Rome, Trieste, Königsberg, Bordeaux, the Poste Parisien, Hamburg, Berlin, Stuttgart, Athlone, Frankfurt and Hilversum.

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THE WIRELESS WORLD
BROADCASTING
STATION GUIDE

INCLUDED as a supplement to this week's number will be found a useful station finder. Particulars are given of all the broadcasting stations within the range of most receiving sets in this country, with suitable spaces for readers to enter the tuning position of their own receivers.

The stations are given in both wavelength and alphabetical order.

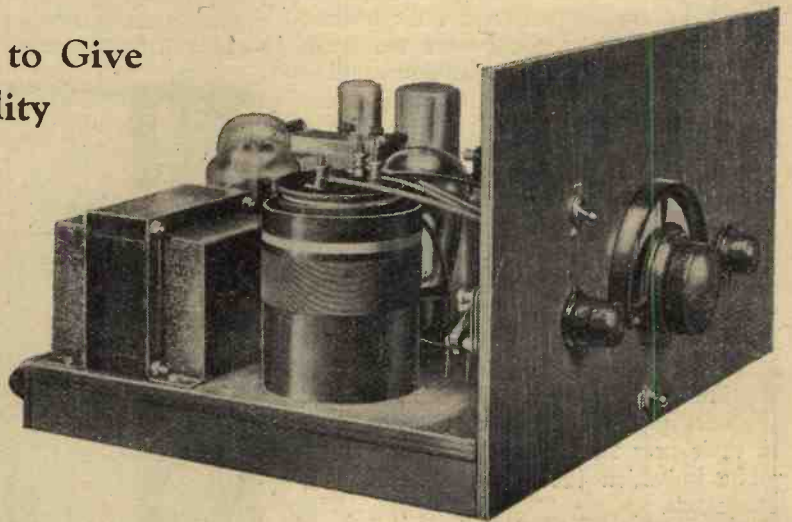
Notice of subsequent alterations to the lists will be given from time to time to enable readers to keep their cards up to date.

The Wireless World

Standard AC Two

A Straightforward Mains Set Designed to Give a Generous Output of Good Quality

THE two-valve receiver is eminently suitable for local reception since it is sufficiently sensitive and capable of providing an output ample for most domestic purposes. This applies particularly to a mains operated set, for then the performance need not be in any way restricted in order to obtain a low anode current consumption. The receiver described in this article covers most needs as regards local reception, and in good districts it is capable of giving several Continental transmissions.



WITH modern high-power transmitters a receiver need have quite a small degree of amplification to provide adequate volume for most purposes when the set is used within the service area of a station. It is possible, therefore, with up-to-date valves and components, to obtain a very satisfactory performance from a two-valve set; indeed, the results are astounding to those whose recollections of this type of set date back to 1926 or so. Although designed solely for local reception, such a set will often give good results from a number of Continental transmissions, but it then requires careful handling and is dependent upon local conditions to an appreciable degree.

Quality of reproduction is of primary importance in any local-station receiver,

and a triode output valve has consequently been chosen in preference to a pentode. It will be seen from the circuit diagram of Fig. 1 that a PX4 output valve is used, and it is capable of delivering about 2½ watts to the loud speaker. For full output this valve requires an input of about 32 volts peak, so that a high ratio transformer is necessary for feeding it if the sensitivity is to be adequate and the detector free from overloading. The ratio obtainable, however, depends upon the frequency response required. If we take a transformer of given characteristics and endeavour to increase the ratio by reducing the number of primary turns, we obtain a relatively smaller bass response, since we have reduced the primary inductance. On the other hand, if we try to obtain a greater step-up by increasing

the secondary turns, we are likely to find that the high-frequency response becomes poor owing to the increased effect of secondary capacity. The maximum ratio obtainable with a good frequency response depends upon the general design of the transformer—largely the size of the core and disposition of the windings. The component selected for this receiver represents about the best which can be done in this respect and has a ratio of 1.7. The output required from the detector, therefore, is $32/7 = 4.57$ volts peak.

A power grid type of detector is used, for there is no other detector capable of a comparable performance. The anode bend rectifier introduces a considerable amount of amplitude distortion and does not usually give good reaction effects. The

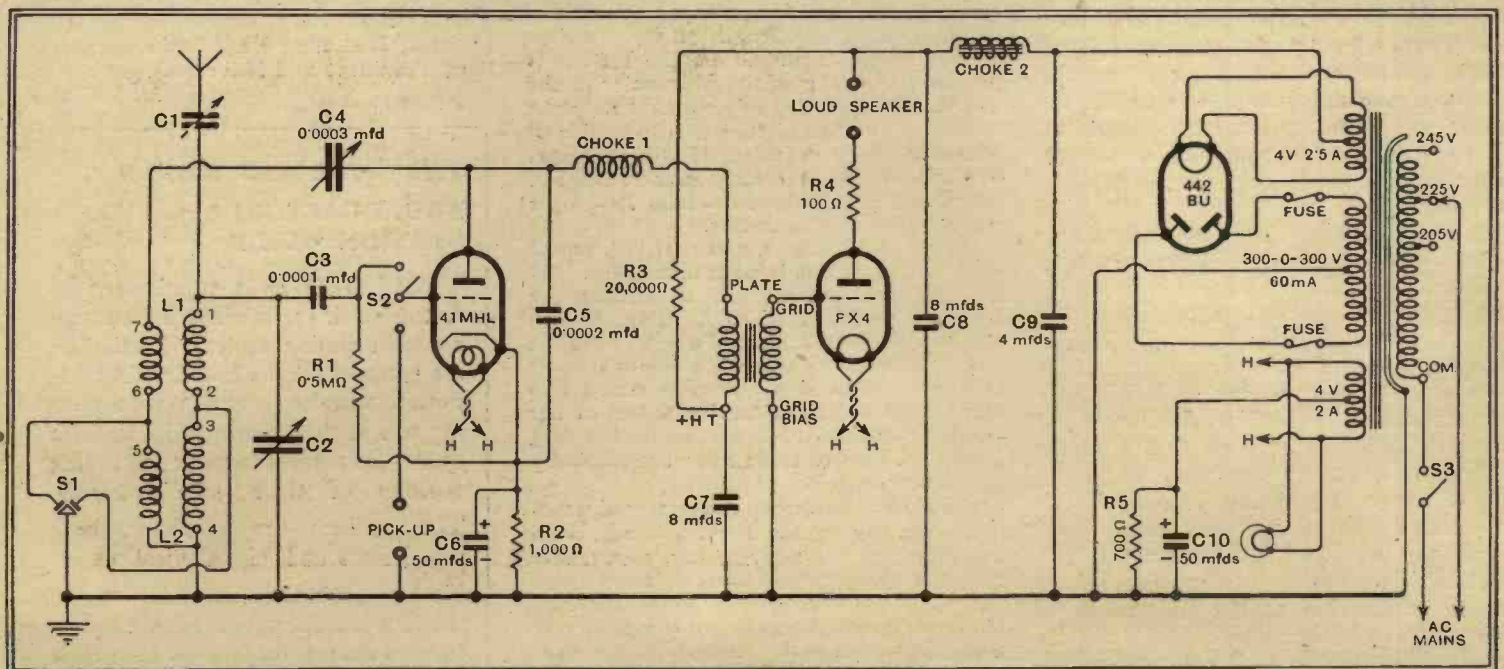


Fig. 1.—The complete circuit diagram of the equipment shows that a single tuned aerial circuit with reaction is used, and that provision is made for the use of a gramophone pick-up.

TWO-VALVE LOCAL-STATION RECEIVER

diode is nearly distortionless, but it gives no amplification; even if the amplification be obtained by an LF stage—as by using a duo-diode-triode—satisfactory reaction effects are almost impossible. The power grid detector, however, is nearly free from distortion, and, provided that it is correctly operated, it gives good amplification, and there is no difficulty in obtaining satisfactory reaction.

The valve chosen for the detector has an AC resistance of about 10,000 ohms, and the transformer primary is connected directly in its anode circuit to avoid the loss of voltage which would occur were a resistance feed to be adopted. This is per-

from radio to gramophone to be made easily, and on gramophone the pick-up is connected between the grid of the valve and the earth line. A volume control will usually be needed, and the resistance of the potentiometer should be chosen in accordance with the pick-up maker's recommendation. The slider of the volume control should, of course, be connected to the pick-up terminal which is joined to S2.

Returning to a consideration of the receiver, a single tuned circuit is employed with an effi-

The wavelength range of the set and the dial settings are somewhat dependent upon the capacity used in C1, so that a precise calibration is not possible unless C1 is left at a fixed setting. In general, the greatest

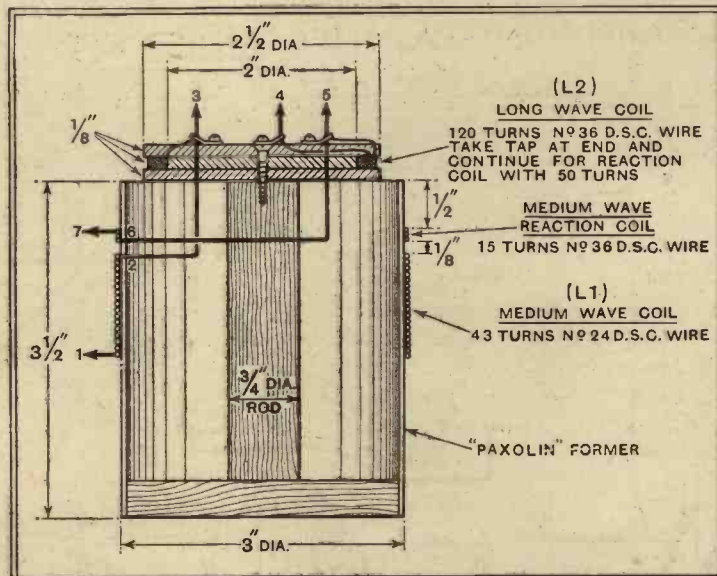


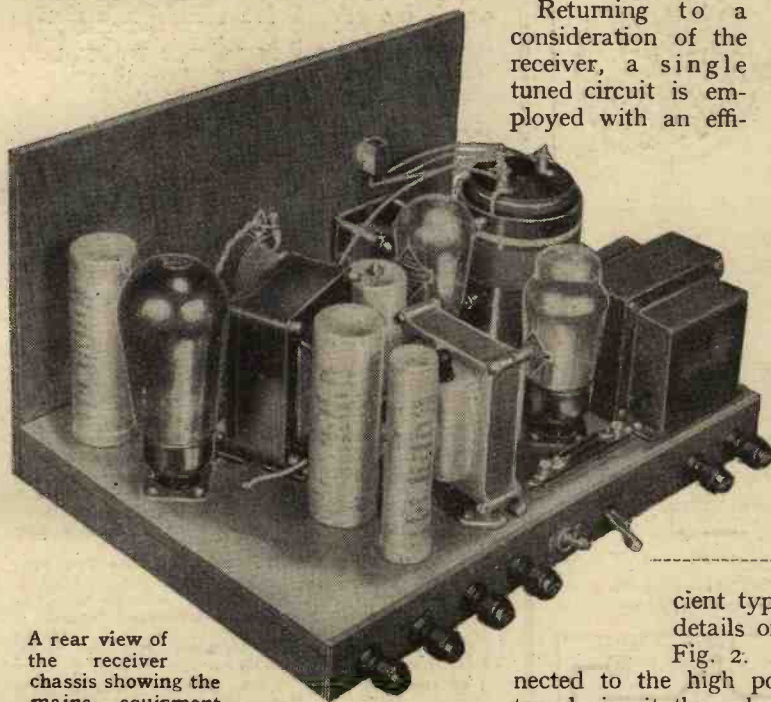
Fig. 2.—This drawing shows the details of the coil assembly; it should be noted that all windings are in the same direction.

A full-size blue print of the wiring diagram is available from the Publishers, Dorset House, Stamford Street, London, S.E.1. Price 1s. 6d., post free.

cient type of coil, winding details of which appear in Fig. 2. The aerial is connected to the high potential end of the tuned circuit through a 0.0001 mfd. air-dielectric variable condenser C1, and the

sensitivity is obtained when C1 is set at maximum, but the selectivity is usually considerably greater at a lower setting. If a station be found to suffer interference, therefore, it may often be avoided by reducing C1, retuning, and altering reaction appropriately.

The mains equipment consists of the usual full-wave rectifier, and the transformer has secondaries rated for 300-0-300 volts at 60 mA., 4 volts at 2.5 A., and 4 volts at 2A. The first two windings supply the rectifier, while the last feeds the filament of the output valve and the heater



A rear view of the receiver chassis showing the mains equipment.

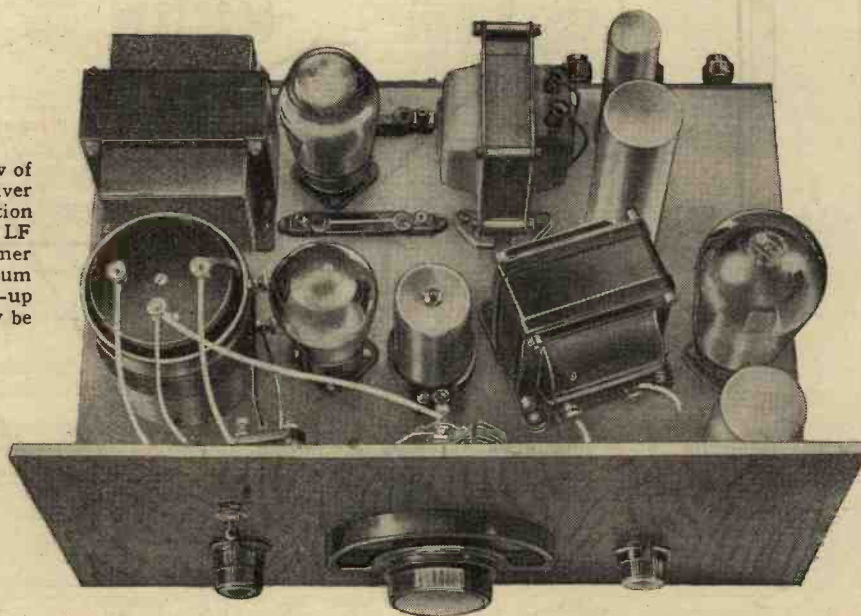
missible with the specified transformer, since it is designed for direct current through the primary. An HF choke Ch1 is included in the detector anode circuit to prevent HF currents from leaking into the purely LF circuits and to enable proper reaction effects to be obtained. The filtering circuit is completed by the 0.0002 mfd. condenser C5, and it should be noted that no condenser is needed after the choke, since one is included in the LF transformer.

The Detector

The grid condenser is given the usual value of 0.0001 mfd., and the grid leak has been fixed at 0.5 megohm, this value representing a satisfactory compromise between the conflicting factors of sensitivity, selectivity and quality. The grid leak is returned directly to the cathode, which is connected to the earth line through the 1,000 ohms resistance R2 shunted by the 50 mfd. electrolytic condenser C6. These components provide the grid bias necessary when the valve is used as an amplifier only for pick-up purposes.

The switch S2 enables the change-over

In this view of the receiver the orientation of the LF transformer for minimum hum pick-up can clearly be seen.



circuit is tuned by the 0.0005 mfd. condenser C2. A solid dielectric condenser C4 is used for reaction and has a capacity of 0.0003 mfd.

of the detector. Grid bias for the output valve is obtained by means of the 700 ohms resistance R5 connected between the centre tap on the filament winding and

The Wireless World Standard AC Two—negative HT. This resistance is shunted by a 50-mfds. electrolytic condenser C10 in order to avoid feed-back effects.

The usual 4-mfds. reservoir condenser C9 is connected across the HT output of

the rectifier and the current passed through the smoothing choke Ch2, after which comes an 8-mfds. electrolytic condenser C8. This simple arrangement provides more than enough smoothing for the output valve, but not sufficient for the de-

rector. In order to obtain freedom from hum, therefore, the detector HT supply is taken through the 20,000 ohms resistance R3 and, in conjunction with the 8-mfds. condenser C7, this provides both additional smoothing and adequate decoupling.

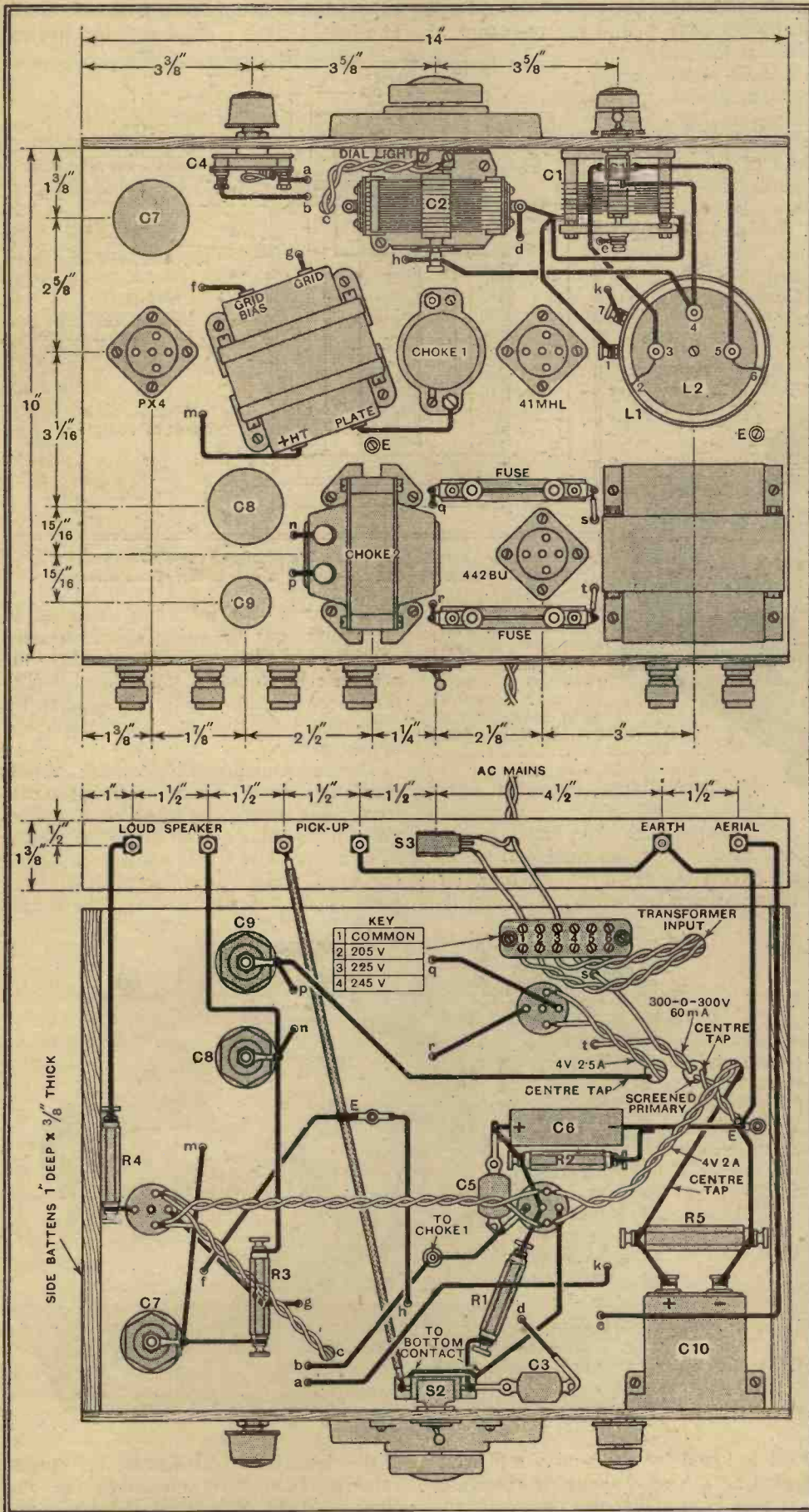
Owing to the particular voltage and current requirements of the receiver it is hardly feasible to use a loud-speaker field winding for smoothing, since this would involve the provision of a mains transformer giving an output around 400 volts and would considerably increase the cost of the apparatus. A permanent magnet-type speaker is, therefore, considered more suitable for this receiver. The output valve requires a load impedance of some 3,000-4,000 ohms, so that the output transformer ratio should be such that the speaker presents this impedance to the valve. The ratio can easily be calculated if the speech coil impedance Z is known, and it is equal to $\sqrt{(3,500/Z)}$.

Sensitivity and selectivity curves are not given, since the performance of the set in these respects depends so much on the precise settings of the aerial and reaction condensers that they would be of little value. At average settings the sensitivity is about 2,600 microvolts for the standard output of 50 milliwatts.

THE LIST OF PARTS

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

- 1 Variable condenser, 0.0005 mfd., C2 Formo S45
- 1 Dial for above Formo Mystic Drive
- 1 Reaction condenser, 0.0003 mfd., C4 Ormond R508
- 1 Knob for above Ormond R355
- 1 Midget condenser, 0.0001 mfd. slow motion, C1 Ormond R149
- 1 Tuning coil, two-range, L1, L2 Scientific Supply Stores, Standard Two Type
- 1 Mains transformer, with screened primary, 200-250 volts, 50 cycles; secondaries, 300-0-300 volts, 60 mA.; 4 volts, 2.5 amps., centre-tapped; 4 volts, 2 amps., centre-tapped Savage
- (All Power Transformers, Davenset, Heayberd, Partridge, Rich and Bundy, Sound Sales, Vortexion, Wearite)
- 1 LF choke, 20 henry, 75 mA., Ch2 Wearite HT12 (Bulgin, Davenset, Heayberd, Partridge, Rich and Bundy, Sound Sales, Vortexion)
- 1 LF Transformer, 1.7 ratio Ferranti SHF
- 1 HF choke, screened, Ch1 Goltone AM6
- 2 Microfuses, 100 mA., 750 volts, with holders Microfuses F4
- Electrolytic condensers:**
- 2, 8 mfd., high voltage type, C7, C8 Dubilier 0281
- 1, 4 mfd., high voltage type, C9 Dubilier 0283
- 1, 50 mfd., 12 volts working, C6 Dubilier 3001
- 1, 50 mfd., 50 volts working, C10 T.C.C. 521
- 1 Fixed condenser, 0.0001 mfd., C3 Dubilier 665
- 1 Fixed condenser, 0.0002 mfd., C5 Dubilier 665 (Graham Farish, T.C.C., T.M.C.-Hydra, Telsen)
- Resistances:**
- 1, 100 ohms, 1.5 watts, R4 Graham Farish "Ohmite"
- 1, 1,000 ohms, 1.5 watts, R2 Graham Farish "Ohmite"
- 1, 20,000 ohms, 1.5 watts, R3 Graham Farish "Ohmite"
- 1, 500,000 ohms, 1.5 watts, R1 Graham Farish "Ohmite"
- 1, 700 ohms, 3 watts, R5 Graham Farish "Ohmite"
- (Bryce, Dubilier, Erie, Ferranti, Claude Lyons, Polar N.S.F. Watmel)
- 3 Valve holders, 5-pin, chassis mounting type Goltone R20/521
- 1 Toggle switch, 3-point, wave-change, S1 Bulgin S87
- 1 Toggle switch, SPDT, radio-gram., S2 Bulgin S81
- 1 Toggle switch, on-off, S3 Bulgin S80T
- 6 Terminals, A, E, 2 PU, 2 LS Belling Lee
- 1 Connector block, 6-way Bryce
- 1 Dial lamp, 6 volts Bulgin
- Panel, plywood, 14 x 8, and side battens
- Baseboard, plymax, 14 x 10 x 3 Peto-Scott
- Screws:**
- 12, 1/16 in. r/hd. No. 6; 2, 1/16 in. c/sk. No. 4; 4, 1/16 in. r/hd. No. 4; 21, 1/16 in. r/hd. No. 4; 2, 1/16 in. 6 BA with nuts and washers.
- Cabinet:** Peto-Scott
- Loud speaker with triode or universal transformer Wharfedale New Bronze Universal Chassis (Celestion, Rola, W.B.)
- Valves:—1, 41MHL, Cossor; 1, PX4, Marconi and Osram; 1, 442BU, Cossor.



Full details of the layout of the components and the wiring are given in these drawings.

The Wireless World Standard AC Two—

The noise level, which consists chiefly of mains hum, is about 26 decibels below standard output; that is, compared with an output of 50 milliwatts, the output of

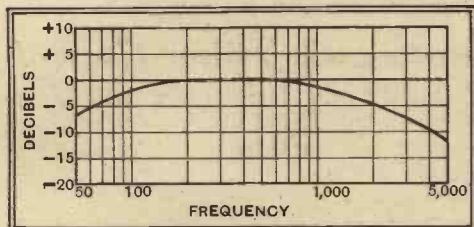


Fig. 3.—The overall fidelity curve of the receiver is unusually good for such simple equipment.

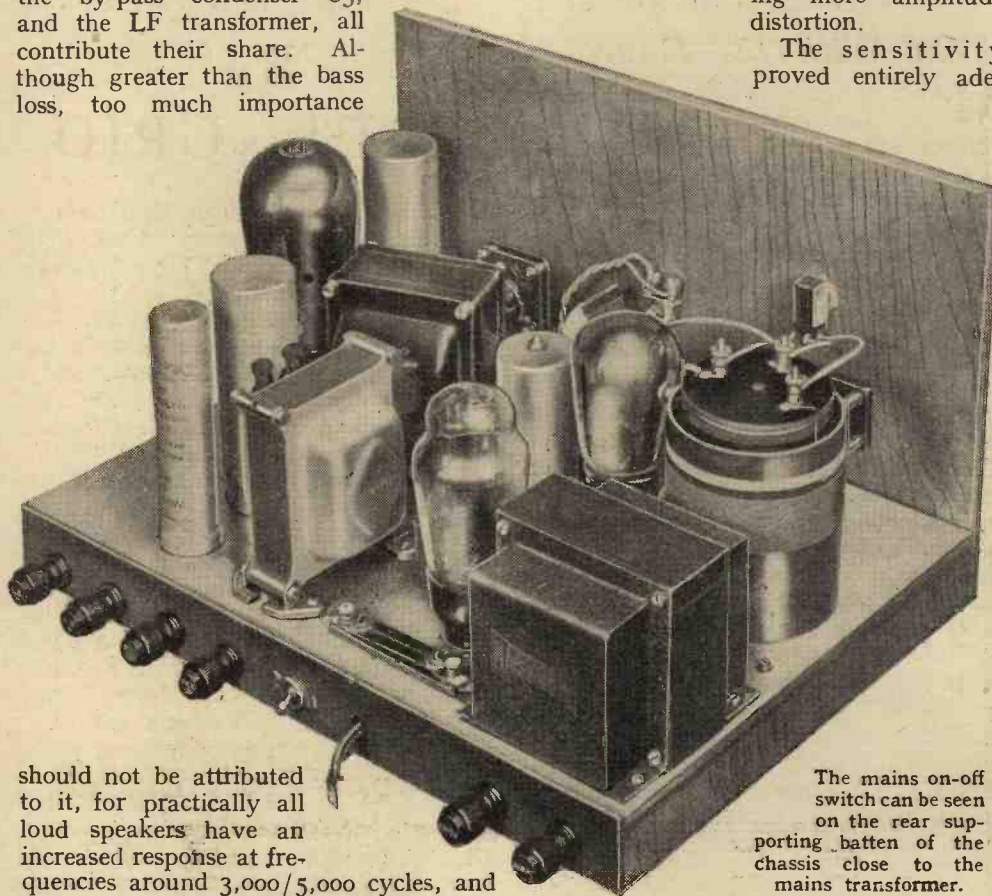
unwanted noise and hum is $50/400 = 0.125$ milliwatt, or 125 microwatts. This is so small that it can barely be detected by ear, and certainly not when listening to a programme. This is due largely to the careful positioning of the LF transformer with respect to the mains transformer, and it can be seen from the illustrations which accompany this article that the transformer is mounted at an angle to the other components. The precise setting is quite critical, so that if hum be found when testing the receiver the first step is to try rotating the transformer to the position of minimum hum.

The overall fidelity curve at 1,000 kc/s, measured with C1 at a maximum and reaction at minimum, is given in Fig. 3, and is unusually good for a receiver of this nature. At 50 cycles the response is about 6.0 db. below that at 400 cycles, and the falling off is due partly to the LF transformer and partly to the automatic bias arrangements. The loss is small and negligible under ordinary conditions.

At high frequencies, also, the response falls off, and at 5,000 cycles the loss reaches 12.0 decibels. This decrease in response is due to many factors, and the tuning coil, the grid leak and condenser, the by-pass condenser C5, and the LF transformer, all contribute their share. Although greater than the bass loss, too much importance

to the very low degree of amplitude distortion introduced by the equipment, the quality, taken as a whole, proved much better than that given by other apparatus possessing a flatter fidelity curve but causing more amplitude distortion.

The sensitivity proved entirely ade-



The mains on-off switch can be seen on the rear supporting batten of the chassis close to the mains transformer.

should not be attributed to it, for practically all loud speakers have an increased response at frequencies around 3,000/5,000 cycles, and this tends to compensate for what would otherwise be a defect of the receiver.

On test the quality of reproduction reached a very satisfying standard. Owing

to the very low degree of amplitude distortion introduced by the equipment, the quality, taken as a whole, proved much better than that given by other apparatus possessing a flatter fidelity curve but causing more amplitude distortion. The National station is weaker at this point, and some degree of reaction was needed for the same volume, but Droitwich, on the long-wave band, provided a very strong signal. The selectivity was entirely adequate for good interference-free reception of these stations, and with careful handling several Continental transmissions could be well received. Even in daylight it proved possible to obtain Radio Paris, Luxembourg and Brussels at reasonable volume, in addition to the North and Midland

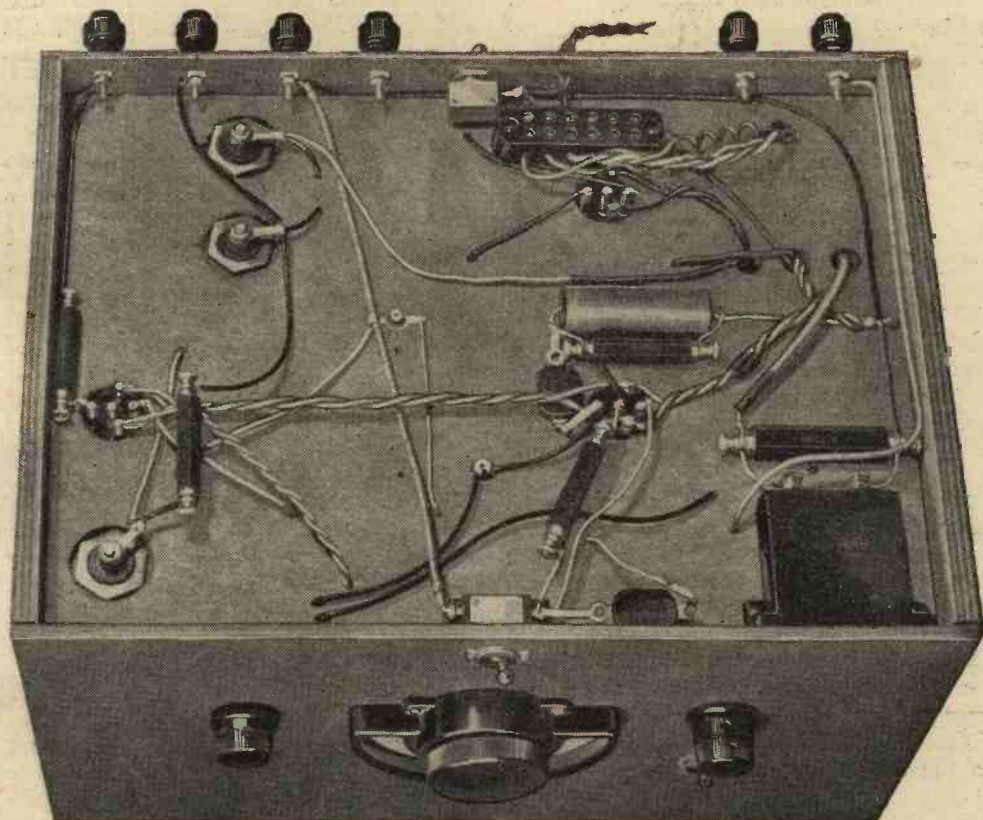
Valve Voltages and Currents.

Valve.	Anode Volts.	Grid Bias.	Anode Current.
Det. 41MHL	140	-2	5.3 mA.
Output PX4	230	-31.5	44.0 mA.

Volts across C9=280. Volts across C8=262.

Regionals, while the local stations were working.

Although in good districts the set will enable a number of distant stations to be received, it is not really intended for this, since it is designed expressly for local reception, the aim being to provide the simplest reliable apparatus for high-quality reproduction. The receiver admirably fulfils the purpose for which it has been designed and, when used with an outdoor aerial, can be relied upon to give a good account of itself.



The simplicity of the wiring is apparent in this photograph.

UNBIASED

On With the Dance

MANY of you who have been readers of this journal from the first number will probably remember the old idea of silent dancing with headphones. The various "dailies" used to dish it up periodically as a new invention.

The idea was that dancers should wear phones and dance in silence, the necessary music (?) being picked up by induction or some such method from strips of tinfoil slung round the walls of the room and connected to the output of a good set. Why dancers should want to go through their dreary evolutions in silence was never explained, but, at any rate, the idea had merit, since it prevented the obnoxious and effeminate noises of a modern dance orchestra from offending the ears of those of us who were old enough to recollect the strong and virile dance music of our youth.

The idea has now, I see, been revived in America, but, according to a so-called scientific journal, it has all the latest modern trimmings. The circuit is arranged in some special unexplained manner so that no music is heard until you actually grasp a partner, so completing a sort of body-capacity circuit. Simi-



At a dance I once attended.

larly, the lady hears nothing until she is partnered. The great feature of the thing is that the more firmly you grasp your partner the louder is the music, due, I suppose, either to better contact or to greater inter-bodily capacity. Needless to say, the apparatus functions in precisely the same manner when sitting out *à deux*, only more so, if you grasp my meaning.

Naturally, in view of the modern craze for noise, and plenty of it, there is a temptation to hold your partner more firmly than is necessary. The ingenious inventor—knowing his American youth—has not overlooked this fact. In the event of anybody overstepping that vague

By FREE GRID

border line beyond which Mrs. Grundy lives and has her being, "a red light shows in the chaperons' room, and an electric foghorn is sounded."

Trouble apparently arose at the first public trials of this apparatus, since the report states that "the loud and persistent blaring of the electric alarms completely drowned out all music in the headphones, with the result that chaos ensued."

Having some little knowledge of the social conditions of New York, I must say I am not surprised. I well recollect that at a dance I once attended in a fashionable night club in the Harlem district the dancing was so exotic that, had this invention been fitted, there would *not*, in my opinion, have been trouble from the electric horns, as the fuses would have blown long before they could utter a protest.

Wireless Sales Exceed Population

IT is astonishing how, in spite of my revelations and protests, certain manufacturers of wireless sets persist in pouring into the gullible ears of lay reporters wild tales concerning the overwhelming numbers of orders taken.

By way of harmless amusement I have added up the number of sets alleged to have been sold during the past twelve months according to published reports, and have made the discovery that it actually exceeds the total population of this country as given by the 1931 census. Now it is hardly likely that a great number of people are purchasing more than one set apiece, and it is obvious, therefore, that, since the last census, the birthrate has been going up by leaps and bounds, exceeding the wildest dreams of the Registrar-General. Since the periodical figures issued by the latter individual belie this, it is clear that a very grave state of affairs exists in this country and that the market is being flooded with thousands of unregistered babies.

Before communicating these facts officially to Scotland Yard I am, however, endeavouring to confirm them by getting into touch with the manufacturers of prams and bottles whose sales should act as a check.

There is an even graver aspect of this matter than a mere evasion of the birth registration laws, and that is the wilful defrauding of the P.M.G. and the B.B.C. in the matter of wireless licences. It is surely strange that, in view of the vast number of sets sold, there are fewer than a beggarly seven million licences in force.

Automatic Visitor Control

I HAVE just completed a task of no mean technical delicacy and finesse of which I am inordinately and pardonably proud.

I was consulted by a well-known business magnate—to be precise, a company promoter—who is pestered by hordes of shareholders and other sharks who wait upon him daily with moans about their wretched investments. Naturally, his first effort at self-defence consisted of



Looking out of the window.

a filter circuit in the form of a hireling varlet whose duty it was to wait below at the street door and sling out all and sundry. Unfortunately, this human rejector circuit proved most unselective, responding equally to all frequencies, with the result that some highly important members of "the profession" were treated as though they were the vulgar investing public.

When called into consultation, I expressed my surprise that anyone in his position should employ such an archaic arrangement as a doorkeeper instead of calling to his aid the principles of science. It did not take me long to design a suitable television transmitter and receiver, the former being located at the street door, and the latter on my client's desk. For the sake of simplicity, a wire link was used instead of a wireless one. My client is so captivated by the arrangement that he has already made preliminary plans to float a company for the express purpose of marketing it. The lists are expected to be opened for public subscription very shortly.

The apparatus has proved entirely satisfactory, except for constant breakdowns. However, this is a trifling matter, for, as I tell him, when the apparatus is not functioning he can quite easily identify his visitors by looking out of the window.

The Radio-Minded Household

A Pioneer's Domestic Installation

By RICHARD ARBIB

EVEN a single extension loud speaker is the exception rather than the rule in the average home. Until broadcasting is made more widely available, listeners cannot make full use of the service.

THE average person in this country does not appear to be really "radio-minded." Most households have only one radio receiver, and the listener who has an extension speaker in a different room is usually regarded by his friends as being really up to date and having all the latest ideas in wireless. The transportable set is helpful, but then it can only operate in one room at a time, and the majority of these instruments require young giants to carry them around the house.

The only really logical method to equip the home with wireless is either to have separate sets or extension speakers in each room.

The separate set method might appear to be ideal, but it has three main disadvantages, the greatest of which is usually

to interfere with the other, and, again, those who are not intentionally listening at all would probably have to hear two or more programmes at once, owing to the walls not being soundproof.

With these points in view the



Appropriate loud-speaker mountings have been devised for each room. These photographs show (left) the bathroom speaker, protected from steam; (above) a white cellulosed cabinet for the kitchen, and (right) a practical form of mounting above a built-in bedroom cupboard.

writer, when moving into a new house recently, decided to have it radio-equipped in the following way. Expense was a big consideration, and he has a strong objection to seeing many loose pieces of furniture about the rooms.

An H.M.V. automatic radio-gramophone is situated in one corner of the sitting room. The external aerial and earth leads have been led through the walls to a plate set flush with the skirting board, on which is also mounted the extension socket for the loud speaker system and a 240-volt AC mains socket. All the loud speakers are wired in parallel, the wiring being concealed in the walls of the house. Whilst this scheme may not be possible when such an installation is

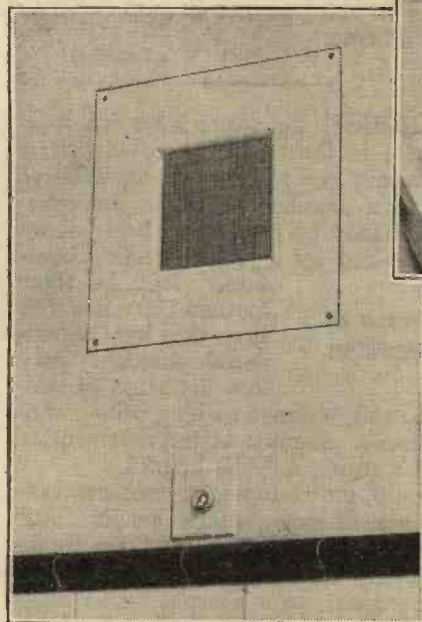
being made in an older house, the different brands of wire coloured to tone with most schemes of decoration could be used instead and should not prove unsightly if carefully installed.

In the kitchen of this house a socket is provided near one of the windows, and the loud speaker is finished in white cellulose to match the decoration of the walls, and the maid can take it up to her own room and plug it in there when required.

In the dining room, which is oak panelled, the loud speaker movement is set behind one of the panels, which is hinged so as to allow any adjustment to be made if necessary. The controlling switch is mounted in the main lighting switch-panel. A similar scheme for the switching is carried out in all the other rooms, with the exception of

the bathroom and bedrooms. In the former the loud speaker is set in the wall behind a square of white oilskin, thus making it steamproof.

In the bedrooms the switches are placed at the sides of the beds. In one of the rooms the loud speaker is concealed in the top of the wardrobe, whilst in two others the speakers are mounted in the upper sections of built-in cupboards behind squares of green and cream silk, which match respectively the decoration schemes of the rooms concerned. The remaining bedroom has a separate radio receiver connected to a panel on the skirting board, with sockets connected to an aerial mounted in the loft, earth, AC mains and loud-speaker extension. A



expense, for if the scheme of entertainment in every room is to be comprehensively carried out, music from an automatic radio-gramophone should be on tap as well as radio. Besides, many housewives would object to having so much space taken up by radio in each room. If several members of the family are listening to a different programme one is likely

The Radio-minded Household.—

waterproof socket is also provided half-way down the garden, and in the garage a separate loud speaker is mounted on a bracket.

The plan of having a radio-gramophone on the ground floor and a radio receiver on the bedroom floor, both connected to a common loud speaker system, works very satisfactorily in practice. The former instrument is used during most of the day and in the evenings, whilst the radio instrument usually provides the music from one of the Continental stations in the bathroom and bedrooms whilst the family are bathing and dressing before breakfast. If no satisfactory programme is being broadcast a batch of records is loaded on to the automatic radiogram downstairs and the entertainment heard in the same way. As the bedroom upstairs which has a radio receiver installed is also used as a sitting room, any member of the family who wishes to hear a programme which the others do not can

retire to this room and listen in comfort. It is not until one has lived in a house radio-equipped in this way that one realises the advantages of having radio in every room. In the case of both instruments, parent loud speaker switches are fitted which cut out the parent loud speaker if required, and disseminates the programme through any other loud speakers which are switched in circuit.

If one member of the family wants to retire early and have a bath, he or she can listen to any special programme without having to wait up for it. In the same way the routine attention to the car is made much easier if one is entertained at the same time.

It is appreciated that many ingenious schemes could be evolved for switching off the sets from each room by means of relays, but this was not adopted in this case on the score of expense, and the one member of the family who usually retires to bed last can switch off the receiver from his bed.

speakers is not always wanted. For example, full volume may be needed from one, while the other, for the moment, is called upon only to reproduce the programme at low intensity. This state of affairs can easily be brought about by an experimental adjustment of the matching transformer; one of the instruments is correctly matched, while the other is so drastically mis-matched that it absorbs a barely appreciable proportion of the total energy available.

An extension speaker system of the type under consideration is shown diagrammatically in Fig. 1; the primary of the built-in transformer serves as an output choke, and the remote speakers are fed through condensers in such a way that the extension leads are "dead" so far as the

HINTS AND TIPS

Practical Aids to Better Reception

THE impression seems to exist that, if only one is willing and able to take sufficient pains in the design of a receiver, it is possible to avoid that peculiar form of interference known as sideband splash, without at the same time marring the high-note response of the receiver. Unfortunately, this is a fallacy, and no development in technique has yet appeared which seems to offer a true cure. But there is a palliative; variable selectivity enables us to reduce the high-note response of our sets when such interference is present, and to extend it when conditions are more favourable for good reception.

Sideband Splash

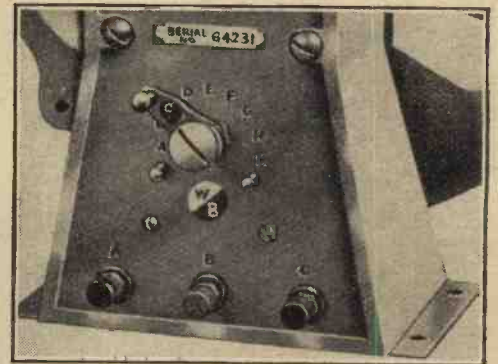
So far as we know at present, sideband splash can only be avoided without sacrificing high notes by making use of directional reception—a principle that is by no means new. Even that is liable to fail in certain circumstances, and it will obviously be of no value when the wanted and the interfering stations lie in the same plane. Nevertheless, it offers a most interesting, but rather neglected, field for experiment; possibly the main objection is that a directional frame aerial is a poor collector of energy as compared with a good aerial, and so more valve magnification is needed, with a consequent increase in background noises.

THE primary purpose of a tapped output transformer, as fitted to so many loud speakers nowadays, is to allow of correct matching between the instrument and output valves of widely different characteristics. There is, however, a subsidiary use of the tapped output transformer (especially if it is fitted with a switch) of which the possibilities are not generally appreciated.

Matching and Volume Control

When two or more extension speakers are fitted it is still possible to make good use of an adjustable matching device, and by its use to obtain the maximum volume and the best possible quality from each of the instruments. As we cannot get something for nothing, the volume from either speaker under these conditions will be less than if one of them were used separately.

Occasions may arise where an equal division of output between the two



A rotary selector switch for matching purposes, as fitted to "W.B." loud speakers.

HT supply system is concerned. Other, and if required, more ambitious, systems can be arranged, and experiments made with a battery of W.B. "Stentorian" speakers prove that the use of the matching transformers in this manner is quite a practicable scheme.

ALTHOUGH an appreciable improvement in the behaviour of a wireless set is usually the result of the cumulative effect of a number of minor improvements, it may be possible to bring about the same end by a single drastic alteration. But in these matters there is a risk that the less experienced amateur may lose his sense of proportion, and, without wishing in any way to deprecate attempts at improvement, a note of warning may be helpful.

A Sense of Proportion

It would, for example, be almost a complete waste of money and effort to attach a high-grade amplifier, such as the Push-Pull Quality Amplifier recently described in this journal, to a sharply tuned long-range receiver in which no effort has been made to retain high notes or to avoid other causes of distortion.

Equally, there would be little point in using a high-grade loud speaker with the set we have just considered. Conversely, it would be just as illogical to go to great pains to improve the frequency characteristics of the set, but to retain an indifferent speaker.

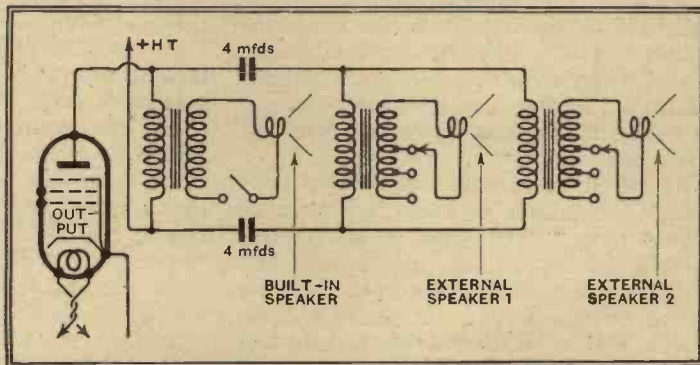


Fig. 1.—Two extension speakers connected in parallel. By suitable adjustment of the tapped output transformers, the available output may be equally divided between the pair, or either can be made to work at almost full volume.

Amplification with Modern Valves



Stability Problems in HF and IF Amplifiers

THE question of feed-back through the interelectrode capacity of an HF valve is one of importance even in these days of screen-grid valves. The precise effect of the feed-back upon amplification is dealt with in some detail in this article, and it is shown to be greater with many HF pentodes than with screen-grid valves.

THE popularity of the superheterodyne has largely overshadowed the difficulties attendant upon the attainment of a high degree of high-frequency amplification, for in such a receiver it is often split up and obtained at different frequencies. A number of factors have combined to make a fresh study of the conditions governing stability in such amplifiers of considerable practical importance, however, and these are chiefly the tendency towards the use of higher intermediate frequencies in superheterodynes and the increase in valve capacities which has recently taken place.

It may be said at once that there is no inherent difference between a high-frequency amplifier and an intermediate fre-

quency amplifier, and the only practical difference is that the former is usually tunable over a band of frequencies whereas the latter is not. The skeleton circuit diagram of a single stage of a typical amplifier is shown in Fig. 1, and the amplification of the stage is defined as the ratio of the voltage e_2 appearing across the tuned anode circuit L_2C_2 to the voltage e_1 applied between the grid and cathode of the valve. When the dynamic resistance R of the tuned anode circuit is small compared with the internal AC resistance of the valve, as is usually the case in practice, the stage gain is given by the simple formula $e_2e_1 = gR$, in which g is the mutual conductance of the valve in

milliamperes per volt and R is the dynamic resistance in thousands of ohms. This amplification is only obtainable in practice if there is no stray coupling between the input and output circuits of the valve, and even if the screening and decoupling be perfect, this can never be the case on account of the capacity existing between the grid and anode of the valve itself. Early screen-grid valves had a grid-anode capacity of about 0.01 mmfd., but in more recent types the capacity has been brought down to about 0.002 mmfd. The maximum stable amplification obtainable depends upon the value of this capacity, the mutual conductance of the valve, and the efficiency of the tuned circuits employed in both grid and anode circuits. When both tuned circuits have identical characteristics, the maximum dynamic resistance for various conditions can be determined from Fig. 2. From the point of view of stability, neither mutual conductance nor grid-anode capacity is as important as their product, and accordingly it is this which is shown.

dynamic resistance must be kept below 780,000 ohms, and it is very unlikely ever to exceed this figure in practice. At 1,600 kc/s, however, it must be below 200,000 ohms. Owing to dielectric losses, it is difficult to obtain a dynamic resistance much above 100,000 ohms at this frequency, so that we find that with a typical screen-grid valve instability due to feed-back through the inter-electrode capacity is unlikely with a single-stage amplifier embodying any normal tuned circuits. Where instability is found, therefore, its cause is almost invariably stray external couplings.

It is important to note, however, that the HF pentode is usually considerably inferior to the screen-grid valve from the stability viewpoint, for its grid-anode capacity is often much higher. The writer knows of only one HF pentode which is comparable with the screen-grid valve in this respect, and it is outstanding among its fellows in having a mutual conductance of 2 mA/V. with a grid-anode capacity of only 0.0025 mmfd. In

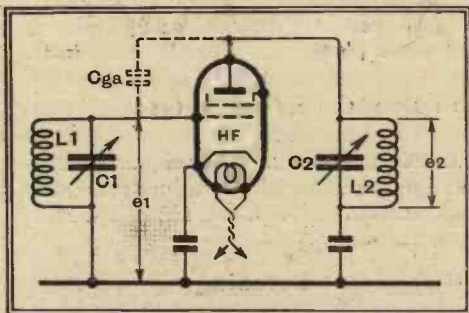


Fig. 1.—The fundamental circuit of an HF amplifier; the grid-anode valve capacity is represented by C_{ga} .

quency amplifier, and the only practical difference is that the former is usually tunable over a band of frequencies whereas the latter is not. The skeleton circuit diagram of a single stage of a typical amplifier is shown in Fig. 1, and the amplification of the stage is defined as the ratio of the voltage e_2 appearing across the tuned anode circuit L_2C_2 to the voltage e_1 applied between the grid and cathode of the valve. When the dynamic resistance R of the tuned anode circuit is small compared with the internal AC resistance of the valve, as is usually the case in practice, the stage gain is given by the simple formula $e_2e_1 = gR$, in which g is the mutual conductance of the valve in

Maximum Dynamic Resistance

The use of these curves is best brought out by an example. Suppose that we have a valve with a mutual conductance of 1 mA/V. and a grid-anode capacity of 0.001 mmfd.; $gC = 0.001$ and at a frequency of 110 kc/s we can see that the dynamic resistance of the tuned circuits should not exceed 1.7 megohms if stability is to be maintained. A dynamic resistance of this order would be almost impossible to obtain under practical conditions, but it can be seen that if the mutual conductance of the valve were increased to 5 mA/V. or the capacity increased to 0.005 mmfd., so that $gC = 0.005$, the dynamic resistance must not exceed 780,000 ohms, which is more nearly realisable.

A typical modern screen-grid valve has a mutual conductance of 2 mA/V. and an interelectrode capacity of 0.0025 mmfd., so that under average conditions $gC = 0.005$. At 110 kc/s, therefore, the

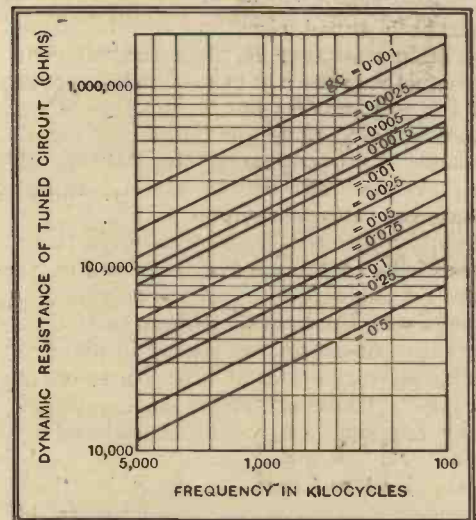


Fig. 2.—These curves enable the maximum permissible dynamic resistance of the tuned circuits to be determined at any frequency for any likely valve. The figures against the curves refer to the product of mutual conductance (mA/V.) and valve capacity (mmfd.).

Amplification with Modern Valves—

general, an HF pentode has a capacity of ten times this figure, and in one example it is as high as 0.1 mmfd. This valve has a mutual conductance of 3.4 mA/V., so that $gC=0.34$, and even at 110 kc/s the dynamic resistance cannot exceed 85,000 ohms.

The valve capacity increases with mutual conductance, but not proportionately, so that there is an optimum combination for maximum stable amplification. So much depends upon the design of the valve that it is impossible to give any definite ruling, but it may be said the product gC should be as small as possible and g as high as possible.

In many cases, the anode coil is tapped as in Fig. 3 (a) or a transformer is used as in Fig. 3 (b). If we denote the ratio of the turns between AB in (a) to those between BC, or the ratio of the primary turns to the secondary turns in (b), as $1-n$,

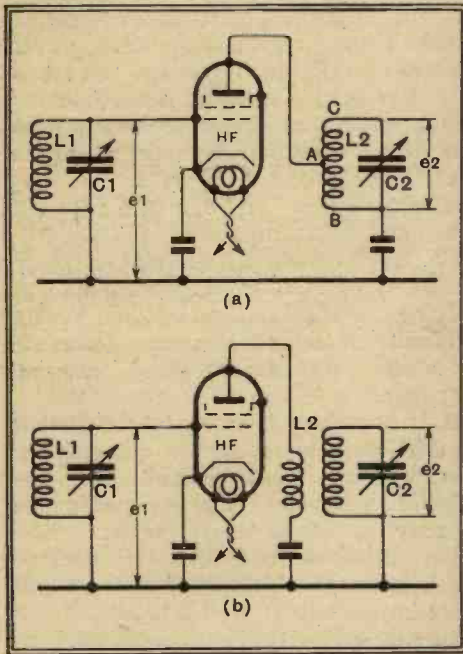


Fig. 3.—A tapped tuned anode coupling is shown at (a) and a transformer at (b).

and both tuned circuits have the same dynamic resistance R , then the value of dynamic resistance to be used in the curves of Fig. 2 is not R , but R/n . Thus if we have a value of $gc=0.1$ and our tuned circuits have dynamic resistances of 100,000 ohms at 1,000 kc/s, we shall find instability with the circuit of Fig. 1, for R must not exceed 56,000 ohms under these conditions. If we use the circuit of Fig. 3, however, and make $n=100,000/56,000=1.78$, we shall just obtain stability. Actually, of course, we should in practice make the turns ratio at least 1.2 in order to give a factor of safety, since external stray couplings can never be reduced to zero.

The load resistance of the valve then becomes R/n^2 , and the amplification is equal to $gRn/n^2=gR/n$. It will be seen, therefore, that tapping down a coil to maintain stability in an amplifier of this nature reduces the amplification just as much as would be the case if stability were

obtained by increasing the losses in the tuned circuits. The effect on selectivity, however, is vastly different, for it can be shown that it tends to increase as the turns ratio increases, whereas it is greatly reduced by an increase in the damping of the tuned circuits.

In a multi-stage amplifier, of course, great care must be taken to avoid instability, and the permissible dynamic resistance is lower. When two valves are used instability will occur due to the anode-grid valve capacities when the dynamic resistance of the circuits is only one-half of the figure obtainable from Fig. 3; when three stages are used, the resistance must be divided by 2.62, and by 3 when four valves are employed.

Stage Gain

The feed-back which is always present has the effect of increasing the amplification of the valve, and it is possible to calculate this increase fairly readily. Taking feed-back into account, $e_2/e_1=gRF$; F can be found from the curve of Fig. 4 when H is known, and this symbol can be evaluated from the simple formula $H=g\omega C R^2$ in which g =mutual conductance in Amps/Volts, C =grid-anode capacity in Farads, R =dynamic resistance in ohms.

Suppose we wish to use a single HF stage in a straight set operating on the medium waveband, and that we have available a valve of mutual conductance 2 mA/V. and with $gc=0.005$. The highest frequency to which the receiver must tune is 1,500 kc/s, and Fig. 2 shows that stability will be maintained, as far as feed-back through the inter-electrode capacity is concerned, if the dynamic resistance is below 208,000 ohms. We are unlikely to obtain a resistance greatly exceeding 100,000 ohms with average coils, however, so we need not fear trouble from instability on this score. The coils usually have the highest dynamic resistance at 1,000 kc/s, and let us assume that at this frequency it reaches 150,000 ohms. A glance at Fig. 2 shows that we need fear no trouble from inherent instability with this valve.

The next step is to calculate the amplification which is equal to $gRF=300F$. The gain of the valve without reaction is 300 times, and we must evaluate the increase due to the valve capacity. We have $H=g\omega C R^2=2 \times 10^{-3} \times 6.28 \times 10^6 \times 2.5 \times 10^{-15} \times 1.5^2 \times 10^{10}=0.708$; from Fig. 4, $H=1.25$, so that the true amplification is $300 \times 1.25=375$ times. Small though it is, the grid-anode capacity of 0.0025 mmfd. gives an increase of 25 per cent. in the amplification in this case. It must, of course, be remembered that the calculation assumes perfect external screening, and where care is not taken in the design of a receiver, instability might be found which could not be in any way blamed on the valve.

It is interesting to note, however, that, had a valve been selected with a value of $gC=0.025$, the stage would be unstable at 1,000 kc/s with the particular coil selected, and it would be impossible to

stabilise it without decreasing the amplification or neutralising the valve capacity. A value of this order is by no means rare with an HF pentode, and the moral is to exercise considerable caution in the use of such valves at high frequencies. HF pentodes with low grid-anode capacities can be obtained, but if they cannot be employed for any reason, it is safer to em-

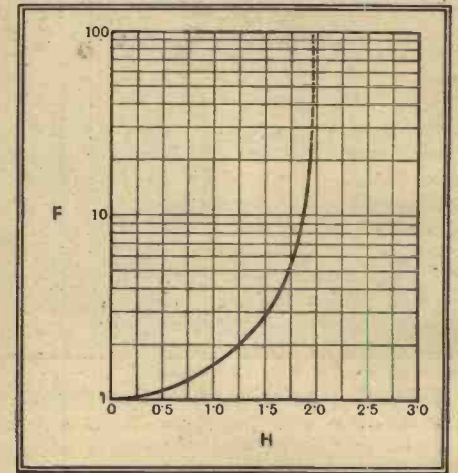


Fig. 4.—With the aid of this curve it is possible to calculate the increase in stage gain due to feed-back.

ploy the screen-grid type of valve, except, perhaps, in the last stage of the amplifier where a large output may be needed for AVC purposes.

The effect of the grid-anode capacity on stability and stage gain has now been discussed in some detail, and it remains to comment on its influence on selectivity. The whole question has been very thoroughly dealt with by M. O'Connor Horgan in the September issue of *The Wireless Engineer*, and those interested in the mathematics of the subject are referred to his paper. It may be said, however, that when an HF amplifier is tuned in the usual way for maximum signal strength, the various circuits are *not* tuned to resonance with one another if there is any appreciable feed-back. Instead, the circuits are slightly mistuned to produce maximum amplification through the aid of the stray regeneration.

Detuning

The effect of feed-back on the selectivity, therefore, is two-fold. First, there is a gain due to the lowering of the circuit losses, and, secondly, there is a loss due to the mistuning of the circuits. Almost invariably the gain exceeds the loss, and the chief effect of the mistuning is to render the resonance curve assymetrical. The degree of mistuning may be quite large, and in one example the author of the paper referred to quotes a figure of 2 kc/s.

It is almost certainly this effect which is responsible for the difficulty in obtaining proper band-pass effects from closely coupled tuned circuits when these are included in an amplifier. It is not difficult to obtain measured response curves almost completely symmetrical with the correct double-hump from a single valve and transformer, but it seems almost impos-

Amplification with Modern Valves— sible to obtain the correct shape of curve when several transformers are used. Invariably, the response curve degenerates into one with a single peak with a small

bump in one side! Stray couplings in an HF amplifier, therefore, may exercise a profound effect upon its performance, even if they do not lead to actual instability. The effect of coupling external

to the valve is similar to that of the grid-anode capacity, but the latter represents the minimum below which a reduction of feed-back is impossible unless neutralised circuits are adopted.

Broadcast Brevities

B.B.C. and Electrical Interference

THE artillery battle between the Post Office and the London and Home Counties Joint Electricity Authority over the matter of electrical interference with broadcasting is being keenly watched at Portland Place, though the B.B.C. refuses to burn its fingers by taking part. Quite naturally, the Corporation is "all agin" interference with its programmes, but it seems in no mood to contribute towards the cost of silencing equipment at rectifier sub-stations.

A Post Office Job

Everyone knows that the General Post Office supplies to anyone troubled with man-made static an Electrical Interference Questionnaire which, if truthfully filled up, helps the official interference sleuths in locating the offender. It is not so well known that the B.B.C. also issues similar forms on request. When these are returned to Broadcasting House they are forwarded to the General Post Office.

The Corporation declines to do any sleuthing on its own account.

That Tuning Note

HOW many people still get a heart flutter out of the B.B.C. tuning note? Not many, I imagine. In these days of fluid light tuning and super-calibrated sets, the tuning note is not relied upon as it was in the bad old days, although it may still be useful to crystal users who get the local stations over three parts of the dial.

Where Interval Signals Fail

By the way, does any reader know of a European station using a tuning note? Interval signals there are in plenty, but these cannot be placed in the same category; it seems to be a characteristic of interval signals that they are exceedingly difficult to tune in with any degree of accuracy. They are usually very staccato in form, with irritating pauses and baffling changes in volume and frequency.

On Tour

COLONEL A. C. DAWNAY, the B.B.C. Controller of Output and Second-in-Command while Sir John Reith was

By Our Special Correspondent

in South Africa, has returned to Broadcasting House after a tour of Scotland and the provinces. During the trip he not only visited B.B.C. studios, but presented prizes at schools up and down the country.

Colonel Dawnay is popular at Broadcasting House as much for his unassuming good nature as for his undoubted ability to keep the temperamental half of the broadcasting machine in working order.

Why Not the Air Force?

By the way, people are wondering when the Air Force will be represented in the high councils of British broadcasting. The Navy (Vice-Admiral Sir Charles

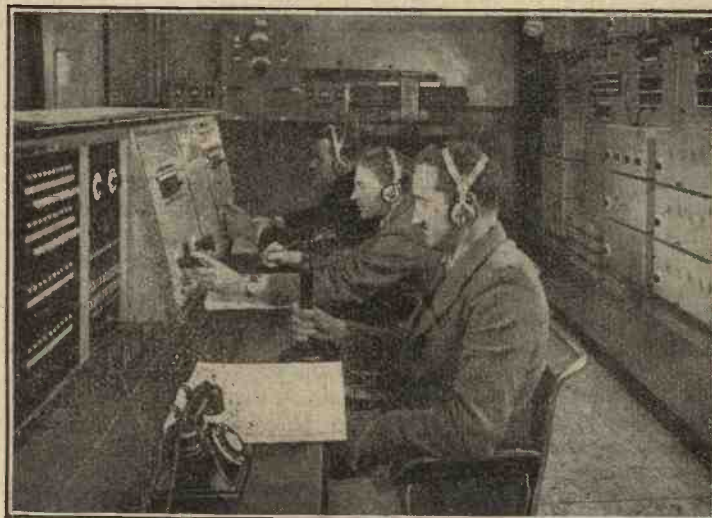
are made to broadcast the songs of wild birds with unexpected results.

Songs from Radio Shows

JOHN WATT, whose "Songs from the Films" series is now finished, will shortly introduce a new series called "Songs from the Radio Shows." As far as possible the songs will be sung by the artists who first introduced them.

Mr. Grierson and His B.B.C. Film

MEET Mr. John Grierson, the Scotsman who directs the G.P.O. Film Unit and who is



IN THE CONTROL ROOM. One of the most important and least conspicuous jobs in the B.B.C. is that of Control Engineer. This picture was taken in the control room at the new Bristol headquarters.

Carpendale) and the Army (Colonel Dawnay) have more than their fair share.

New Studios for the North-East

AS befits a Region which will soon have a full-blooded high-power station of its own, Newcastle is this month opening new studios. Friday, November 23rd, is the date scheduled for the first use of the new dramatic studio, in which a play, "Touch of Nature," by Raymond Burns, will be performed by local actors.

The theme is a broadcasting one, and concerns a strange "O.B.," in which frantic efforts

now actually engaged on producing the first film solely devoted to British broadcasting methods.

"We are aiming," Mr. Grierson told me, "at portraying the voice of the country. The film will take, as it were, a cross-section of the community so that audiences will see and hear statesmen speaking, orchestras performing, jazz bands playing—in fact, a synthesis of all that broadcasting stands for. We hope to introduce novelties in sound shots.

"While we are avoiding the style of 'A trip round the B.B.C.' or anything silly like that, we shall steer clear of any forced allegorical effects."

A Spring Release

The film will run to five reels, lasting approximately one hour, and Mr. Grierson tells me that it will be the biggest "documentary" film yet tackled. It will be released next Spring, probably under the simple title: "B.B.C."

Artists in Person

PLACE no credence in stories that the B.B.C. is overcoming the land-line difficulty by transporting certain artists in person to provincial studios.

Sometimes it does happen that a big London name appears in the bill of the local station, the artist actually visiting the studio. In all such cases the visit to the B.B.C. station is due only to the fact that the artist has a local engagement bringing him or her to the town in question.

No B.B.C. station director can resist the opportunity to engage a London artist who happens to flit within speaking distance.

A Royal D-Xer

KING PRAJADHIPOK of Siam is now trying to pick up Radio Bangkok with a powerful receiver installed at his temporary home in Cranley, Surrey.

A Palatial Station

King Prajadhipok is very proud of Siam's radio, for his country possesses what is probably the most palatial broadcasting station in the world. While lunching with a Fleet Street globe-trotter the other day I learnt that this extraordinary station is located in the palace of Phya Thai, Bangkok, where the staff work in marble halls, or their Siamese equivalent. His Majesty himself opened the station in 1931, and the picturesque silver gilt microphone bearing the Royal Arms is carefully preserved. It was used again by King Prajadhipok last December, when the opening of the Siamese People's Assembly was relayed.

Old Etonian as "D.G."

The station operates on about 350 metres, although the short-wave band is sometimes resorted to. The Director-General, Luang Che Kolnan, wears the old school tie (Etonian) and speaks English. During the war he served in the British Navy.

★ ★ ★ Listeners' Guide

Outstanding Bro



AFTER-DINNER BROADCASTS.

NOTHING makes a more succulent broadcast than the Lord Mayor's Banquet in the Guildhall. All after-dinner broadcasts have a sumptuous flavour, but this one excels them all—politically, socially and gastronomically.

We need more of these post-prandial titbits. It has been proved that the spectacle of a well-fed man has a stimulating effect on a hungry one, whose sharpened imagination helps its owner to a vicarious pleasure in the well-being of others.

In to-night's broadcast there will be a variation from the usual practice in that Mr. Howard Marshall will describe the scene just before the Prime Minister's speech.

IF YOU MISS THE BANQUET.

Of all broadcasts, the after-dinner speech is, strangely enough, the least formal. The B.B.C. dare not demand a sight of the manuscript in advance, consequently the whole affair has an atmosphere of exciting uncertainty. Anything may happen, from the upsetting of a bottle of Chateau d'Yquem to one of those wicked asides which the "mike" picks up so much more easily than the speech proper.

If you miss to-night's feast try for the Eighth Annual Dinner of the Bristol Branch

of the Incorporated Sales Managers' Association, to be broadcast from the Royal Hotel, College Green, on Thursday next at 8.15 (Regional).

This must be the first time that so many real live sales managers have been on the British ether in a single broadcast.

of the Incorporated Sales Managers' Association, to be broadcast from the Royal Hotel, College Green, on Thursday next at 8.15 (Regional).

GALA CONCERT AT PRAGUE.

THE musical standard of the Prague programmes is always high, although the modernistic tendency is often too pronounced for my liking. I see that on Thursday next at 7.5 the station is broadcasting a gala concert, with the celebrated Willen Mengelberg as conductor.

SCRAPBOOK FOR 1918.

LESLIE BAILY'S "Scrapbook" series of broadcasts are becoming an institution. To-night (Regional) and tomorrow (National) we shall hear "Scrapbook for 1918," presented by Leslie Baily and Charles Brewer. Dealing with such a memorable year, it has not been difficult to bring a number of interesting personalities to the microphone. They include Frank Donovan, R.N.A.S., and George Moyses (Corporal of Marines), who

took part in the raid on Zeebrugge; José Collins and Thorpe Bates, who were in the original cast of "The Maid of the Mountains," in memories of that musical show; and Sir Philip Gibbs, who, as a war correspondent, went into Mons on November 11th, 1918.

Perhaps the most dramatic item will be the reconstruction of the scene in the railway carriage in the forest of Compiègne on November 8th, when the Armistice terms were read to

A SURPRISE ITEM.

So the B.B.C. has not yet abandoned the Surprise Item. I am glad to see that one occurs in the "Entertainment Hour" in the Regional programme on Monday next, which includes Marius B. Winter and his Dance Orchestra.

AND SO TO BED.

IT is one of numerous bees in the bonnet of the B.B.C. that the British listener can stomach nothing heavier than dance music after 11 p.m., and this is why so many of us roam the European ether as the evening draws to a close. The Germans delight in "Serenades"—soothing concerts of classical and semi-classical items, which are far more conducive to subsequent slumber than many of the hot dance numbers that hurtle from the B.B.C. aerials.

Frankfurt, for example, is giving a Beethoven concert by the station orchestra this evening from 11 o'clock to midnight.

SIR HENRY WOOD'S HOLIDAY.

LIONEL TERTIS, prince of viola players, appears with the great 'cellist, Pau Casals, in the B.B.C. Symphony Concert (National) on Wednesday next, November 14th.

Sir Henry Wood, whose



MUSICAL EXPRESS. Maintaining their tradition of high speed programmes, Geraldo and his Orchestra provide a "Non-stop Hour" on Tuesday in the National programme.

the Germans. Captain J. P. R. Marriott, R.N., who, as Naval Assistant to the First Sea Lord, was present on the historic occasion, will assist.

holiday after the "Proms" has taken the shape of conducting concerts *not* in the Queen's Hall, will direct this Bach and Mozart concert.

for the Week

roadcasts at Home and Abroad

WEBER-MARVELL-POSFORD.

WHY did Weber write "Invitation to the Waltz"? The reason was probably sentimental, but in any case Holt Marvell and George Posford have taken no risks in writing around this celebrated waltz the prettiest little story you can imagine. It is nothing

TOSCANINI IN PARIS.

THE great Toscanini figures more frequently in the foreign programmes nowadays, and if the B.B.C. had not already arranged for this famous conductor to direct broadcast concerts in May next, listeners would now be asking why. A week or two ago he conducted



WEBER IN SLOW MOTION. Contemporary impressions of the composer conducting his own works. The "Invitation to the Waltz" sets the key to the Marvell-Posford radio play on Wednesday (Regional) and Thursday (National).

more or less than Weber falling in love with a dancer, and, seeing her waltzing to the strains of a German village band, becoming inspired to write something rather better.

The scene of the play is Venice, and later the little German kingdom of Wurtemberg, where the Weber of real life was secretary to the King. Tessa Deane plays the heroine and John Hendrik the hero.

"Invitation to the Waltz" is to be broadcast on Wednesday next, November 14th (Regional), and Thursday, November 15th (National).

ANOTHER WEBER NIGHT.

THIS seems to be a Weber week, for Hamburg is broadcasting "Euryanthe," Weber's romantic opera, at 7.10 p.m. on Monday.

Weber's death in 1826 was hastened by a chill which he got when coming to London to conduct the first performance of "Oberon."

ARMISTICE DAY.

WE rarely hear broadcasts of military bands in their proper element—the open air. On Armistice Day the broadcast of the ceremony at the Cenotaph will start at 10.30 a.m., when the Guards Band will be heard playing such pieces as "The Minstrel Boy," "Skye Boat Song" (bagpipes), "When I am laid in earth" (Purcell), and Chopin's Funeral March.

This year the 11 o'clock chime of Big Ben will be taken on the microphone at the Cenotaph, not on the usual instrument in the clock-tower. At the end of the Silence the Last Post will be sounded and a short service will be conducted by the Bishop of London. The ceremony will close with the Reveille and the National Anthem.

In the evening the British Legion Rally will be relayed from the Royal Albert Hall.

FROM THE NORTH.

"JANNOCK" may be a good title for a play, but I prefer those that let one into the secret, such as "The Murder in the Red Barn" and "Sweeny Todd, the Demon Barber." But, whether we like it or not, "Jannock" is the title of the play in the Regional programme on Wednesday next (relayed from North Regional). It is described as "a malicious medley of the North," and as a Southerner I have a squirmy feeling that people south of the Trent do not come out at all well in it.

THE AUDITOR.

HIGHLIGHTS OF THE WEEK

FRIDAY, NOV. 9th.
Nat., 8.45 Lord Mayor's Banquet. London Reg., 8.45 "Roosters."

Abroad.
Budapest, 6.50 "Aida" (Verdi).

SATURDAY, NOV. 10th.
Nat., 10.0. "Scrapbook of 1918." Scottish, 7.45, The Reel Players.

Abroad.
Radio Paris, 8-10.30, opera, "La Perichole" (Offenbach).

SUNDAY, NOV. 11th.
Nat., 10.30 a.m., Armistice Day, Cenotaph Service.

Nat., 9.10, British Legion Rally. 10.0, "The Spirit of England," by Laurence Binyon, set to music by Edward Elgar.

Abroad.
Königsberg, 7, Operetta Concert.

MONDAY, NOV. 12th.
Nat., 8, "The Lady Sally," a romantic play by Wilfred Rookley, with music by Handel. London Reg., 8, "Entertainment Hour."

Abroad.
Kalundborg, 8.5, Acts II and III of "La Tosca" (Puccini).

TUESDAY, NOV. 13th.
Nat., 8.30, Geraldo's "Non-Stop Hour."

London Reg., 8.30, "The Lady Sally."

Abroad.
Brussels, No. 1, 8, Borodin Centenary Concert.

WEDNESDAY, NOV. 14th.
Nat., 8.30, B.B.C. Symphony Concert in the Queen's Hall, directed by Sir Henry Wood.

London Reg., 7.30, "Invitation to the Waltz," play by Holt Marvell and George Posford.

Abroad.
Deutschlandssender, 8, Dance Music Through 200 Years.

THURSDAY, NOV. 15th.
Nat., 8.15, "Invitation to the Waltz."

London Reg., 6.30, The Kentucky Minstrels.

Abroad.
Berlin (Reichssender), 7.10, Film Stars and their Songs.



"IN TOWN TO-NIGHT"—but not the Maschwitz variety! A night scene in Barcelona, where the microphone is taken around the city in search of impromptu talent.

News of the Week

Current Events in Brief Review

King Alexander's Set

THE late King Alexander of Yugoslavia was a keen listener, spending many an hour tuning-in foreign stations. According to a correspondent, the late King's receiver in the Royal Palace is now veiled with crêpe, the valves having been broken by "a pious hand."

An Early Start

BRITISH broadcasting starts daily at 10.15 a.m., but the Egyptian State broadcasting system, only recently formed, is able to bestir itself at 6.45 a.m. with physical exercises. Readings from the Koran are given from 7 to 7.30 a.m.

Mussolini to Tell the World?

SIGNOR MUSSOLINI, it is stated, will broadcast a

League of Listeners

PARIS is forming a "Listeners' Association." Its aim is to bring together all radio users without distinction of creed, politics or other preferences.

A Famous Band

HITHERTO the famous Garde Republicaine Band has been too expensive for broadcasting from the French private stations. Now that the State has taken over the control of broadcasting, however, the Garde Republicaine band is to appear in a number of concerts during the coming winter.

Amateurs' Handbook in Braille

TO enable blind people to become amateur radio operators, the Braille department of the New York Chapter of the

British Radio Institution

"THE Electrometer Triode and Radio Research" is the title of a lecture to be given by Mr. L. M. Myers, B.Sc., before the British Radio Institution, 36, Gordon Square, London, W.C.1, on Tuesday next, November 13th.

Synthetic Sound Demonstration

A DEMONSTRATION of Herr Rudolf Pfenninger's synthetic sound system is to be given by Captain A. G. D. West, M.A., B.Sc., before the Television Society on Wednesday next, November 14th, at 7 p.m., at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1.

Herr Pfenninger's method, described in *The Wireless World* of February 3rd, 1933, consists

Egyptian Soccer Broadcasts

THE first football commentary from the Egyptian high-power station at Abu Zabal was given on October 14th, when the opening match of the season between Alexandria Union Club and the Cairo International Club was described in Arabic by the well-known Egyptian sportsman, Ibrahim Mostafa Effendi. By kind permission of the Crown Prince Farouk, the commentator was allowed to occupy the Prince's private box.

New Relay H.O.

STANDARD Radio Relay Services, Ltd., have opened at Westwood-in-Thames what is claimed to be the largest building solely devoted to wireless relay work in the country. The new building houses five separate receivers with eight amplifying units giving a total output of 16,000 watts.

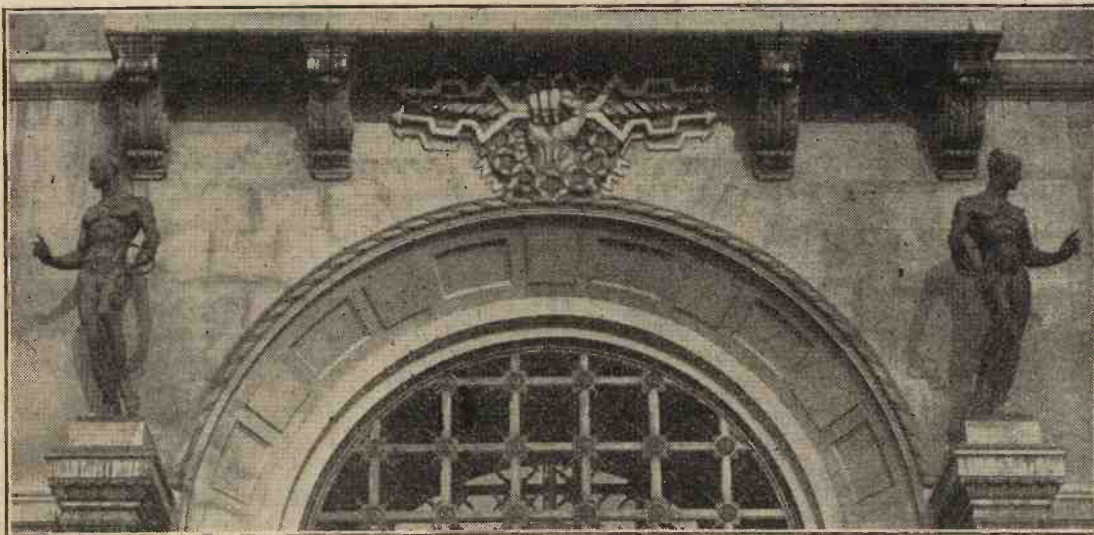
The service to clients consists of two separate daily programmes from 8.15 a.m. to midnight, the choice being made from both British and foreign transmissions. More than 300 miles of wire are used to supply programmes to residents in Ramsgate, Margate, and Broadstairs. The receiving equipment includes a specially designed directional aerial which has been found very useful in picking up distant stations. A modified American short-wave receiver is also used for receiving the U.S. short-wave stations.

A Growing Army

RADIO'S biggest periodical—the 312-page "Radio Amateur Call Book Magazine," Fall Edition, 1934—has arrived. Even heavier than its predecessors, the Call Book lists the names and addresses of amateur transmitters all over the world and actually includes stop-press additions inserted with a rubber stamp. We have not dared to count the number of names it sets forth, with nationalities ranging from American to Chinese, Russian to South African.

One point that emerges is that the United States has a walk-over victory in the matter of numbers. More than 200 pages are required to contain U.S. amateurs in small type, while the remainder of the world's "knob-punchers" can be accommodated in 54 pages.

Copies of the Call Book can be obtained in this country from Mr. F. W. Postlethwaite, G5KA, 41, Kinfawns Road, Goodmayes, Ilford, Essex, price 6s. 6d., post free.



MESSENGERS OF THE GODS. The two roft. statues of Mercury, the work of Mr. Charles Wheeler, which were unveiled last week at Electra House, Victoria Embankment, headquarters of Cable and Wireless Ltd. The Mercurys are hatless, the sculptor considering that the conventional mercurial headgear too closely resembles the war-time tin hat.

Christmas message to the world from the short-wave station at Prato Smeraldó. Engineers are now working at high speed to install a high-power transmitter by December 25th.

Distance Lends Enchantment?

WIRELESS licence fees in South Africa are now graduated according to the distance of the licence holder from his local station. Private set owners or members of radio clubs pay £1 15s. if they live within a 100 miles of the station, £1 5s. from a 100 to 250 miles, and £1 beyond that radius. Hotels boarding houses and cafés pay on a similarly graduated scale, ranging from five guineas down to £1 15s.

American Red Cross has transcribed the Radio Amateurs' Handbook, published by the American Radio Relay League, into nine Braille volumes, complete with more than a hundred diagrams.

The Deutschlandsender

THE new 150-kilowatt German National station, the Deutschlandsender, was originally to occupy a site some thirty miles to the south-west of Berlin. According to our Berlin correspondent, the plans are being altered in response to representations by the German National Defence Organisation, and a new site will have to be found. In the meantime the transmitter is under construction at the Telefunken factory.

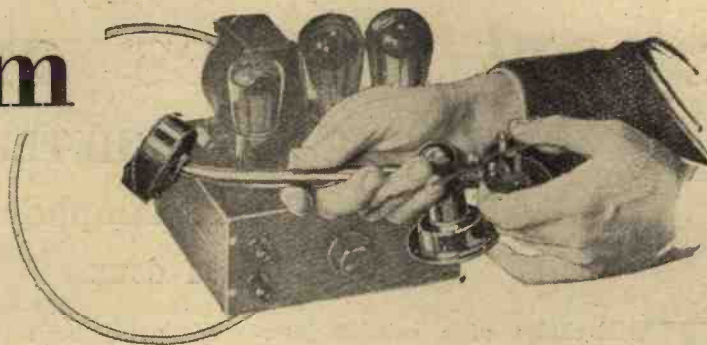
in photographing sound tracks on a drawing board, and combining these tracks to form synthetic sounds and music.

Cards of invitation can be obtained by readers of *The Wireless World* on written application to the Hon. Business Secretary, Mr. J. J. Denton, 25, Lisburne Road, Hampstead, London, N.W.3. Early application is advised.

Leeds Triumph

AMONG recent provincial radio exhibitions one of the most successful was the Leeds Radio Show, held in the Fenton Street Drill Hall, from October 20th to 27th. Approximately 12,000 people attended. The organisers were Wireless Instruments (Leeds), Ltd.

Avoiding Hum When Using a Pick-up



Common Causes and How to Avoid Them

By "CATHODE RAY"

IT is annoying, when one has gone to the expense and trouble of getting a gramophone motor and pick-up and has mounted them in a box and connected everything up, to be rewarded by such a compelling hum that it is not really worth trying a decent record.

I have been asked to deal with this, because it is not an uncommon experience. The point at which a gramophone pick-up is connected is the most hum-sensitive

is a break somewhere in the connections. Check that the system is working by making sure that when a needle inserted in the pick-up is plucked with the finger, and the volume control is full on, there is an answering click from the loud speaker. If correct, the hum may be present now merely because of the high resistance in circuit, and this is so when the short-circuit test is repeated, but using the detached volume control (or equivalent resistor) in place of the short wire. In such a case the blame can still be placed on the receiver.

But when it requires the pick-up itself to cause the trouble a further small test is necessary. Move the volume control knob around. If the hum remains more or less constant there must be some leakage, which will in all probability be cured by connecting the frame of the pick-up to the earth terminal of the receiver. But if variable it is more likely that there is induction from a neighbouring transformer or choke. Move the pick-up to a position where it is quiet.

It is only fair for me to say that it is highly unlikely that anything will be discovered by the foregoing tests, but the perfect detective never takes anything for granted.

Screening the Pick-up Leads

Now plug in the motor connection, but do not switch it on. Severe hum is unlikely if the pick-up frame is earthed and the leads left well apart from the motor leads, and, if necessary, encased in earthed metal braiding; and make sure that the insulation of the motor circuit is satisfactory throughout.

Next, set the motor going. If the hum is being caused by induction from the coils of the motor, it will vary as the pick-up is moved about and as the volume control is rotated. We have now arrived at quite a possible cause. So much so that at least one make of pick-up, Columbia, I believe, is provided with a special hum-neutralising coil inside. Well-designed motors are free from bad hum-fields in the region of the pick-up; but it is rather difficult to convert those that are not. A thick iron motor box, or at least a sheet of iron screening the motor board, is the only cure; most pick-ups have insufficient room for an

anti-hum coil, and the design and fitting is a tricky job.

But if it is a capacity hum—much more troublesome with D.C. motors—earthed metal screening around the motor will supplement that already in use for the pick-up and its leads.

Quite thin metal, preferably copper, is suitable. You will be very unfortunate—and very exceptional—if a screening box round the motor is really necessary. It is a hateful job making it. In passing, you should note that one of the pick-up terminals goes (inside the receiver) to the grid of a valve, and is the one sensitive to hum; the other may or may not go to "earth." Usually there is the voltage of a bias battery between it and the earth, so take great care that this is not short-circuited.

Sparking Commutators

There is still the possibility of noise—not true hum—being caused by the motor radiating interference. The D.C. or "Universal" types, which have commutators and brushes, are the offenders, and should not be chosen if A.C. is available. Unfortunately, there is no alternative for D.C. The trouble may be reduced by cleaning and adjusting the brushes to minimise sparking, and by screening the motor as described; but its existence shows

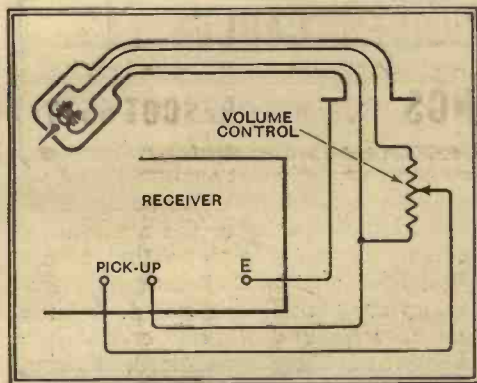


Fig. 1.—Standard connections of a pick-up and external volume control.

in the whole receiver, for it is followed by the full L.F. amplification. Any stray disturbance picked up from the supply mains has the maximum effect.

Vast technical knowledge and experience are not necessary in order to succeed in locating the cause. All that is needed is system.

First make sure that the receiver itself can be exonerated from blame. To do this, short-circuit the receiver pick-up terminals or sockets by joining them with the shortest possible piece of wire; all other external connections to these terminals must be removed. If the hum is present when this is done, the receiver is to blame, and the makers' attention should be drawn to the fact.

Now (assuming the receiver is innocent) connect the pick-up in the correct way, by short wires. The connections, incidentally, are as shown in Fig. 1. Have no extension wiring or anything of the sort hanging on. And particularly see that the electric gramophone motor is totally disconnected, not merely switched off. If there is hum now, it may be because there

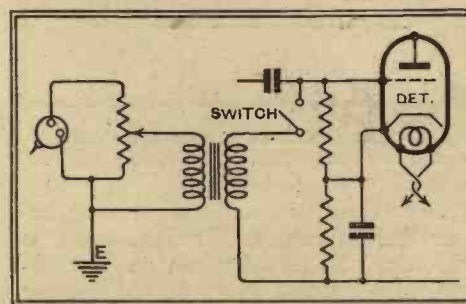


Fig. 2.—The pick-up must be isolated from a D.C. mains receiver; and here are the connections to a typical detector valve, by means of a low-ratio intervalve transformer.

that the radio part of the receiver which should be entirely out of action is still sensitive. If some sort of switching cannot be conveniently introduced one may have to fall back on pulling out the H.F. valves.

Talking of D.C., for safety there must be no direct metallic connection between pick-up and receiver. A low-ratio intervalve transformer is the best coupler with a circuit as in Fig. 2.

Short Waves and the Amateur

THE SUPERHETERODYNE RECEIVER

Part II.—The IF Amplifier

By G2TD and G5KU

THE choice of a suitable intermediate frequency for a short-wave superhet, designed for use on the amateur wavebands is governed by a different technique from that employed for conventional broadcast receivers.

First, the need for high fidelity does not exist and the transmission band may be considerably reduced, thereby gaining in selectivity and signal-to-noise ratio, as pointed out in our previous notes on the subject of noise. Without the use of a quartz-crystal filter it is not practicable to get an effective band transmission much less than 1 kc with tuned coils. A transmission band width of 1 kc or slightly less will still render speech intelligible and a receiver so designed will therefore not be restricted to morse reception, which may be achieved on a transmission band of less than 50 cycles in width.

In order to obtain highly selective intermediate frequency transformers, it is necessary to tune both primary and second-

eliminated by raising the intermediate frequency to 3,000 kc/s, but the loss in selectivity would be intolerable not only with regard to the resultant interference between adjacent stations but to the much greater noise-level of the receiver. A very suitable intermediate-frequency transformer for 50 kc/s may be constructed from the data in Fig. 1, in which winding specifications are given, together with the sensitivity curve of Fig. 2.

It is advisable to use a fixed 0.0005 mfd. mica condenser of low power factor across each winding and then tune by an added parallel trimmer of 0.0003 mfd. max. on each winding. A suitable screening can should have a height of not less than 6 in. and a diameter not less than 3 in., and should be constructed of either pure copper or aluminium.

An elegant method of obtaining exceedingly high selectivity is by the use of a quartz-crystal filter circuit which resonates at the intermediate frequency. The circuit in Fig. 3 shows how this is achieved and the explanation of its action is as follows:—

The intermediate frequency is supplied to the tuned IF transformer, the secondary of which is centre tapped to earth. The IF voltages appearing at A and B are, at every instant, completely out of phase, and if these points were both con-

nected to G there would be no resulting signal on this account. A quartz crystal suitably ground to resonate at the IF chosen is inserted in the connection A—G, while a small neutralising capacity of about 50 mmfd. max. is inserted in the connection B—G. Over an exceedingly small band of frequencies the quartz crystal acts as practically a short circuit between A and G. At all other frequencies the impedance due to the crystal-holder's capacity is present. It can be seen that

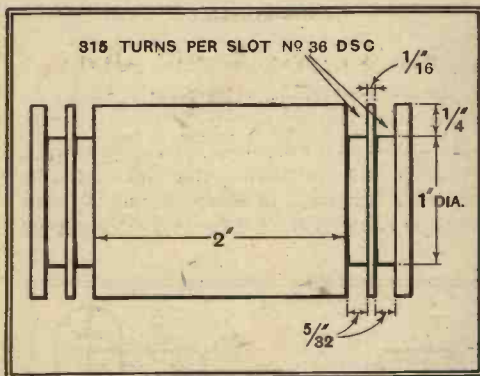


Fig. 1.—Dimensions of former and winding data for a 50 kc/s IF transformer.

ary and arrange for critical coupling between the windings. Furthermore, a high order of selectivity can only be obtained in a reliable and practical manner by using a low frequency, and after a series of measurements on various intermediate frequencies 50 kc/s was adopted as suitable for short-wave superheterodyne reception. Naturally this frequency will bring about second-channel interference unless a high degree of pre-selection is utilised. This is exceedingly difficult to achieve on the short waves, but it is to be argued that a double response to every station is not a great drawback and is rather to be regarded as an asset when searching for a weak signal, one channel of which may be passed over during a fading period. Second-channel response on all amateur bands could be

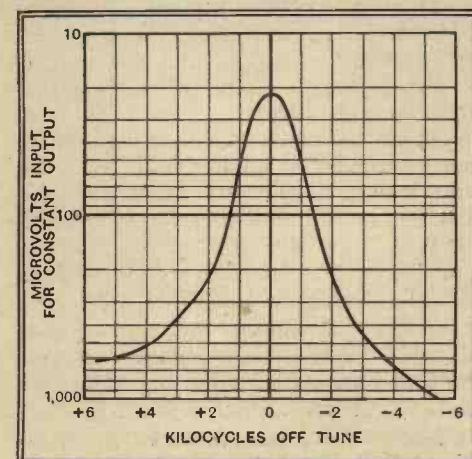


Fig. 2.—Resonance curve of the 50 kc/s IF transformer described in the text.

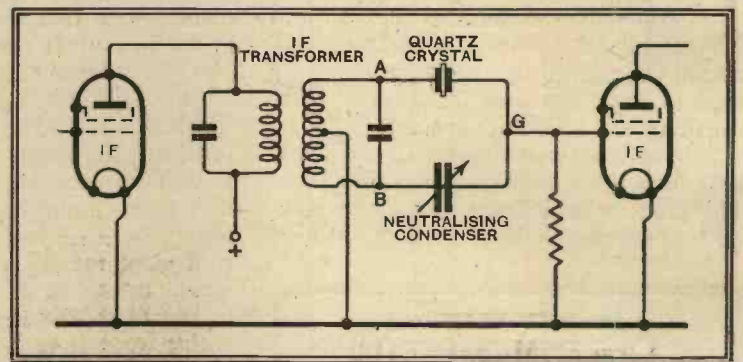


Fig. 3.—Circuit arrangement for incorporating a quartz-crystal filter in the IF amplifier.

the circuit arrangement enables the effect due to this small capacity to be balanced out when the capacity of the neutralising condenser is made equal to that of the crystal holder, so that all unwanted frequencies are entirely eliminated. At the resonant frequency of the crystal the bridge is completely unbalanced, allowing the signal to pass on for further amplification.

Some idea of the selectivity obtained by this method may be seen by an inspection of a typical selectivity curve for such a filter as shown in Fig. 4. The high order of selectivity obtained is such as to render the reception of intelligible speech impossible. It is, however, a simple matter to throw the bridge out of adjustment by increasing or decreasing the capacity of the neutralising condenser so that the crystal selectivity is swamped by the broad selectivity of the IF transformer, thus obtaining the additional side-band response necessary for intelligible speech reception. This method is greatly in vogue in the latest American superheterodyne receivers designed for the amateur, and it is only necessary to handle the arrangement to appreciate the enormous improvement in signal/noise ratio and reduction of mutual interference between adjacent transmissions.

DX Notes

Listening between the hours of 0500 and 0800 GMT is now amply repaid by many interesting effects on the 20 m. band. Interesting echo effects on some

Short Waves and the Amateur—

commercial stations show evidence of "round-the-world" transmission with very little attenuation. Excellent signals have been heard from VK, ZL, PY, LU and CN countries at this period. Condi-

Acorn Valves

An American Development for Ultra Short Waves

employ ordinary circuit technique represents a big step forward in this important branch of radio development.

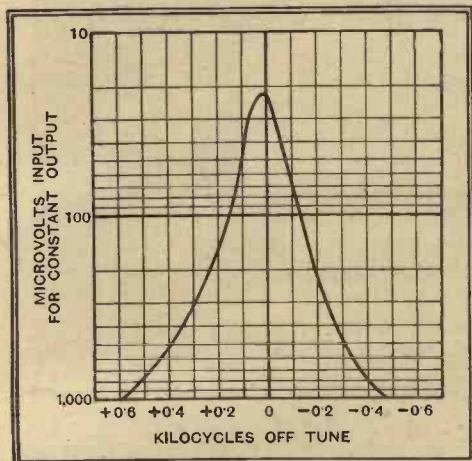
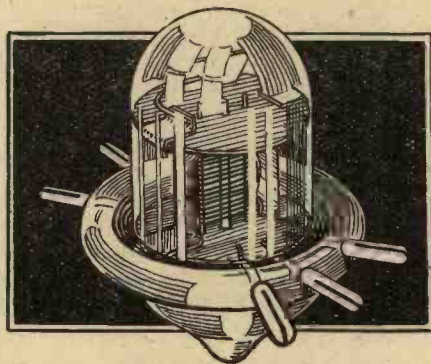


Fig. 4.—Resonance curve of a correctly neutralised quartz crystal filter arranged as in Fig. 3.

It is well known that successful reception on the ultra-short wavelengths demands careful attention to detail in receiver design, but although ordinary valves can be used on wavelengths around 5 metres, there is a definite limit in wavelength below which they cannot be employed. It has been shown¹ that if the dimensions of a valve are reduced it can function at lower wavelengths, and so the logical step in ultra-short wavelength technique is to employ specially small valves of minute physical dimensions.

The September issue of *Electronics* contains details of the first type of ultra-short wavelength valve, and it is known as the Acorn valve in view of its astonishingly small size. It is an indirectly heated triode rated for 6.3 volts at 0.16 ampere and for a 180 volts HT supply, its heater rating being chosen so that the valve may be used for AC or battery operation. It has an internal resistance of 12,500 ohms and a mutual conductance of 2 mA/V., and it passes an anode current of 4.5 mA. with a grid bias of 5 volts.



To show the construction of the Acorn valve clearly our sketch is printed at twice the size of the actual component.

The construction is one leading to very small inter-electrode capacities; the grid-cathode capacity is 1 mmfd., the anode-cathode 0.6 mmfd., and the grid-anode capacity only 1.4 mmfd. This is obtained through the small dimensions of the electrodes and the absence of the usual pinch. No base is fitted, and the connections are made to metal stubs set around the periphery of a glass ring. As shown in the drawing, these stubs support the electrodes, and some idea of the smallness of the valve may be gathered when it is said that its overall height is less than one inch, while the diameter around the ring is under 3/4 in. The diameter of the bulb is about 1/2 in.

The valve is being developed in the Radiotron Laboratories, and it is understood that successful operation has been secured at as high a frequency as 600 mc/s (0.5 metres). Previously operation at such frequencies has only been possible with the Barkhausen oscillator, and the ability to

What is an Earth?

COMMENTING on the revised I.E.E. regulations, a contributor to *The Electrician* notices radical alterations, even with regard to the official definitions of the significance attaching to expressions used in the regulations.

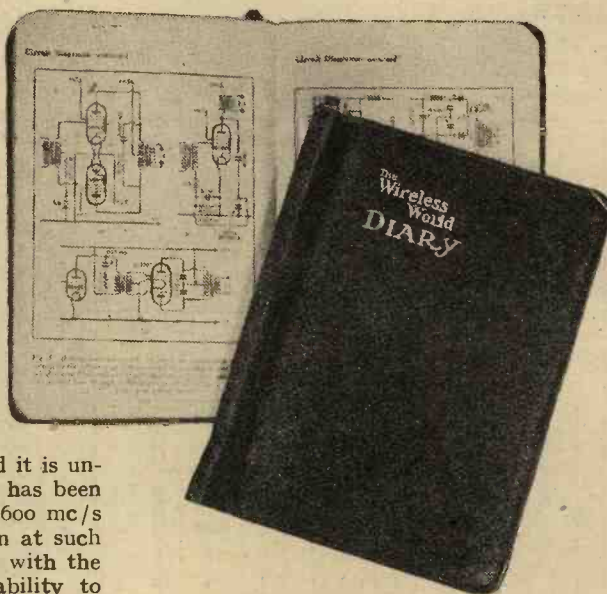
The old and time-honoured definition of the expression *earth*, implying a connection to "the general mass of the earth in such a manner as would ensure at all times an immediate discharge of electrical energy without danger" no longer appears. According to the writer, its impossible and pretentious provision has at last been found suspect and its fallacy exposed.

The new definition is "Earth: A connection to the general mass of the earth by means of an earth electrode. An object is said to be earthed when it is electrically connected to an earth electrode, and a conductor is said to be solidly earthed when it is connected to earth without a fuse, leak, switch, circuit breaker, resistor or impedance in the earth connection." A later definition states that an earth electrode may be a metal plate, water pipe, or other conductor which is electrically connected to the general mass of the earth in such a manner as to comply with these regulations.

This will immediately arouse an intense desire to find out just what is now required by these regulations.

The Wireless World Diary for 1935

DO you know off-hand how to fit an anti-interference filter to your mains? How to wind a 40-metre tuning coil? How to wire up a Westinghouse HT8 rectifier? What is the wavelength of Reykjavik? The normal anode current of a PX25?



Answers to all such questions are in the 1935 edition of *The Wireless World Diary*, obtainable from booksellers or direct from Iliffe and Sons, Ltd., Dorset House, Stamford St., London, S.E.1 Price 1s. 6d. (by post, 1s. 7d.).

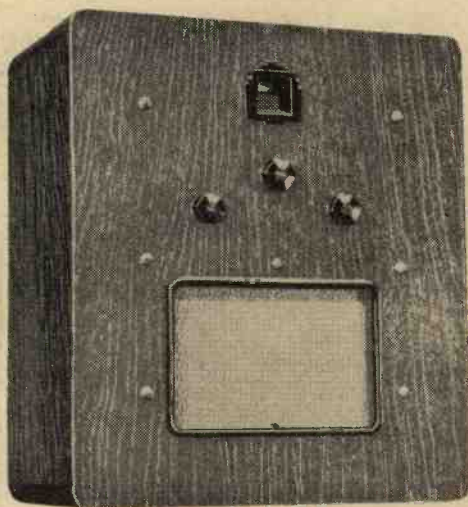
¹ Vacuum Tubes of Small Dimensions for Use at Extremely High Frequencies, by B. J. Thompson and G. M. Rose, Jun. Proc. I.R.E., December, 1933.

tions in the afternoon and until 2100 GMT are also good with reception from five Australian districts and all American districts.

Lissen Model 8102

A New Class "B" Battery Portable

THE very reasonable price and the wide range of usefulness of this receiver are sufficient to ensure for it an important place in the Lissen range of receivers for the coming season. It is fitted in a polished figured oak cabinet, which also houses the self-contained frame aeri-als. Provision is made for the addition of an outside aerial if desired.



The latest addition to the range of Lissen receivers, the Model 8102 Class "B" portable.

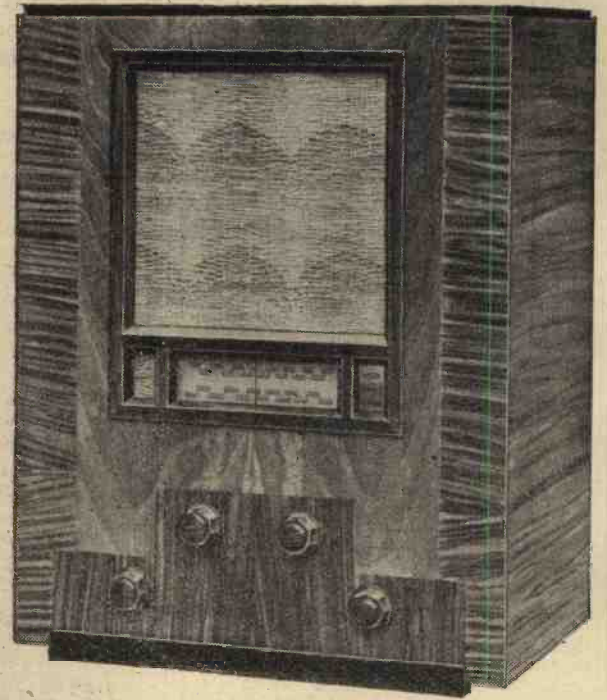
The circuit is straightforward, and the valves are arranged as follows: Screen-grid H.F.—detector—driver—Class "B" output. The two tuned circuits are ganged, and a combination of reaction and variable bias on the H.F. amplifier provides volume control.

The specification includes a permanent-magnet moving-coil loud speaker, and the price of 9 guineas includes valves and batteries. The makers are Lissen, Ltd., Worples Road, Isleworth, Middlesex.

Halcyon Model 4501

A Universal Superheterodyne with Many Interesting Features

FEATURES.—*Type.*—Table model superheterodyne receiver with universal valves. *Circuit.*—Octode frequency changer—variable-mu pentode IF amplifier—metal oxide second detector—LF amplifier—pentode output valve. *Controls.*—(1) Tuning, with visual tuning indicator. (2) Volume control and on-off switch. (3) Waverange switch. (4) Three-position tone control. *Price.*—14 guineas. *Makers.*—Halcyon Radio Ltd., Valetta Road, London, W.3.



ALTHOUGH following in essential design the general trend of modern superheterodynes, this receiver incorporates several modifications which enhance the performance and contribute to ease of control. The tuning scale, for instance, is divided into three sections, and is illuminated from behind by no fewer than six pilot lamps. Two are associated with the main tuning scale, while a third illuminates the shadow tuning indicator on the left. The remaining three are controlled from the waverange switch, and show the appropriate settings by illuminated lettering on a translucent panel to the right of the tuning scale.

The controls comprise the main tuning, volume control and mains switch, waverange switch and a three-position tone control. The latter is useful in cutting down background noises under exceptionally difficult conditions, but in our opinion it will not be called into service very often, as the built-in mains filter and the special type of automatic volume control adopted have resulted in a very high signal-to-noise ratio.

The manner in which quite feeble transmissions stand out from the prevail-

ing level of background noise is probably the most noteworthy feature of the performance. The set has a high degree of sensitivity, and consequently the number of programmes available is very considerably above the average for this class of receiver.

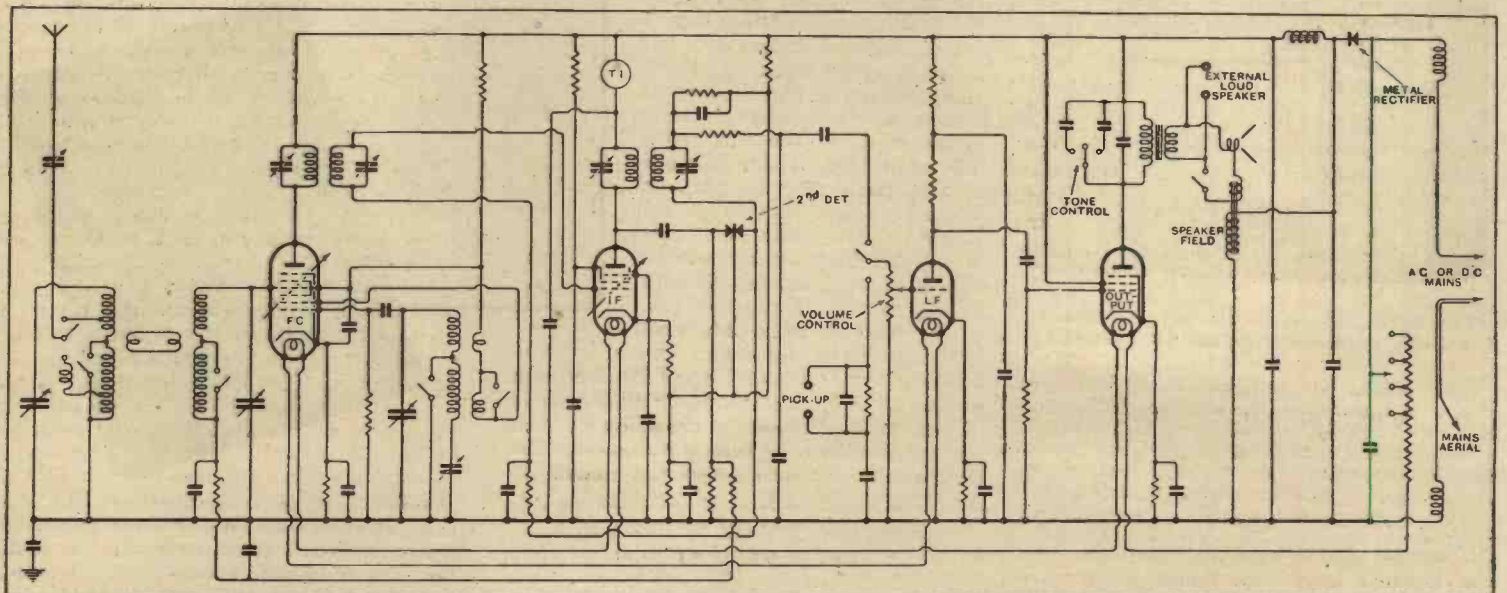
The mains filter consists of a pair of high-frequency chokes in the mains leads in association with a small by-pass condenser, and the level of interference attributable to mains pick-up is very considerably lower than that of the majority of universal receivers. This applies only when an internal aerial is used, and a certain amount of interference is unavoidable with the mains aerial in operation.

Effective AVC

The automatic volume control has an exceptionally wide range of operation, and there is very little difference in volume in Central London between the London Regional and Midland Regional transmitters. Tuning has many of the characteristics of QAVC, but it is probable that the effective mains filtering con-

tributes as much to this effect as the characteristics of the volume control. The control bias is provided by a double-ended "Westector." The right-hand side in the circuit carries out the signal rectification and supplies undelayed bias to the variable-mu IF amplifier valve. The left-hand side is used exclusively for AVC, and is connected to the primary of the output IF transformer. The bias from this half of the rectifier is applied to the frequency changer valve, and is backed off by a delay voltage derived from the cathode of the IF valve.

A band-pass filter is included in the aerial circuit, and the selectivity is sufficient to give clear reception in Central London one and a half channels on either side of the Brookmans Park transmitters. The long-wave selectivity is equally good, and the Deutschlandsender has definite programme value even when Droitwich is in operation.



Complete circuit diagram. The AVC circuit is unusual and the bias is provided by a twin element metal oxide rectifier.

Halcyon Model 4501—

The set is reasonably free from second-channel interference, and the only whistle noted was at approximately 460 metres on the medium waveband. This was considerably reduced in amplitude by careful trimming of the aerial circuit in accordance with the instructions given. There was a trace of hum on AC mains, but this was not noticeable more than a foot

ance is impregnated with heat-resisting material, and is mounted well clear of all other components.

A Westinghouse metal oxide rectifier is used in the power supply circuit and a separate choke is used for smoothing, the loud speaker field being connected across the HT supply.

One small criticism in conclusion. In a receiver giving such a wide choice of

The Diary of an Ordinary Listener

TO find a programme exactly suited to one's taste is a rare occurrence. Such a programme I found on Friday, October 26th, when I happened on Huizen sending out a concert by the Haarlem Orchestra. It began with Beethoven's Symphony No. 1 in C, which, apart from its own peculiar charm, is doubly interesting as showing the lingering influence of Mozart on Beethoven's earlier work. This was followed by Mendelssohn's Violin Concerto in E Minor, in which the solo instrument was admirably played by Leydendorff. I am not ashamed to confess that I never tire of this Concerto, though I know it is at present the fashion to gibe at Mendelssohn for being "too sugary" for this age of ugliness. Were I a violinist I should enjoy playing such music far more than some of those unmelodious solos which seem to be written solely to display technique. The concert concluded with Liszt's Symphonic Poem, "Les Préludes," and I felt the evening had been well spent. Huizen was coming through with almost its old clearness, though at times a slight background was evident—presumably from Brasov.

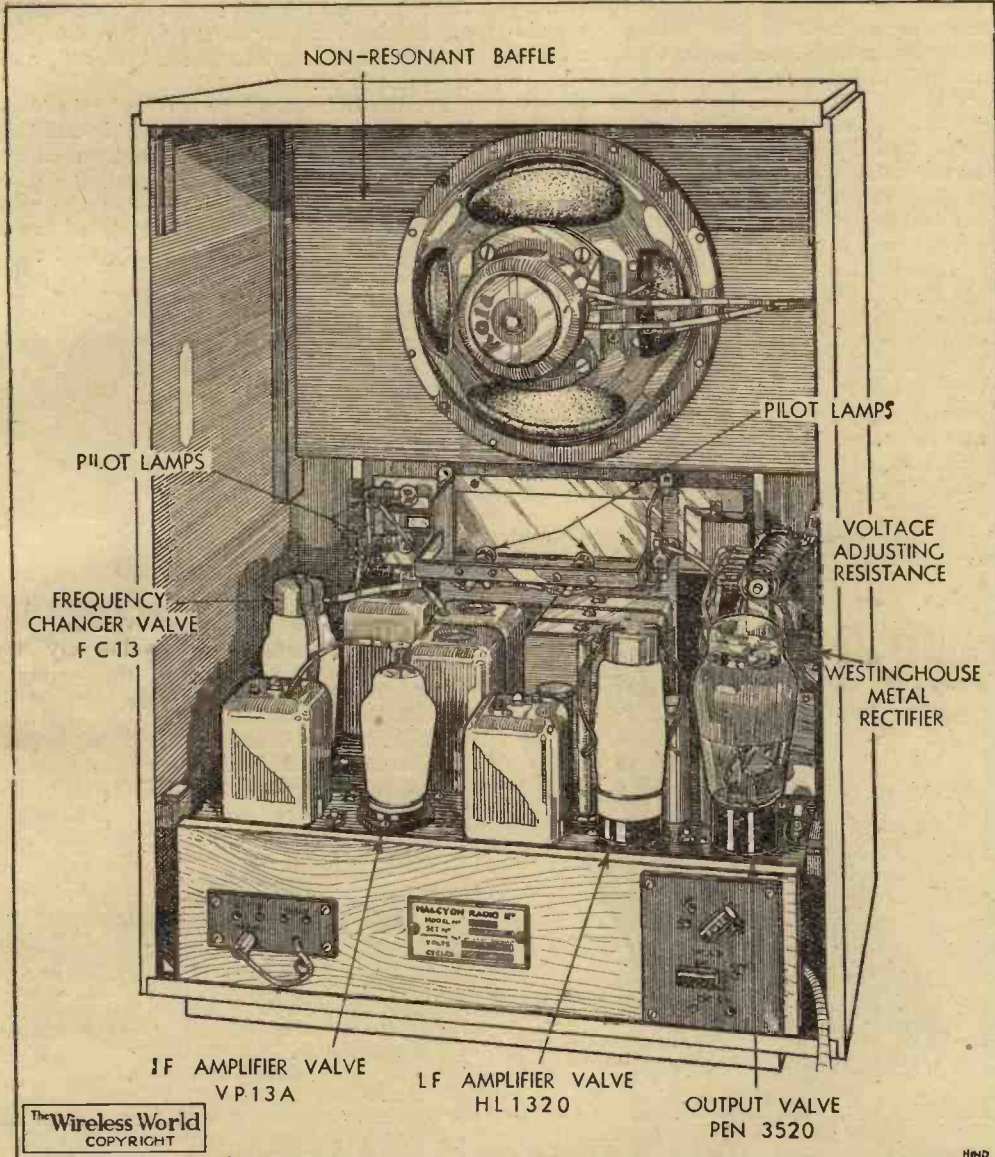
The following evening I listened for a time to the French National Symphony Orchestra from Paris P.T.T., but as this station was not coming in very well I soon switched over to Radio-Paris for a part of Offenbach's opera, "La Périchole," and then to Mulacker, where the Stuttgart station orchestra was giving a concert of operatic music in which I enjoyed the bass solo by Hermann Rieth from Rossini's "Barber of Seville."

Italian Memories

On Sunday morning I made an ineffectual attempt to get Vienna, as I greatly wished to hear Verdi's Requiem performed by the State Opera House Choir and the Philharmonic Orchestra, conducted by Toscanini, but was unable, at so early an hour, to hear more than faint snatches of the music.

Italian stations occupied most of my attention on Monday. Rome is very often the first station I pick up when switching over from Droitwich, as, on my dial, 420 metres is almost exactly opposite the 1,500 mark on the long waveband. This time I came in for the end of Braga's "Serenata," and then went over to Milan for a concert of Italian Folk Music. After listening for a time I began roaming the wavelengths until my progress was arrested by hearing Denza's "Funiculi Funicula," evidently coming through from Trieste. I tarried there to hear several Italian folk songs, which revived happy memories of a holiday spent in Northern Italy.

Tuesday evening offered a varied selection of interesting programmes, beginning with Leipzig, where the Dresden Philharmonic Orchestra was giving a popular classical concert, of which I heard a selection from Berlioz' "Faust," comprising two of the dances and the Rakoczy march, followed by Tchaikovsky's Andante Cantabile. Then on to Cologne for the beginning of Richard Strauss' "Sinfonia Domestica," but, feeling rather tired and more inclined for lighter music, I soon went over to Radio-Paris for a little of Delibes' opera "Lakmé." CALIBAN.



Rear view of Halcyon Model 4501 receiver. Note the multiple pilot light system and non-resonant loud speaker mounting.

or two distant from the loud speaker. The quality of reproduction is notable for the good bass response, the tone and quality of the lower notes in piano transmissions being exceptionally realistic. With the station accurately tuned there might perhaps be a little more output in the upper register, even with the tone control in the high position, but this is a matter of personal taste, and in any case may be to some extent corrected by very slight mistuning. Special care has been taken to avoid cabinet resonances, and the loud speaker is mounted on a thick panel of non-resonant material. The chassis is well designed mechanically and is finished in the characteristic Halcyon blue. The mains voltage adjusting resist-

stations of programme value, we should like to have seen a wavelength scale giving greater precision of tuning than the isolated figures provided.

"THE WIRELESS ENGINEER"

PRINCIPAL CONTENTS OF THE NOVEMBER NUMBER

- Radio Wave Propagation.
- Cambridge Versatile Galvanometer.
- Design of Constant Resistance Attenuators.
- A Note on Self-bias Circuits.
- Abstracts and References.

Now on Sale. Price 2s 6d.

New Apparatus Reviewed

Recent Products of the Manufacturers



Marconi and Osram X21 new economical battery heptode frequency changer.

MARCONI AND OSRAM X21 VALVE

THE X21 is a new battery-operated heptode valve for use as a frequency changer, its characteristics permitting the stage to be included in the AVC system. Economy is one of its chief features, for the filament current is 0.1 amp. only at two volts, while the average HT current under working conditions is 1.7 mA. It is rated for 150 volts on the detector anode, and between 40 and 50 volts on both the screen and the oscillator anode.

A seven-pin base is fitted, and the pins arranged as is now standard for this type of valve, and having the control grid connection located at the top. The total HT current is divided up approximately as follows: with zero grid bias on the control grid the detector anode circuit passes 0.45 mA., the anode circuit of the oscillator sections accounts for 0.6 mA., and the screen 0.6 mA. also.

These low current values are not obtained by cutting down the voltages to the lowest that will give results, but the valve is designed for economical working, and no improvement can be effected by applying higher voltages. The efficiency definitely falls off when the oscillator and screen potentials are raised, and our tests show that the valve functions at its best with voltages nearer 40 than 50 in each case.

The output from the detector to the first IF stage is controllable by the negative bias applied to its grid, since the tetrode section has variable- μ characteristics, and a sufficiently wide variation for normal purposes is provided by a change of the order of 10 volts.

There is every advantage in using an efficient IF transformer following the X21, as it has a high AC resistance, this being about 1.4 megohms at zero bias and increasing with negative bias on the control grid. With zero bias the conversion conductance is 0.2 mA. per volt.

The X21 is included in both the Osram and the Marconi lists, and costs 18s. 6d.

PLUMAX H.T. BATTERY

THESE batteries are made by the Vee Cee Dry Cell Co. (1927), Ltd., Northwold Road, London, N.16, there being several different series ranging from the Standard Energy models with a maximum discharge rate of 8 mA. to a heavy-duty class rated to give up to 25 mA.

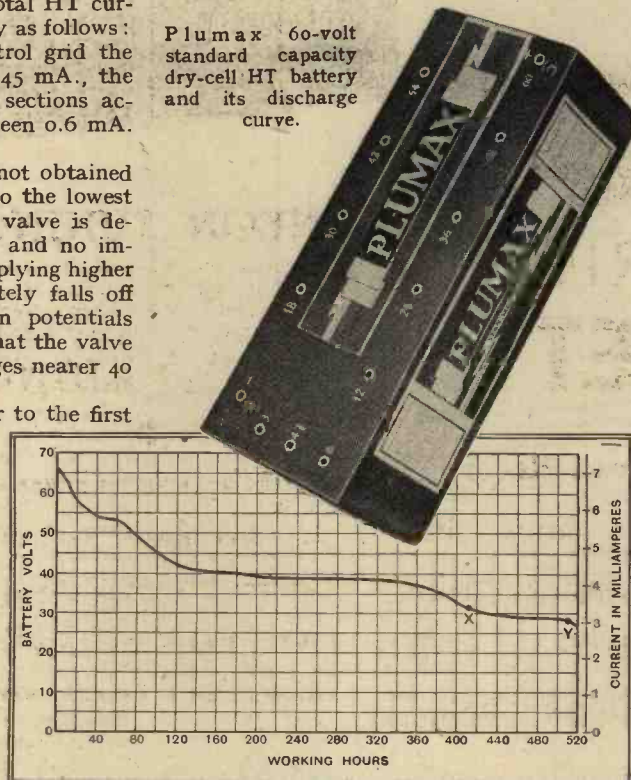
The specimen tested falls within the first-mentioned category, being a 60-volt unit measuring 9 $\frac{1}{2}$ in. \times 3 $\frac{1}{2}$ in. \times 2 $\frac{1}{4}$ in. This model is very reasonably priced, yet it gives a most satisfactory performance, for, as shown by the discharge curve, the voltage is maintained at a high level throughout the useful life of the battery.

For the purpose of test, this is taken to be where the voltage of each cell has fallen to 0.75 volt, and, as there are forty-two cells in the 60-volt unit, the end-point would be reached at a battery potential of 31.5 volts. This gives a working time of 412 hours, and corresponds to the point X on the curve.

The discharge was intermittent, being arranged in periods of four hours' work with like intervals for recuperation, but in the curve the rest periods are omitted for convenience. In the present case the battery does not show a marked falling-off in voltage after this point is reached, but continues at a somewhat lower voltage for a quite considerable time, though after the point marked Y there is a rapid decline in the output.

Up to the theoretical cut-off point X the ampere-hour capacity is 83.3, or 1.98 amp.-hours per cell. Continued to the

Plumax 60-volt standard capacity dry-cell HT battery and its discharge curve.



natural end-point of the battery, an additional 9 amp.-hours are provided, giving each cell a capacity of 2.2 amp.-hours.

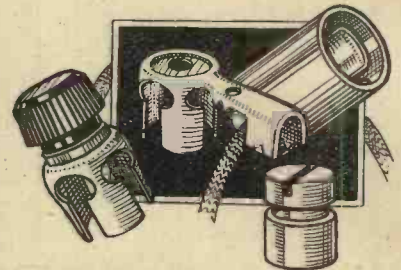
This is a very satisfactory performance, especially so considering the price of the 60-volt unit is 4s. 3d. only.

BELLING-LEE PLUG TOP VALVE CONNECTORS

THE push-on connectors made by Belling and Lee, Ltd., Cambridge Arterial Road, Enfield, Middlesex, for valves having the grid connection on the top of the bulb,

are available in several different styles. There is a simple clip made from springy brass and silver-plated having the list No. 1175, costing 1d. For experimental work the type No. 1167 will be found very useful, as, although similar to the first mentioned, it is fitted with an insulated terminal, and the price is 2d.

For use in cases where a completely insulated connection is required Belling and Lee have evolved a shrouded model in which the metal clip is totally enclosed, the wire being inserted through a hole in the side and held in place by a silver-plated brass insert which screws into the insulated cap. This pattern costs 4d.



Range of Belling-Lee connectors for valves fitted with a top plug, also an adaptor for those having screw terminals

As there are now some valves fitted with a small screw terminal in place of the top plug for the grid connection Belling-Lee has included in this series of connectors an adaptor which replaces the terminal so that the push-on connector can be used; this is useful for experimental work and it costs but 1d.

THE RADIO INDUSTRY

A NEW H.M.V. radio-gramophone, to be known as Model 45A, is announced. The price is to be 22 guineas, and an important feature of the set is the provision of "silent tuning," or QAVC.

Vortexion (S. A. Brown), 182, The Broadway, Wimbledon, London, S.W.19, has sent in a specimen mains transformer for *The Wireless World* Standard AC Three. It is easily accommodated in the space available, and from examination appears to be a well-made article. The price is 20s.

The City Accumulator Co., Ltd., 18-20, Norman's Buildings, Central Street, London, E.C.1, has introduced a new model Superpak for use with heptode frequency changers. The circuit is that of a band-pass input filter and oscillator with all connections in the tuned circuits completed. A combined wavechange and gramophone switch, also a potentiometer for use as a tone or volume control, are included, and the price is 52s. 6d.

The Switchit Service, Ltd., radio and relay engineers, of 24, Portland Place, Brighton, have obtained the contract for the provision of loud speakers for the 1935 Aldershot Tattoo.

Mr. G. L. D'Ombra, B.Sc., late of the Electrical Research Association, has joined Kingsway Radio, of 3-9, Dane Street, London, W.C.1, and is taking charge of the design and testing departments.

A.V.C.

How to Obtain Complete Station Separation Without Sideband Cutting

By F. H. HAYNES.

SELECTIVITY as afforded by the use of tuned circuits can be defined only in reference to a given signal input. A set may readily separate weakly received stations perhaps only 8 kc. apart. On the other hand, the same set may fail in an attempt to pick up a distant station without interference, when 8 kc. is the separation between distant and local transmitters. As we all know, the spread of a station on the tuning dial usually depends on the distance from the broadcasting station, so that without qualification, it is incorrect to talk of a set giving a "cut-off" at so many kc.

Band pass tuners such as are used to-day, comprising pairs of tuned circuits, may be arranged to give high selectivity. Inasmuch as their response curves have sloping sides, selectivity will vary with signal strength, and if any attempt be made to produce the desirable broad top to the accompaniment of steep sides, there will be a considerable dip in the peak, creating most evident distortion. Such filters that may give fair separation of a nearby station will produce serious high note loss when tuned to a weak distant station. Where selectivity is governed by sharply tuned pairs of circuits which necessarily possess severe "double humped" tuning, quality reception cannot be expected.

Previous reference has not been made to the fact that AVC can be so arranged as to prevent the simultaneous reception of two transmissions, provided, of course, that they are not of identical

wavelength. As a station is tuned in and the point of resonance is reached, the sensitivity as governed by the AVC declines to a minimum. On going slightly off tune the sensitivity rises again, but as soon as another station is approached the AVC can have the property of completely suppressing the slightly off tune residual signal of the first transmission. Such an effect will result only by the use of an *amplified* system of AVC, but this is rarely to be found in receivers to-day. By amplified AVC is implied an arrangement whereby the negative potential created by a diode is in turn applied to the grid of a triode, so that a considerable change occurs in the value of the current in the cathode circuit, and it is this amplified potential which biases the controlled HF valves. "Full" and even amplified AVC now appears in the specification of many sets, although the circuits do not conform to the conditions just outlined. A simple diode detector will produce without amplification up to some 20 volts negative for AVC bias purposes. However, as soon as this is applied to the valves to be controlled, so that the diode input is in turn reduced, the range of the available bias control becomes so limited that the claim for AVC is substantiated mainly by the provision of a circuit detail rather than by the achievement of a well-marked effect.

Amplified AVC has been a feature of Haynes receivers for well over a year. In the Haynes two HF tuner it prevents the simultaneous

reception of two stations. Complete separation is given in London, for instance, between Droitwich and Berlin, where the interval is only 9 kc. There is no loss of sideband when listening to either station, and when tuning in the direction of the adjoining but more liberally separated Eiffel Tower transmission there is a spread which suggests flatness of tuning. The tuning meter, which by the way is a high grade moving-coil instrument and is actuated by the AVC, shows a liberal movement on the precise position of tune for every European station of note, and at this time of the year American medium-wave stations heard in the early morning cause an easily discernable dip of the needle. The set is absolutely stable and has no reaction.

A 32-page booklet is available on request, which describes the new two HF tuner unit and the exclusive Haynes system of Duophase LF amplification as well as Haynes loud speakers. A clear explanation is also given for the superiority of the straight HF set over the superheterodyne.

Haynes tuners, amplifiers, chassis, cabinets, radio-gramophones and loud speakers embody exclusive features and have achieved an unrivalled reputation for outstanding performance. Demonstrations are given every Friday evening from 7.30 to 9.30 p.m. at the factory, and at other times if advice is received by telephone, when information will be given as to the most convenient route.

Announcement of Haynes Radio, Queensway, Enfield, Middlesex. Telephone: Enfield 2726.

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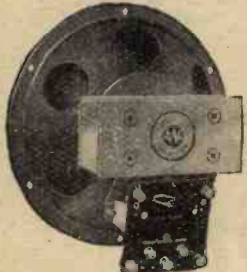


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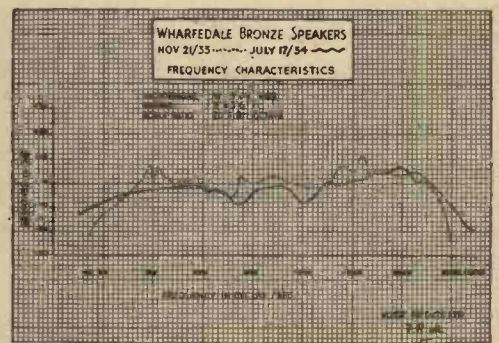
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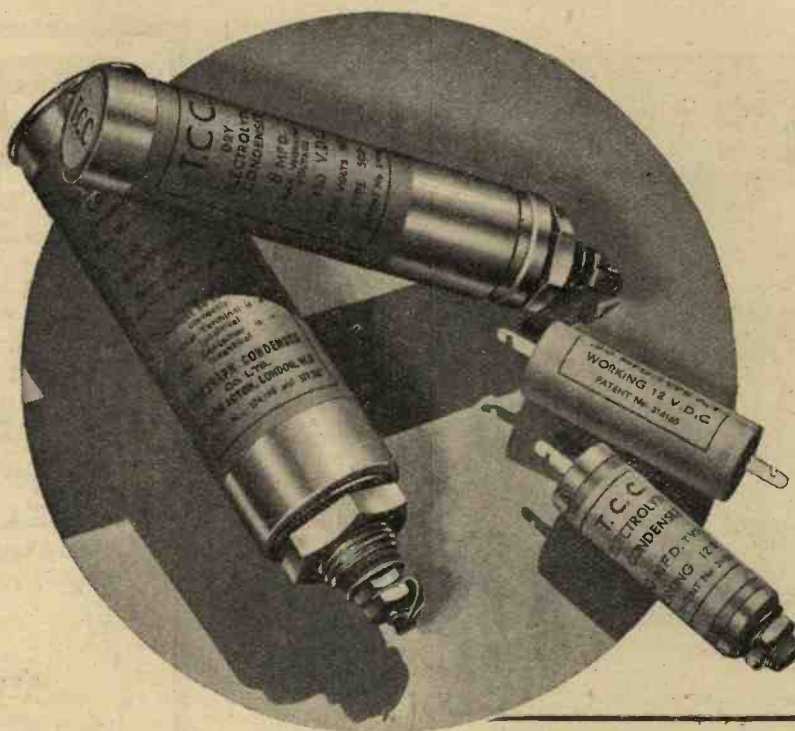
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50	12 D.C.	2	3	2	6

Type "AT" with soldering tags. Type "C" one hole chassis fixing.

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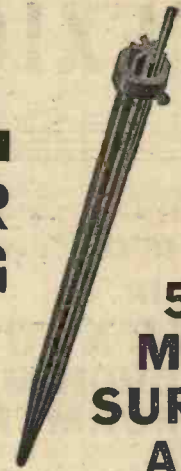
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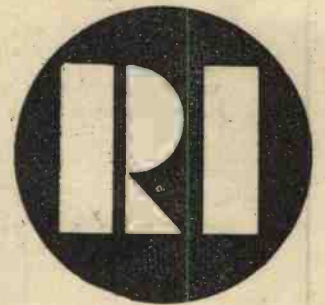
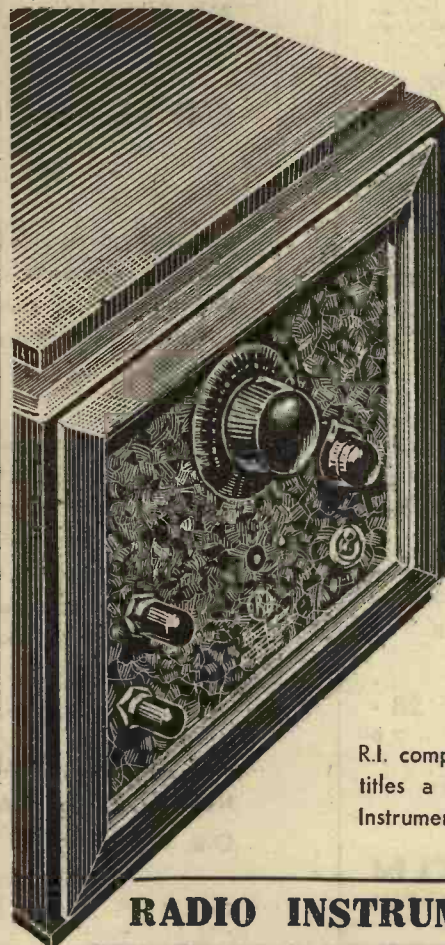


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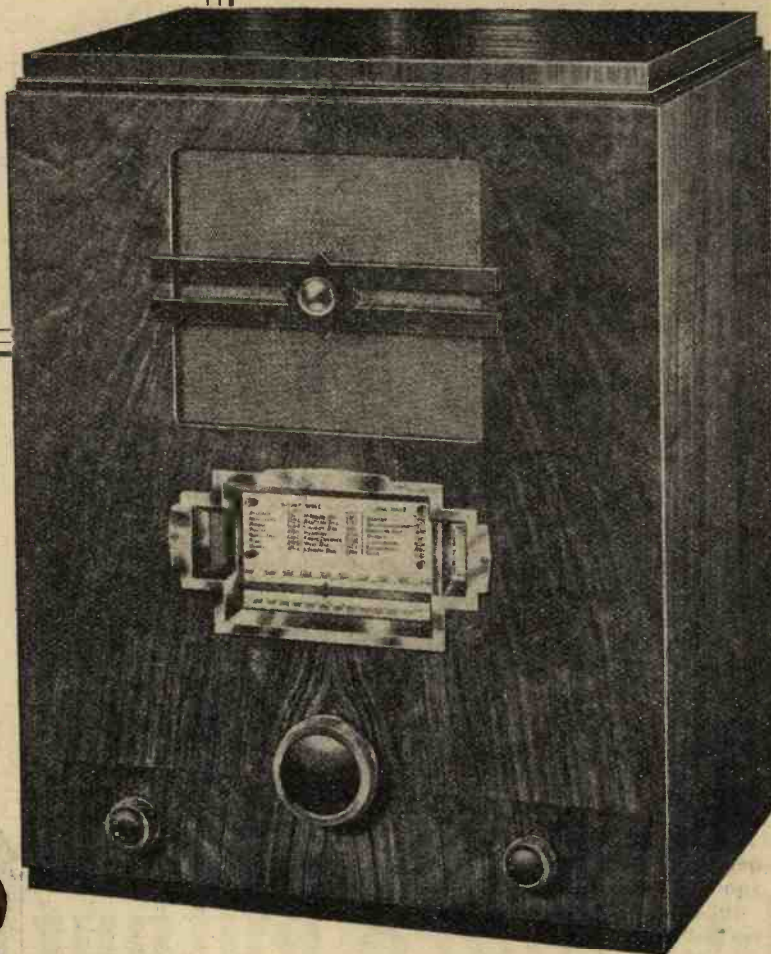
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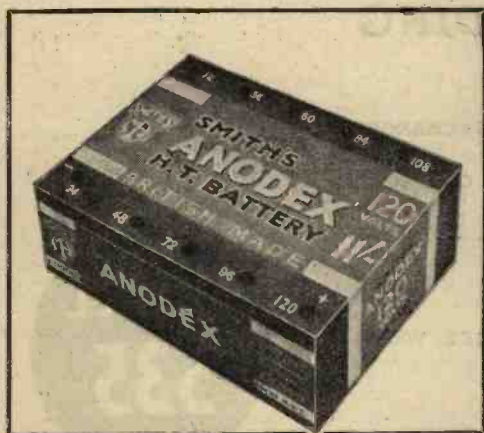
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Our congratulations to **THE WIRELESS WORLD** for resuming its proper function: to cater for the man who is not content with the ordinary sort of thing. All round the town the folks are saying, "we don't want foreign broadcasts; what we want is faithful reproduction of our own stations." So many people have bought Hartley-Turner sets and speakers that, among the more sensible section of the public at any rate, the desire for foreign listening is killed. The joy of listening to a good transmission on a Hartley-Turner outfit is so complete that our customers take pride in asking their friends to spend a "wireless evening" with them. Then they buy Hartley-Turner, and so it goes on and on.

We listened to the symphony concert on the evening of October 31st; may we confess that we were lost in admiration at the excellence of our reproduction? How can a man listen, in one evening, to the "Planets," "Prometheus" and "Zarathustra" on an ordinary wireless set? Perhaps that is why the broadcasting of modern music is not so enthusiastically received as it might be. The more complex the music the better must be the set, and it is hopeless to expect yourself to be able to follow the intricacies of more advanced orchestral scoring if your set, with its 100 to 5,000 cycle frequency range, reduces the instruments to a least common multiple. You've got to have top for this sort of thing; and for the more usual things too. Mind you, we are not too modern ourselves, and we might have gone mad listening to Scriabin on someone else's set, but we got through it all right.

We have left the subject of truth in advertising alone this week, but we will have something more to say next week.

Meanwhile, take up those pearls: send for our illustrated free literature.

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Telephone: HOUnslow 1854.

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ARMSTRONG Universal Superheterodyne, chassis works on A.C. or D.C. mains, specification as superheterodyne model above; £6/18/6, complete with valves, royalties paid.

ARMSTRONG Senior Universal A.C.-D.C. Chassis, 3 tuned circuits, full bandpass tuning, 3½ watts double pentode output, massive construction, with valves; £5/18/6.

ARMSTRONG A.C.4 Chassis, incorporating 3 pentodes, 3 tuned circuits, full band-pass, 3 watts output; £5/18/6, with valves.

ARMSTRONG Latest 4v. Battery Chassis, 2 screened stages, 3 tuned circuits, single knob tuning, full vision dial calibrated wavelengths, good selectivity with exceptional pulling power; £4/10, with valves.

ALL Armstrong Chassis are constructed of the Highest Grade Components Throughout, carry 12 months' service free guarantee, and are sent on 7 days' approval, carriage paid.

ARMSTRONG MANUFACTURING Co., 100, King's Rd., N.W.1. Phone: Gulliver 3105. [6688]

MIDGET Receivers; every one brand new and guaranteed, carriage paid; stamp with all enquiries; every one complete with valves and moving coil speaker in walnut cabinet; all operating, unless otherwise stated, on A.C.-D.C. 200-250 volts, being universal; Savoy, 5-valve super-het., made by Belmonts, M. and L. wave, A.V.C., last year's model, cabinet 10x7x5½, at £4/10; all the following are E.C.A. Victor's, each in cabinet 12x8½x6; all have delayed A.V.C., illuminated dials, pick-up terminals, incorporating 2 ultra modern triple function valves, super-het. 5-valve, 190-550/900-2,000 metres, £6/10; this chassis in larger cabinet, table model, 14x16x9½, with 8½in. speaker, giving 3 watts undistorted output, at £7/7, can be supplied for A.C. as well, £7/10; as in £6/10 model, but 6-valve, at £7; this model 6-valve, but covering 13-50 metres as well as M. and L. waves, £7/17/6; table models in really handsome cabinets, massively constructed super-het. 6-valve, 8 stage, 13 metres to 2,000 (3 wave bands), 3 watts undistorted, uses 2 H.F. pentodes, heptode frequency changer, double diode triode, Airplane dials, sensitivity one microvolt absolute, cabinet 19x16x10½, at £8; can be supplied in A.C. also, at £9/5, carriage 4/-; another in A.C. only, 6-valve, 8 stage, the world's first double intermediate super-het., 12 metres to 2,000 in 4 wave bands (specification as in £9 job), Airplane dials (extra large), sensitivity better than ¼ microvolt absolute, maximum efficiency over whole wave-band coverage, cabinet 21x11x17, at £15, carriage 5/-.—Degallier's, 6, Coryton House, 21, Upper Marylebone St., London, W.1. Museum 7795. Nearest Stations, Oxford Circus, Great Portland St. [6905]

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S.S. Olympic Six, less amplifier; £8/8.—Oglesby, 55, Toston Drive, Wollaton Park, Nottingham. [6870]

B.T.H. 6-watt Amplifier, in steel case, for sale or exchange, for good chassis set.—Jackson, 21, Harold Estate, Waltham Abbey, Essex. [6882]

OUR Kit of Parts for "Wireless World" Quality Amplifier, complete in every detail, including valves; amplifier only, £8/10; feeder unit, 36/-.

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EMERSON and CROSLLEY 1935 Midgets, car radio, and all American valves, send for wholesale catalogue, importer.—Royal, 5, Buckingham Rd., South Woodford, London, E.18. [6890]

TWO S.T.500 Sets, one complete with cabinet Rola speaker, £7; other assembled, valves, gram. switch, £5/10, less speaker.—Wood, North St., Punnett's Town, Heathfield, Sussex. [6874]

1935 Models 4-valve Superhet. Midgets, A.C. or D.C., M.C. speaker, £3/19/6; 5 valves, £4/19/6; car radio, £7/15 including valves.—Lovell Bros., 11, Avon Rd., Walthamstow, London, E.17. [6891]

BRUNSWICK 7-valve Superhet., 200-240 A.C., American-built, a super set, in magnificent cabinet, with superlative tone M.C. speaker, too powerful for owner's present needs; £9/10.—Steen, 9, Cleveland Terrace, W.2. [6892]

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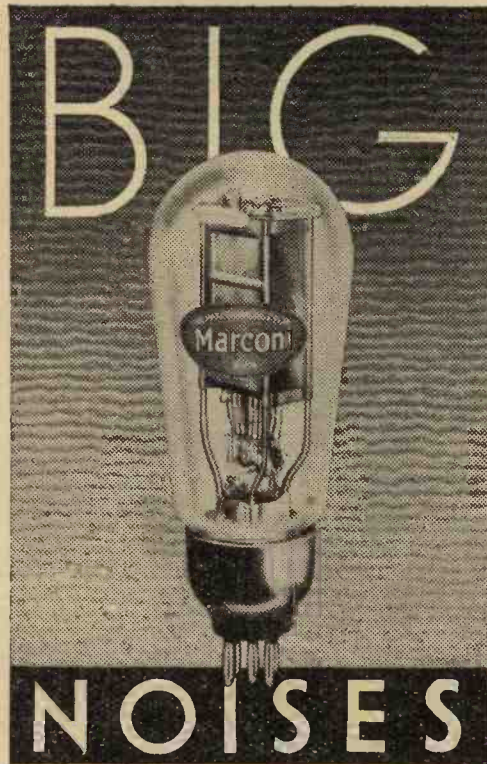
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MAGNAVOX D.C.152 (9in. cone), 22/6; Magnavox 154 (6½in. cone) 16/3; all with humbucking coils, power or pentode transformers, and 2,500- or 6,500-ohm fields; Magnavox P.M.254, 18/-; Magnavox P.M.252, 22/6.
ATTENTION to All Orders Within 24 Hours; carriage paid; cash with order or c.o.d.
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CABINETS for Any of Above, 2/9 each only; secure one of these amazing bargains now; cash with order or c.o.d.—Hulbert, 6, Conduit St., W.1. [6769]

VAUXHALL—Magnavox permanent magnets, universal, suitable for Class "B," power or pentode, 7in. cone, 17/6, 10in. cone 25/-; mains energised, 2,500 or 6,500, 10in. cone, 22/-; 7in. cone 15/3, brand new, with humbucking coils; state power or pentode transformer.
VAUXHALL—American Rola, type F.6, 2,500 or 6,500, 8in. cone, 16/6; large type, 9½in. cone, 24/-; complete with humbucking coils, power or pentode; permanent magnets for power, super power, pentode, Q.P.P. or Class B., 8in. cone, 25/-; large type 9½in. cone, 35/-; unused manufacturers' stock; immediate delivery, carriage paid, cash with order or c.o.d.—Vauxhall Utilities, 163a, Strand, W.C.2. Temple Bar 9338. [6898]

MOVING-COIL Speakers, for experimenters wanting something different; hear the drums and oboe without resonance, all sealed cartons, brand new, carriage paid; cash with order or c.o.d.; state if power or pentode transformer required; energised speakers incorporate humbuckers; Rola's (American) Scilor models only 9½in. diameter, 100-150v. (2,000 ohms), 110-175v. (2,500 ohms), 200-250v. (6,500 ohms), list 47/6 at 23/- each; permanent magnets, same size diaphragms, 9½ cobalt magnet, 7,400 lines per sq. cm., list 23, at 33/-; as sensitive as an energised speaker; 12 sets only, cannot again be offered, dual matched (1) Rothermel-Bush Piezo electric speaker, R.95, listed 55/-, and (1) 9in. P.M. U.S.A. Rola, complete with transformer, mounted on baffle, wired ready for use, at 57/6 per pair; also (6 only) Piezo electric speakers, R.95, at 35/-—Degallier's, 6, Coryton House, 21, Upper Marylebone St., London, W.1. Mus. 7795. [6906]

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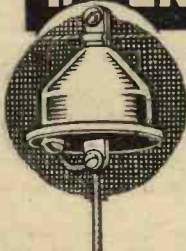
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Please send me (a) (Medium) Wave Radioformer Kit for which I enclose P.O. for 17/6. (b) Illustrated Descriptive Literature. (Delete words not required.)

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Loud-Speakers.—Contd.

25/-—New steel quality P.M.s, reputable manufacturers' cancelled export order; a real high-grade 8in. speaker, with newly discovered Alni magnet, superseding cobalt and giving 7,500 lines in gap, handsomely finished in black and chromium, honestly worth 45/-; Universal transformer; also 8in. nickel-chrome P.M.s (4,500 lines). Universal transformer, 15/-; sealed and guaranteed; 7 days' approval against cash, or c.o.d.—Mountgrove Supplies, 76, Mountgrove Rd., N.5. [6902]

TRANSMITTING APPARATUS.

PREMIER SUPPLY STORES Offers the Following Brand New Gear: Standard Cables transmitting valves (out of limits), 4211E and 4211D, 15/- each; 4212D, £3; American 866, 20/-; T.C.C. 2 ml., 1,500v., working, 6/-; Standard Cables transformers, 1,000-0-1,000v. 250 m.a., 4v. 3a. C.T., 4v. 3a. C.T., 49/6; 2,000-0-2,000v. 150 m.a., 49/6.—Premier Supply Stores, 20, High St., Clapham, S.W.4. 'Phone: Macaulay 2188. [6861]

VALVES.

ALL Types of American and Continental Valves in Stock, keenest prices; send for list.—Anderson, 35, Lansdowne Rd., Walthamstow, E.17. [6913]

METROPOLITAN RADIO SERVICE Co. for American Valves with a Guarantee, any type at keenest prices; trade supplied.—1021, Finchley Rd., Golders Green, N.W.11. Speedwell 3000. [0436]

SURPLUS Valves.—All brand new; battery types, 2-volt, H.F.2, L.F.2, L.P.2, 1/9; super power, P.P.2, 2/6; screens and pentodes, 3/9; A.C. mains, 4-volt 1 amp. general purpose, 3/3; power, 4/-; screens and pentodes, 4/6; full wave rectifiers, 3/6; postage paid cash with order, or c.o.d. over 10/-.—Clarion Radio Valve Co., 885, Tyburn Rd., Edlington, Birmingham. [6339]

PREMIER SUPPLY STORES Announce the Purchase of the Complete Stock of a World Famous Continental valve manufacturer, all the following standard main types fully guaranteed, 4/6 each; H., H.L., L. power, medium, high, low mag. and variable mu screen grids, one, three and four watt A.C. output, directly heated pentodes, 250v. 60 m.a., full wave rectifiers, D.C. types, 20v. 18 amp. filaments, screen grid H., H.L. power.

THE Following Types, 5/6 each: 350v. 120 m.a., full wave rectifier, 500v. 120 m.a., full wave rectifier, 2½ watt indirectly heated pentode.

THE Following American Types, 4/6; 250, 112, 171, 210, 245, 226, 47, 46, 24, 35, 51, 57, 58, 55, 37, 80.

THE Following Sizes, 6/6 each: 42, 77, 78, 25Z5, 36, 38, 83, 39, 44, 53, 6A7, 6B7, 2A5, 2A6, 2A7, 2B7, 5Z3, 6C6, 6A4, 6D6, 6F7; 43.59.

PREMIER SUPPLY STORES, 20 and 22, High St., Clapham, S.W.4. [6860]

ALL Types of Brand New American Valves in Stock, only first-class makes such as Arcturus and R.C.A. stocked, guaranteed for 6 months, 247, 235, 551, 89, 18, 19, 46, 59, 6A7, 15, 42, 41, 38, 39, 78, 75, 57, 58, 224, 44, 36, 235, 83, 43, 5Z3, 12/-; 25Z5, 12Z3, 14/6; UX171, UX199, UX280, UX245, UX226, UX227, 7/6; UX250, UX210, UX281, 17/6; UX 867 photocells, 25/-; all other types of American valves in stock; we also stock transmitting valves, post paid, cash with order or c.o.d.

WARD, 45, Farringdon St., London, E.C.4. Telephone: [6517] Holborn 9703.

COMPONENTS, ETC., FOR SALE.

PREMIER SUPPLY STORES. ANNOUNCE a City Branch at 165 and 165a, Fleet St., E.C. (next door to Anderson's Hotel), for the convenience of callers; post orders and callers to High St., Clapham.

OFFER the Following Manufacturers' Surplus New Goods at a Fraction of the Original Cost; all goods guaranteed perfect; carriage paid over 5/-, under 5/- postage 6d. extra, I.F.S. and abroad, carriage extra. Orders under 5/- cannot be sent c.o.d. Please send for illustrated catalogue post free.

STUPENDOUS Purchase of Set Manufacturers' Stock.—All electric 3-valve (S.G. det. pen.) set, in walnut cabinet, with moving coil speaker, 200-250 volt 40-60 cycles, chassis built, 200-2,000 metres, with 4 valves; £4/19/6.

ALL-ELECTRIC 3-stage Amplifiers, 200-250v., 40-60 cycles, 10 watts undistorted output, complete with 5 valves, and Magavox Super 66 energised speaker; £12/3/0.

TYPE 4480, 9in. diameter, permanent magnet, handles 4 watts, 7 ohms speech coil, 13/6; multi ratio transformer, 4/6 extra.

ELIMINATOR Kits, including transformer, choke, Westinghouse metal rectifier condensers, resistances, and diagram, 120v. 20 m.a., 20/-; trickle charger, 8/- extra; 150v. 30 milliamps, with 4v. 2-4 amps. C.T., L.T., 25/-; trickle charger, 6/6 extra; 250v. 60 milliamps, with 4v. 3-5 amps. C.T., L.T., 30/-; 300v. 60 m.a., with 4 volts 3-5 amps., 37/6; 200v. 50 m.a., with 4v. 3-5 amps. L.T., 27/6.

PREMIER Chokes, 40 milliamps, 25 hys., 4/-; 65 milliamps 30 hys., 5/6; 150 milliamps, 30 hys., 10/6; 60 milliamps, 80 hys., 2,500 ohms, 5/6; 25 milliamps, 20 hys., 2/9; 250 milliamps, 30 hys., 20/-.

ALL Premier Guaranteed Mains Transformers Have Engraved Terminal Strips, with terminal connections, input 200-250v., 40-100 cycles, all windings paper interleaved.

PREMIER H.T.7 Transformer, output 135v. 80 m.a., for voltage doubling, 8/6; 4v. 3-4a., C.T. L.T., 2/- extra; with Westinghouse rectifier, giving 200v. 30 m.a., 17/6.

PREMIER H.T.8 and 9 Transformers, 250v. 60 m.a. and 300v. 60 m.a., rectified, with 4v. 3-5a. and 4v. 1-2a., C.T. L.T. and screened primary, 10/-; with Westinghouse rectifier, 18/6.

PREMIER H.T.10 Transformer, 200v. 100 m.a., rectified, with 4v. 3-5a., and 4v. 1-2a., C.T. L.T., and screened primary, 10/-; with Westinghouse rectifier, 19/6.

PREMIER Mains Transformer, output 250-0-250v. 60 m.a., 4v. 3-5a., 4v. 2-5a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

(This advertisement continued on next page.)

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as specified by "Wireless World" for "THE STANDARD A.C. TWO" described in this issue.

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All or any of the specified components supplied on receipt of P.O., or sent C.O.D.

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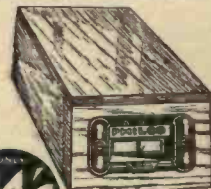


1 .0005 Variable Condenser with Mystic Drive (Formo 8U8)	2 s. 6
1 .0003 Reaction Condenser with Knob (Ormond R508/R505)	6 6
1 .0001 Midget Condenser (Ormond R149)	2 3
1 2-Range Tuning Coil ("Scientific")	3 0
1 Mains Transformer (Savage)	5 6
1 Mains Transformer (Savage)	1 4 0
1 L.F. Choke (Wearie HT12)	12 6
1 L.F. Transformer (Ferranti AF6)	1 10 0
1 H.F. Choke (Goltone 81F)	4 0
2 Microfuses (F4)	2 0
2 8 mf. Electrolytic Condensers (Dubilier 0281)	11 0
1 4 mf. Electrolytic Condensers (Dubilier 0283)	4 6
1 50 mf. 12v. Electrolytic Condensers (Dubilier 3001)	3 0
1 50 mf. 50v. Electrolytic Condensers (T.C.C. 521)	4 6
1 .0001 Fixed Condenser (Dubilier 668)	0 6
1 .0002 Fixed Condenser (Dubilier 663)	0 6
5 Fixed Resistances ("Ohmite")	8 3
3 5-pin Chassis Valveholders (Goltone R20/521)	1 0
3 Toggle Switches (Bulgin 887, 881, 880T)	6 6
2 Terminals (Belling Lee)	3 0
1 6-way Connector Block (Bryce)	3 0
1 Dial Lamp, 6v. (Bulgin)	0 9
1 Cabinet with baffle board (Peto Scott)	1 2 6
1 Loudspeaker—Wharfedale New Bronze Universal	2 2 6
3 Valves as specified	2 5 0

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Phone: Hop 4177



NEW! PHILCO SHADOW TUNING METER

For any make of set with A.V.C. — A.C., D.C., or Battery.



Now you can put Philco Shadow Tuning on any make of A.C., D.C., or Battery set which has A.V.C. This new accessory can be fitted without adjustment and makes this exclusive Philco tuning device available to all. The Shadow Tuning Meter is complete with its own cabinet, decoupling condenser, wire, lamp and full fitting instructions. Or, if desired, can be fitted inside the set's own cabinet. Shadow Tuning shows you when you have hair-line tuning—and therefore pure, undistorted reproduction. Tuning-in completely silent. Makes station-finding child's play. Indicates as well the comparative signal strength of stations.

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65/- POLISHED 35/- CABINET FOR 35/-
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PICKETT'S
Piano Tone Cabinet (W.W.) Works, Albion Road, Bechey Heath, near London.

Components, Etc., for Sale.—Contd.

(This advertisement continued from previous page.)

PREMIER Mains Transformers, output 350-0-350v. 120 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

PREMIER Auto Transformers, 100-110/200-250v., or vice versa, 100-watt; 10/-.

WESTERN ELECTRIC Mains Transformers, 300-0-300v. 65 m.a., 4v. 1-2a., 4v. 2-3a., 6/6; 500-0-500v. 150 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1a. C.T., 4v. 1a. C.T., 19/6.

SPECIAL Offer of Mains Transformers, manufactured by Phillips, input 100-200v. or 200-250v., output 180-0-180 volts 40 m.a., 4v. 1 amp. 4v. 3 amps., 4/6; 200-0-200v., 4v. 1a., 4v. 3a., 4/6.

PREMIER L.T. Charger Kits, consisting of Premier transformer and Westinghouse rectifier, input 200-250v. A.C., output 8v. 1/2 amp., 14/6; 8v. 1 amp., 17/6; 6v. 2 amp., 27/6; 30v. 1 amp., 37/6; 2v. 1/2 amp., 11/-.

B.T.H. Trussed Induction Type (A.C. only) Electric Gramophone Motors, 100-250v.; 30/- complete.

SPECIAL Offer B.T.H. Gramophone Motors, A.C. and D.C. 100-250v.; 30/-; listed £3/3.

COLLARO Gramo. Unit, consisting of A.C. motor, 200-250v. high quality pick-up and volume control, 49/-; without volume control, 46/-.

EDISON BELL Double Spring Gramophone Motors, complete with turntable and all fittings, a really sound job; 15/-.

SPECIAL Offer of Wire Wound Resistances, 4 watts, any value up to 50,000 ohms, 1/-; 8 watts, any value up to 15,000 ohms, 1/6; 15 watts, any value up to 50,000 ohms, 2/-; 25 watts, any value up to 50,000 ohms, 2/6.

CENTRALAB Potentiometers, 400 ohms, 1/-; 50,000, 100,000, 1/2 meg., any value, 2/-; 200 ohms, wire wound, 1/-.

POLAR STAR, manufacturers' model, 3-gang condensers, fully screened; 7/6, with trimmers; unscreened, 5/-.

AERICAN Triple Gang 0.0005 Condensers, with trimmers, 4/11; Utility bakelite 2-gang 0.0005, screened, with uniknob trimmer, 3/6; Polar bakelite condensers, 0.00035, 0.0005, 1/-.

ORMOND Condensers, 0.0005 2-gang semi-shielded, 2/6; brass vanes with trimmers, 3/6; British Radiophone 110 kc/s intermediate, 3/-.

MAGNAVOX D.C. 152, 2,500 ohms, 17/6; D.C. 144, 2,500 ohms, 12/6; D.C. 152 magna., 2,500 ohms, 37/6, all complete with humbucking coils; please state whether power or pentode required; A.C. conversion kit for above types, 10/-; Magnavox P.M., 7in. cone, 16/6.

RELIABLE Canned Coils with Circuit, accurately matched, dual range, iron cored; 3/6.

RELIABLE Interval Transformers, 2/-; multi-ratio output transformers, 4/6.

T.C.C. Electrolytic Condensers, 8 mf. 440v. working, 3/-; 15 mf. 50v. working, 1/-; 6 mf. 50v. and 2 mf. 100v. working, 6d.; 8+4 mf., 450v. working, 4/-; 50 mf. 12v., 2/-.

UTILITY 3-gang Condensers, 0.0005, fully screened, with trimmers, ball bearing straight or superhet., 6/9, complete; with disc drive, 7/11; the best 3-gang available.

BRITISH Insulated Cables Condensers, 8 mf. 550v. peak working, 3/6; 50 mf. 50v., 2/9.

T.C.C. Condensers, 250v. working, 1 mf. 1/3, 2 mf. 1/9, 4 mf. 3/-; 4 mf., 450v. working, 4/-; 4 mf., 750v. working, 6/-; 2 mf., 750v. working, 3/-.

DUBILIER Condensers, 8 or 4 mfd., dry electrolytic, 450v. working, 3/-; 4+4+2+0.1, 300v. working, 3/-.

VARLEY Constant Square Peak Coils, band-pass type B.P.7, brand new, in maker's cartons, with instructions and diagrams; 2/4.

VARLEY H.F. Interval Coils, B.P.8, band-pass, complete with instructions, in original cartons; 2/6.

SCREENED H.F. Chokes, by one of the largest manufacturers in the country; 1/6.

PREMIER British-made Meters, moving iron, flush mounting, accurate, 0-10, 0-15, 0-50 m.a., 0-100, 0-250 m.a., 0-1, 0-5 amps.; all at 6/-.

WESTERN Electric Condensers, 250v. working, 1 mf., 6d.; 2 mf. 1/-, 4 mf. 2/-; 400v. working, 1 mf., 1/-; 2 mf., 1/6.

WIRE-WOUND Potentiometers, 1,000, 2,500, 15,000, 20,000, 50,000, 90,000, 120,000, 200,000, 500,000, 2/- each; 1,000 ohm. semi variable, carry 150 m.a., 2/-.

COSMOCORD Pick-ups, complete with arm and volume control, a really good job; 12/-.

A LARGE Selection of Pedestal, table and radiogram cabinets, by best manufacturers at a fraction of original cost, for callers.

THE Following Lines 6d. each, or 5/- per dozen.—Chassis valve holders 5-, 6-, or 7-pin, screened screen-grid leads, any value 1-watt wire resistances, wire end condensers 0.0001 to 0.1. Bulgin 3-amp. main switches, Cydon capacitors, double trimmers.

SUPER Moving Coil Speakers, handle 10 watts, energised directly from A.C. mains, manufactured by world famous radio and gramophone company; 40/-.

CONDENSER Blocks, 350v. working, 6+4+2+1+1. 4/6; 4+2+1+1+1+1+0.5, 3/9; 9+3+2, 3/-.

PREMIER SUPPLY STORES.

20-22, High St., Clapham, S.W.4. Phone: Macaulay 2188. Nearest station: Clapham North, Underground. [6859]

1/6.—Cadmium plated chassis, 4-valve, pressed steel, 14x9; post 6d.

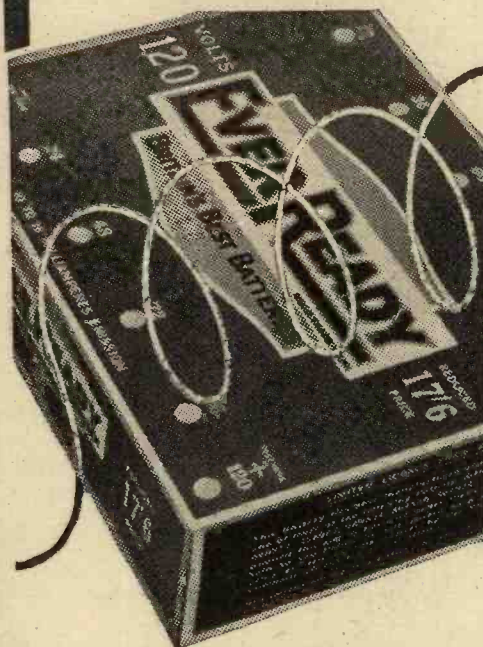
12/6.—Conversion transformer, 20/300 A.C. input, 220v. output, 120 watt; Everett and Edgumbe A.C. voltmeter, 0/250, with resistance block, 12/6; G.E.C. ironclad switch and fuses, 2/6; complete outfit in metal case, 25/-.

20/-.—A.C. supply unit for P.A. loud-speaker, 400v., 100 m.a., suitable for amplifier mains unit.

27/6.—Ediswan D.C. all-electric S.G., detector and Pentode, complete minus valves, breaks up to 50/- worth of parts or converts to A.C.; c.o.d., carriage forward.—Kay, 167, City Rd., London, E.C.1. [6726]

"I changed over to batteries . . . that swarm of bees had gone"

—a short-wave listener writing in "WORLD RADIO"



This short-wave listener has quickly learnt one thing—that a smooth, steady supply of H.T. was, above all things, necessary. He changed to batteries and got it. If you, too, would have the thrill of receiving vast distances, try short-wave reception with Ever Ready Batteries. The unfluctuating flow of current from an Ever Ready Battery ensures for you the essentials for short-wave reception—a dead silent background and a smooth, accurate control of reaction.

THE EVER READY CO.

(Gt. Britain) LTD.

Hercules Place, Holloway, London, N.7.



Components, Etc., for Sale.—Contd.

R.YALL'S RADIO, 44, Lamb's Conduit St., London, W.C.1, callers note: we are just off Theobald's Rd., best approach from Holborn through Red Lion St.; Holborn 3529. Hours 11 to 7 p.m. Saturdays 5 p.m. Thursdays 1 o'clock.

HOWE Box Baffle, large type, 11in. aperture, half price, 20/-; similar, amateur built slag wool, 5/-; R.I. second-hand 250 m.a. output transformer, to clear, 17/50-1, 7/6; set Varley 2 H.F. coils, on base, air, 15/-; Colvern Ferrocart R.F. superhet. coils, 10/14/8, 20/-.

H.T.7, new, with second-hand R.I. transformer with 4v. 6 amps., 15/-; H.T.8, with Heayberd transformer with L.T., 27/6; H.T.10, with Heayberd transformer with L.T., 27/6; Heayberd D250 eliminator, for 200-250v. output, 250v. 60 m.a., 3 var. taps, cost £6, sell £3.

SET Eddystone Single Span Coils, 27/6; 3 Colvern intermediates, air, 6/- each; Rothermel P.M. speaker, 15/-; W.B. Microleed, P.M., 27/6; B.T.H. energised minor speaker, 2,000 ohms, 10/-.

FERRANTI A.F.7, 15/9; A.F.6, 15/9; O.P.c. 2-1 P.P., 5/9; O.M.M.12c, 7/6; B8 chokes, 4/-; Varley constant inductance choke, 10/-; Hypermu, 7/6; R.I.14-28 h. chokes, second-hand, 10/-; Polar minor 3-gang, with moving scale drive complete, 12/6; Ferranti voltmeter, 0-250v., 1,000 ohm per volt, as new, flush type, 35/-.

VARLEY 500,000 ohm Wire Wound Resistances, 9d.; Belling Lee Unit pick-up, new, 17/6; Lewcos S.W. intermediates, 4/-; pairs new Polar thumb drive 0.0005 condensers, with double escutcheon plate, 7/6 pair to clear; Garrard Junior B.D./S. motor, with unit plate, etc., new, 15/-.

WIRE, new Knifetown, etc., 1/2lb. reels, 16 swg. En., 8d.; 1/2lb. 18 swg. C.C., 8d.; 1/2lb. 20 swg. En., 6d.; 1/2lb. 32 swg. En., 9d.; 2oz. 20, 30, 32, C.C., 6d each; 1lb. 26 swg. D.C.C., 1/6; 1lb. 34 swg. D.C.C., 2/-; 1/2lb. 34 swg. D.C.C., 9d.

NEW Ekco K.25 Eliminators, 150v. 20 m.a., with 1/2 amp. trickle charger 45/-; Sonochorde 2,500 ohm speakers, with tapped transformer, 10/6; Met-Vick 250v. transformers, 4v. 2a., 4v. 5a. input, 200-250v., with terminals, 11/-, new; Varley Pentode Nichokes, new, 6/-.

DECONTROLLED Sets: Columbia 4v. battery, S.G. det., Q.P.P. output, Exide and Marconi batteries, complete, £6/5; McMichael Twin Supervo receivers for A.C. mains, 2 H.F. with twin speakers, £9; Ultra Panther superhet, 6v. and rectifier, £10; Lotus D.C. 2 sets, £4/10, all new, complete, etc.

HEYBERD Transformers, new, with leading-out wires, 350v., 120 m.a., 4v. 4a., 4v. 5a., 4v. 2 1/2a., 25/-; Heayberd 500v. 120 m.a., 4v. 4a., 4v. 6a., 4v. 2 1/2a., 32/6; both screened primary and input 200-250v.; carriage forwa d.

RYALL'S RADIO Offer Reliable Resistances, suitable for all sets where a 1-watt resistance is specified, in values 100, 150, 250, 400, 500, 600, 1,000, 2,000, 5,000, 10,000, 15,000, 20,000, 25,000, 30,000, 40,000, 50,000, 75,000, 100,000, 150,000, 250,000, 1/2 meg., 1 meg., 2 meg., all values stated in ohms, 4l. each; also 2-3-watt type, 400, 700, 800, 1,000, 4,000, 5,000, 6,000, 10,000, 20,000, 9d. each wire ends.

RADIOPHONE Volume Controls with Switch, 5,000, 10,000, 15,000, 20,000, 100,000, 2/6; also 10,000 graded 9-1 with 3-P switch, 25,000 graded 9-1 with 2-P switch, 3/6.

POLAR Minor 3-gang Condensers, with "Arcuate," "Horizontal" or "Semi Circular" drive, new, list 24/6, 14/6.

RYALL'S RADIO Offer British-made Mansbridge Condensers, metal cased, brand new, fully guaranteed, 1 mf., 400 vw., 1/3; 2 mf. 400 vw., 1/6; 4 mf. 400 vw., 3/-; 4 mf. 750 vw., 6/-.

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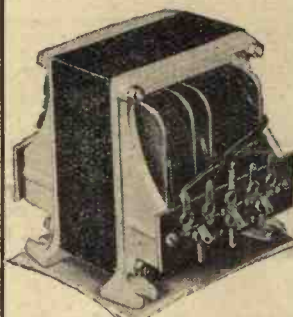
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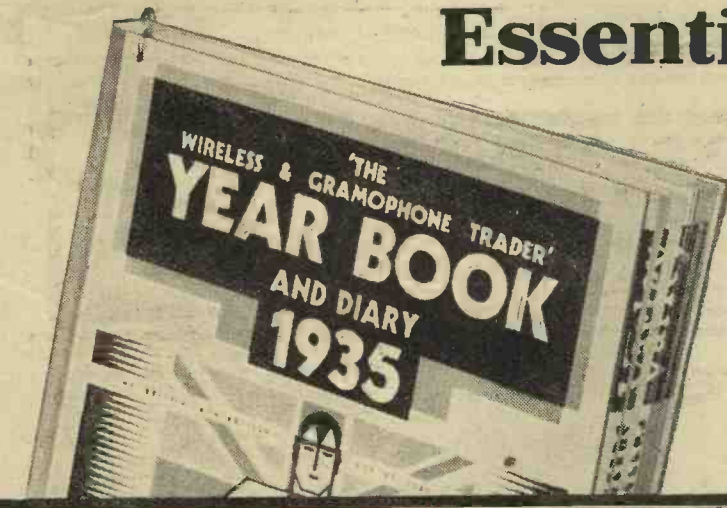
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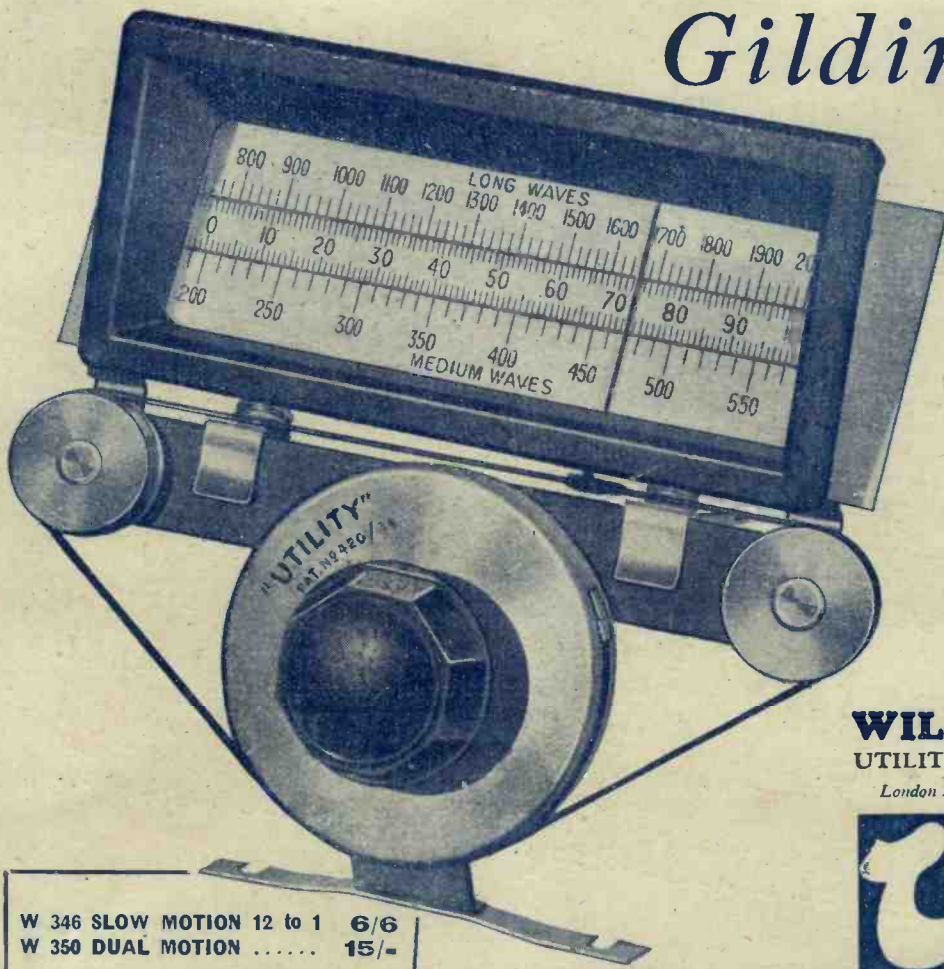
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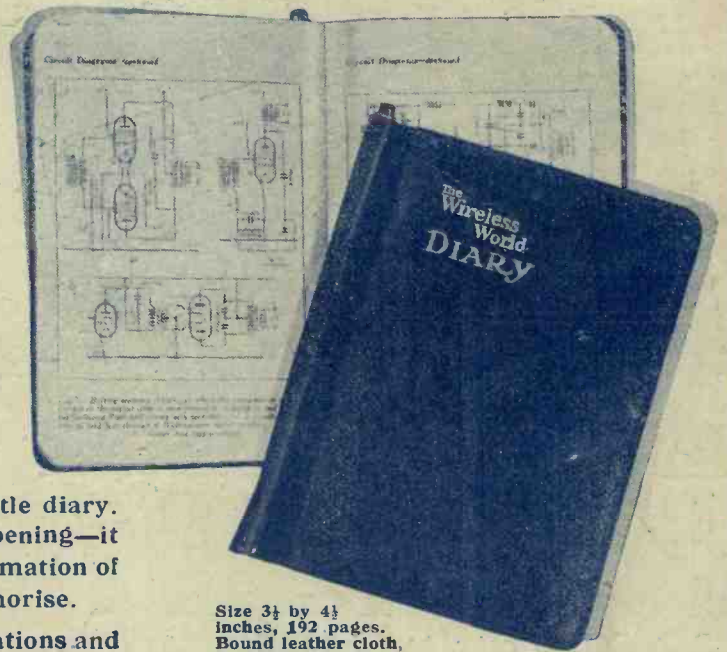
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24th Year of Publication

No. 794.

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

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EDITORIAL COMMENT

Electrical Interference

Responsibility of Listeners

AN article in this issue dealing with the efforts of the Post Office to locate sources of electrical interference and take what steps are possible to bring about the suppression of the trouble, should bring home to listeners what a great deal of effort is being put into this endeavour to make their reception as good as possible. But the listener should not take all this as a matter of course without feeling an obligation on his side. The listener can very materially assist in bringing about the ultimate removal of most sources of interference, and there are three main directions in which he can help. First of all, he should himself cultivate and encourage others to adopt the attitude that noises produced by electrical interference ought not to be there, and he should be prepared to co-operate to remove them.

The Institution of Electrical Engineers, in a report which is summarised elsewhere in this issue, draws attention to the fact that there are several methods whereby interference from electrical apparatus can often be reduced at the receiver itself.

Secondly, the listener can avail himself far more generally than he does at present of the facilities which the Post Office offers where the interference is outside his premises and beyond his power to suppress unaided. It is stated that the Post Office is dealing with some 40,000 cases of interference a year, but unless it is that the Post Office is far behind in dealing with the complaints received, which we do not think is likely, 40,000 seems to be a very small percentage of the total population inconvenienced by interference. It would, therefore, seem that a large proportion of the

public puts up with these distressing noises, perhaps even regarding them as inevitable.

Thirdly, listeners, and particularly those who are technically knowledgeable, should do whatever they can, in the interest of the general cause, to discourage the purchase of domestic electrical apparatus not fitted with the very simple apparatus which is generally all that is required to eliminate disturbances. There are few manufacturers of such articles as refrigerators or motors for domestic purposes who would risk a loss of sales if their customers demanded that the apparatus should be interference-free.

We sincerely hope that our readers, in particular, will do their part in trying to bring about a situation where the ether is no longer polluted with unnecessary noises which mar reception to a degree often unbelievable until interference-free reception has been experienced.

Variations in Reception

Should the B.B.C. Warn Listeners?

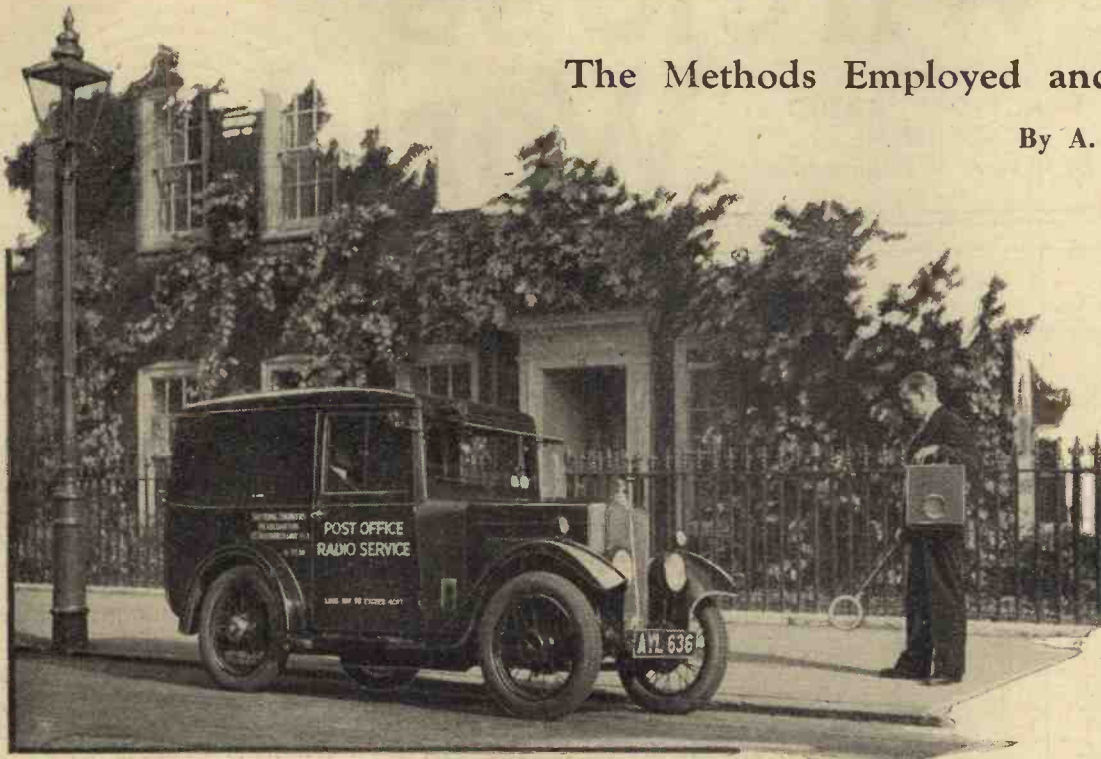
ACASE has recently come to our notice where a reader, in common with most regular listeners, being accustomed to average reception conditions from B.B.C. stations, was somewhat dismayed to find a particular station suddenly change from good strength to almost inaudibility. The explanation for this, given by the B.B.C. was that directional adjustments had been made to the aerial of this particular transmitter.

When such changes become necessary it would seem to us that the B.B.C. should give listeners the benefit of some notice, since otherwise considerable confusion may at times result and sets be blamed for poor performance for which they are in no way responsible.

Radio Interference: Pos

The Methods Employed and Equipment Used

By A. MORRIS, A.R.C.Sc., M.I.E.E.



*M*ANY listeners all over the country have availed themselves of the Post Office free service of electrical interference tracing and elimination. Those who have done so have reason to be grateful for the very great improvement in reception conditions which has resulted whenever the Post Office officials have been able to persuade those causing the interference to adopt the remedies recommended. In this article an account is given of the equipment used by the Post Office to locate the sources of trouble.

THE Post Office gives, free of charge, assistance to wireless licensees who experience interference with their reception of the B.B.C. programme. This radio interference-elimination service is available for the investigation of complaints received from any part of the country; a staff is engaged exclusively upon it in many of the larger towns. Listeners are invited to make known their difficulties by filling in a form, known as an "Electrical Interference Questionnaire," copies of which can be obtained at their local Post Office. Investigations are dealt with by local enquiry officers, who locate the interfering source, demonstrate an appropriate suppression unit and negotiate between the owner and the complainant for the permanent installation of a similar device.

This service has received extensive publicity of late and is now fairly well known to listeners; complaints are being dealt with at present at the rate of 40,000 per annum. Arrangements are now in hand to augment the service by furnishing fundamental information on various aspects of radio interference. This information will be published in the form of a handbill, and will shortly be available to the general public, on request, at local Post Offices throughout the whole country.

Equipment

Enquiry officers are provided with equipment for the carrying out of simple tests of broadcasting receivers and aerials

and for the detection of electrical interference and localising its source. A range of interference suppressors, in the form of testing units, for investigation and demonstration purposes completes the outfit.

Perhaps the most important item of an enquiry officer's equipment is the portable receiver used for the detection of electrical interference. Observations of the relative strengths of the interference at different localities, augmented by the approximate directive properties of such a receiver,

used for the transport of the staff, thereby greatly expediting, as well as cheapening, the cost of handling interference complaints. Photographs of the van and of the equipment which it carries are given in this article.

Suppression Units

The various components for making-up radio-frequency suppressors, of the mains-shunting condenser and series choke (with or without shunt condensers) types, as well as audio-frequency filters, do not need detailed description. A testing unit, arranged so as to facilitate greatly the trial of alternative types of suppressor, is perhaps of more interest. A schematic diagram of its arrangement is given in Fig. 1. Operation of the switches in the appropriate manner, permits of four suppressor arrangements being tried out, namely, (i) condenser, (ii) choke, (iii) choke-condenser, with the condensers on the output side of the chokes, (iv) choke-condenser, with the condensers on the input side of the chokes. There are two types of this unit, each containing chokes of appropriate current-carrying capacity.

One is suitable for use on plant operating with currents of from 3 to 15 amps.; the other is a 25- to 100-amp. type. When the chokes are short-circuited in the former type, the whole of the

operating current is carried by the switch contacts; in the latter type the chokes are short-circuited only to radio-frequency currents, by means of condensers, thus obviating the necessity for the provision of heavy contacts on the switch, which



A general view of the Post Office portable interference detector equipment.

when fitted with a frame aerial, are also made use of for the purpose of tracing interfering sources.

The whole of the equipment is stowed into a specially designed body fitted to a Morris Minor (8 h.p.) van, which is also

Office Service for Listeners

passes only a portion of the operating current. The 25- to 100-amp. type is shown in Fig. 1.

Portable Receivers

Various mass-produced portable broadcasting receivers, of both the straight and superheterodyne types, as constructed and sold at a moderate price by the leading manufacturers in this country, have hitherto been used for the Post Office Radio Service. Such receivers, tuned by means

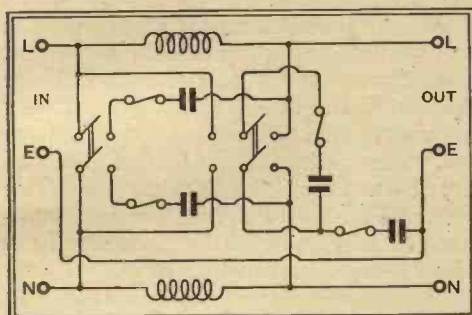
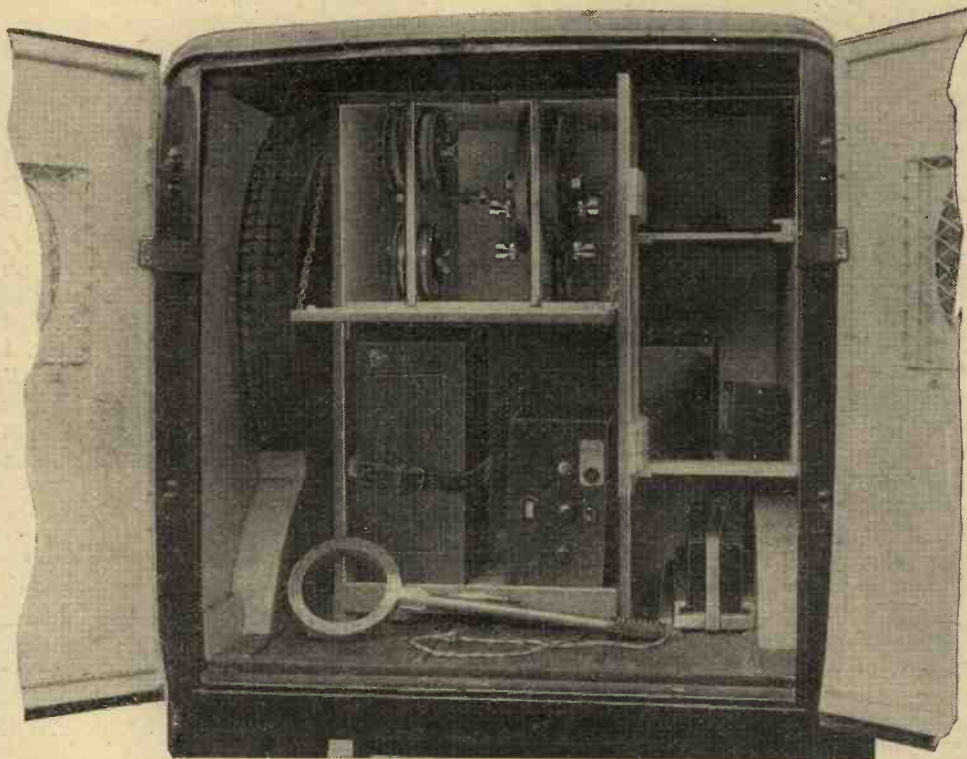


Fig. 1.—Circuit arrangement of a suppression unit used for testing purposes.

of a single control, are provided with a wave-change switch to cover the 200- to 600-metre and 1,000- to 2,000-metre bands, and embody "volume" and "on/off" control in a single switch. They are of robust construction with frame-aerial, loud speaker and batteries fitted within the containing case, which is furnished with the usual carrying-handle and turntable, and with a waterproof cover with pouch for headphones, and flap with press-studs providing access to the controls.

In regard to sensitivity such receivers give normal loud speaker volume when operated by signal strengths of the order of from 0.3 to 0.9 millivolt per metre,

switching the frame aerial out of circuit and for its replacement by an external aerial and earth system, and also for the substitution by means of jack and plug



Inside the enquiry officer's van, which carries all the necessary equipment for hunting-down interference.

whilst their selectivity is such as to enable broadcasting stations, whose frequency separations are not less than 9 kc/s, to be received free from mutual interference.

It is of great convenience to provide for

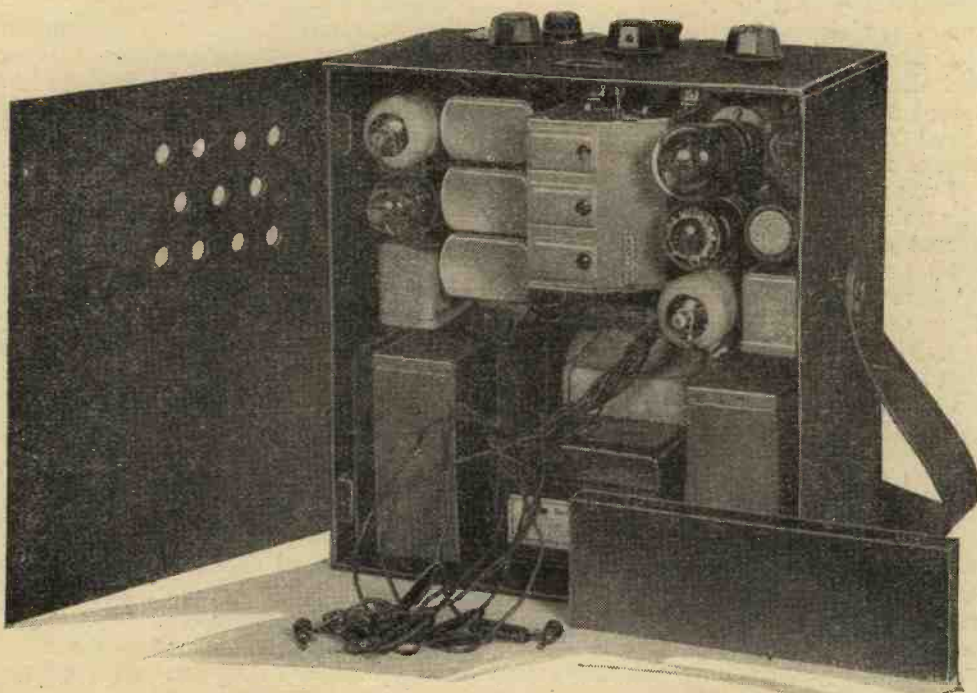
connections of the loud speaker by headphones. Such arrangements have been incorporated in these commercial broadcast receivers.

Taking all their features into consideration and bearing in mind that they have not been primarily designed for interference investigation work, the receivers referred to above have given considerable satisfaction. Their bulk and weight, the latter of the order of 40lb., gives rise, however, to considerable objection.

Post Office Portable Detector

The Post Office has now designed for this service a special portable interference locator of very convenient shape and size, the weight of which has been restricted to 30lb. This detector consists of a five-valve superheterodyne receiver, the signal being introduced either *via* a search coil or a normal aerial and earth system. It is normally battery operated, but can be readily adapted to mains operation. Photographs of the locator, in use and stowed in the van, are given in this article.

In a further article a fuller description of this receiver will be given, and the methods adopted by the Post Office to trace and cure interference will be described.



The new Post Office five-valve superheterodyne with its associated batteries and loud speaker housed inside the portable unit.

UNBIASED

By

FREE GRID

Succour!

I HAVE just been entrusted with a task calling for considerable technical research, and, as I am somewhat pressed for time, am wondering whether any of you are willing to co-operate by carrying out certain experiments in your laboratories and letting me know the results. The circumstances are these:

There is in my neighbourhood some sort of parliamentary by-election pending, and one of the candidates has approached me with the complaint that his unscrupulous opponent started the campaign by rigging up a powerful amplifier and a battery of loud speakers in an armoured car which he had bought cheaply at a Government disposals store. He used this apparatus to address intending voters, and, owing to the nature of the vehicle, the stones of the mercenaries hired by my consultant proved of no avail.

My consultant therefore replied with still more powerful equipment mounted in a tank; with this he was successful in shouting his opponent down until the rival camp went one better in the matter of power. Retaliation of the same kind was made, but naturally this only resulted in still greater power being forthcoming from the other side.

Will You Help?

He had therefore called on me, he explained, in order to get me to design apparatus for causing electrical interference to his opponent's amplifier. In a moment of mental aberration I rashly undertook the contract.



"I was under the impression."

I can only excuse my foolishness by pleading that for the moment I was under the impression that radio was being used in the van, the actual words being spoken into a microphone associated with transmitting apparatus located at the local headquarters of the political party concerned. I must confess that I had not hitherto thought that politicians had sufficient courage to venture out personally in these armoured cars, which I had thought to be steered and operated by wireless control from headquarters.

However, I was speedily enlightened,

finding that the amplifier is purely an audio-frequency arrangement and therefore immune from radio oscillations, violet ray machines, and other things which had passed through my mind. To design an audio-frequency oscillator which will, by induction, introduce an interfering signal into the rival apparatus means, of course, considerable experiment, as it will, I believe, call for the use of large power. It is in this respect that I am asking you to help me.

In order to get round any scruples on the part of people who might not care to design apparatus to combat the efforts of what may be their own political party, I decline to say to which of the "old gangs" my client belongs; in fact, I don't know myself, and neither do I care. Politics are, I feel, quite a secondary consideration where science is concerned.

The Sound of the Hound

INVENTION is the mother of necessity, to judge by the number of impecunious inventors one meets in Carey Street, whither the payment of Patent Office fees has driven them.

I cannot help feeling, however, that it is really the unpatented inventions which are the most meritorious, since in most cases these have been evolved to fill a real and long-felt want on the part of their sponsors, and not with the hope of sordid gain, which, alas! inspires so many would-be innovators.

One of the most interesting inventions falling into the unpatented category was brought somewhat forcibly to my notice the other night. After the final strains of the dance orchestra of the Tom Cat Club had died away at midnight recently, I sallied forth to pay a visit to a very old friend of mine at whose house I am always a welcome visitor.

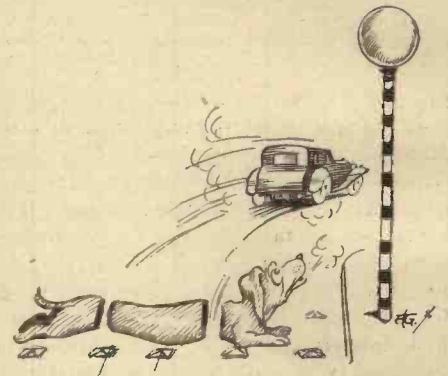
I was surprised to be greeted by a volley of snarls and growls emanating from the kennel of the faithful watch-dog whose habitat my friend keeps in the front porch. As this animal and myself were old friends I was considerably astonished, more especially when soothing words on my part failed to improve matters, so I wisely determined to return home and delay my call until daylight.

The Empty Kennel

At sunrise I sallied forth again, only to be met by the same canine cacophony as soon as I crossed the threshold of the garden gate. To my amazement the kennel was empty, and no animal was to be seen. I was standing debating with myself whether or no I had been bereft of my senses when the milkman came along on his morning round and, with a

cheery "Good morning" to me, dumped his watery wares on the front doorstep without taking the slightest notice of the snarls and growls.

When I pressed him for an explanation he urged me to put my head in the kennel, assuring me on his honour as a lactician that no harm would befall me. Taking my courage in both hands I did as he bade me. Such a sorry tale of human guile and deceit was unfolded before my wondering eyes as I have seldom met with in a somewhat lengthy and varied experience of this wicked world and its evil ways.



"Taking a Belisha beacon at its face value."

Inside the kennel was an electric gramophone contraption, using a continuous band of talkie-film as a record, and it was on this that the offending noises were imprinted. The act of crossing the threshold of the garden gate operated a relay which set the mechanism in motion.

Dog's Vocal Efforts

Subsequent enquiry of my friend revealed the fact that recently his faithful hound had met with a sudden end owing to foolishly taking a Belisha beacon at its face value. My friend had been too heartbroken to buy another animal, but, realising the necessity of a nocturnal watchdog, had installed the present apparatus, making use of a film-recording which he had made of his dog's vocal efforts some years previously in anticipation of the animal's eventual demise.

He is now designing a mechanical figure fitted with snore-producing apparatus. This he intends to install in his bed in order to allay his wife's fears on those occasions when pressure of work at the office necessitates his non-return until the early hours of the morning.

A "New" Source of Filament Current

The Air Depolariser Cell

By R. W. HALLOWS, M.A.



*I*N America what is known as the air cell has been used for some little time now for filament-heating purposes in sets intended for operation in out-of-the-way places where there are difficulties about accumulator charging; but though cells of this kind have been manufactured in this country for many years their use seems to have been confined almost entirely to the working of signalling circuits on railways, and their possibilities for heating the filaments of valves have hardly been realised.

THE air cell, or the air depolariser cell, to give it its British name, is, briefly, a Léclanché cell, which differs from the more familiar types, whether dry or wet, in that when placed under load it settles down within a few minutes to a steady voltage which is maintained for long periods on end. The ordinary Léclanché cell, on the other hand, never reaches a perfectly steady voltage. On its being brought into action, either when new or after a period of recuperation, the fall in EMF is initially fairly rapid, and then becomes less marked; the fall, however, continues during the whole time that the cell is under load. If, therefore, plain Léclanché cells are used for filament heating, frequent movements of a control rheostat are necessary to compensate for the falling voltage.

A further difference is to be found in the fact that whereas a Léclanché cell would have to be of enormous size to stand up to a load of one ampere for, say, three hours a day such a load is easily within the powers of an air depolariser cell weighing ten pounds.

To understand the way in which the air depolariser works it is necessary to have a rough idea of the operation of the ordi-

nary Léclanché cell. The electro-chemical action of a Léclanché cell is actually somewhat complex, but the following is a brief outline of what takes place within it.

The simplest form of Léclanché cell (illustrated in Fig. 1) consists of a containing vessel, partly filled with a solution of

the cell. Hydrogen molecules travel through the electrolyte to the zinc rod, where they quickly form a surrounding envelope of gas bubbles. The presence of these bubbles causes the cell to choke or polarise owing to the high resistance offered.

Fig. 2 shows the way usually adopted for getting rid of the hydrogen. The carbon rod is surrounded by a depolariser, a mixture of manganese dioxide and powdered carbon contained in a porous pot or in a sac. Manganese dioxide parts readily with some of its oxygen. Each molecule consists of one manganese atom and two of oxygen. On the arrival of a hydrogen molecule containing two hydrogen atoms an oxygen atom is given up, and instead of manganese dioxide and hydrogen we have manganese oxide and water.

Dispersing the Hydrogen

In theory the system is excellent; in practice it has many defects. It may, in fact, be said with truth that the real weakness of a Léclanché cell is to be found in its depolarising action. It is clear, in the first place, that the amount of the depolariser present is definitely limited by the size of the cell and by the fact that it must contain also the electrodes and the electrolyte. Unless the current taken from the cell is very small, the depolariser is never quite up to its work. If it were, the cur-

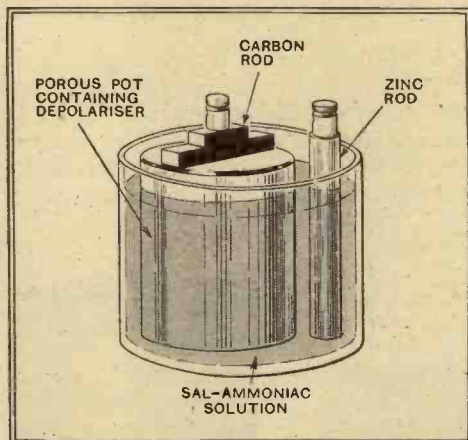


Fig. 2.—Léclanché cell with depolariser.

sal-ammoniac and water, in which are immersed a carbon rod and a zinc rod.

The chlorine in the solution (sal-ammoniac is ammonium chloride) attacks the zinc, tearing out atoms of the metal. But the atoms do not come away complete; each leaves behind it two electrons. It therefore passes into the electrolyte as a positive ion.

The result of the action is that the zinc obtains an excess of electrons, whilst the electrolyte accumulates an excess of positive ions. This being so, when an outside circuit is made between the electrodes, electrons stream from the zinc to the carbon by way of which they pass to the solution to unite with positive ions.

This means that an electric current passes through the outside circuit from the zinc to the carbon. But if an ammeter is connected into the external circuit it will be found that the current from such a cell starts with a rush, and then rapidly falls until only a minute flow is taking place. This is due to a secondary action within

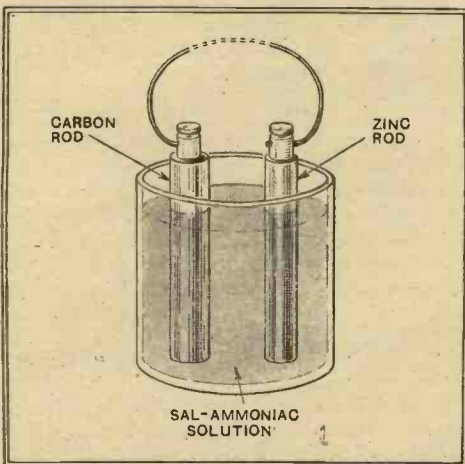


Fig. 1.—The simplest Léclanché cell.

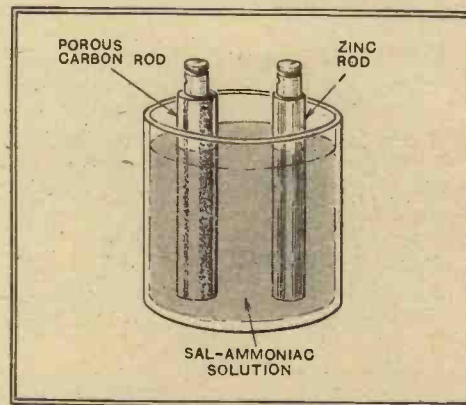


Fig. 3.—The principle of the air depolariser cell.

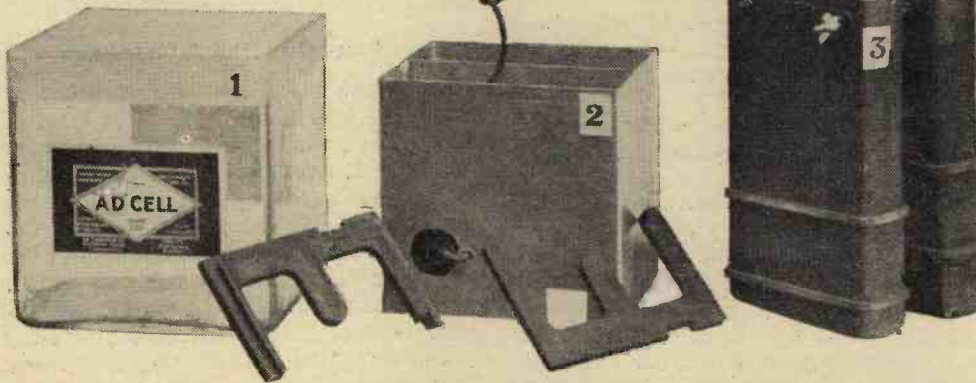
A New Source of Filament Current—

rent would remain steady, since the hydrogen would be disposed of as fast as it arrived. As it is, the current falls because there is a certain lag in the action of the depolariser.

Give a Léclanché cell time by resting it, and the depolariser will clear away the greater part of the hydrogen excess. In other words, the cell will recuperate. What we want for filament heating purposes is a cell the recuperation of which is instantaneous, so that the internal resistance under load is unvarying, and there is therefore no fall in voltage or current taking place.

The way in which the air depolariser cell works is illustrated diagrammatically in Fig. 3. No chemical depolariser of any kind is used. The electrodes and the electrolyte are, in fact, exactly the same as those seen in Fig. 1, except for the fact that the carbon rod is of a special highly porous type. Such a carbon rod may almost be said to breathe—air. Its pores are always filled with air, which contains a large proportion of oxygen, and parts with air readily when the cell is in action.

One great advantage of the system is at once apparent. The supply of air, or, in other words, the quantity of depolariser available, is unlimited, and it is constantly and rapidly renewing itself. Provided that the carbon rod is of the right size and made of the proper material, there is no lag of importance in the depolarising action.



The unassembled parts of an air depolariser cell manufactured by Le Carbone, Ltd.: 1, glass container; 2, renewable zinc; 3, double depolariser carbon electrode.

And this is precisely what happens in the air depolariser cell. Fig. 4 shows the discharge curve for a 10-lb. cell of this kind run for three hours under a load of 0.7 ampere, or about that imposed on the filament heating battery by the average superheterodyne receiving set. It will be seen that the initial EMF is about 1.45 volts. This falls within ten minutes or so to 1.2 volts, a figure which is maintained steadily during the whole of the three hours' run.

A cell of this size has an actual capacity of 500-ampere hours, provided that we see to it that the load imposed is not greater

than one ampere for eight hours a day.

The usefulness of these cells for filament-heating purposes in out-of-the-way places at once becomes plain. Two in series are required, and a rheostat must be used for controlling the voltage. It is particularly important that it should be turned only a little way from the off-position for ten

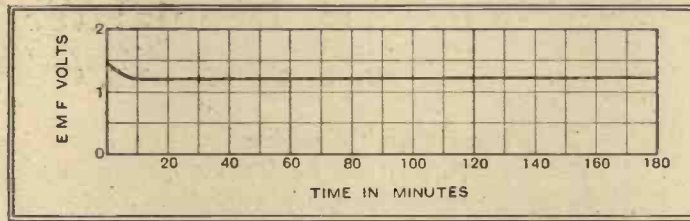


Fig. 4.—Discharge curve of 10-lb. air depolarised cell run for three hours under load of 0.7 ampere.

minutes or so until the battery has settled down. After that it may be moved to the normal working position and left there during the whole time that the set is in operation.

After 500 ampere-hours of service the zinc electrode and the electrolyte require renewal. The carbon electrode, however, has a life at least three times as long, and merely requires cleaning.

Other Forms of Air Cell

Air depolariser cells are made up in other forms besides the wet Léclanché type with sal-ammoniac electrolyte. There is, for instance, a cell weighing nineteen pounds with caustic soda electrolyte which will deliver *continuously* one ampere of

The Diary of an Ordinary Listener

I WONDER if I have been unusually unlucky this week, or if other listeners have experienced similar trouble through the vagaries of the Heaviside Layer, which seemed to be extraordinarily corrugated—or whatever it is that causes frequent and intermittent fading. The trouble causes irritation to those members of my family who cannot understand that I am not to blame.

On Thursday, November 1st, the famous Concertgebouw Orchestra, conducted by Bruno Walter, was relayed from Amsterdam by Hilversum. The programme comprised Weber's Overture to "Der Freischütz" and Beethoven's Pianoforte Concerto No. 4, in which the solo instrument was in the capable hands of Franz Osborn. Fading was somewhat bad, so I sought refuge with Radio-Paris, where the French National Orchestra, under the leadership of D. E. Inghelbrecht, gave a fine rendering of the Prelude to Act III of "Parsifal" and Bach's "Actus Tragicus," in which this famous orchestra, with choir and soloists, was heard to great advantage.

The following evening, being an ardent admirer of Handel's music, I naturally turned first to Kalundborg and Copenhagen, but too late to hear the whole of the Concerto in B flat for organ and orchestra. This was followed by extracts from "The Messiah," of which I specially enjoyed the very clear and firm singing of the "Amen" chorus. Then on to Huizen for an organ recital by Tom Andriessen, which concluded an Andante by Mendelssohn, but I soon found the station suffering from interference, the source of which I was unable to locate; it sounded like hand-riveting in a boiler shop.

Where German Scores

On Saturday a good performance of "Cavalleria Rusticana" was relayed by Munich from the State Opera House. I was especially struck with the sympathetic singing of the Santuzza and the fine baritone voice of the Alfio, whose despairing song, just before the intermezzo, sounded, I thought, far more emphatic in German than in the somewhat trite English translation so often heard. A 'cello recital was down on the programme for Radio Toulouse at 8.15, but came on later in the evening owing to M. Doumergue's broadcast speech. While waiting for the recital I went over to Brussels No. 1 for a Mendelssohn concert and heard part of the "Ruy Blas" overture.

On Sunday, after ineffectual attempts to retain Stockholm and Paris P.T.T., I settled down for a time with Copenhagen, where the Radio Orchestra was playing Dvorak's Slav Dance in A flat and Arensky's Variations on a theme by Tchaikowsky.

Tuesday's programmes were rather a "mixed bag," beginning with Beethoven's "Egmont" Overture from Huizen, and two fine bass solos from Brussels No. 2: first, an Aria from "The Magic Flute," and secondly, "Mentre ti fascio," both by Mozart. I then went over to Copenhagen for the Overture to Rossini's "Tancredi," and the Ballet music from Verdi's "Aida," finishing up the evening with a harpsichord recital from Radio Paris. CALIBAN.

current at over one volt for 1,000 hours. Again, there is a dry cell weighing eight and a half pounds which has a capacity of 300 ampere-hours, and can be depended upon to deliver one ampere of current for three hours a day.

So far, the air depolariser principle has not been applied to the small cells used in high-tension batteries. If this could be done at reasonable cost, it would solve one of the most pressing problems of the battery user.

But for filament heating the cell has long been available, and it is strange that its use has not been extended to this need.

Making the Most of a Dual Loud Speaker

Experiments in Stereoscopic Sound Effects

By "CATHODE RAY"



Piezo-electric high-note speaker (R. A. Rothermel Ltd.).

FOR some years now the vogue has been for receivers wearing their own built-in loud speakers. Even so, the very reasonable demand for freedom to place the loud speaker where it is most needed is recognised in the "EXT. L.S." sockets or terminals that are practically always fitted. I suppose that these are thought of chiefly as an attempt to solve the servant problem by running a music line into the kitchen. And, of course, there are many other situations in which it is useful to be able to listen without having to uproot the entire receiving installation.

But some readers may be interested in a subtler use of additional loud speakers; that is, as a means of making the programmes more realistic.

One of the things that mar the illusion of reality in radio is the spreading of the sound from a single restricted source—the loud speaker. Even although the sound actually reaches the ears from all direc-

ance. The comparison of a flat photograph with the original scene is rather similar.

Experiments in what is known as "binaural hearing" (or "stereoscopic sound") have shown how very much more natural is the effect that can be got in this way. But it involves duplicating the whole equipment, including both transmitter and receiver, so is not likely to come into general use in the near future.

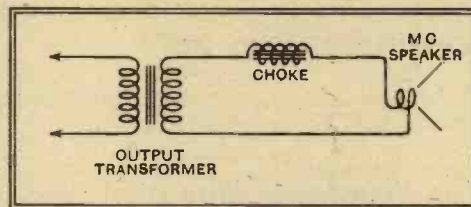


Fig. 2.—A choke of suitable inductance interposed between the loud speaker coil and its transformer winding restricts the output to low notes.

in size and otherwise adapted to reproduce only the upper tones. All these are incapable of supplying the very lowest notes; but for the purpose we have in view just now it may even be a good thing to cut out most of the middle notes, too, either by choosing an appropriate model or by connecting the speaker in such a way that only the real "top" gets through in any force. Actually force is perhaps not the best word to use, because the volume from the tweeter alone may seem almost absurdly small. But as those who suffer from a chattering gramophone pick-up know, a small volume of very high pitch has the ability to colour a large mass of low and middle sound.

Those of you who have heard a demonstration of the "Multitone" sound-unmasking system, as used in the originators' deaf-aid apparatus, would be impressed by the way in which a whisper of high notes applied to one ear transforms a deafening and unintelligible "whoofiness" in the other ear into clear speech. Although this principle can be strictly applied only when the two lots of sound are taken separately to the ears by headphones, some of the effect is noticeable even with loud speakers as described.

Realistic Reproduction

Another interesting thing is that, although the proportion of sound coming from the tweeter is so small, one usually gets the illusion that it is very large. It is quite difficult to realise that the main loud speaker is doing anything at all. Yet one gets very pleasing effects. For instance, when there is a "hot" trumpet piece in the playing of a dance band, the soloist seems to step forward and stand out in front of the band. There is greater separation of the ingredients in a mixed programme of speech, music effects, and so forth. They are reproduced with something of the original distinctness, instead of being fixed into a single, obviously mechanical, mass of sound.

Of course, the success of this dodge depends very much on how it is contrived. Obviously I cannot give information that would fit every possible case. The type of receiver that has been sold during the last year or two is, unfortunately, deficient in really high notes and does not provide very promising material for the experiment. Moreover, pentode output valves are generally used, and it is very difficult to make an electrostatic speaker work satisfactorily from them. The magnetic

An inferior but quite worth-while imitation can be obtained by the much more practicable method of duplicating only the loud speaker. But it should not be a strict duplication; that is to say, the loud speakers should be thoroughly different.

The idea of using two, or even more, different sorts of loud speaker, each handling part of the musical scale, has been well used abroad; but in my opinion a large part of the advantage is lost by mounting them close together. For one thing, there is some reason to believe that the working of the small high-note partner is liable to be upset when a powerful low note from the bass speaker makes everything near it flap to and fro.

"Tweeter" Types

However that may be, it is worth while making the experiment of separating them by some distance. I suggest that the moving coil speaker that handles the low notes should be at the far end of the room, say, in a corner; while the high-note speaker (popularly called a "tweeter") should be within a few feet of the listener. When there are several listeners it is more difficult, but this should be the general idea to aim at.

Several distinct types of "tweeter" are now available. There is the electrostatic (Primus Manufacturing Co.), which is my own choice; the piezo-electric (made by R. A. Rothermel, Ltd.), and others which are merely ordinary loud speakers reduced

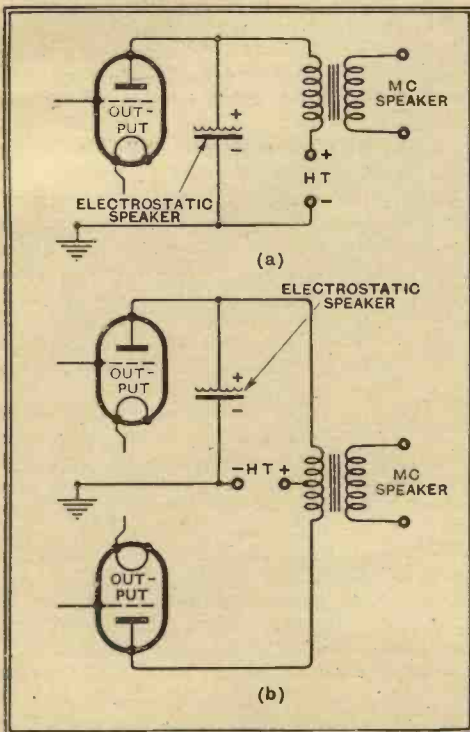


Fig. 1.—An electrostatic loud speaker is connected direct from the anode of the output valve to -HT or earth. The connections for a single valve and for a pair in push-pull are given at (a) and (b) respectively.

tions, being reflected from all parts of the room, the distribution has a fixity which makes one miss some sense of space and depth obtained at an original perform-

Making the Most of a Dual Loud Speaker—types of "tweeter" are probably more suitable.

The *Wireless World* quality-enthusiast is more likely to use a triode output to which an electrostatic speaker can very easily be connected as shown in Fig. 1. Remember when running the flex about the room that it is taking the full HT voltage.

One of the small electrostatics is enough for this duty, and is less likely than a large one to present difficulty in working.

In the absence of anything better, the bass note speaker may be the ordinary moving-coil type incorporated in most receivers. But a small cheap loud speaker with a stiff cone suspension, mounted in a plywood cabinet of the usual size, gives only a travesty of bass reproduction: the connoisseur will bring into action a large

heavy model with ample coil motion, and mount it on a large non-resonant baffle.

As even a loud speaker intended first for bass reproduction does also reproduce the high notes (usually with an unpleasant peak at about 2,000-3,000 c.p.s.) it is a good thing to keep as much as possible of the latter from reaching it. The simplest method is to connect an iron-cored choke coil in series with the secondary of the output transformer (Fig. 2). The best coil to use depends on the impedance of the loud speaker coil itself. Sometimes the low-impedance secondary of a step-down output transformer makes a good choke. A very rough way of telling whether it is suitable is to see whether the resistance of the proposed choke is equal to or rather less than that of the loud speaker moving coil.

tric clock mechanism is used to operate the switching system.

Exceptionally wide wave-range coverage is a feature of many new American sets. For example, the multi-wave receivers produced by the American General Electric Company, and by the R.C.A.-Victor concerns, cover wavelengths between $8\frac{1}{2}$ metres and over 2,000 metres in five steps.

A correspondent, referring to reception in the United States of the short-wave British Empire transmitters, complains that Pittsburg interferes with GSB on 31.55 metres. Similarly, GSD on 25.53 metres is interfered with by the German station DJD, and by CJR, Winnipeg.—*Radio News*, New York, October, 1934.

BOOK REVIEW

Short Wave Radio Handbook. By Clifford E. Denton, B.S., E.E., M.E., M.A. Published by The Radio and Technical Publishing Co., 45, Astor Place, New York City. Price one dollar.

The author has set himself the not-too-easy task of compiling a handbook that, while essentially practical, will nevertheless appeal to all interested in short-wave reception. Its scope is well summed up in the Introduction, where it is stated "In the course of several years' work it is only natural that a great deal of practical data would find its way into the author's files. The information, culled from observations and tests conducted during the design of many short-wave receivers and equipment, plus findings of others engaged in short-wave design work, should prove as valuable to the reader as it has to the author."

This is the keynote throughout, helpful data without mathematical reasons for the facts stated, for it is assumed that, as the amateur experimenter is mainly interested in results, theoretical circuits and design questions in general are of little help unless accompanied by values and constructional data.

Coils are dealt with very fully, in Chapter III some fifteen different styles are illustrated and winding details provided, while in the later part of the book, where there is a chapter devoted exclusively to construction of receivers, oscillators and power packs, still more coil data is given. This section is well illustrated and deals with simple three-valve sets as well as multi-valve superheterodynes, battery- and mains-operated.

There are numerous tables and charts for quick determination of circuit values and best operating conditions. Of these the valve chart is especially useful, as it gives the functions of all the American valves, or tubes, as they are described here, for throughout the book they are referred to only by their type numbers.

It covers every aspect of short-wave reception, with some notes compiled especially for the beginner, and it is indubitably a valuable addition to the bookshelf, for there are few manuals dealing so lucidly with the practical side of this very interesting part of the radio spectrum. H. B. D.

Motor Driving Made Easy (5th edition), by R. F. Broad and the Technical Staff of *The Autocar*. This book contains complete information for the beginner concerning all aspects of the ownership and driving of a car. Pp. 158 with 73 diagrams. Published by Messrs. J. J. Cliffe and Sons Ltd., Dorset House, Stamford Street, S.E.1. Price 2s. 6d. net.

Short-wave Working Model

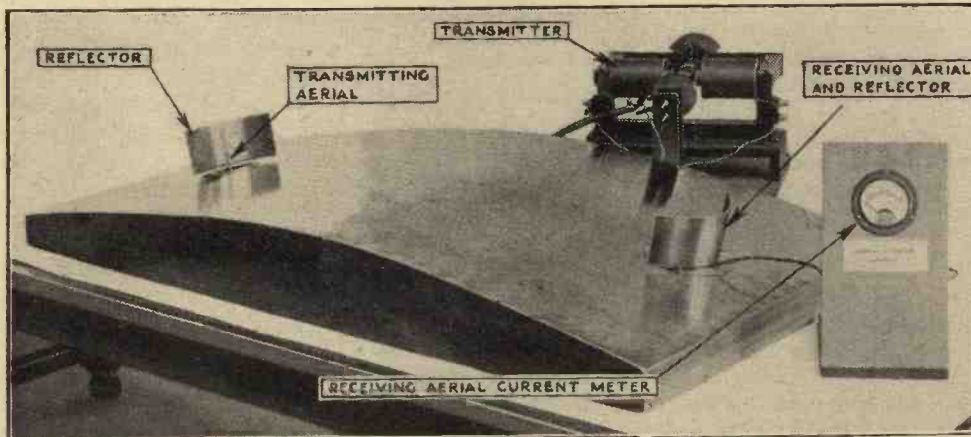
A Micro-wave Demonstration Set

THE generation of electromagnetic waves shorter than one metre has for some years past occupied the attention of radio engineers, and such progress has been made in this field that in our issue of February 2nd last we reported the inauguration of a 17-cm. radio service between Lympe and St. Inglevert. The development of efficient and stable oscillators for

form the subject of an article in the November issue of *The Wireless Engineer*.

Transparent Wire Insulation

A NEW method of insulating instrument wire (as used for the windings of transformers, etc.) has been devised by an American firm. The wire is first enamelled, and



Experimental model for investigating wave propagation using micro-waves.

wavelengths of this order has, however, provided the physicists and research workers with a useful tool for investigating in the laboratory the principal phenomena of wave propagation, and at the 1934 Physical Society's Exhibition there was a demonstration model shown by the Research Staff of the M.O. Valve Company, Ltd., at Wembley.

Miniature aerials with reflectors mounted on a curved frame to represent the curvature of the earth's surface, but exaggerated in comparison with the height of the aerials, as shown in the illustration, were used. Signal strength within and beyond the optical range could be recorded on a meter, and also the effect of reflection from a metal plate held at different heights.

The results obtained with this model and the apparatus used for these experiments

is then protected by a strip of transparent cellophane, which is wound on spirally, being sealed and finished with a coat of baked lacquer. It is stated that the finished product has approximately 64 per cent. the volume of double cotton-covered wire. The layer of cellophane protects the enamel insulation against heat and varnish solvents.—*Radio Engineering*, New York, October, 1934.

A Self-tuning Receiver

THE new Atwater-Kent 11-valve console model has what is described as a self-tuning system; this means that the receiver can be set beforehand to tune itself to any one of fourteen different programmes for any predetermined length of time. Thus it is possible to plan an evening's listening in advance, and, having set the controls, to leave the receiver to do the rest. An elec-

Developing Single-Span

An Improved Aerial Filter

By W. T. COCKING

Tuning

CONSIDERABLE development has recently taken place in the field of single-span tuning and the improvements in technique have been embodied in a new receiver, constructional details of which will shortly appear in "The Wireless World." A description of the advances in design will not be withheld until the appearance of the set, and in this article details are given of a new form of aerial filter—one of the most important parts of a single-span receiver.

THE single-span system of reception is unique in that it provides single-control tuning without the need for ganging, and this is particularly important for it makes accurately matched components unnecessary. It will be remembered that a set of this type is a superheterodyne with an intermediate frequency higher than any signal frequency within the tuning range. This means that second-channel interference from stations operating within this tuning range is an impossibility, and it consequently becomes unnecessary to tune the aerial circuit.

The oscillator always functions at a frequency considerably higher than that of any desired signal, so that the ratio of its maximum to minimum frequencies is much smaller than the ratio of the highest to the lowest signal frequency. As a result it is readily possible to cover the medium and long wavebands in a single swing of

range of the set, it may occur from stations operating on frequencies of 3,350-4,700 kc/s (89.5-63.8 metres). The aerial coupling circuit, therefore, must be designed to give high attenuation to this band of frequencies. The ideal aerial filter would be one which would pass without loss all frequencies between 150 kc/s and 1,500 kc/s (2,000-200 metres), but form a complete barrier to all other frequencies.

The Design of the Filter

Now it is by no means easy to design a filter which combines an even response in the pass region with a high attenuation outside this range. In theory, it would be possible to employ a low-pass or band-pass filter of the Campbell type, and there are more or less definite rules for their design. In order to obtain a flat response in the pass region, however, the filter must be designed for a terminating resistance which is high compared with the aerial reactance at the lowest frequency concerned. The aerial reactance at 150 kc/s is about 5,000 ohms, and if the filter impedance be made only 10,000 ohms it will call for coils of 1,000 μ H and condensers of only 10 mmfds. The impracticability of using such small condensers will be realised when it is remembered that it is not uncommon for the input capacity of a valve to exceed 10 mmfds. The coils, moreover, would be another source of difficulty, for their self-capacity would be such that they would cease to act as inductances at too low a frequency.

In the case of the early single-span receivers the problem was met by employing a pair of fixed tuned circuits coupled by a common capacity. Fundamentally, the circuit is the same as that used for the capacity coupled band-pass filter often employed in straight sets. The values assigned to the components, however, are widely different, as befits the different requirements. The performance obtainable with a filter of this type is quite good considering its simple nature, and in the pass region it is shown by the dotted curve of Fig. 1. This curve shows the voltage applied to the grid of the first valve for 1 volt injected into the aerial, so that the

percentage efficiency can be obtained simply by multiplying the vertical scale by 100.

It will be seen that the efficiency is by no means constant, and varies from 190 per cent. at 570 kc/s to 17 per cent. at 1,500 kc/s, and this naturally means that the sensitivity of the set varies in like manner. With present-day valves, moreover, the high efficiency at the peaks of the curve proves a disadvantage, since overloading may occur if a peak happens to coincide with the frequency of a local station.

Considerable research has recently been devoted, therefore, towards the development of a filter possessing better characteristics. Very many arrangements have been tried, and the best has been found to be a modification of the original filter. The connections are shown in Fig. 2, and it will be seen that the only change which has been made in the circuit is the addition of R3 and L3.

The purpose of these components is to give a good response on the long waveband, with the result that the other components can be chosen, not as before for

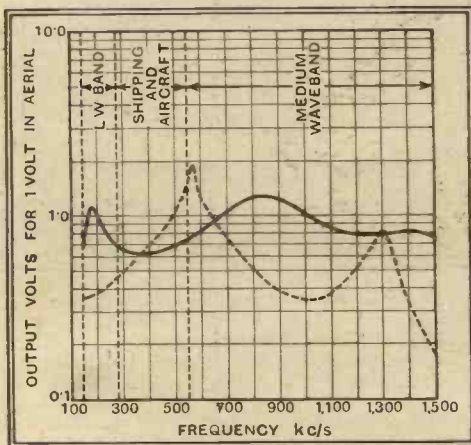


Fig. 1.—The dotted curve shows the response of the original single-span aerial filter, while the performance of the new circuit is indicated by the solid-line curve. The improvement is very striking.

the variable condenser controlling the oscillator, and coil changing, whether by plug-in coils or by switching, becomes a thing of the past. It will be seen, therefore, that single-span tuning offers very considerable advantages over other methods.

Although second-channel interference is impossible from stations in the tuning

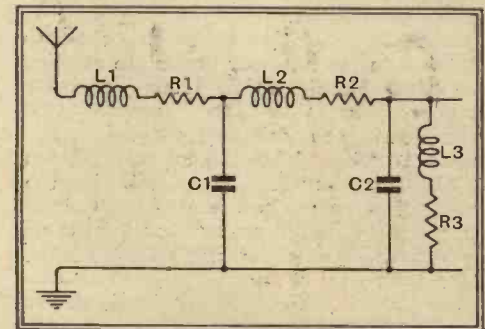


Fig. 2.—The connections of the new filter are shown in this diagram. The values of the components are $L_1 = L_2 = 200 \mu$ H; $L_3 = 1,450 \mu$ H; $C_1 = 125$ mmfds.; $C_2 = 100$ mmfds.; $R_1 = 700$ ohms; $R_2 = R_3 = 300$ ohms.

the best average response over the whole tuning range, but for the medium waveband only. The coils, therefore, can be of lower inductance and the coupling can be looser; with the result that the inherent efficiency is higher, and it is possible to use higher value damping resistances with a consequent gain in uniformity of response.

On the long waveband, the coils L_1 and L_2 and the resistances R_1 and R_2 can be ignored, so that in effect the filter becomes a simple parallel tuned circuit with C_1 and C_2 in parallel with the aerial capacity tuning L_3 to about the middle of the long waveband. The resistance R_3 is inserted in order to prevent an excessive response

Developing Single-Span Tuning—

being obtained, and the measured response for the whole broadcast band is shown by the solid curve line of Fig. 1.

The improvement over the original filter is very marked, particularly at the extreme ends of the tuning range. Moreover, the point of lowest efficiency has been moved to the middle of the shipping band, where good reception is not usually required. Taking the broadcast ranges as 150-280 kc/s and 550-1,500 kc/s, the maximum variation in efficiency is plus or minus 30 per cent. about the 100 per cent. mark. This is so much smaller than the variation experienced with most straight sets and many ordinary superheterodynes that it can be said to be negligible.

The practical advantages of the new filter are a noticeable increase in signal strength on the long waveband and at the lower end of the medium waveband. There

is also a reduced risk of interference from morse transmissions on frequencies lower than 150 kc/s, since the filter cuts off more sharply than the old one at this point. Furthermore, owing to the absence of the peak at 570 kc/s there is less chance of valve overloading in districts having a transmitter operating on a frequency around this figure. In this country, this will most affect those who have the North Regional station for a local transmitter.

Development in single-span reception has not been confined to the aerial filter, however, and there is no part of the equipment which has not received attention. Increased efficiency has been obtained in the frequency-changer, and improved selectivity in the IF amplifier, and these points will be dealt with in detail in next week's issue of *The Wireless World* preparatory to describing a new receiver embodying them.

Activity in the Dutch East Indies seemed to be increasing a few weeks ago, but nothing has been heard recently except an occasional transmission from Bandoeng on 15.93 metres.

Of the European transmissions there is no need to say much. The various wavelengths used by Zeesen all seem to produce quite a strong signal in England; Radio Coloniale is not so strong, neither is its quality so good, but overseas listeners do not appear to agree on this point. GSA (Daventry) on 49.6 metres has frequently been heard in London at R9, and Moscow and Rome, whatever wave they use, seem to be received at that strength.

MEGACYCLE.

THE RADIO INDUSTRY

IT is understood that a new car radio receiver, to be known as the Austin, has been developed by the City Accumulator Co., Ltd. Production models will be ready in a few weeks. Negotiations are already afoot for equipping taxicabs with Austin sets.

Britannia Batteries, Ltd., of Union Street, Redditch, Worcestershire, have now produced additional Pertrix replacement batteries for a number of receivers, including Portadyne, Philips, Marconiphone, etc.

A broadsheet issued by Belling and Lee, Ltd., Cambridge Arterial Road, Enfield, Middlesex, shows pictorially the connection of Belling-Lee interference-suppressing devices to various electrical appliances, and also to the listener's house-wiring system. Copies are available for our readers.

All Cossor receivers and kits are attractively illustrated and described in a new catalogue

Short-wave Broadcasting**Listen for South America : Short Waves in Europe**

UP till this summer the majority of short-wave listeners imagined that the outstanding reception of Central and South America was in the nature of a freak. The fact that conditions were good for those particular localities, together with the large number of active stations from which to choose, seemed to indicate something of the sort.

One may safely say now, however, that it has been established that this reception was no freak, and that Central and South Americans, like the North Americans, will be always with us.

Conditions for the reception of South America on the amateur bands are at their best from March till September or early October, after which they usually fade away until the following spring. The South American broadcasters have shown no such tendency this year, and with the arrival of new stations (generally in Colombia!) at the rate of one per month it seems that South America is fast establishing a claim to be lord of the short-wave ether.

The latest official list shows no fewer than fifteen Colombian broadcast stations between 45 and 52 metres. True, there are very few of them on the shorter waves at present, but the fact remains that on certain nights practically every other station heard is a Colombian.

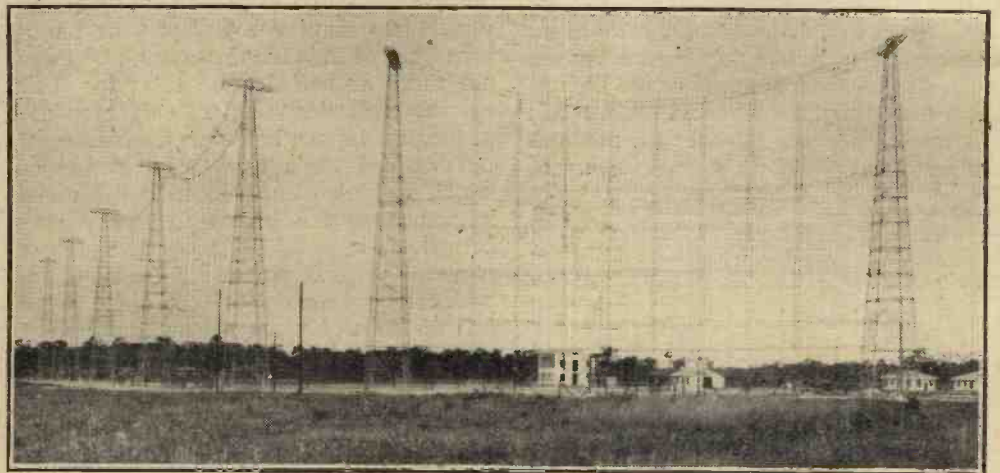
Patchy Conditions

Venezuela, too, stakes her claim in no uncertain fashion with some twenty stations in all, and the latest country to appear in quantity is the Dominican Republic, from which one may hear HI4B (46.37 metres), HIZ (47.5), HI1A (47.8), HIX (49.5), and yet another just above 50 metres.

One is tempted to ask why all this short-wave activity is going on. Many of the programmes are obviously intended for overseas listeners, who do not contribute to the running costs of the stations. Presumably there is some reason for it all. Meanwhile, the short-wave enthusiast has reason to be grateful for all the entertainment provided.

Conditions during the past fortnight have

been rather patchy. One or two extraordinarily good days have been followed by "dead" periods, although on no day has it been impossible to receive the writer's usual "test" station—W3XAL on 16.87 metres. *The Wireless World* 1935 AC Short-Wave Receiver has never failed to operate the speaker on this station between 4 and 5 p.m.



PROGRAMMES FROM BRAZIL. Special programmes, with news in English, are broadcast daily, except Sundays, from PRF5, Rio de Janeiro, on 31.5 metres (9,505 kc/s). The English news bulletin is sent out between 23.00 and 23.15 (GMT). The transmitter, seen above, is situated at Marapicu, in the Brazilian jungle, some 80 kms. from the city. Reports, which are welcomed, should be sent to the Short Wave Station, Caixa Postal 709, Rio de Janeiro, Brazil.

Extremely good transmissions from the Melbourne station VK3LR have been received on one or two mornings round about 7.30 a.m. This station seems to be even more consistent than Sydney, VK2ME, although the wavelengths are not far apart. These are the only two transmissions from the Antipodes within the reach of the average short-wave broadcast listener.

Broadcasts from the Far East, however, are increasing in strength and reliability as the days grow longer. Bangkok, HSP, on 16.92 metres, although not listed as a broadcast station, has been using gramophone records occasionally. VUB, Bombay, in the middle of the 31-metre band, has also been heard quite frequently.

(Booklet No. B.25). Copies will be sent to readers who apply to A.C. Cossor, Ltd., Cossor Works, Highbury Grove, London, N.5.

New Catalogues Received

Electro Dynamic Construction Co., Ltd., Devonshire Grove, London, S.E.15.—Power for Public Address: Leaflet describing various portable generator, including petrol-driven sets, for supplying amplifiers, etc. Another leaflet describes an inexpensive 20-watt rotary transformer suitable for charging car or radio batteries from D.C. mains.

Wilkins and Wright, Ltd., Utility Works, Holyhead Road, Birmingham 21.—Utility wireless components (variable condensers, switches, and the Utility television mirror drum).

Broadcast Brevities

By Our Special Correspondent

Letters to the B.B.C.

HAS the worm turned? Time was when the failure of a B.B.C. station led to a spate of letters at broadcasting headquarters and a corresponding spate of polite replies indicating that if listeners were not getting the best of results it was the fault of their sets or of the upper atmosphere.

So Pleased

Usually listeners were so pleased to receive anything on official notepaper that the substance of the reply was scarcely heeded until the luckless listener made another attempt to pick up the station.

They Write to Us

I have definite indications that listeners no longer write to the B.B.C. when in trouble. They now turn to the Press. In recent weeks numerous correspondents have told me of poor reception of Droitwich in Northern Ireland and in the North of England, yet enquiry at Broadcasting House goes to show that the B.B.C. postbag on this matter is exceptionally small.

This is somewhat distressing, because, surprisingly enough, the Corporation is this time ready with a really good excuse, namely, the special autumnal vagaries of the Heaviside Layer.

Conditions are said to be improving, however, reception now being reliable for a greater proportion of the programme time.

Newcastle is Troubled

Newcastle listeners complain that their own station is badly heterodyned; this trouble the B.B.C. lays at the door of Radio Lyons and Beziers. Representations are being made to the French authorities, who may be persuaded to keep their station closer to their allotted frequencies.

Shuffling the Wavelengths

SOME excitement has been caused by the announcement of changes in the British wavelengths in the New Year. I can say that any plans in this direction are at the moment indefinite. Any change that takes place will be nothing more than a reshuffle of a few British wavelengths among a few British stations.

Those "Obsolete" Stories

Even so, stories have gone the rounds that these changes will render certain receivers ob-

solete. How do such tales arise? One hesitates to think that they can be inspired by any reputable manufacturers.

Only in one sense can a wave-change render a set obsolete, and that is in regard to station-marked tuning dials.

More Water With It

THE Chief Engineer has decided that the Midland Regional will no longer require so strong a wave power . . . and a lower wave will be allotted to it."—Special Daily Mail News.

No Bouquets, No Reiths

AT the time of writing, no special plans have been made for greeting the Director-

Applied Frequencies

YOU are acquainted, as I am, with wireless men to whom music, *per se*, is something strange and incomprehensible—like a snake's dinner. Ask them to test your speaker for frequency response, and they will put it faithfully through its paces from 30 to 30,000 cycles, noting all the weak spots. But get them to sit through an example of applied musical frequencies—a Beethoven sonata or an Elgar suite—and they will gnaw wood or run amok in other ways.

An Australian Guide

Would they, I wonder, be helped by "Music and the Listener," price 2s. 6d., published in London by Robertson and Mullens (Aust.), Ltd., 231, Strand? To my mind, this Aus-

In the first place, we should protest against bad music being called popular. I am afraid that sometimes over the air, after we have had a couple of hours' enjoyable music, the announcer says, in a voice of complete relief, 'For the rest of the evening we shall entertain you with popular music.' A sort of sly inference that classical music is not popular!

Picking Out Themes

"If announcers, instead of saying 'We shall now entertain you with popular music,' said, 'We shall now entertain you with some low-grade music' or 'cheap music,' it would be a neat psychological experiment to observe the reaction of the audience after a few months."

"Listening," he adds in the concluding chapter, "can be made a hundred per cent. more pleasurable when the listener follows the themes and understands what is going on."

Filming "In Town To-night"

DESPITE its detractors, "In Town To-night" continues to be one of the most successful of all the short programme features. Now comes the highest form of flattery from the film world, for I hear that British Lion have begun production at their Beaconsfield studios of a radio musical comedy under the same title.

The cast reads like a mixture of several big radio, theatre and cinema programmes, including, as it does, such artistes as Stanley Holloway, Leslie Sarony, Leslie Holmes, Tessa Deane, Val Rosling, Wilson, Keppell and Betty, the Three Radio Rogues, and the Tiller Dancing Girls.

Dave Apollon and Carroll Gibbons

Two importast dance orchestras are also appearing, viz., Dave Apollon and his Band, which has proved a great success since its arrival in this country a few months ago, and Carroll Gibbons' Orchestra, which is well known to listeners.

"In Town To-night" is being directed by Herbert Smith, who was responsible for the radio revue, "On the Air."

What It Sounded Like

FROM the Yorkshire Observer:—

The shrill soprano on the wireless reached her top note, and there was some applause from the studio audience.

"Oh, Mummy," said a small boy who did not like the singing, "listen to them smacking her."



BROADCASTING A STAG HUNT. A Deutschlandssender radio squad at a meet in the former Imperial hunting ground, "Schorfheide," near Berlin. The commentator carries a short-wave transmitter and his companion the batteries. In the rear is the control engineer.

General at Broadcasting House after his long trip. There are no festoons, no banners, no addresses of welcome.

It is expected that Sir John Reith will arrive one morning at 9.29, nod a "good morning" to the liftman, and at 9.31 be once more deep in his work.

The Portrait Album

Perhaps, on the other hand, he may instantly ask to see the new staff portrait album, to which I was able to make first exclusive reference in these columns some weeks ago. The collection of portraits is not yet complete, because, for understandable reasons, very few of the staff are consenting to be photographed in their offices.

tralian handbook is ideal for the man who seeks a conversational knowledge of music and would like to get more kick out of the broadcast programmes.

The author, Keith Barry, Lecturer in Music to Sydney University, treats brightly of musical forms (fugue, nocturne, minuet, etc.), describes instruments of the orchestra and how they can be distinguished, has helpful words on harmony and rhythm, and includes some rare practical hints on listening.

Classical and Popular

"Many people," he writes, "instinctively divide music into 'classical' and 'popular.' This is a very haphazard division, and also quite a misleading one.

Radio Interference Committee

Record of Progress to Date

THE Institution of Electrical Engineers has just issued a statement in regard to the work of their Radio Interference Committee appointed to investigate the whole question of Radio Interference caused by electrical apparatus. The following is a summary of the report.

THE Committee have received valuable help from the Technical Secretariat of the Committee and the organisations represented by its members, viz., the G.P.O., the B.B.C., the E.R.A., and the I.E.E. Evidence and assistance from a number of official and unofficial bodies have been given to the Committee, as a result of which it was confirmed at an early stage that radio interference was widespread and constituted a serious annoyance to the public. The knowledge of the technical side of the question of radio interference has advanced considerably during the year under review, and the Committee have, they believe, been instrumental in no small measure in fostering a desire to rectify the trouble and to bring together in mutual effort those who are able to take action towards its elimination. The Committee are convinced of the importance of solving this difficulty quickly, and of securing the co-operation of the many sections of the industry, without whose goodwill and help little can be achieved.

Appeal to Listeners

The Committee find that listeners and those who advise them have not yet done on their receiving sets all that is possible to mitigate some of the effects of interference. A memorandum has been prepared for the Committee by the B.B.C. on the features of design and installation of radio sets which, when attended to, help to lessen, and sometimes greatly to lessen, the trouble. The Committee consider that these precautions should receive the special attention of those who supply radio sets and their components and who service radio sets for the public.

Nevertheless, even given such favourable conditions as the listener can provide, there is left a large amount of interference which can only be effectively corrected by suppression at the source—that is to say, by fitting suitable condensers (and sometimes condensers with choke coils) to existing types of apparatus causing the interference, and by improvement in design of new models. Such interfering apparatus usually contains a commutator motor, but exceptions to this occur in large plant such as mercury rectifiers or high-tension lines which, under certain conditions, may cause trouble. Apparatus in which a contact or contacts are only occasionally operated need not be considered objectionable if properly maintained.

It appeared to the Committee early in

their deliberations that preparations should be made by which manufacturers of interfering apparatus could know how to apply the necessary correction and how to appraise the interference. The Committee therefore took the initiative in the preparation of a specification covering this side of the subject, as a first step towards assisting those manufacturers who desired to produce interference-free appliances. It might be difficult, to commence with, to apply correction to much existing apparatus, but there seemed every reason to make the way as plain as possible for those who desired to render new apparatus inoffensive. In the preparation of the specification the Committee have had the co-operation of the British Standards Institution, and it is expected that it will be possible to issue the Specification early next year, without extensive modification, as a British Standard.

At an international meeting, which was held in Paris at the end of June, an approximate idea was obtained of the level of interference which other countries are thinking of accepting as permissible in connection with their regulations. As far as can be seen, this permissible level is more tolerant than any of the countries would like to be in a position to prescribe, and more so than the Committee have desired to adopt as an "objective." But the Committee have agreed that if hard-and-fast regulations are to be laid down at the present time the more tolerant figure is inevitable.¹

Compulsory versus Voluntary Suppression

The I.E.E. Committee are reluctant to be dogmatic on the subject of compulsory versus voluntary suppression of radio interference. They state that it is not the tradition in England to make regulations until it is certain first that they are needed, and secondly that they can be carried out effectively when made. There is at present much goodwill amongst all concerned, and readiness to help to rectify trouble where it is serious; the Committee believe that in many directions a threat now to impose compulsory regulations might have the effect of retarding rather than enhancing these influences. But they agree that when co-operation and goodwill have done their best there may be a residuum of recalcitrant cases in which some

form of compulsion will probably be desirable. The manufacturers of household apparatus are unwilling at the moment to express themselves definitely on the question of compulsion. The extent of the increase in price of appliances appears to depend materially on the level of interference which is permissible. Manufacturers have been very ready to prepare technically the design of non-interfering apparatus, but on account of increased price there may be a reluctance to market such articles until the requirement is made to apply to all—including importers. This, however, is in the nature of surmise and is not at the moment a practical issue because the Committee consider that more experience and investigation are needed before there can be any feeling of certainty that the proposed standards and methods of appraisal of radio interference are practical and could be effectively included in any form of official regulations. Although certain Continental countries are already imposing regulations for a measure of compulsory suppression at the source, the Committee would prefer to see the technical standards and methods to be used better established before suggesting whether or not this country should follow their example.

NEW BOOKS

The Wireless and Gramophone Trader Year Book, 1935: 256 pages. The Trader Publishing Company, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 5s. 6d. (3s. 6d. to subscribers to *The Wireless Trader*).

This annual work of reference, now in its tenth year of issue, is available only to those connected with the radio and gramophone trades. It contains much useful information—technical, commercial, legal, and statistical—of interest to all branches of the industry, and, in addition, a diary section of practical size is included.

In the directory section are to be found some 1,800 addresses of manufacturers and wholesale agents, and there is also a Buyers' Guide, giving sources of supply of more than 200 different classes of apparatus and other articles.

The technical section contains articles on the organisation and equipment of a dealers' service department, information on the suppression of interference, accumulator charging, etc., in addition to valve data tables.

The book has been completely revised, and many alterations and additions have been made to the 1935 edition.

Wireless for the Man in the Moon, by Coulombus and Decibel.

This book presents the fundamental principles of wireless in an entirely novel and refreshing manner, and gives a real insight into its subject. Pp. 128 with thirteen illustrations. Published by George Newnes, Ltd., Southampton Street, Strand, London, W.C. Price 2s. 6d. net.

¹ A reference was made to the work of the Paris meeting in *The Wireless World* of July 27th, 1934.

New Apparatus Reviewed

Recent Products of the Manufacturers



New Dubilier condensers; the Type 620, B770 and tubular pattern, all tested at 1,000 volts DC.

DUBILIER CONDENSERS

RECENT additions to the Dubilier range of condensers comprise an extension of the 620 series to include some new models for 500 volts DC working and a new series in the B770 type, also for the same working voltage. Both styles are mica-condensers.

The Type 620 are assembled in small bakelite cases measuring $2\frac{3}{8}$ in. \times $1\frac{1}{2}$ in. \times $\frac{1}{2}$ in. wide; they are tested at 1,000 volts DC, and are made in sizes ranging from 0.0001 mfd. to 0.005 mfd., the prices being from 2s. 6d. to 3s. 3d., according to capacity.

We have measured a 0.0001 mfd. specimen and found its capacity to be 0.000102 mfd., and subjected it also to a 1,050-volt test without puncturing the dielectric, for no measurable leakage was observed.

Similar tests were applied to a specimen 0.05 mfd. Type B770 condenser, this style being an upright pattern, also in a bakelite case, but measuring $2\frac{3}{8}$ in. \times $2\frac{3}{8}$ in. high over the terminals \times $\frac{1}{2}$ in. wide. In the 1,000-volt test series the sizes range from 0.01 mfd.

tube with wire ends securely fixed to the container, and capacities range from 0.001 mfd. to 0.5 mfd., and they cost from 1s. to 2s. each according to size.

The makers are the Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.

LISSEN QPP TRANSFORMER

THIS transformer is for use with a QPP output stage, and as it has a step-up ratio of 1 to 8; sufficient amplification for normal home requirements is obtained with one LF stage after the detector, which would be the output valves. In appearance it is similar to the Lissen Hypernik transformers, being of quite small size, made possible by the use of a nickel-iron core, and it is housed in a mottled brown bakelite case.

The primary inductance is adequate for the usual type of detector valve, though the makers recommend one of 10,000 ohms AC resistance. Best results will be obtained with parallel-feed connections, and the recommended values are 0.5 mfd. coupling condenser and between 20,000 and 30,000 ohms for the anode resistance. It may be used in the more orthodox manner, but the steady DC through the primary should not exceed 4 mA. A parallel-feed circuit was used for our tests, and the overall amplification of the first valve and of the transformer, taking the output of one-half only of the secondary, was measured at all audible frequencies from 30 to 10,000 c/s, using in the one case a 25,000-ohm anode resistance and in the other a 50,000-ohm,

the two sets of measurements being shown by a full-line curve and by a broken-line curve respectively.

It will be seen that the amplification is sensibly constant over the major part of the audible range despite the use of a valve having a higher AC resistance than sug-

satisfactory in this respect, as the measured output from each half was identical.

The makers are Lissen, Ltd., Lissenium Works, Worple Road, Isleworth, Middlesex, and the price is 12s. 6d.

BROWN'S "A" TYPE HEADPHONES

MANY readers will recall the "A" type headphones made by S. G. Brown many years ago, for they had acquired a reputation for high sensitivity which was an



Brown's "A" type headphone, incorporating a cone diaphragm and an adjustable reed.

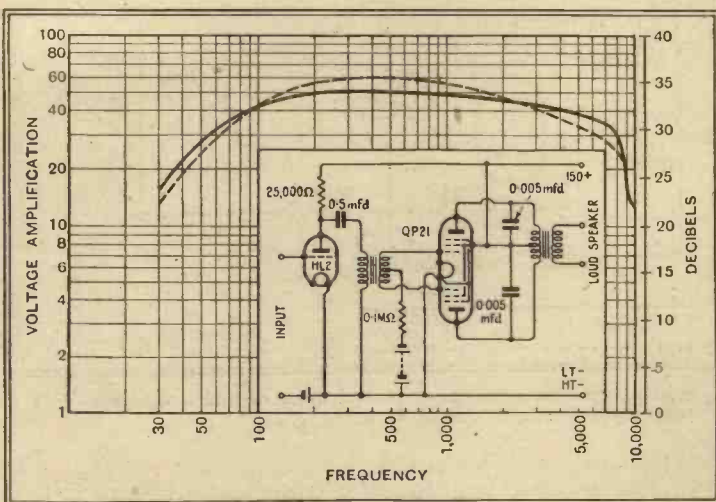
achievement of no mean order in those early days when headphones were used almost exclusively for reception.

It is of interest to record, therefore, that these 'phones are still available, and in an improved form, being made by The National Radio Service Co., 15-16, Alfred Place, Tottenham Court Road, London, W.C.1. The original design is retained, and as this is so widely different from any other style a brief description may interest those not familiar with the arrangement. In place of the customary flat diaphragm is a light spun aluminium cone clamped at its edge by the perforated cap. The centre of this cone is attached to a small reed fixed at one end, while the other, or free, end is located close to the pole pieces, which in these 'phones are placed in line and on each side of the reed.

The construction is not very dissimilar to a reed-type loud speaker, only in miniature.

The distance between the reed and the pole pieces can be varied, and the adjusting screw—a large milled knob—is found at the back of the ear piece.

We have tested a pair of the latest pattern and find them exceedingly good; they are very sensitive to weak signals and give excellent reproduction on broadcast. The very fine workmanship that characterised the original 'phones is maintained in the present make; they are comfortable and light, and the head-band is adjustable for size. The pair sent to us are wound to 2,000 ohms, and they cost 50s.; they are obtainable, however, wound to any resistance at the same price.



to 0.1 mfd., the former costing 3s. 6d. and the latter 12s. Its capacity was within 7 per cent. of the marked value, and it showed no trace of leakage on a 1,050-volt DC test.

These higher voltage types have been introduced to meet the demand for high-grade mica-condensers suited for use in modern sets where the working voltage often exceeds 350 DC, but the original models rated for 250 volts DC working are still retained in both styles.

There is, also, a new tubular pattern rated at 400 volts DC peak working and tested at 1,000 volts. It is a non-inductive paper dielectric condenser fitted into a bakelised

Lissen QPP transformer with step-up ratio of one to eight.



gested by the makers. In general, mains valves have a lower impedance than their equivalent battery type, and in such sets the LF amplification will be even more uniform throughout.

In a QPP circuit it is essential that both valves receive equal voltages, which requires that the secondary be accurately centre-tapped. The Lissen transformer is entirely

Short Waves and the Amateur

THE SUPERHETERODYNE RECEIVER (Concluded)

Part III.—The Second Detector

By G2TD and G5KU

THE frequency changing and IF amplifying systems have been fundamentally considered, and it is now necessary to discuss the problem of efficient second detection, particularly with reference to obtaining audible signals from CW transmissions, and bearing in mind the necessity for maintaining a high signal/noise ratio. It would be very absurd to attain the object in the amplifying system and lose it in the process of second detection. In the first place a consideration of this stage from the viewpoint of receiving telephony transmissions only involves a simple detector circuit in which a certain amount of damping upon the previous IF tuned circuit is permissible, and probably necessary, in order to obtain sufficient fidelity to make speech intelligible. In this case simple diode detection followed by audio frequency amplification by a triode will be sufficient for headphone reception, while a further power stage will enable a loud speaker to be operated. Alternatively, a triode or tetrode used as cumulative grid detector may be connected in a manner common with normal superheterodyne second detectors.

The efficient reception of CW signals, however, presents a new problem, as it is necessary to apply to the detector not only the IF signal, but also a local frequency having a difference of a few hundred cycles from it. The rectification of the combined input produces an audible note as is well known. One process which achieves this result is by the use of an oscillating detector to produce the hetero-

condenser C. The method suffers from three distinct disadvantages, with a possible fourth:—

- (1) Single signal reception is not possible.
- (2) The detector cannot be working at maximum sensitivity.
- (3) Since grid detection is essential for smooth reaction the input circuit must be damped, impairing selectivity.
- (4) The signal/noise ratio does not appear in practice to be good.

The question of single signal response arising in (1) is very important and will be elucidated as follows:

When using an oscillating detector it will be noticed that during the process of

By this method of CW reception there are, therefore, two channels of reception available and only one is used. This is not economical, for the remaining channel might be used for other signals. As it is, a signal in this other channel causes mutual interference and results in one or even both signals being unreadable. The single signal system of CW reception enables one of the pair of channels to be practically eliminated and its efficiency in this respect, expressed as the ratio of the two channel strengths, depends fundamentally on the IF selectivity. It is useless to attempt single signal reception with poorly designed IF transformers or even the best band-pass IF transformers; or if using a badly damping detector after the IF amplifier. It is only amenable to an IF stage as described in the writers' last note.*

For single signal reception two important conditions must be fulfilled. (1)

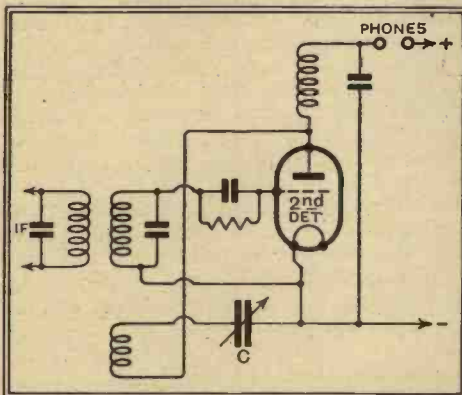


Fig. 1.—The simplest arrangement of the second detector for reception of CW signals.

dyne as found in many straight sets. This is depicted in Fig. 1, a few turns of reaction being loosely coupled to the secondary of the preceding IF transformer, oscillation being controlled by the

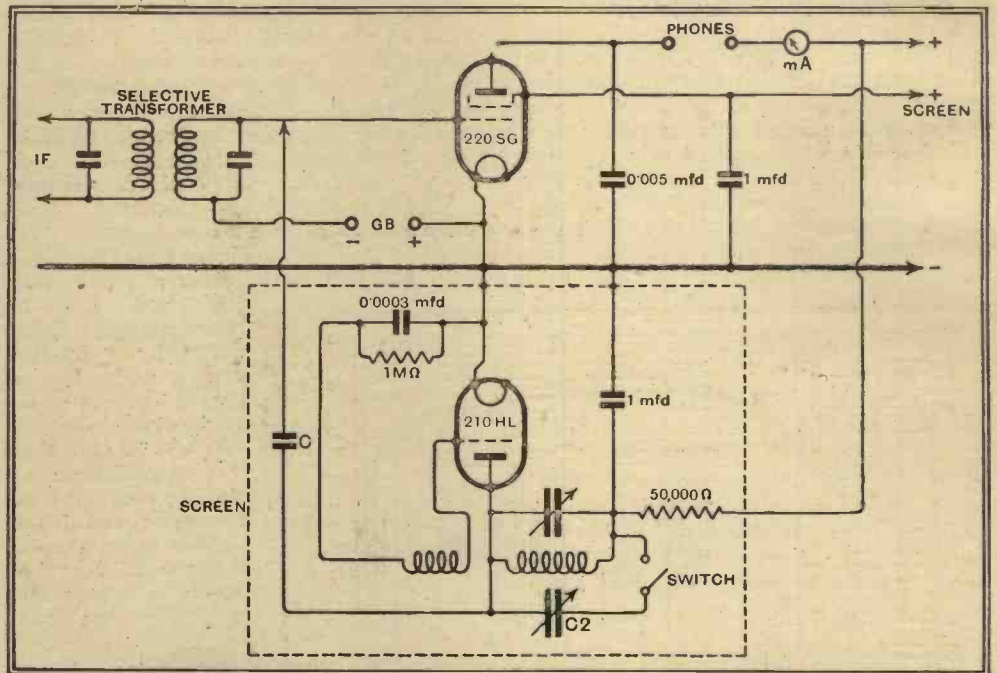


Fig. 2.—For single signal reception an anode bend second detector and a separate heterodyne oscillator should be used.

tuning through a CW station the note is at first high in pitch and as the tuning condenser is rotated the note decreases in pitch, becoming zero as correct tuning is obtained, and then rising once again to an extremely high note when the condenser is on the other side of the tuning point. It will be noticed that any particular note may, therefore, be obtained with two settings of the tuning condenser, both producing equal strength. It is usual to tune until the note is of the order of 1,000 cycles, which is approximately the resonant frequency of the headphones and the pitch to which the ear is most sensitive, thus obtaining the highest possible acoustic result from the arrangement.

A separate heterodyne must be employed in place of an oscillating detector. (2) The use of a second detector which does not impair the IF selectivity by input damping. Fig. 2 shows a practical circuit for achieving single signal response. The coupling condenser C should be a low loss air condenser, not more than 50 mmf. total capacity, only a few mmf. being found necessary to obtain optimum heterodyne voltage.

The oscillator, in the case of 50 kc/s IF should be capable of variation between 48 and 52 kc/s and in practice is tuned to approx. 51 kc/s, C2 being set so that

* Short Waves and the Amateur, "The Superheterodyne Receiver," Part 2, *Ibid.* Oct. 26th.

Short Waves and the Amateur—

when switched in 49 kc/s is obtained, enabling either channel to be selected and each giving a note of 1,000 cycles.

After adjusting to 50 kc/s the oscillator may be used to trim the IF amplifier with the aid of a detector anode current meter and then, in the presence of a CW signal tuned in to give maximum deflections on the meter, the oscillator is detuned until the required heterodyne note is heard, C2 then being switched in and tuned to give the same note with the lower frequency of separate heterodyne oscillation as explained above. For all purposes the detector requires initial biasing to anode current cut-off, observable on the meter, which is an indispensable adjunct and, provided excessive heterodyne voltage is not used, will prove useful in aiding the ear in signal strength measurement. The single signal effect relies upon the fundamental fact that the oscillator is now mistuned from IF, together with the fact that the IF amplifier has a selectivity comparable with this degree of mistuning (approx. 1 kc/s); conditions which cannot be attained with an oscillating detector.

DX Notes

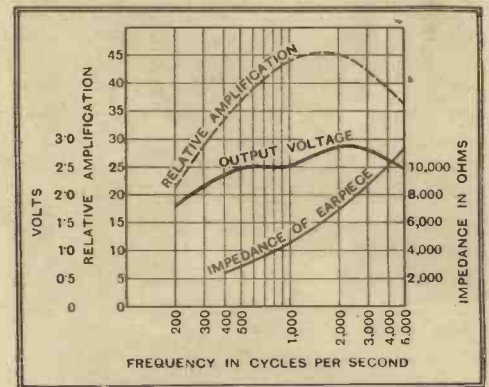
An interesting comparison can now be

made with 20 m conditions between summer and early winter. Whereas, in summer, it was usual to find transmission over the Atlantic at its best round 21.00 GMT the band is now dead at that time, the maximum now occurring during the afternoon. The band appears to be active only along daylight paths, except for countries where it is now summer, e.g., S. Africa, which can now be worked at about 19.00 GMT. ZSIP and ZSIH are among the best heard from S. Africa, reaching R7, while simultaneous signals from Kenya are much weaker at R5. ZS5P would welcome reports on his low power 40 m signals, and VEIAK, who is using a 20 m beam aerial, would welcome European reports. A few W6 stations are also experimenting with West to East beams on 20 m, so that good 'phone reception from California may be possible soon. English amateurs requiring reports and co-operation on tests are: G2SY cw and 'phone, G6PJ on 20 m, also G5XT; and G5LC requires Canadian reports on 20 m.

The next B.E.R.U. contest is fixed for February, 1935; it includes a Receiving Contest, and anyone interested is advised to communicate with R.S.G.B. Headquarters.

from the curves supplied by the makers and reproduced by courtesy of the G.E.C., in whose laboratories the measurements were made.

An unspillable 2-volt accumulator supplies LT current, and should give about a week's service before recharging; HT is derived from a special small dry battery of 30 volts, and, as about 3 mA. only are taken from it, from three to four months' use should be obtained before replacement becomes necessary.



Curves showing overall amplification and frequency response of Radio-aid Midget amplifier.

Radio - Aid Midget Amplifier

Portable Unit for the Deaf

THE design of acoustic amplifiers in portable form for the deaf, and especially units in which the response is corrected scientifically to compensate for the individual's aural defects, has for long been a speciality of Radio-Aid Ltd., 45, Duke Street, Oxford Street, London, W.1., for as far back as October 21st, 1932, we reviewed what at that time was thought to be one of the smallest amplifiers of its kind.

The latest production of this firm is not only smaller but embodies a two-stage amplifier, as compared with the single stage of the earlier model. But perhaps its most important feature is that it leaves the hands free, the new model being so proportioned that it is very conveniently carried by a shoulder strap. It measures 9in. x 4in. x 3in., and this small compass is made possible mainly by the use of the new Marconi and Osram Midget valves, which have been developed especially for amplifiers of this kind.

In order to obtain a power output sufficient to meet all contingencies, for obviously only a small HT battery can be accommodated, three of the Midget L11 type valves are used in parallel, with resistance-capacity coupling from the input stage, in which one H11 is fitted.

A carbon microphone of seemingly

orthodox pattern is embodied in the unit, but it possesses particularly good characteristics, being adequately sensitive, yet having a low noise level, and there are no outstanding resonances.

Quite a high order of amplification is obtained, and from various tests we have made we feel convinced that the unit will prove of inestimable value to all requiring an artificial aid to hearing. Some idea of its general characteristics can be gleaned



The price of the Radio-Aid Midget (wearable) Amplifier, as the unit is described, is 20 guineas, complete with headphones, of which a choice of two styles, one with a headband and the other with a spring clip that fits comfortably behind the ear, is provided.

Design of Naval Receivers

THE difficulties of wireless reception aboard a heavily armoured battleship are clearly brought out in a paper by Dr. W. F. Rawlinson in the September issue of the *Journal of the Institution of Electrical Engineers*. It is interesting to note that the method of solution is the same as that which has been successfully applied to broadcast reception in the presence of local interference, namely, the use of a shielded low-capacity downlead with suitable transformers at the deck level and in the wireless room.

Another interesting feature of naval receivers is the use of an aperiodic screen-grid HF stage in front of the circuit proper. This is to enable several receivers to be operated from a single aerial, should this necessity arise in action.

Service conditions demand the ability to receive signals over a frequency range of 15 to 23,000 kc/s. For this three main receivers are used: a straight short-wave set for 1,500-23,000 kc/s, a medium-wave superhet. (150-1,500 kc/s) and a long-wave receiver (15-150 kc/s), consisting of a tuner unit, HF amplifier, note magnifier, and note selector units. There is also a stand-by det-LF set covering the whole of the above waverange with plug-in coils, and special DF and non-directional receivers employing frame aerials.

In addition to the electrical design of the sets, the mechanical design of tuning condensers, etc., which may be in continuous use for twenty-four hours per day are disclosed.



Listeners' Guide

Outstanding Broadcasts



LISTENING TO SHAKESPEARE

SHAKESPEARE'S "Cymbeline"—even after whittling down for the microphone—will last two hours on Sunday next (National) beginning at 5.35. This seems rather a long time, but the possibility of tedium can be lessened by following the drama from the printed page. Personally, I always find excitement in pursuing the nimble performers from one "cut" to the next. Their script, of course, is taken from an acting edition, still further abridged for broadcasting purposes, while mine is (I hope) taken from the original folio.

Peter Creswell is the producer of Sunday's performance. Norman Shelley takes the part of "Cymbeline," and Peggy Ashcroft that of "Imogen." Mary Hinton will be "Queen of Britain."

LEFT-HANDED LEADER.

THE listener would never guess that the leader of the Kolisch String Quartet, broadcasting this evening, is left-handed.

The Quartet will be heard in a Schubert and Beethoven Chamber concert at 8.50 in the Regional programme. All four instruments in the Quartet were built by the same maker.

KENTUCKY MINSTRELS as they appear in the Universal Pictures' production of that name, with Nina McKinney, singer and dancer. In to-night's broadcast (National, 8.30) they are under the direction of Harry S. Pepper, giving a genuine black-faced minstrel show.

THIS WEEK'S OPERAS.

THIS is a good week for opera. To-night Beromunster relays Lortzing's opera, "Undine," from the Berne Municipal Theatre (7 p.m.); Rome gives "Capitan Fracassa," the three-act opera by Costa (7.45 p.m.); to-morrow Milan offers "Mephistopheles," the four-act opera by Boito (7.45 p.m.); and Paris (P.T.T.) at 8.5 p.m. relays from the Opéra Comique Massenet's "Werther."

Verdi lovers will tune in Radio-Paris at 8 on Sunday for a studio performance of "Otello," the orchestra conducted by Bigot. Warsaw offers full measure on Tuesday evening at 7 o'clock with an Offenbach five-act opera-comique, "La Vie Parisienne."

BLACK-FACED SHOW.

HARRY S. PEPPER, who presents the Kentucky Minstrels to-night in the National programme at 8.30, may be depended upon to instil into the microphone version as much vitality as is possible; perhaps the picture on this page will

supply the necessary visual image. This black-faced minstrel show, complete with bones, will include Scott and Whaley, C. Denier Warren, Ike Hatch, and the Kentucky Banjo Team. Harry S. Pepper and Doris Arnold will be at the piano, and the B.B.C. Theatre Orchestra and the Male Voice Chorus will be conducted by Leslie Woodgate. The book is by Denier Warren.



"SOFT LIGHTS AND SWEET MUSIC," devised by Austen Croom-Johnson, will be heard in the National programme at 9.10 on Tuesday. Soloists are John Burnaby, Albert Harris and Elisabeth Welch. In the photograph, taken during the first presentation of this popular feature, Mr. Croom-Johnson can be seen at the right-hand pianoforte.

ALL MOZART.

PARIS has its own Mozart Society, which sponsors a concert of the Master's works relayed from the old Conservatoire by Radio-Paris at 9.15 on Monday.

SUBSTANTIAL CHIMERA.

"CHIMERA" suggests fantasy, but the play of that name to be broadcast next week has a substantial enough cast, e.g., a tea-shop customer, film star, policeman, usher, judge, Mrs. Brown, etc. The author is Rowland Crossley. "Chimera" will be broadcast at 8.40 in Monday's National programme, and 8 p.m. (Regional) on Tuesday, immediately after John Watt's first production of "Songs from the Radio Shows" (7 p.m.).

"CONDUCTED BY THE COMPOSER."

I HAVE always a mysterious admiration for a composer who conducts his own work in public. There are two such on Saturday. Louis de Vocht conducts a concert of his music for the fifteenth anniversary of the Brussels Sacred Concerts, relayed from the Conservatoire Royale and broadcast by Brussels No. 1 at 3 p.m. At 7.15 Frankfurt will relay a Paul Lincke concert from the Hippodrome, conducted by the composer.

for the Week

casts at Home and Abroad

PLUS FOURS?

It would be a pity to miss the first concert to-night (London, Midland and West Re-



BROADCASTING TO-NIGHT.
A characteristic picture of Mr. Winston Churchill, who gives the sixth talk in the "Causes of War" series at 10 o'clock to-night.

gional, 7 p.m.) of the new B.B.C. Variety Orchestra, to be presented by Kneale Kelley and John Watt, under the title of "Two Fours, Three Fours, and Four Fours."

MR. CHURCHILL TO-NIGHT.

THERE are two outstanding talks this week. To-night at 10 o'clock the Rt. Hon. Winston Churchill, C.H., M.P., will give the sixth talk in the "Causes of War" series. Mr. Churchill has a compelling microphone manner, and has broadcast on a number of occasions, the last being in the "Whither Britain?" series last January.

On Tuesday, November 20th, Sir James Jeans will at 10 p.m. continue the "Tour Through Time and Space," describing the Milky Way.

THE STRASBOURG TOUCH.

STRASBOURG broadcasts have a flavour of their own, perhaps because there are so many "O.B.s" from its gardens and groves. Music seems to be the prevailing religion, and the zest and enthusiasm which the musicians put into their playing might be copied by some other European stations guilty of perfunctory performances. If you have not already noted this enthusiasm of Strasbourg, tune in the Oratorio Concert to be relayed from the Palais des Fêtes at 8.30 on Monday. The Strasbourg Cathedral Choir will take part with the Municipal Orchestra in Saint-Saëns "Le Déluge" and Cesar Franck's "Rebecca."

REAL OPERA.

IN nine cases out of ten a studio presentation has more artistic finish than an "O.B." from church, theatre or music hall. But opera, it seems to me, supplies the tenth case. Studio opera bears the same relation to the real thing as a flat picture does to one in stereoscopic relief. Opera, almost alone among musical art forms, has a visual as well as a sound appeal, and consequently a broadcast version often suffers; the absurdities of plot and action are more

startlingly portrayed. Sitting before our loud speakers, we are not dulled into acquiescence, as we are in the opera house, by the presence of a tolerant audience, eager to get their money's worth by accepting the bombast and fustian as the genuine article.

This week there are two operatic relays, both from Sadler's Wells. To-morrow at 9 o'clock in the Regional programme we have Act II of "Die Fledermaus" by Johann Strauss, while on Wednesday next, November 21st, Rimsky-Korsakov's "The Snow Maiden" will be heard at 7.40 in the National programme.

A MUSICAL PANORAMA.

IF picturesqueness can be used to describe the invisible, I would apply it to some of the chronological German programmes. They have a fondness in the Fatherland for re-creating the past, and to-night's programme from Munich (7.5 to 9 p.m.) is a case in point. "Strolling Minstrel to Master Singer," a sequence, will portray to us the history of itinerant musicians. There are to be bands of old and obsolete instruments, assisted by strolling players.

THE AUDITOR.



"JOHANN STRAUSS IN COVENT GARDEN," the "musical memory" to be broadcast at 10 p.m. (National) on Thursday next, commemorates the visit of the famous musician to Covent Garden Theatre in 1867 at the invitation of the Prince of Wales. He was then Director of Music to the Emperor of Austria.



HIGHLIGHTS OF THE WEEK

FRIDAY, NOV. 16th.

Nat., 8.30, The Kentucky Minstrels.

10, Rt. Hon. Winston Churchill: "Causes of War."

London Reg., 8, Henry Hall and the B.B.C. Dance Orchestra.

Abroad.

Beromunster, 7, "Undine"—Opera in 4 Acts (Lortzing).

SATURDAY, NOV. 17th.

Nat., 8.30, "Music Hall"—Beryl Orde, Alexander and Mose, Will Hay.

London Reg., 8, "Moonstruck Fish"—The Herring Industry in Speech and Sound.

Abroad.

Frankfurt, 7.15, Paul Lincke Concert from the Hippodrome.

SUNDAY, NOV. 18th.

Nat., 1.30, Maurice Cole, Pianoforte Recital.

9, Bournemouth Municipal Orchestra. Soloist: Garda Hall (soprano).

London Reg., 5.30, Relay from Brussels, The Radio Orchestra. 6.30, Billy Mayerl and Wynne Ajello in popular concert.

Abroad.

Kalundborg, 9.10, Light Russian Music, by the Balalaika Quintet. Radio Paris, 8, Opera, "Otello" (Verdi).

MONDAY, NOV. 19th.

Nat., 8.40, "Chimera," a play by Roland Crossley.

London Reg., 8, Mozart Programme by the B.B.C. Symphony Orchestra (Section E).

9, Entertainment Hour.

Abroad.

Radio Paris, 9.15, Mozart Concert from the Old Conservatoire.

TUESDAY, NOV. 20th.

Nat., 9.10, "Soft Lights and Sweet Music," devised by Austen Croom-Johnson.

London Reg., 7, Songs from the Radio Shows.

Abroad.

Kalundborg, 9.35, Slav and Hungarian Dances by the Station Orchestra.

WEDNESDAY, NOV. 21st.

Nat., 7.40, "The Snow Maiden" (Rimsky-Korsakov), relayed from Sadler's Wells.

London Reg., 9, "Charing Cross Road," a show with music by Gladys and Clay Keys. Produced by John Watt.

Abroad.

Brussels (No. 2), 8.30, Peter Benoit Concert by the Augmented Station Orchestra.

THURSDAY, NOV. 22nd.

Nat., 8, "Charing Cross Road." 9.30, Speech by Sir Giles Gilbert Scott, R.A., at Banquet of Royal Institute of British Architects, Guildhall, London.

London Reg., 8.15, Royal Philharmonic Society's Concert at the Queen's Hall, directed by Sir Hamilton Harty.

Abroad.

Brussels (No. 1), 9.15, Symphony Concert. Works by Rossini, Lalo and Granados.

Letters to the Editor:—

Receiver Performance

Droitwich : Service Operating : Home Television

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

Receiver Performance

MR. W. T. COCKING'S excellent article on receiver performance prompts me to write to suggest that it is now even more opportune for manufacturers to publish specific data as to the performance of their products. My observations lead me to believe that the general standard of technical knowledge is higher than ever before, a fact that is probably due more to your own very excellent publication than to any other cause, providing as it does to all and sundry an opportunity of keeping abreast with the latest developments, without the introduction of too advanced terminology.

It is therefore to be deplored that the majority of manufacturers still frame their advertisements and literature to appeal to the non-technical alone. Surely, it would well repay them to include exact data for the benefit of those who require such information; at the moment, the few who do provide such information must appear to the unbiased reader to represent in themselves the firms who have most confidence in their wares.

Twickenham.

L. J. LOWEN.

Does Droitwich Please ?

IN reply to the question put by the writer of "Broadcast Brevities," "Does Droitwich Please?" I may say that, so far as the North-east is concerned, it does not. There have been many complaints in the local papers about the disappointing reception of the new station. Although the quality is better than that given by Daventry, and the strength is increased a little, it fades severely nearly every night, the fades being accompanied by very bad distortion. Daventry never faded in this manner, and I don't know of any other long-wave station which does, so I do hope the B.B.C. engineers will try to remedy this distressing fault. Another matter which should be investigated is the morse, mentioned on the same page, which seems to be caused by a beating effect from some other station. Surely an important station like Droitwich should be kept clear of such interference.

Hebburn-on-Tyne.

J. D. B.

Service and Commercial Operating

AS my letter complaining of bad quality in commercial and service transmissions has only elicited two replies, and both these from the least expected quarter, I feel some trepidation in presuming to waste any more of your valuable space. To clear the issue, first let me say that I realise that I cannot possibly have heard more than a small percentage of R.A.F. operators, I will, therefore, withdraw my charge of bad operating.

It would appear that your readers are in entire agreement with me on all points with the exception of the R.A.F. I would, therefore, be glad if I might just mention one or two points which these two gentlemen have brought forward.

The most astonishing fact which has

come to light is that the R.A.F. apparatus is ten years old. I had no idea things were as bad as that, even when due allowance has been made for economy cuts. Also, although I do not propose to discuss my own operating, I certainly think that the R.A.F. should be able to turn out good operators if the course of training is as intensive as I presume it to be.

I can quite sympathise with your correspondent in his Sidcot suit with the thermometer below freezing; it is certainly unfair to expect him to give of his best with apparatus ten years old! I quite frankly admit that I have never been in a similar predicament.

What this gentleman can possibly mean by calling my confrères the "tongue tied hams," I cannot imagine. As I am one of these "hams" myself, of course it is certain that I am acquainted with a number of them, seeing that I obtained my licence just about the time when the R.A.F. apparatus was designed.

ARTHUR O. MILNE.

Larkfield, Kent.

Alternatives to Home Television

I READ with interest the article entitled "Alternatives to Home Television," which appears on page 297 in the October 12th issue of *The Wireless World*, and in particular read with interest the brief description of a system of "Retarded Television" which is referred to at the bottom of the first column of the article.

I should like to know whether there is any further information on this system available, and also, if possible, the people who are concerned with its development.

24, Stoneville Road, C. H. EVANS.
Stoneycroft, Liverpool.

I CAUGHT sight of an article in your issue of 12th October, under the title "Alternatives to Home Television: The Programme Value of Still Pictures," and was both excited and exasperated. For here, I thought, is the very idea that I have been turning over in my mind for the past few months as the only way (barring some fundamentally new discovery) of getting round the band-width difficulty which blocks the way to television on ordinary wavelengths; and here, I thought, is the news that while I have been dallying someone else has gone ahead and brought my plan to a practical form.

But as I read the article I found both emotions fading away and being succeeded by what I can only describe, rather rudely, I fear, as torpor. Try as I would, I could not picture the British public becoming enthusiastic over the prospect outlined by your contributor, as a substitute for their long-desired television, or in their millions bending, night after night, to watch a little stylus laboriously trace out a pen-and-ink sketch of something which, when finished, turned out to be of nothing very exciting. In fact, I felt, Sir, that someone had taken

my swan and turned it into a rather unattractive goose.

For what I had been seeing, with my mind's eye, all these months had been so very different. I had pictured myself listening to my audio receiver and watching, a few feet away, the foot-square translucent screen of my visio receiver. For the moment this screen is dark, but in a few seconds, as I watch, it begins to glow, and in another second it is fully lit up with the scene, in all its natural colours, at which the audio item has arrived. The picture is "held" for a moment or two and then fades away; but in another 20 seconds or so the glow again appears and develops into the next picture.

Such, Sir, is "Still" Television—as I picture it—described in less than a hundred words. It is not an accomplished fact—because no one has thought of it and therefore no one has tried to accomplish it. But there is no fundamental difficulty in its way, as there is in the way of "moving" television. By having a framing frequency of 1/20 instead of 25 we divide the necessary width of wave-band by 500 at one stroke. We do not need such an enormous reduction factor, so we can use, if we wish, a fifth of it to give us our colours, leaving still a factor of 100. With this factor at our disposal, an excellent picture quality would be possible. There are, of course, a lot of points that require working out. Presumably the scene would be filmed on an "intermediate-film" equipment of special design. The audio transmission would, of course, have to be "retarded" so as to synchronise with the visio transmission. I know that the obvious way of doing this—by magnetic recording—is liable to lose quality and introduce background noise, but I decline to believe that there is any real difficulty in getting rid of these defects when the audio impression has only to be preserved for a matter of 20 seconds or so. The building-up and retention of the visio transmission in the receiver, ready for illumination at the end of the 20 seconds, is more difficult, involving as it does some new retentive screen or some magnetic, photographic or other "storage" process; but here, again, I cannot believe there will be serious difficulty now that the problem is actually set. As I pointed out in a letter in your issue for 28th September, it has taken some five years for *The Wireless World* suggestion of "volume compression and expansion" to come to fruition. But television is very much in the mouths and minds of the technicians to-day, so perhaps the time lag in this case will be very much less.

D'ORSAY BELL.

London.

22nd October, 1934.

Heterodyning by U.S. Stations

A YEAR ago a note was published in *The Wireless World* suggesting that soon heterodyning by U.S. medium-wave stations would become a serious problem for listeners in this country. My experience, using a new Monodial Super, is that it is serious already. Recently I traced these medium-wave heterodynes at 11 p.m. to U.S. stations, which were well received at 2 a.m. I have seen little reference to this, and it has made me wonder if it is less serious in the South.

Might I once more entreat manufacturers to publish leading dimensions of components. I am sorry that this practice has lapsed since it was last stimulated in your columns a few years ago.—With very best wishes for your continued success.

Edinburgh 9. A. CRAIG-BENNET.

Current Topics

Events of the Week in Brief Review

A New Neighbour

RENNES, the new French Regional station in Normandy, will begin testing on 40 kilowatts towards the end of this month. The wavelength is 288.6 metres.

Programmes from Japan

A 150-KILOWATT station is being erected by the Japanese Broadcasting Corporation near Tokio, and will be ready by next summer. Before then, however, a number of stations ranging from 10 kilowatts to 40 kilowatts will make their debut on the ether.

The Wrong Word?

THE discovery that "Radiogram" is the wrong word to use in respect of a radiogramophone, having been employed in radio traffic parlance for many years, has led to the usual crop of alternative suggestions. They include "Radiograph," "Radiophone," and even "Gramradio."

Why not "Radio-gramophone"?

Next, Please!

THE usual autumn glut of "smallest wireless sets" is upon us. The latest has been invented by a Mr. Davis, of Wolverhampton, and is a crystal set built on a piece of ebonite smaller than a three-penny piece.

Mr. Davis made the set after reading that a London man had made a set half an inch square.

"Read Your Newspaper"

GERMAN broadcasting stations are transmitting less news. When the National Socialists took over control of the system the news service became more efficient, with the result that important news items were broadcast long before the daily papers could handle them.

The Press has made representations to the authorities, with the result that the German announcers now give a mere summary of the news and refer listeners to the daily Press.

A Neighbourly Action

GREECE still has no broadcasting service of her own, but special transmissions are being given in Greek by the Italian station at Bari. Italy is also considering transmitting programmes in Turkish and Arabic.

High Power from Strasbourg

RADIO STRASBOURG has begun testing on 40 kilowatts.

New Portuguese Relay

PORTUGAL is to have a new broadcasting station at Oporto. This will relay the Lisbon programmes over the present silent zone round Oporto, Aveiro, Coimbra and Baraga.

French Mysteries Solved

UNTIL recently the number of French licences has been a mystery. The first census, taken in May last, revealed 1,554,295 registered receivers, of which 702,426 were located in Paris. The latest census

Italian "People's Set"

ITALY is now building a "People's Receiver" on the lines of the famous Hitler set. It is laid down that all components must be of Italian manufacture.

The Biggest Yet?

RUSSIA claims to have one of the largest broadcasting symphony orchestras in the world. This is the Soviet Symphony Orchestra, the performances of which are a regular feature of Moscow's daily programmes. It has been augmented from 120 to 163 players.

Secret Transmitters

SINCE the *coup d'état* in Vienna which resulted in the death of Dr. Dollfuss, the

Television Experts in Berlin

THE British Television Committee on its arrival in Germany on Monday of last week was greeted by Herr Giess, of the Ministry of Posts, who is well known for his work as head of the German delegations at the Madrid, Lucerne, and Lisbon Conferences.

The Television Committee spent last week in visiting the laboratories of all the German firms connected with the development of television.

Broadcasting German Radio Trial

THE trial now proceeding in Berlin of the officials formerly in charge of German broadcasting is being recorded at great length. Four microphones are placed in the court, and a small control room is installed in a specially reserved gallery. The intention is to broadcast excerpts of outstanding passages in this exceptionally interesting legal process, which concerns charges of bribery and corruption during the former broadcasting régime.

English Readings from Cairo

READINGS from English literature are now given regularly from the Egyptian station by Mr. Christopher Scaife, who won the Newdigate Prize for English verse in 1923 and was President of the Oxford University Union Society in 1924. Mr. Scaife will be heard in the main Egyptian programme from 7.15 to 7.35 p.m. (G.M.T.) on December 2nd, December 16th, and December 30th.

Public Address on Armistice Day

PUBLIC address equipment was used to a greater extent than ever on Armistice Day. At the Royal Exchange twelve Marconiphone long-range loud speakers were installed and a further battery was in use at the Mercantile Marine Memorial on Tower Hill. The British Legion Armistice service at Sloane Square was catered for by Marconiphone, as well as the service at Westminster War Memorial and the Finsbury War Memorial. Marconiphone public address equipment was also in use at the British Legion Festival of Remembrance at the Royal Albert Hall.



BRITISH TELEVISION COMMITTEE IN GERMANY. Members of the P.M.G.'s Committee at a demonstration of ultra short-wave television reception in Berlin last week. Left to right: Mr. J. Varley Roberts, secretary; Mr. H. L. Kirke, of the B.B.C.; Mr. O. F. Brown, Department of Scientific and Industrial Research; Mr. A. J. Gill, G.P.O. Engineering Dept., and Dr. Banneitz, head of German P.O. television laboratory.

brings the total to 1,625,444. It is believed that a much more rapid increase will take place in December with the opening of the new Regional stations. The present licence figures indicate four receivers for every hundred inhabitants, as compared with fifteen in Denmark, twelve in Britain, nine in Germany, and eight in Switzerland.

It Might Have Been Worse

TO give listeners a thrill, the Austrian Broadcasting Company recently arranged for a commentary by a parachute jumper, Theodore Denhart, who was to describe his sensations while descending by parachute from a plane. Unfortunately, at the moment of jumping the intrepid airman dropped the microphone.

police have been seeking a reason for the rapid communication effected between the Viennese Nazis and their brethren outside the city. It is significant that 139 small radio transmitters have now been confiscated in the city.

Ship-Shore Radio

THE Ship-Shore Wireless Service is the title of an address to be given by Lt.-Col. C. G. G. Crawley, M.I.E.E., at a meeting of the Post Office Telephone and Telegraph Society, London, on Monday next, November 19th, at 5.30 p.m., at the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2.

The lecture will be illustrated by lantern slides and followed by a discussion.

Foundations of Wireless

PART I OF A NEW SERIES OF INSTRUCTIVE ARTICLES

Volts, Ohms and Amperes

FOR a firm grasp of the principles of wireless, foundations are essential. This article, which is the first of a series, endeavours to give the less qualified of our readers a sufficient grasp of fundamentals to lead to a better understanding of many of the articles regularly appearing in our pages.

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

AN atom of matter of any kind is made up of a central nucleus surrounded at a considerable distance by one or more electrons. The nature and function of these electrons need not concern us very deeply, but it is important to note that they consist of, or carry, a considerable charge of electricity. If we regard them as "weightless atoms of electricity," having no properties other than an electric charge, we shall be able to use them as the basis of a mental picture in terms of which almost all electrical phenomena can be satisfactorily described.

In its ordinary state, matter contains a certain normal supply of electrons, which are part of the constituent atoms of the material. Since no visible electrical phenomena are connected with it, ordinary matter is said to be "neutral." If by any process it loses some of its electrons, or acquires an excess supply, it develops the characteristics by which we recognise the presence of an *electric charge*.

A piece of ebonite (such as a fountain pen) can very easily be given a charge by brisk rubbing against the coat-sleeve or a piece of perfectly dry flannel. The presence of the charge can be demonstrated by holding the pen close to a tiny scrap of thin paper, which will be found to jump up and cling for an instant to the charged surface, and then, a moment later, will be violently repelled.

The sudden change in the behaviour of the paper can only be ascribed to a transference to it from the pen of some of the electric charge; we therefore deduce that:

If an uncharged body touches one that is charged, some of the charge is transferred to the originally uncharged body.

This is interpreted as the flow of electrons from one body to the other, so that after contact both are equally richer or poorer in electrons than a neutral object. Combining this interpretation with the observed fact that the pen repelled the paper after making contact with it, we conclude that:

Like charges repel one another.

Sometimes two bodies are found to attract each other more strongly when

both are independently charged than when one only is charged. In such a case it is always noticed that when the two bodies are brought into contact both charges largely disappear. This latter fact suggests that in such cases the bodies are oppositely charged, one having a defect and the other an excess of electrons, so that neutrality, approximate or exact, would be the natural result of allowing electrons to pass from one body to the other. We therefore deduce that:

Unlike charges attract one another.

And, in addition, we are confirmed in our original supposition that electrons tend to flow from a point where they are in excess to a point where they are in defect, either absolutely or relatively.

Conductors of Electricity

For this flow to take place an electrically conducting path must be provided between the two points. In a conducting material electrons are very readily detached from their parent atoms, so that if a wire is stretched between two oppositely charged bodies, electrons can enter the

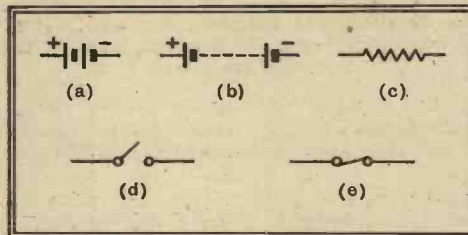


Fig. 1.—Some conventional signs used in constructing electrical diagrams. (a) A battery of few cells, used for filament accumulator or grid battery. Two cells are shown, making either a 4-volt accumulator or a 3-volt dry battery. (b) A battery of many cells, e.g., a high-tension battery. (c) A resistance. (d) A switch, shown open. (e) A fuse. Note that a simple line always indicates an electrical connection of negligible resistance.

wire at one end and cause a displacement of free electrons all down the wire, resulting in the emergence of an equal number of electrons at the other. Picture a long pipe of very wide bore, already filled with water. If an extra teaspoonful

of water is forced into it at one end a teaspoonful will emerge at the other—but not the same actual water. If milk had been forced in instead of water, water would still have emerged. In the same way, the wire in its normal state must be pictured as already filled with electrons, all in continuous random movement from atom to atom. The passage of electricity through the wire amounts to no more than the superposition upon this vast random movement of a trifling drift in one direction; the emerging electrons may only have moved a thousandth of an inch.

If the atoms of a substance have their electrons so firmly fixed that this exchange is not possible, the material will not conduct; it is called an *insulator*. All metals are *conductors*; to the class of insulators belong ebonite, bakelite, rubber, the silk or enamel covering on wire, and, indeed, most non-metallic substances.

The flow of electrons through a conductor constitutes a *current of electricity*.

Effect of a Source of Current

So far we have considered the current as originating from a body which has a small and temporary excess of electrons; when the charge is dissipated the current must inevitably stop. Matters are different if the current is driven by a dry battery or an accumulator cell, for either of these will supply an electric current for a prolonged period. This happens because there is a chemical action within the battery which sets up, and maintains, a certain discrepancy of electron-content between the terminals. The difference in electron-level is maintained, even in face of the flow of current, at the cost of using up the materials within the cell.

The magnitude of this difference, which represents the *electromotive force*, or EMF, waiting to drive a current through any continuous path, or *circuit*, leading from one terminal to the other, is measured in *volts*. The current that flows might very reasonably be measured in terms of the number of electrons passing from the battery into the circuit each second, but the electron is so extremely small that such a description of any useful current would lead to inconveniently large numbers. In consequence, it has become customary to take as the practical unit a body of about six million billion (6,000,000,000,000,000) electrons. This unit is called the *coulomb*, and is a unit of *quantity of electricity*, just as the gallon is a unit of quantity of water.

Just as one might speak of a flow of water of so many gallons per second, one can quite correctly describe an electric current as so many coulombs per second. Such a description, however, is rather

Foundations of Wireless—

cumbersome for frequent use, and the composite unit coulombs-per-second, as a measure of the rate of flow of electricity, is replaced by the shorter unit, the *ampere*. The statement that a current of one ampere is flowing means that one coulomb of electricity, or about 6×10^{18} electrons, flows past any point in the path of the current in each second.

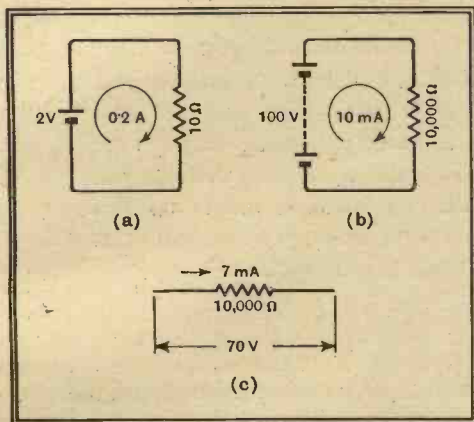


Fig. 2.—Circuits, illustrating Ohm's Law, constructed from symbols of Fig. 1. (a) and (b) show the application of Ohm's Law to a complete circuit, including the EMF of the battery. (c) The application of the Law to part of a circuit; if 7 mA flows through 10,000 ohms the PD across the resistance must be 70 volts.

With a constant pressure to drive it, the rate of flow of a current of water through a pipe will depend on the frictional resistance between the water and the inside of the pipe. In just the same way, the magnitude of a current of electricity driven through a conductor by a battery depends on the *resistance* offered by that conductor to its flow. This resistance is measured in units called *ohms*.

The relationship between EMF, resistance, and current is the most fundamental and important quantitative relationship in electrical science; it is known, in honour of its discoverer, as *Ohm's Law*.

Ohm's Law may be written as:

$$\text{Current in amperes} = \frac{\text{EMF in volts}}{\text{Resistance in ohms}}$$

or, using the usual single-letter abbreviations for the three quantities, as $I = E/R$.

It will at once be seen that if for any particular case any two of these quantities, voltage, resistance, and current are known, the third can immediately be found. If, for example, we have a 2-volt accumulator connected to a length of wire having a resistance of 10 ohms (Fig. 2), the current flowing will be 2/10ths of an ampere. If the resistance had been only half this value, the current would have been twice as great, and it would have had this same doubled value if the original resistance had been retained and a second accumulator cell had been added to the first to make a total EMF of 4 volts.

Other Examples

Taking another case, we might find, in investigating the value of an unknown resistance, that when it was connected

across the terminals of a 100-volt high-tension battery a current of 0.01 ampere was driven through it. Twisting Ohm's Law round into the form $R = E/I$, we get for the value of the resistance $100/0.01 = 10,000$ ohms. Alternatively, we might know the value of the resistance and find that an old battery, nominally of 120 volts, could only drive a current of 0.007 ampere through it. We could deduce, since $E = I \times R$, that the voltage of the battery had fallen to $10,000 \times 0.007 = 70$ volts.

No wireless engineer would ever describe a current as 0.007 ampere, as in the last paragraph; he would speak of "7 milliamperes," or, more familiarly still, of "7 milliamps." A milliampere is thus seen to be a thousandth part of an ampere. Several other such convenient prefixes are in common use; the most frequent are:

Prefix.	Meaning.	Symbol.
milli-	One thousandth of	<i>m</i>
micro-	One millionth of	μ
kilo-	One thousand	<i>k</i>
mega-	One million	<i>M</i>

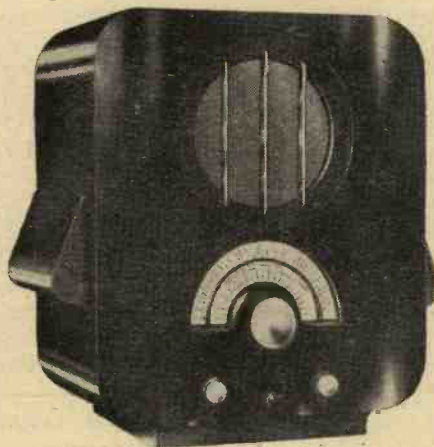
These prefixes can be put in front of

any unit; one speaks commonly of milliamps., microamps., kilocycles per second, megohms, and half a dozen other such odd-sized units. "Half a megohm" comes much more trippingly off the tongue than "Five hundred thousand ohms," just as $\frac{1}{2}M\Omega$ is quicker to write than 500,000 Ω .

It must be noticed, however, that Ohm's Law refers to volts, ohms, and amperes; the indiscriminate use of odd units will lead to odd results. If a current of 5 milliamps (mA.) is flowing through 15,000 ohms (Ω), the voltage across that resistance will *not* be 75,000 volts. The current must be expressed as 0.005 amp. before the correct result, 75 volts, is obtained for the magnitude of the potential difference.

The term *potential difference* is used in preference to EMF because the voltage across the resistance is a result of the current, and not the cause of it. The EMF driving the current probably resides in a battery elsewhere in the circuit, though the problem does not specifically say so.

Ekco Model 95



An Interesting Transportable in Battery and Universal Mains Form

pentode giving three watts. Both models have double-diode-triode detectors giving fully delayed AVC, and the mains model has an optional inter-station noise suppressor. The designers have given special attention to the reduction of valve hiss and background noise in general, and there can be no doubt that these receivers will do much to popularise the idea of the self-contained transportable.

DELIVERIES have now commenced of this superheterodyne transportable, advance details of which were available at Olympia. It is made both for universal mains and for battery operation, and the price in both cases is 15 guineas (10s. 6d. extra for black and chromium finish).

The chief advantage of this type of set is that it can be moved from room to room without the necessity of arranging for external aerial connections, and the inclusion of an initial HF stage ensures that range will not be sacrificed by the use of self-contained frame aerials. The set is provided with a turntable, and full advantage can be taken of the directional properties of the frames, which are enclosed in electrostatic screens to minimise local interference.

The battery set (Model BT95) has a triode-pentode frequency changer and a QPP output stage, while in the universal set (Model ADT95) the frequency changer is an octode and the output valve a power

KELLY'S DIRECTORY OF THE WIRELESS AND ALLIED TRADES (First Edition), 655 pages. Kelly's Directories, Ltd., 168, Strand, London, W.C.2. Price 25s. post free.

The fact that a directory of the wireless trade in England, Scotland and Wales occupies a large volume of over 650 pages is indicative of the rapid growth of those industries depending partially or wholly on broadcasting.

This book has been compiled on the same lines as other Kelly's directories; firms supplying goods or services of various kinds are traced by referring either to the "List of Places" or "Trades" sections. There is also a section arranged alphabetically under "Trades" for the London postal area.

With the help of "Kelly's" it is an easy matter to find not only retail dealers in broadcast sets, but suppliers of every imaginable commodity used in the making of wireless apparatus. Similarly, firms engaged in any branch of the wireless industry in any particular town or area are traced with equal facility.

"Hyvoltstar" All-Wave Superhet 5



A Sensitive and Selective Receiver Employing High-Voltage Universal Valves

Features.—**Type.**—Table model superheterodyne with AVC for short, medium and long waves. **Universal AC-DC mains supply.** **Circuit.**—Heptode frequency changer—var.-mu pentode IF amplifier—metal oxide 2nd det.—metal oxide AVC rectifier—triode LF amplifier—pentode output valve. **Half-wave valve rectifier.** **Controls.**—(1) Tuning, calibrated in wavelengths. (2) Volume control and on-off switch. (3) Waverange switch. (4) Tone control. **Price.**—18 guineas. **Makers.**—Universal High Voltage Radio Ltd., 28/9, Southampton Street, London, W.C.2.

THIS receiver works equally well on AC and DC mains and the valves employed are of the indirectly heater low-current type. In this case, however, the principle of high-voltage low-current heaters has been carried to its logical conclusion inasmuch as the filament voltage is only slightly less than the mains voltage; the difference is, of course, necessary to give some latitude for adjustment to different mains voltages. The individual heater current is consequently very low (about 24 milliamps.) and the circuit differs from standard practice in that the heaters are connected in parallel instead of in series.

The important advantage of this system is that practically the whole of the energy in the filament circuit is dissipated in the valves. Apart from increased efficiency, this gives more uniform heat distribution in the chassis and reduces the size of the voltage-regulating resistance which is always a troublesome component to dispose of safely in a universal receiver. The valves employed are also notable for the attention which has been given to screening. A fine wire mesh covers the glass envelope, and not only are screening plates inserted between the pins in the moulded base but the valveholders themselves are also screened.

The circuit functions on the superheterodyne principle and, in addition to the normal medium- and long-wave ranges, the short waves between 19 and 52 metres are covered. On the latter waveband the frequency changer functions as an autodyne, the short-wave inductance in the aerial circuit being untuned.

The frequency-changer valve is of the heptode type and on the normal broad-

cast wavelengths is preceded by a band-pass filter with inductive coupling. A variable-mu HF pentode is employed in the intermediate frequency stage and the coupling transformers comprise four tuned circuits. Signal rectification is carried out by a Type WX6 "Westector" connected across the tuned secondary of the output IF transformer. A second rectifier of the same type deriving its input from the primary of the same transformer serves to supply the AVC bias. The delay voltage is provided by a potentiometer connected across the main HT supply and the control bias is applied to the frequency changer and the IF amplifier.

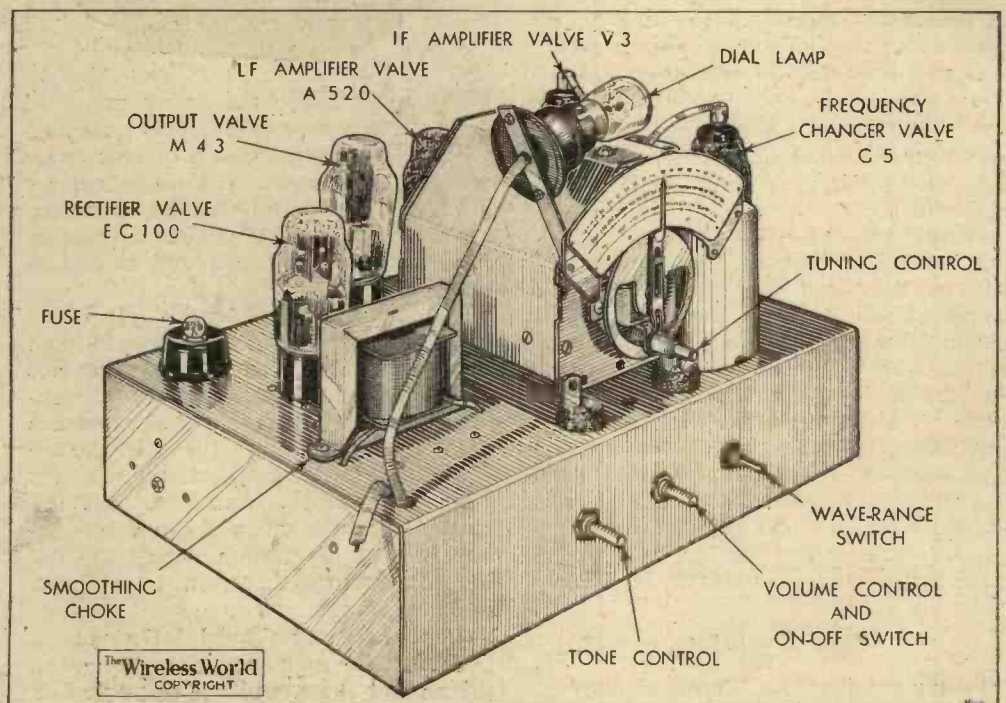
The metal oxide detector is followed by a triode LF amplifier feeding into the power pentode output valve through the medium of a parallel-fed nickel-iron

transformer. An external loud speaker may be fed from the anode of the output valve through a fixed condenser incorporated in the set. The tone control is also connected in the output circuit of the pentode valve.

A separate choke is used to smooth the HT supply, the loud speaker field being fed in parallel. The half-wave valve rectifier is specially designed to have low internal resistance and consists of a pair of elements in parallel.

Circuit Efficiency

Those who buy this receiver for short-wave reception will look first for sensitivity and overall magnification, since these qualities are essential if the more interesting short-wave transmissions are to be discovered and enjoyed. They will not be disappointed, for the set is definitely one which can be described as



A tuning scale calibrated on short as well as medium and long wavelengths and an unusually large pilot lamp are features of the chassis.

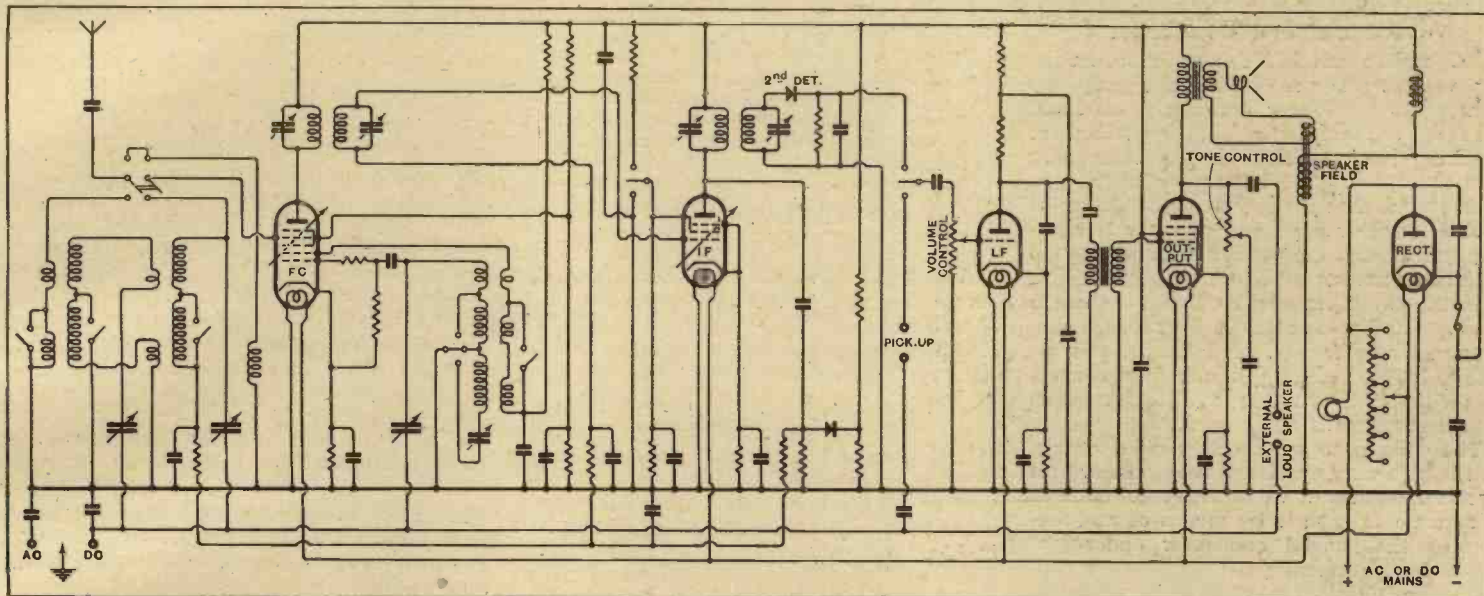
"Hyvoltstar" All-Wave Superhet 5— having a "sports" performance. In the early evening no difficulty was experienced in tuning in American broadcasting from W8XK at full loud speaker strength. The AVC on the occasion of the test was fully capable of compensating for any fading which might have been present, but

the overall dimensions, but the two rounded pillars running up each side of the front give additional rigidity, and in actual fact there is little evidence of cabinet resonance due to flexing of the sides. With the tone control set to give the full high-note response, the balance of tone is surprisingly good having regard to the high

here of the employment of unskilled labour either in the routine processes of assembly or wiring.

Dial Illumination

An unusual feature is the employment of a 15-watt dial lamp in series with the



Separate "Westectors" are used for detection and AVC supply and the heater filaments are connected in parallel.

it was found that the use of the tone control resulted in better intelligibility of speech due to the reduction in background noise.

The short-wave scale is calibrated in wavelengths and was found to be remarkably accurate. Care is necessary in taking note of readings, however, as each station can be received at two points separated by a frequency difference equal to twice the IF. The slow-motion dial might have been given a higher ratio for short-wave work but for the fact that it would be unnecessarily slow for the medium and long waves. However, the complete absence of back-lash ensures precision of tuning even though closer attention may be required on the lowest wavelengths.

On the medium- and long-wave ranges the feeling of liveliness is equally apparent, and no fewer than eleven foreign programmes were tuned in on the medium-wave range in daylight. After dark when the signal strengths of distant stations are much greater it is still possible to obtain clear reception in Central London of stations other than those occupying the single channels immediately adjacent to the London Regional and National transmitters.

Tone Quality

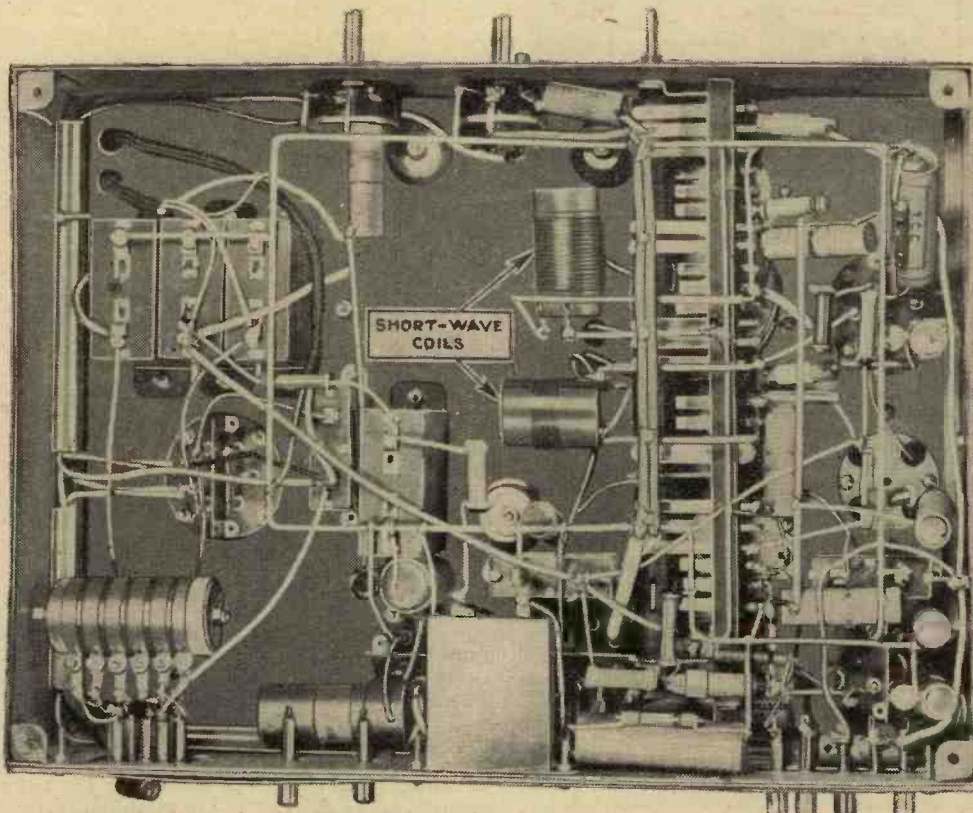
The quality of reproduction affords little opportunity for criticism. It is much better than usual in the extreme bass and the 8-inch diameter moving-coil loud speaker is largely responsible for this. The cabinet is also above the average in size and provides a greater effective baffle area. The wood used in its construction is perhaps a little thin having regard to

selectivity of the set. It is quite unnecessary to indulge in slight mistuning or in any other artifice to strengthen the high-note response, and good quality is obtained with the set accurately tuned to the station.

The chassis is well made and the accompanying photograph of the underside shows that components are well spaced and neatly wired. There is no evidence

positive mains lead. This lamp has a standard bayonet cap and is rated at the mains voltage so that it does not burn at full brilliance. Nevertheless, the scale illumination is much above the average.

Undoubtedly this set will appeal to those who require a lively performance for distant reception on all wavelengths and who take pride in the possession of an instrument of unique design.



General view of the underside of the chassis showing short-wave aerial and oscillator coils.

READERS' PROBLEMS

An Unmatched Condenser ?

A CORRESPONDENT, who fears that the various sections of his three-gang condenser are no longer accurately matched, asks us to describe a simple method of checking the condition of this component without the use of laboratory apparatus. It is stated that a fairly large collection of various receiver parts and ordinary measuring instruments are available for setting up a testing circuit.

In the circumstances, we doubt if there is a better arrangement than that shown diagrammatically in Fig. 1. Here the absorption principle recently described in connection with making comparative measurements of coil goodness is again used.

The plan is to set up an oscillatory circuit, which may consist of the ordinary grid circuit of a detector valve with reaction, and to arrange to tune it by means of any section of the ganged condenser under suspicion by transferring the appropriate connection to terminal 1, 2, or 3, as shown in the diagram. An absorption circuit consisting of another coil coupled to the grid

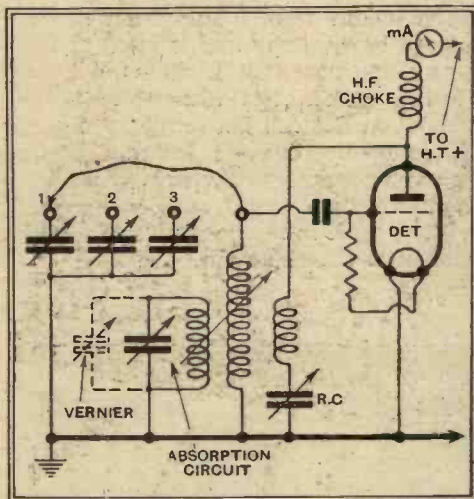


Fig. 1.—An improvised tester: circuit for checking the matching of ganged condenser sections.

winding and a variable condenser, preferably shunted by a "vernier" fitted with a clearly readable scale, will also be required. A milliammeter should be connected in the anode circuit of the oscillating valve to act as an indicator of exact resonance; the needle of the meter will "kick" as the absorbing circuit is brought into tune with the grid circuit.

As a preliminary step, all the trimming condensers should be adjusted at a low wavelength so that the point of resonance on the absorption tuning condenser is precisely the same whether section 1, 2 or 3 of the ganged condenser is in circuit. The operation of checking is then carried out by rotating the ganged condenser to a number of settings and observing whether at each setting the absorption point is the same irrespective of the condenser section in circuit. The trimmers must of course not be touched after the preliminary adjustment.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

Although this simple method is applicable for testing the "straight" sections of a superheterodyne type of ganged condenser, it cannot be applied to an oscillator section with specially shaped plates.

A Helpful Surge

THE user of a comparatively simple and straightforward battery-operated set tells us that a fault which completely prevents the reception of signals has developed. It has been discovered accidentally, however, that reception may be temporarily restored by momentarily interrupting the HT circuit by removing and then replacing the HT battery plug. But, after a few moments, rustling and crackling noises are heard, and the signal again fades away.

We are fairly safe in saying that a fault of this nature is almost certain to be due to what is sometimes described as an "electrolytic break" in the primary winding of the LF transformer, or, at any rate, in some other fine-wire inductive winding which carries a steady current. Although it is believed that no completely acceptable explanation of the effect observed has been published, it is generally considered that continuity is temporarily restored by a surge of current; this surge may be produced either by interrupting one of the receiver circuits, as in the present case, or by breaking an adjacent electrical circuit, such as that of a lamp.

Screen Current Omitted

IN calculating the value of a bias resistor for an indirectly heated HF valve, the current consumed in the screen circuit must be taken into account, and must be added to that normally passed in the anode circuit. A little consideration will show that

The Wireless World INFORMATION BUREAU

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

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

both these currents will flow through the bias resistor when it is connected in the normal manner in series with the cathode of the valve.

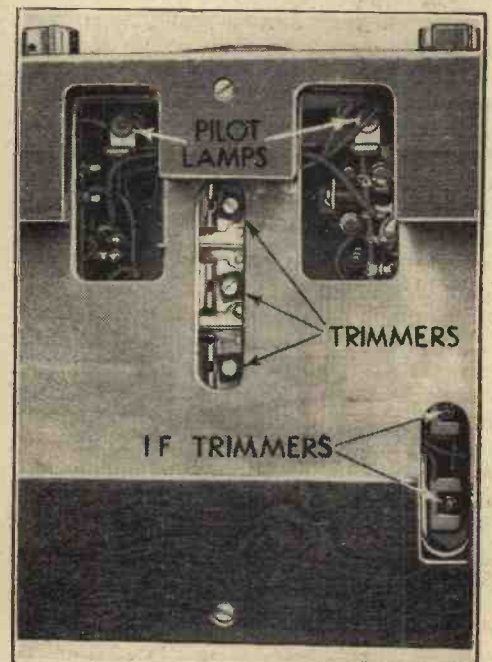
A correspondent who has failed to take the screening current into account has consequently arrived at a wrong value of resistance, but as the normal screen current of his valve happens to be particularly low, it will hardly be necessary to make any change.

"Miles per Milliamp"

AN amateur designer, who is planning a special portable set, in the design of which drastic economies must be made in HT consumption, has apparently overlooked the possibilities of saving current in the anode circuits of HF or IF amplifying valves. It is a fact that amplification does not fall off in anything like direct proportion to reduction in anode current; indeed, the result of halving consumption may be only just perceptible.

It is also useful to know that it may be more economical from this point of view to use two HF or IF valves than a single one. For example, two valves normally consuming 3 milliamps each, but operating at 1½ milliamps each, will afford vastly more amplification than a single valve of the same type taking the full rated current of 3 milliamps.

Of the various methods available for limiting consumption, it matters little which is chosen, but in practice it will generally be found most convenient to control anode current by variation of screening grid voltage. Further reductions in current and sensitivity can then be made, for purposes of volume control, by variation of negative bias in the usual way.



ACCESSIBILITY: *The Wireless World* has urged that many sets are operated in a state of chronic maladjustment solely because the interiors are inaccessible. It is gratifying to record that, in the Kolster-Brandes KB381 receiver, slots (normally closed by a protective covering) are cut through the base of the cabinet to give easy access for trimming, replacing pilot lamps, and for cleaning or adjusting switch contacts.

MISCELLANEOUS ADVERTISEMENTS

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is

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Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

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All letters relating to advertisements should quote the number which is printed at the end of each advertisement and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

Set Manufacturers' Surplus, Clearance and Bankrupt Stocks offered in any of these columns may not be Manufacturers' current lines. Radio components advertised at below the list price do not carry any manufacturer's guarantee.

RECEIVERS AND AMPLIFIERS, ETC.

UTILITY SALES.—This week's red hot bargain.

TWO-VALVE (plus rectifier) All Electric A.C. 200-250v. chassis built mains set, walnut cabinet, speaker, illuminated dial, all waves, mains aerial, complete, ready for use; 52/6.

CASH With Order carriage paid, per return; to obtain lists regularly send name, address.

UTILITY SALES, 57, Praed St., Paddington, London. [6958]

CENTURY 7-valve Superhet. Car Radio; listed £14/14, as new complete, £7/7.

PHILIPS 5-valve 1935 Battery Set, model 834B; listed £10/10; complete, in perfect condition; £6.

FOX 4-valve A.C. Superhet.; listed £13/13, complete, as new, £7-58 Flat, Mantell St. N.1. [6967]

ALL-WAVE, 1935 A.C. superhet., bargain.—Platt, 42, Hedsor Flats, Shoreditch, E.2. [6968]

G.E.C. 1934 8-valve A.V.C. Superhet, walnut console model. perfect condition; £15 or near offer.—Box 2172, c/o *The Wireless World*. [6921]

OUR Kit of Parts for "Wireless World" Quality Amplifier, complete in every detail, including valves; amplifier only, £8/10; feeder unit, 36/-. [6968]

OUR Kit of Parts for "Wireless World" Olympic S.S. Six, complete in every detail, including valves and loud-speaker; £14/10.

OUR Kit of Parts for "Wireless World" Standard A.C.3, complete with valves and speaker; £11/10.

SEND for Detailed List of Components for Either of the Above Kits; carriage paid, cash with order.

WARD, 45, Farringdon St., London, E.C.4. Phone: Holborn 9703. [6907]

A Marvellous Set at a Bargain Price; G.E.C. 8v. A.C. superhet. Q.A.V.C. and automatic noise suppression. 13½ guineas table; 14½ guineas console.

EXPERIMENTERS specials.—Ekco S.II. 25 5v. A.C. superhet. chassis only, with valve and speaker; 7½ guineas.

LISSEN.—7-valve battery superhet. kit, incl. valves, no batteries; 7 guineas; wired free if necessary.

SNIPS in Radiograms.—Columbia 5-valve battery, Q.P.P. output, inclusive valves, batteries; 13½ guineas.

CLIMAX 4v. A.C. Table Radiogram; 9 guineas.

TERMS, cash with order; carr. paid U.K.; cash refunded if not satisfied.—51, Leicester Rd., London, N.2 [6947]

OLYMPIC 6, complete in two cases, very carefully constructed, extremely sensitive, with quality; price £12.—Lownds, The Cottage, Old Lenton, Nottingham. [6935]

EMERSON and CROSLLEY 1935 Midgets, car radio, and all American valves, send for wholesale catalogue, importer.—Royal, 5, Buckingham Rd., South Woodford, London, E.18. [6890]

COLOURATION

Round a grain of truth may be built a whole edifice of plausible exaggerations; of pseudo-scientific explanations of physical inaccuracies. In other words, one may adopt "advertising journalese."

It is considered proper to claim far more for an advertised article than it is capable of giving, on the assumption that the points of an (illogical) argument have to be knocked hard into the thick heads of an ignorant public to carry conviction.

The sort of people who buy Hartley-Turner radio tell us that the customary advertisement arouses their derision. That is what we would have expected, and that is why we have never claimed for our goods anything that we could not prove, and prove *with ease*.

As we do not colour our advertisements so does our apparatus impose no colouration on the reproduction of musical sounds.

While on this subject, do you realise the benefits to be obtained from the "True Bass Baffle?" Although we have not found a better name, we promise absolute freedom from cabinet and air column resonances when your loud speaker cabinet is baffled. It is not necessary that the speaker be a Hartley-Turner. That is, obviously, desirable, but any speaker is impaired by being allowed to generate "boom." The baffle will cure that, and at a very low price. In fact "anti-colouration," complete and absolute. Treatment for existing cabinets can be supplied in almost any size and shape. Prices from 27s. 6d.

Complete baffles in any size and finish from £2.

Illustrated literature free on request.

The eagerly awaited second volume of "New Notes in Radio" is taking a little longer to complete than we anticipated, but is worth waiting for. An announcement will appear in this space.

HARTLEY TURNER RADIO LTD.,

Thornbury Road, Isleworth, Middlesex.

Please note our new telephone number: HOUNslow 4488.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."

DEPOSIT SYSTEM.

Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Stamford Street, London, S.E.1, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post. When sending remittances direct to an advertiser, stamp for return should also be included for use in the event of the application proving unsuccessful.

Receivers and Amplifiers, Etc.—Contd.

RECEIVERS, A.C. Bandpass, shop soiled, slightly scratched, Mullard valves, S.G., Det., Pen., Rect., Magnavox speaker; £4/10; carriage, packing, 2/6.—Glasgow, 230, Risley Ave., Tottenham [6952]

1935 Manufacturers' Stock of 4-valve A.C. Band Pass Receivers, in walnut cabinets, Mazda valves and Rola speakers, fash with order; £5/10.—J. Maude, 1, Martin St., Brighouse. [6937]

1935 Models 4-valve Superhet. Midgets, A.C. or D.C., M.C. speaker, £3/19/6; 5 valves, £4/19/6; car radio, £7/15 including valves.—Lovell Bros., 11, Avon Rd., Walthamstow, London, E.17. [6891]

CROSLLEY 1935 Superhet. 5 A.C. A.V.C., ultra short (chromium) and medium wave band, aeroplane illuminated dial, three watt output, futuristic walnut cabinet; usual price £14, brand new £7/10.—Somers, 84, South St., Exeter. [6950]

AMPLIFIER, complete with power pack in steel case, 25 watts undistorted output, A.C. 100-250 volts, complete, less valves, £7/10; Minello 3-valve A.C. receiver, Band Pass, S.G., detector, pentode, Rola speaker, £4/10.—Phone: Hendon 8804. [6917]

ARMSTRONG Latest Luxury Radiogram Battery Chassis, Class "B"; full bandpass, Litz wound coils, 3 tuned circuits, chassis incorporates 2 Mullard H.F. Pentodes and Mullard Class "B" valves; results equal good electric receiver; £5/18/6, including valves; royalties paid.

ARMSTRONG.—Latest 5v. bandpass superheterodyne chassis, with fully delayed A.V.C., 7 highly efficient tuned circuits, bandpass input, Marconi Heptode frequency changer, combined 1st detector and oscillator, bandpass I.F. coupled to Marconi H.F. pentode, bandpass coupled to Cossor Double Diode, giving distortionless detection and A.V.C., resistance coupled to Mazda high slope pentode, Marconi bi-phase rectifier, full vision illuminated tuning, calibrated in wavelengths, combined radio and gramophone volume control, corrected pentode output, giving exceptionally good reproduction; £6/18/6, with valves, royalties paid.

ARMSTRONG Universal Superheterodyne, chassis works on A.C. or D.C. mains, specification as superheterodyne model above; £6/18/6, complete with valves, royalties paid.

ARMSTRONG Senior Universal A.C.-D.C. Chassis, 3 tuned circuits, full bandpass tuning, 3½ watts double pentode output, massive construction, with valves; £5/18/6.

ARMSTRONG A.C.4 Chassis, incorporating 3 pentodes, 3 tuned circuits, full band-pass, 3 watts output; £5/18/6, with valves.

ALL Armstrong Chassis are Constructed of the Highest Grade Components Throughout, carry 12 months' service free guarantee, and are sent on 7 days' approval, carriage paid.

ARMSTRONG MANUFACTURING Co., 100, King's Rd., N.W.1. Phone: Gulliver 3105. [6942]

PUBLIC Address Amplifiers and High-quality Receivers, amplifiers A.C. mains 21 watts, undistorted output, £15; 9 watts, £10; A.C.-D.C. 9 watts, £11; 3½ watts, £9; trade supplied; deferred terms.—D. E. Clarkson, B.Sc. (Eng.), 10, Park Rd., Wallington, Surrey. Phone: Wallington 3953. [6974]

Receivers and Amplifiers, Etc.—Contd.

£7/7.—Alba 5-valve superhet. 200-250 volt, Plessey chassis, Magnavox moving coil, complete with valves in futuristic walnut cabinet, listed £16/16, brand new, c.o.d., carriage paid; ditto radiogram for £9/9; ditto Band Pass Four, 200 to 250 volts, either A.C. or D.C., complete with valves, Magnavox speaker, in walnut cabinet, for £4/19/6.

27/6.—Screen Grid Three Gresley Radio battery receiver, 2-gang Polar, metal chassis, screened coils, Ormond loud-speaker, in futuristic walnut cabinet, similar to Lotus; c.o.d., carriage forward.—Kay, 167, City Rd., London, E.C.1. [6908]

MIDGET Receivers; every one brand new and guaranteed, carriage paid; stamp with all enquiries; every one complete with valves and moving coil speaker in walnut cabinet; all operating, unless otherwise stated, on A.C.-D.C. 200-250 volts, being universal; Savoy, 5-valve super-het., made by Belmonts, M. and L. wave, A.V.C., last year's model, cabinet 10x7x5½, at £4/10; all the following are R.C.A. Victor's, each in cabinet 12x8½x6; all have delayed A.V.C., illuminated dials, pick-up terminals, incorporating 2 ultra modern triple function valves, super-het. 5-valve, 190-550/900-2,000 metres, £6/10; this chassis in larger cabinet, table model, 14x16x9½, with 8½ in. speaker, giving 3 watts undistorted output, at £7/7, can be supplied for A.C. as well, £7/10; as in £6/10 model, but 6-valve, at £7; this model, 6-valve, but covering 13-50 metres as well as M. and L. waves, £7/17/6; table models in really handsome cabinets, massively constructed super-het. 6-valve, 8 stage, 13 metres to 2,000 (3 wave bands), 3 watts undistorted, uses 2 H.F. pentodes, heptode frequency changer, double diode triode, Airplane dials, sensitivity one microvolt absolute, cabinet 19x16x10½, at £9; can be supplied in A.C. also, at £9/5, carriage 4/-; another, in A.C. only, 6-valve, 8 stage, the world's first double intermediate super-het., 12 metres to 2,000 in 4 wave bands (specification as in £9 job), Airplane dials (extra large), sensitivity better than ½ microvolt absolute, maximum efficiency over whole wave-band coverage, cabinet 21x11x17, at £15, carriage 5/-.—Degallier's, 6, Coryton House, 21, Upper Marylebone St., London, W.1. Museum 7795. Nearest Stations, Oxford Circus, Great Portland St. [6905]

MAINS EQUIPMENT.

VORTEXION Specified.

STANDARD A.C.3 Transformer, polished die cast, shrouding guaranteed 5 years; £1; chassis 6/-, choke to match, 12/5; see also displayed advertisement on page 9, November 9th.

STANDARD A.C.2 Transformer, 18/-; choke to match, 10/6; 5 years' guarantee.

VORTEXION Specified Olympic S.S. 6 Transformer, S.S.352, 5 years' guarantee, 25/-; less terminals and guarantee, 21/-; power chassis, £3/17/6; choke, 12/6; Single Span model, 25/-; power chassis, £3/10.

VORTEXION—Quality Amplifier or Super Monodial, 425-0-425, 120 m.a., 4v. 6-8a. C.T., 4v. 3a. C.T., 4v. 1a., 4v. 1a., super shrouded, core size 2½ in. x 1½ in., 2½% regulation primary engraved insulated terminals, weight 14lb., 26/-, carriage 2/-; normal shrouded, 22/-; open type, 20/-, post 1/3; speaker field replacement choke, 16/-; special output transformer to "W.W." specification, 12/6, post 9d.; staté valve and speaker; "W.W." universal output transformer, £1; normal 40h. 50 m.a. primary output transformers, 10/6, post 9d.

VORTEXION 7.30h. 120 m.a. Choke, 215 ohms, in die cast shrouding to match; 12/6.

IMITATED, but unequalled. Good enough for a "Wireless World" specification is good enough for you.

VORTEXION Cost Little More than the Cheapest, but unequalled by the dearest.

VORTEXION A.C./34, used by author in construction of A.V.C. Three, as illustrated; 18/-.

GUARANTEED 12 Months, and within 5% normal and 2½% super models, neat shrouding, with detachable feet, as used by Government Departments, etc., etc., any model guaranteed 5 years at extra cost of 2/-.

ALL Secondaries Centre Tapped.

VORTEXION—250-0-250 60 m.a., 4v. 1 to 2a., 4v. 2 to 4a., open type, 10/-; shrouded, 12/6; post 9d.

VORTEXION—Ferrocort III 350-0-350, 60 m.a., 4v. 2.5 C.T., 4v. 3.5 C.T.; open type 13/6, shrouded 16/-; post 9d.

VORTEXION—Super model for H.T.8 or 9 or 10, 4v. 1 to 2, 4v. 2 to 4, open type 14/6, shrouded 16/6; post 1/-.

VORTEXION—350-0-350, 120 m.a., 4v. 2 to 5a., 4v. 2 to 4a., 4v. 2.5a.; open type 14/6, shrouded 16/6; super shrouded model, weight 11lb., 4 filaments to specification, 21/-; post 1/3.

VORTEXION—400 or 450 or 500v., 120 m.a., 4v. 2 to 5, 4v. 2 to 5, 4v. 2.5a.; open type 19/-, shrouded 23/-.

VORTEXION—400 or 450 or 500, 150 m.a., 4v. 4a., 4v. 2.5, 4v. 2, 4v. 2, 4v. 2, core size 2½x1½ in., a super job, 2% regulation 35/-, shrouded, with terminals; less terminals, 30/-; open type, 26/-; post 1/3.

VORTEXION Auto Transformers to B.E.S.A. Specification, 100, 110, or 120v. to 200, 220, or 240 volts, 60 watts, 9/-; post 9d.; 120 watts, shrouded 12/6, open type 10/6, post 1/-; 200 watts, shrouded 16/6, post 1/-; 2,000 watts, £4/10.

VORTEXION 1,000-watt Transformers; £4/10, carriage free.

VORTEXION 30h. at 60 m.a., Chokes, 5/6; 40h. at 60 m.a., 8/6; 30h. at 150 m.a., 200 ohms, 10/6 open type, 12/6 shrouded.

VORTEXION Transformers Made to Your Specification; price according to wattage, 6v. filaments same price unless wattage grossly exceeded; special quotations by return.

VORTEXION (S. A. BROWN), 182, The Broadway, Wimbledon, S.W.19. Tel.: Liberty 2814. [6954]

TANTALUM for A.C. Chargers, H.T. and L.T.—Blackwell's Metallurgical Works, Ltd., Garston, Liverpool. [6477]



The Cry of the "Bitten"

THIS IS NOT a story of Bulldogs and pants, but of the many disillusioned Amplifier builders who plead with us to take their "not to specification" amplifiers in part exchange for a

SOUND SALES PRODUCT.

WE HATE to be disobliging, but what can we do with them? The designer chose certain components to give him the results he aimed at and so successfully achieved. The "Wireless World Amplifier" is a quality job and naturally the highest quality components were chosen. Those unfortunate people who departed from the specification are now realising their error. Hence—

THE CRY OF THE "BITTEN."

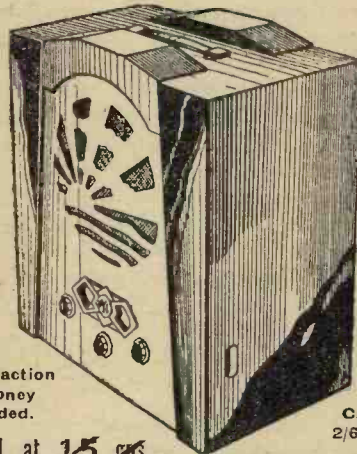
A COMPREHENSIVE catalogue is now being prepared, giving full details of the 4-12 watt Sound Sales "Wireless World Quality Amplifier." This will be available in about 7 days. If you are contemplating building the amplifier yourself, may we send you our latest catalogue of transformers and chokes?

SOUND SALES LTD.,

Contractors to the G.P.O., etc.
TREMLET GROVE, JUNCTION ROAD,
LONDON, N.19. Telephone: Archway 1661.

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Satisfaction or money refunded.

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- Walnut Case.
- A.V.C.
- Self Contained.

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Mains Equipment.—Contd.

P. PARTRIDGE, B.Sc., A.M.I.E.E., A.I.Rad.E.

PARTRIDGE Mains Transformers.—"Certainly above the average... very soundly constructed."—Wireless Trader.

PARTRIDGE Output Transformers.—Officially recommended by Messrs. Tungfram for their 21w. output valves.

PARTRIDGE.—See last week's detailed advertisement; delivery from stock; trade enquiries invited.

PARTRIDGE, N., King's Buildings, Dean Stanley St., London, S.W.1. Tel.: Vic. 5035. [6598]

PARAMOUNT Mains Transformers Lead in Price and Quality.

PARAMOUNT Transformers are Suitable for all "W.W." Circuits.

PARAMOUNT Transformers Guaranteed for 2 Years, and the best British materials, 2½ mils. thick insulating paper between each layer, with standard primaries, 270-250v. 50 cycles, all secondaries C.T.

PARAMOUNT 250-0-250v. 60 m.a., 4v. 1 to 2a., 4v. 2 to 4a., open type, 9/-; shrouded, 11/-; post 9d.

PARAMOUNT Ferrocort III, 350-0-350v. 75 m.a., 4v. 2.5a., 4v. 3 to 5a., open type, 12/-; shrouded, 14/-; post 9d.

PARAMOUNT Transformers Made to Your Own Specification; price according to wattage; quotations by return.

PARAMOUNT 350-0-350v. 120 m.a., 4v. 2.5a., 4v. 4a., 4v. 5a., open type, 14/-; shrouded, 15/6; post 1/-.

WE are Proud of our 5-valve Super Inductance Receiver; write for details; price £9, complete in walnut cabinet.

PARAMOUNT 400v., 450v. or 500v. 120 m.a., 4v. 2.5a., 4v. 4a., 4v. 5a., open type 17/-, shrouded 19/-, post 1/3; 150 m.a. with 2 extra filaments (not exceeding wattage), open type 22/6, shrouded 25/-, post 1/3.

PARAMOUNT Super Models.—H.T.8, 9 or 10, 4v. 1 to 2a., 4v. 2 to 4a., open type, 14/-; shrouded, 15/6; post 1/-; don't pay high prices for your mains components.

PARAMOUNT Auto Transformers, 100-120v. to 200-250v. or vice versa, 60-watt, 8/-; 120-watt, 9/6; shrouded, 1/- extra; post 9d.

PARAMOUNT Mains Chokes, 30 h. 60 m.a., 5/6; 20h. 120 m.a., 8/-; post 9d.

PARAMOUNT Guaranteed Electrolytic Condensers, 4-4 mfd., 500 ppc; price 3/6; post 3d.

PARAMOUNT Mains Transformers Manufactured by R. H. Saller, 66, Hartfield Rd., Wimbledon, S.W.19. Tel.: Liberty 3226. [6929]

MAINS Transformer for W.W. A.C. Two; 10/-; guaranteed.—P. & D. Radio, 1, Gooding Rd., N.7. [6927]

HOYNE'S Transformers are Manufactured by Engineers with 14 Years' Experience in Radio Transformer design.

HOYNE'S Transformers, fitted with tapped and screened primaries, filaments, all centre tapped, stout cast aluminium clamps and clearly marked terminal strips are fitted to all models; write for list.

HOYNE'S Components are Guaranteed for One Year; one type only manufactured, the best, as used by many well-known set manufacturers after testing all others.

HOYNE'S—"W.W." transformers wound strictly to specification of author: "W.W." test reports, June 22nd: "The insulation is particularly good throughout... the transformer is satisfactory in all respects."

HOYNE'S—Push-pull quality amplifier transformer, 25/-, post 1/3; 7/30 henrys choke, 9/6, post 9d.; 20 henrys, 7/6, post 9d.

HOYNE'S—Single span, 15/-, post 1/-; choke, 10 henrys, 7/6, post 9d.

HOYNE'S—Everyman A.C. super transformer, 12/6, post 1/-; choke, 10 henrys, 7/6, post 9d.

HOYNE'S—A.V.C. Straight Four transformer, 18/-, post 1/3; choke, 28 henrys, 12 m.a., 140 ohms, 9/6, post 9d.

HOYNE'S—Push-pull quality amplifier, complete to "W.W." specifications, wired and fully tested, less valves, £5/12/6; complete kit of components, including metal chassis, £5/2/6; field replacement choke, 1,250 ohms, 13/6, post 1/-; output transformer, 12/6, post 1/-.

HOYNE'S—250-0-250v. 60 m.a., 4v. 1 to 2a., 4v. 2 to 4a., 10/-, post 9d.; with extra 4v. 1 to 2a. winding, 12/6, post 1/-.

HOYNE'S—Ferrocort III, 350-0-350v., 60-70 m.a., 4v. 2 to 3a., 4v. 2 to 4a., 12/6, post 1/-; with extra 4v. 1 to 2a. winding, 13/6, post 1/-.

HOYNE'S—350-0-350v., 120 m.a., 4v. 2 to 3a., 4v. 4 to 6a., 4v. 1a., 4v. 1a., 18/-, post 1/3.

HOYNE'S—400 or 450 or 500v., 120 m.a., 4v. 2 to 3a., 4v. 2 to 5a., 4v. 1 to 2a., 18/-, post 1/3.

HOYNE'S—500-450-0-450-500v. 140 m.a., 4v. 2 to 4a., 4v. 4 to 6a., 4v. 2a., 4v. 2a., 27/6, post 1/3; weight 11lb.

HOYNE'S Transformers, built to specifications, keenest prices, best materials and workmanship; quotation by return.

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DECONTROLLED Sets: Columbia 4v. battery, S.G., det., Q.P.P. output, Exide and Marconi batteries, complete, £6/5; McMichael Twin Supervo receivers for A.C. mains, 2 H.F. with twin speakers, £9; Ultra Panther superhet, 6v. and rectifier, £10; Lotus D.C. 2 sets, £4/10, all new, complete, etc.

HEYBERD Transformers, new, with leading-out wires, 350v., 120 m.a., 4v. 4a., 4v. 5a., 4v. 2 1/2a., 25/-; Heyberd 500v. 120 m.a., 4v. 4a., 4v. 5a., 4v. 2 1/2a., 32/6; both screened primary and input 200-250v.; carriage forward.

R. YALL'S RADIO Offer Reliable Resistances, suitable for all sets where a 1-watt resistance is specified, in values 100, 150, 250, 400, 500, 600, 1,000, 2,000, 5,000, 10,000, 15,000, 20,000, 25,000, 30,000, 40,000, 50,000, 75,000, 100,000, 150,000, 250,000, 1/2 meg., 1 meg., 2 meg., all values stated in ohms, 4d. each; also 2-3-watt type, 400, 700, 800, 1,000, 4,000, 5,000, 6,000, 10,000, 20,000, 9d. each wire ends.

RADIOPHONE Volume Controls with Switch, 5,000, 10,000, 15,000, 20,000, 100,000, 2/6; also 10,000 graded 9-1 with 3-P switch, 25,000 graded 9-1 with 2-P switch, 3/6.

POLAR Minor 3-gang Condensers, with "Arcuate" or "Semi Circular" drive, new, list 24/6, 14/6.

RADIOPHONE Radiopacks, new, complete, Band pass Superhet, 110 K.C. and 2H.F. type; 35/- each.

R. YALL'S RADIO Offer British-made Mansbridge Condensers, metal cased, brand new, fully guaranteed, 1 mf. 400 vw., 1/3; 2 mf. 400 vw., 1/6; 4 mf. 400 vw., 3/-; 4 mf. 750 vw., 6/-.

READY RADIO 0.0005 Extensor Condensers, new, 2/6; Radiophone S.G./Det./Pen. and rectifier chassis, with valves, complete, 65/-.

WEGO, British condenser blocks, containing 4x4 at 350 vw., also 1x1x1x0.1x0.1x0.1 at 250 vw., new, 4/-; Wearite H.F. screened chokes, 2/-; T.C.C., wet type, 8 mf., 2/9, 440 vw.

T.C.C. 0-1 Non-inductive Tubular Condensers, 10d. each, 350 v.; T.C.C. 0.01 mica, type M, 1/-; T.C.C. 0.0001, type M, 5d.; H.M.V. condenser blocks, 250v. working, 4x4x1x1x1/2 mid., 3/-; T.C.C. 0.1x0.1, 450v. working, 1/6; T.C.C. 8 mid., electrolytic, 500v. working, 3/9; Dubilier 2 mid., 250v. working, 1/6.

UNIKNOBS, Polar 2-gang, new, brown, 8/-, with cover, 9/-; R. and A. type output transformers, 18-23-32-1, new, 5/-; Paxolin formers, with guides, lin., 8d.; R.I. Hyperite transformers, 4/-, second-hand; R.I. Parafed transformers, 5/-, second-hand.

RADIOPHONE Disc Dives, less escutcheon, fit 3/16in. spindle, read 0-100 from left to right; 1/6 post free.

R. [6955]

PEARL and **PEARL** Bargain List A Free.—190, Bishopsgate, London, E.C.2. [0421]

TELE-RADIO Have Purchased Manufacturers' Surplus; same are being sold at ridiculous prices.

WESTINGHOUSE Rectifiers, H.T.7, H.T.8, 9/3; H.T.9, 9/6; H.T.10, 10/9; L.T.2, 9/3; L.T.4, 11/3; L.T.5, 11/9; transformers for same from 7/11.

DUBILIER Resistances, 1 watt wire ends, all sizes in stock from 100 ohms to 2 meg.; 7d.

A.C. Eliminators, input 200-250v., 150v. 25 m.a., finished in neat Crystalline case, 3 positive tapings, Westinghouse rectified, fully guaranteed, 19/11, 1/- postage; D.C., 150v. 25 m.a., 10/11, 1/- postage.

WE Have a Large Stock of Microphones and Meters by Weston, Ferranti, Turner, also input and output transformers; send us your requirements and send for our full lists, "We are cheaper."

ALL Goods sent Carriage paid (except when marked), c.o.d. or cash with order; prompt delivery; part exchange arranged.

TELE-RADIO SUPPLIES, 305, King's Rd., S.W.3. [6948] Flaxman 9710.

BRAND New Moving Coil Speakers for 10/6 each; see advertisement under loud speakers.—Hulbert, 6, Conduit St., W.1. [6945]

"In a Class by themselves"

says "PRACTICAL WIRELESS" TEST REPORT (Oct. 13th, 1934)

QUALITY is YOUR First Requirement

Follow the Example of the large majority of British Radio Manufacturers who have used over 750,000 ROLA Speakers in 3 years

and install.



These Rola Units offer you THE WORLD'S HIGHEST QUALITY REPRODUCTION

Model F7-PM (Dia. 9") . . . 60/-
A unit of supreme fidelity—the last word in radio realism.

Model FR7-PM (Dia. 9") . . . 49/6
A speaker for the radio connoisseur, delighting the ear with its perfect interpretation of every note.

Model F7-FE (Dia. 9") . . . 47/6
The mains energised counterpart of the FR7-PM. A speaker which sets new standards of fidelity in radio reproduction.

NEW DUST-PROOF MODELS

Model FR6-PM (Dia. 7 3/4") . 39/6
An absolutely dust-proof model with all vital parts fully protected.

Model F6-FE (Dia. 7 3/4") . . . 35/-
A mains energised model with complete dust-proof protection.

ROLA DUAL BALANCED PAIRS

These specially compensated pairs of speakers reach a degree of perfection unattainable by any single speaker. Here indeed is radio at its best.

TYPE	CONSISTING OF	PRICE
A	2 F5 field excited	£2 12 6
B	2 FR5 permanent magnet	£2 17 6
C	2 F6 field excited	£3 7 6
D	1 F6 field excited & 1 F7 field excited	£4 0 0
E	2 FR6 permanent magnet	£3 17 6
F	1 FR6 permanent magnet and 1 FR7 permanent magnet	£4 5 0
G	1 F6 field excited and 1 FR7 permanent magnet	£4 0 0
H	1 F6 field excited and 1 F7 permanent magnet	£4 12 6

All models are supplied with transformer for either Pentode or Triode valves. If you are using high resistance Pentode or Class B valves state type of valve used when ordering. Please state field resistance when ordering field excited types.

Write to-day for the Rola Folder and Extension Speaker Broadsheet.

THE BRITISH ROLA CO., LTD.
MINERVA ROAD, PARK ROYAL, N.W.10
Phone Willesden 4322-3-4-5-6

Components, Etc., for Sale.—Contd.

PREMIER SUPPLY STORES

ANNOUNCE a City Branch at 165 and 165a, Fleet St., E.C. (next door to Anderton's Hotel) for the convenience of callers; post orders and callers to High St., Clapham.

OFFER the Following Manufacturers' Surplus New Goods at a Fraction of the Original Cost; all goods guaranteed perfect; carriage paid over 5/-, under 5/- postage 6d. extra; I.F.S. and abroad, carriage extra; orders under 5/- cannot be sent c.o.d.; please send for illustrated catalogue, post free.

STUPENDOUS Purchase of Set Manufacturers' Stock.—All electric 3-valve (S.G. det. pen.) set, in walnut cabinet, with moving coil speaker, 200-250 volt. 40-60 cycles, chassis built, 200-2,000 metres, with 4 valves; £4/19/6.

ALL-ELECTRIC 3-stage Amplifiers, 200-250v. 40-60 cycles, 10 watts undistorted output, complete with 5 valves, and Magnavox Super 66 energised speaker; £12/10.

ELIMINATOR Kits, including transformer, choke, Westinghouse metal rectifier, condensers, resistances, and diagram, 120v. 20 m.a., 20/-; trickle charger, 8/- extra; 150v. 30 milliamps., with 4v. 2.4 amps. C.T., L.T., 25/-; trickle charger, 6/6 extra; 250v. 60 milliamps., with 4v. 3.5 amps. C.T., L.T., 30/-; 300v. 60 m.a., with 4 volts 3.5 amps., 37/6; 200v. 50 m.a., with 4v. 3.5 amps. L.T., 27/6.

PREMIER Chokes, 40 milliamps., 25 hrs., 4/-; 65 milliamps., 30 hrs., 5/6; 150 milliamps., 30 hrs., 10/6; 60 milliamps., 60 hrs., 2/500 ohms, 5/6; 25 milliamps., 20 hrs., 2/9; 250 milliamps., 30 hrs., 20/-.

ALL Premier Guaranteed Mains Transformers Have Engraved Terminal Strips, with terminal connections, input 200-250v., 40-100 cycles, all windings paper interleaved.

PREMIER H.T.7 Transformer, output 135v. 80 m.a., for voltage doubling, 8/6; 4v. 3-4a., C.T., L.T., 2/- extra; with Westinghouse rectifier, giving 200v. 39 m.a., 17/6.

PREMIER H.T.8 and 9 Transformers, 250v. 60 m.a. and 300v. 60 m.a. rectified, with 4v. 3-5a. and 4v. 1-2a., C.T., L.T., and screened primary, 10/-; with Westinghouse rectifier, 18/6.

PREMIER H.T.10 Transformer, 200v. 100 m.a., rectified, with 4v. 3-5a., and 4v. 1-2a., C.T., L.T., and screened primary, 10/-; with Westinghouse rectifier, 19/6.

PREMIER Mains Transformer, output 250-0-250v. 60 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

PREMIER Mains Transformers, output 350-0-350v. 120 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

PREMIER Auto Transformers, 100-110/200-250v., or vice versa, 100-watt; 10/-.

WESTERN Electric Mains Transformers, 300-0-300v. 65 m.a., 4v. 1-2a., 4v. 2-3a., 6/6; 500-0-500v. 150 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 2-3a., 4v. 1a., C.T., 4v. 1a. C.T.; 19/6.

SPECIAL Offer of Mains Transformers, manufactured by S. Phillips, input 100-110v. or 200-250v., output 180-0-180v. 40 m.a., 4v. 1 amp., 4v. 3 amps., 4/6; 200-0-200v., 4v. 1a., 4v. 3a.; 4/6.

PREMIER L.T. Charger Kits, consisting of Premier transformer and Westinghouse rectifier, input 200-250v. A.C., output 8v. 1/2 amp., 14/6; 8v. 1 amp., 17/6; 6v. 2 amp., 27/6; 30v. 1 amp., 37/6; 2v. 1/2 amp., 11/-.

B.T.H. Trusped Induction Type (A.C. only) Electric Gramophone Motors, 100-250v.; 30/- complete.

SPECIAL Offer B.T.H. Gramophone Motors, A.C. and D.C., 100-250v.; 30/-, listed £3/3.

COLLARO Gramophone Unit, consisting of A.C. motor, 200-250v. high quality pick-up and volume control, 49/-; without volume control, 46/-.

EDISON BELL Double Spring Gramophone Motors, complete with turntable and all fittings, a really sound job; 15/-.

SPECIAL Offer of Wire Wound Resistances, 4 watts, any value up to 50,000 ohms, 1/-; 8 watts, any value up to 15,000 ohms, 1/6; 15 watts, any value up to 50,000 ohms, 2/-; 25 watts, any value up to 50,000 ohms, 2/6.

CENTRALAB Potentiometers, 400 ohms, 1/-; 50,000, 100,000, 1/2 meg., any value, 2/-; 200 ohms, wire wound, 1/-.

POLAR Star, manufacturers' model, 3-gang condensers, fully screened, 7/6, with trimmers; unscreened, 5/-.

AMERICAN Triple Gang 0.0005 Condensers, with trimmers, 4/11; Utility bakelite 2-gang 0.0005, screened, with uniknob trimmer, 3/6; Polar bakelite condensers, 0.00035, 0.0003, 0.0005, 1/-.

ORMOND Condensers, 0.0005 2-gang semi-shielded, 2/6; brass vanes with trimmers, 3/6.

MAGNAVOX D.C. 152, 2,500 ohms, 17/6; D.C. 154, 2,500 ohms, 12/6; D.C. 152 magna., 2,500 ohms, 37/6; all complete with humbucking coils; please state whether power or pentode required; A.C. conversion kit for above types, 10/-; Magnavox P.M. Tin. cone, 16/6.

RELIABLE Canned Coils with Circuit Accurately Matched, dual range, iron cored, 2/11; microphone transformers, 50 and 100-1, 2/6.

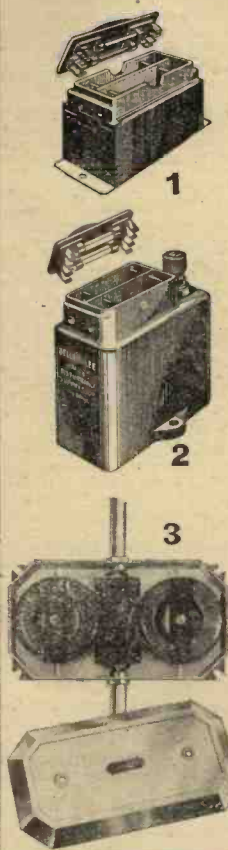
RELIABLE Intervalve Transformers, 2/-; multi-ratio output transformers, 2/6; Ormond cone speaker units, large magnet type, 3/-; with pentode tone corrector, 4/-.

UTILITY 3-gang Condensers, 0.0005, fully screened, with trimmers, ball bearing straight or superhet., 6/9, complete; with disc drive, 7/11; the best 3-gang available.

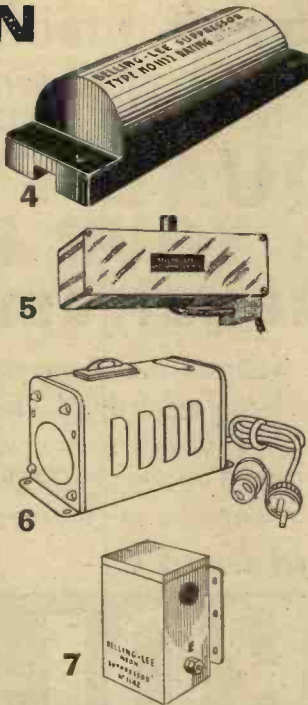
T.C.C. Condensers, 250v. working, 1 mf., 1/3; 2 mf., 1/9; 4 mf., 3/4; 4 mf., 450v. working, 4/-; 4 mf., 750v. working, 6/-; 2 mf., 750v. working, 3/-.

(This advertisement continued on next page.)

INTERFERENCE SUPPRESSION



- 1 No. 1171. For use across brushes of small unearthed motors. Price 8/6
 - 2 No. 1118. Standard model—all that is required in 80% of cases. May be fitted either at source or at listener's main switch. Price 10/6
 - 3 Double Choke Condenser Unit. An H.F. filter to be inserted in series with mains. May be adjusted to give several filter circuits, and supplied with chokes from 3 to 60 amperes, in metal case to take conduit. Prices from £3 - 10 to £9 - 15
 - 4 No. 1172. For Flashing Signs or other make-and-break contacts, thermostats, etc. Price 11/6
 - 5 No. 1182. Lift Suppressor to take the place of half-way contact box. Also suitable for large multi-contact signs up to 2 amperes per line. Price £3 - 15
 - 6 No. 1140. D.C. Hum Suppressor. Price £3 - 7 - 6
 - 7 No. 1142. For use on Neon Signs. To be inserted in secondary of each transformer. Price £3 - 15
- Send 6d. for copy of treatise on this subject. How to trace and suppress electrical interference.



BELLING-LEE SUPPRESSION SERVICE

CAMBRIDGE ARTERIAL ROAD, ENFIELD, MIDD.

THE VERDICT OF EXPERTS

of Scientists, Musicians, and all discriminating listeners that no set, whether its price is £5 or £100, can fail to show an immeasurable improvement with the addition of the

PRIMUSTATIC

Electrostatic Speaker

WILL ALSO BE YOURS

It clarifies the reception and adds a touch of naturalness that no other medium can possibly do. See "The Wireless World" of September 15th, 22nd and 29th, 1933. As a dual combination this ELECTROSTATIC SPEAKER is the only worthwhile addition. (Frequencies reproduced up to 20,000~). Many hundreds of testimonials from delighted listeners. Hailed by the Radio Press all over the world as the greatest advance in quality and natural reproduction. Used and recommended by Professor Einstein, etc., etc.

A correspondent writes: "If people only knew how good radio can be with the 'Primustatic,' they would not be without one."

DEMONSTRATIONS AT THE RADIO CENTRE, HAYMARKET, LONDON, S.W.1.

PRICES: Model "D," size 14" x 16", in Oak Chassis ... 25/-
Standard model, size 19" x 20", in Polished Oak Cabinet ... 40/-
Super model, 27" x 24" x 6", in Chassis £2 10 0
In Cabinet £3 3 0

All these models are also suitable for dual working.

FOR IMMEDIATE DELIVERY, POST FREE, C.O.D. ORDER TO-DAY FROM:

PRIMUSTATIC SALES (Primus Mfg. Co.)
Primus House, Willow St., London, E.C.2 'Phone: Bishopsgate 7681

10,000 MOTORS, SPRING and ELECTRIC, for RADIOGRAMS and GRAMOPHONES in Stock

Thousands of components: Tonearms, Soundboxes, Pick-ups, Horns, Pedestal-Portable Cabinets, Hinges, Lidstays, Springs, Gears; Repairs; Portable Gramos. from 18/-; Violins, Strings, Accordions. 64 page Catalogue. How to Make Them, 2d. All Brand Radio 1935 70 page catalogue 4d. Est. 30 years.

The Regent Fittings Co. (WO.), 120, Old Street, E.C.1.

Add 50/- WEEKLY to your earnings

by charging accumulators in your spare time. Complete plant for A.C. mains incorporating Westinghouse Rectifiers to charge 105 L.T. cells weekly. Trade price £4 4s.

Send for descriptive booklet.

M.P.R. Ltd ROMFORD, ESSEX.

TRIX

QUALITY AMPLIFIERS

for P.A. with a Punch!

Send for illustrated lists and free estimate for any public address installation. Special A.C./D.C. Dance Band Outfits.

THE TRIX ELECTRICAL COMPANY LTD.,
8/9, Clerkenwell Green, London, E.C.1.
Contractors to H.M. Government.

BOOKS on WIRELESS

Write for complete list to
ILIFFE & SONS LTD.
Dorset House, Stamford St., London, S.E.1. w.w.1

Components, Etc., for Sale.—Contd.

(This advertisement continued from previous page.)

VARLEY Constant Square Peak Coils, band-pass type B.P.7, brand new, in maker's cartons, with instruction and diagram, 2/4.

VARLEY H.F. Intervale Coils, B.P.8, band pass, complete with instructions, in original cartons; 2/6.

SCREENED H.F. Chokes, by one of the largest manufacturers in the country; 1/6.

PREMIER British-made Meters, moving iron, flush mounting, accurate, 0-10, 0-15, 0-50 m.a., 0-100, 0-250 m.a., 0-1, 0-5 amps.; all at 6/-.

WESTERN Electric Condensers, 250v. working, 1 mf., 6d.; 2 mf., 1/-; 4 mf., 2/-; 400v. working, 1 mf., 1/-; 2 mf., 1/6.

WIRE-WOUND Potentiometers, 1,000, 2,500, 15,000, 20,000, 50,000, 90,000, 120,000, 200,000, 500,000, 2/- each; 1,000 ohm, semi variable, carry 150 m.a., 2/-.

COSMOCORD Pick-ups, complete with arm and volume control, a really good job; 12/-.

A LARGE Selection of Pedestal, table and radiogram cabinets, by best manufacturers at a fraction of original cost, for callers.

THE Following Lines 6d. Each or 5/- Per Dozen: Chassis valve holders, 5-, 6-, or 7-pin, screened screen-grid leads, any value 1-watt wire resistances, wire end condensers, 0.0001 to 0.1, 3 amp. main switches, Cylcon capacitors, double trimmers.

SUPER Moving Coil Speakers, handle 10 watts, energised directly from A.C. mains, manufactured by world famous radio and gramophone company; 40/-.

LISSEN Mains Receivers, A.C. 200-250 volts, complete with 3 valves, with self contained speaker; 59/6.

SCOTT Aerial and Anode Coils, dual range, complete with S.G.3 circuit; 2/6 per pair.

BLUE SPOT 29D.O. Moving Coil Speaker, with multi-ratio output transformer, 7in. cone, 2,500 ohms, 9/11; ditto 29P.M., permanent magnet, 18/9.

ELPHRO Volume Controls, 10,000, 12,000 or 15,000 ohms, complete with mains switch; 1/-.

T.C.C. Electrolytic Condensers 8 mf. 400v. working 3/-; 4 mf., 440v. working, 3/-; 15 mf., 50v. working, 1/-; 50 mf., 12v. working, 1/-; 15 mf., 100v. working, 1/3; 6 mf., 50v. working, 6d.; 2 mf., 100v. working, 6d.; 8+4 mf., 450v. working, 4/-.

DUBLIER Dry Electrolytic Condensers, 8 or 4 mf., 450v. working, 3/-; 12 mf., 20v. working, 6d.; 50 mf., 50v. working, 1/9.

CONDENSER Blocks, H.M.V., 400v. working, 4+2+1+1+1+1+0.5, 3/9; 2+2+1+1+1+0.5, 3/-; Dubilier, 300v. working, 4+4+2+0.1, 3/-; Phillips 6+4+2+1+1, 4/6; 9+3+2, 3/-.

RADIOPHONE Logarithmic Wire Wound Potentiometer, with mains switch, 2/-; S.W. H.F. chokes, 10-200 metres, 9d.

CELESTION P.P.M.19 P.M. Moving Coil, with multi-ratio transformer; listed 48/-, at 25/-.

BRITISH RADIOPHONE 2-gang Condensers, fully screened, with trimmers, and disc drive with Uniknob trimmer; 5/6.

SPECIAL Offer.—American Midget sets, A.C./D.C., 100-250v. 25-60 cycles, 4 valves, including rectifier, superhet, moving coil speaker, £3/9/6; 200-550 metres, same as above but 200-2,000 metres, £4/7/6.

PREMIER SUPPLY STORES Announce the Purchase of the Complete Stock of a World-famous Continental Valve Manufacturer, all the following standard mains types, fully guaranteed, 4/6 each: H.L., L, power, medium, high, low mag. and variable mu screen grids, 1-, 3- and 4-watt A.C. output, directly heated pentodes, 250v. 60 m.a., full wave rectifiers, D.C. types, 20v. 13 amp. filaments, screen grid V.M., H., H.L., power.

THE Following Types, 5/6 each; 350v., 120 m.a., full wave rectifier, 500v. 120 m.a., full wave rectifier, 2 1/2-watt indirectly heated pentode.

THE Following American Types, 4/6: 250, 112, 171, 210, 245, 226, 47, 46, 24, 35, 51, 57, 58, 55, 37, 80, 6A7, 2A7, 27.

THE Following Types, 6/6 each: 42, 77, 78, 25Z5, 36, 39, 83, 39, 44, 53, 6B7, 2A5, 2A6, 2B7, 5Z3, 6C6, 6A4, 6D6, 6F7, 43, 59.

PREMIER SUPPLY STORES,
20-22, High St., Clapham, S.W.4. 'Phone: Macaulay 2193. Nearest Station: Clapham North (Underground). [6957]

MAINS RADIO DEVELOPMENT COMPANY.

A GAIN We Offer Something Original; perfect goods, carriage paid; list free.

EMICOL 3-range High Grade Meters, bakelite case, reads 0-6 volts, 0-150 volts, 0-30 milliamps. 0-2,000 ohms, complete with leads and internal battery; 8/9 post free.

SPECIAL Offer of British Made 2 mfd. Condensers, eminent maker, 250v. working; 10d.

SONOCHORDE Energised Speakers, 2,500, 6,500 ohms, 7in. cone, new and boxed; 11/6.

COLVERN Wire Wound Potentiometers, 25,000 ohms, 1/3; 50,000 ohm potentiometers, 1/3.

STUPENDOUS Clearance Offer of Manufacturer's Super Efficient H.F. Chokes; 4d.

BRITISH Standard Tubular Condensers, new, wire ends, 400v. working, 0.01, 0.02, 0.05, 0.1 mfd., 6d.; 0.25, 0.5 mfd., 8d.

CHASSIS Valve Holders, new, latest type, 4-pin 1 1/2d., 5-pin 2d., 7-pin 5d.; Radiophone 3-point toggles 7d., on-off ditto 5d.; Paxolin formers, 1in. diameter, 4in. long, 1 1/2d.; Mikado 0.001, 0.002, 0.0005 mfd. condensers, 8 for 6d.

FRANKLIN 1-watt Colour Coded Resistors, wire wound, 100 to 100,000 ohms, dead accurate, your choice; 4d. each, 3/6 per dozen.

MAINS RADIO DEVELOPMENT COMPANY, 4-6, Muswell Hill Rd., London, N.6. Tudor 4046. [6920]

Components, Etc., for Sale.—Contd.

SOUTHERN RADIO'S Wireless Bargains.

RECEIVERS.—G.E.C. Osram 4-valve (actual) sets, complete with 4 Osram valves, permanent magnet moving coil speaker, magnificent pedestal cabinet, ready to use on all voltages A.C., all Osram proprietary components in original sealed cartons; £6/15 (list £15/15); an exceptional bargain.

CROMWELL 3-valve Battery Sets, complete with three Cosor valves, permanent magnet moving coil speaker in magnificent walnut console cabinet, brand new, in original sealed cartons, £3/12/6 (list £8); same model as above for Class B, £3/17/6.

COILS.—Igranite superhet, set of four (1 Osc., 2 L.F. with pigtales, 1 L.F. plain), 12/6 (list 50/-); Lissen superhet, 3-coil kit, screened, ganged on base with switch, type L.N.5181, 9/6; same description for band pass or any straight circuit, type L.N.5162, 7/-; Varley constant square peak coils, B.P.5, complete with all accessories in sealed cartons, 2/3; Lewcos B.P.F.R., B.F., O.S.C./126 (extensor) T.O.S./R., all at 3/6 each; a full range of Edison Bell plug-in coils, 2-pin, at 9d. each.

PICK-UPS.—Marconi model K.25 (1935 issue), 22/6 (list 32/6); six only Rothermel Piezo electric pick-ups, 35/-; four only B.T.H. Senior pick-ups, 32/6.

CONDENSERS.—Lotus 3-gang, 12/6; 2-gang, 8/6; single dyblock, 4/6; all capacities 0.0005, fully screened with trimmers, complete with dials, knobs and escutcheons; special bargain line, Plessey 4-gang condensers, superhet type, fully screened with trimmers (less dials) (standard dial will fit), 10/6 (list 45/-); Dubilier block condensers 4 mid. (2x1x1), 1,000v., 2/9; 4.5 mid. (2.25x2.25), 3/-; T.C.C. (0.1x0.01), 1/3 each.

SPEAKERS.—Rothermel permanent magnet moving coil, universal transformer, 16/- (7in. cone); Blue Spot permanent magnet speakers, universal transformer for power, super power, pentode and Class B, 23/-; Blue Spot 66R, units, brand new and boxed, 10/6 (list 35/-); complete, mounted on Blue Spot chassis, 16/6 (list 45/-).

MISCELLANEOUS.—Westinghouse metal rectifiers, H.T.6, 7, 8, 9/3; Morse tapping keys with flash signal and buzzer, complete with battery and bulb, 2/-; Lissen general purpose output chokes, 20-28 henries, 18-60 m.a., L.N. 5301, 6/- each; Lewcos superhet. dual wave frame aerials, 9/-; thousands of other bargains; callers are assured of a tremendous saving in all branches of wireless needs by visiting any of our shops; all 1935 receivers can be supplied on the most favourable hire purchase terms.

ALL Goods Guaranteed and Sent Post Paid.

BRANCHES at 46, Lisle St., W.C.2; 16, Leicester St., W.; 271-275, High Rd., Willesden Green, N.W.10; all mail orders to 323, Euston Rd., N.W.1.

SOUTHERN RADIO, 323, Euston Rd., London, N.W.1 (near Warren St. Tube). Phone: Museum 6324. [6965]

T.C.C. Electrolytic Condensers, 6 mf., 25 mf., 50 mf., 25 volt, 1/- each; 15 mf., 110 volt, 1/6.

IGRANIC Iron Core B.P. 1, 2, 3, 6/-; No. 1 H.F., 4/-; Nos. 1, 2, O.S., 6/-; with wiring plan.—H. Henry, 60, Hockley Hill, Birmingham. [6971]

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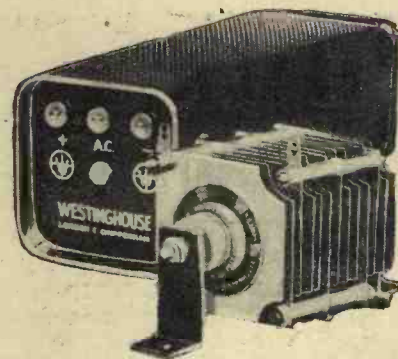
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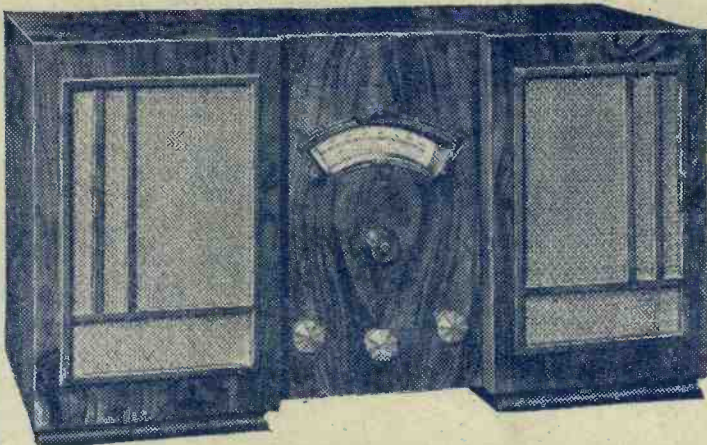
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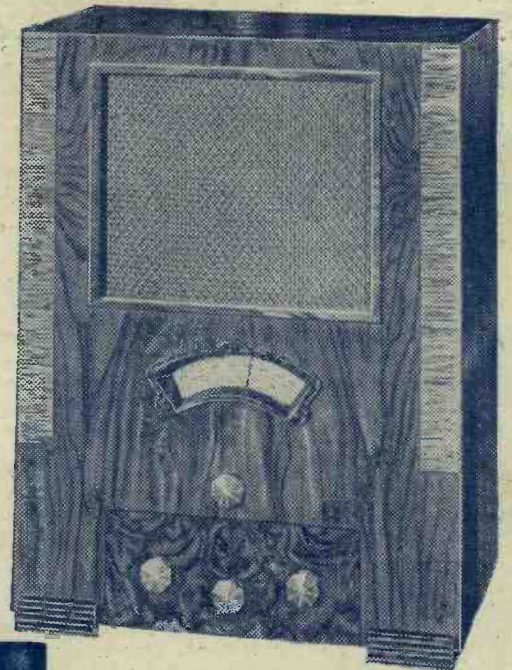
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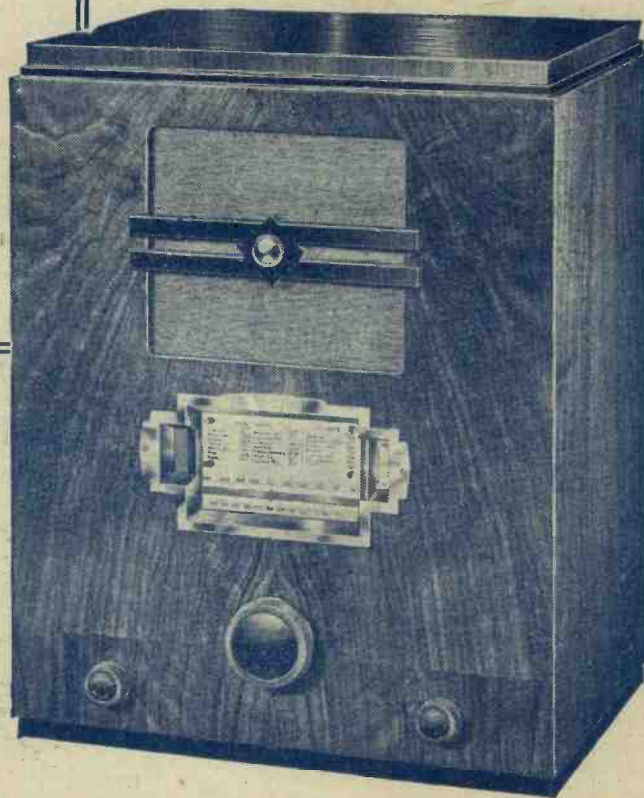
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As many of the circuits and apparatus described in these
pages are covered by patents, readers are advised, before
making use of them, to satisfy themselves that they would
not be infringing patents.

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EDITORIAL COMMENT

Valve Shy

More Valves Would Often Mean Better Sets

IN the early days of wireless receivers, the valve was a very precious article indeed; it was one of the most costly individual components, and being in addition somewhat fragile, was treated with great respect and, quite naturally, valves were used in set designs as sparingly as possible.

There were other reasons, too, which contributed towards this attitude; the royalty on patents payable on the manufacture of wireless receivers was calculated on the basis of the number of valves employed and was at the rate of 12s. 6d. per valve. When this had to be added to the manufacturing cost, it was a considerable item.

Again, it was not for some considerable time that sets were designed to operate from the electric supply; all the early receivers were battery fed and the early filaments were heavy in their consumption from accumulators, and H.T. batteries supplying anode current were more limited in capacity than they are to-day, so that this question of battery supply had to be very carefully considered by set designers. It seems hardly surprising in view of all this, that it became a habit of designers to work to the smallest possible number of valves.

To-day such an attitude can no longer be justified; valves are substantially cheaper, their current consumption is much lower, so that in the case of battery sets it is not now necessary to take such precautions, and a large proportion of the sets are operated from electric supply, where a little current more or less is of no consequence; the high royalty, too, has disappeared.

Designers to-day should, we believe,

treat valves just as they would any other component in the set. Where two valves are better than one, two should certainly be used, and if with six the set will give a worthwhile improvement in performance, then by all means let us employ six. We are still "valve shy" and cling to the old tradition that valves should be sparingly used, in spite of the fact that all the old reasons justifying such an attitude have disappeared, with the sole exception of the cost of the valves themselves.

There is a very pronounced tendency on the part of valve manufacturers to-day to produce valves of multiple types which have as their sole merit the fact that in one valve two or more valves are combined; again, we have many instances of valves which are of extreme efficiency and, in consequence, difficult to manufacture with a reasonable degree of constancy, yet offering no particular advantage over two valves of somewhat less outstanding performance.

As the high prices of more or less standardised types of valves are undoubtedly, in part, due to the cost of developing new and special valves, it seems questionable whether the valve side of the industry is not being developed on unsatisfactory lines. To endeavour to get the last ounce out of every valve in a set and reduce the total of valves to the lowest possible minimum is, in our view, merely to carry on out-of-date traditions.

In next week's issue there will be published our annual valve supplement giving data on all types of receiving valves on the market. An examination of this list must bring home to any intelligent enquirer how greatly the production of valves could be simplified, with a probable reduction in price, if we could destroy the idea that the fewer valves we employ the cleverer we are as designers and manufacturers.

Those High Notes

Their Influence on Quality of Music and Intelligibility of Speech

MEASURED in terms of power the higher frequencies form only a small fraction of the total energy of speech and music. The following analysis shows, however, that their instantaneous value may be quite considerable and that their place in the acoustic spectrum is quite as important as that of the low tones carrying the bulk of the energy.

READERS of wireless periodicals are often puzzled by technical articles which state that for really good wireless reproduction of speech and music a receiving set should transmit audio frequencies up to 10,000 cycles per second without appreciable falling off in intensity. Such statements, even though they are frequently backed up by an impressive display of experimental evidence, fail to convince the average listener who, as he hears the daily sounds of speech, receives the impression of syllables pitched in a fairly low key for men and about an octave higher for women, each sex occupying its own narrow band in the scale—a band no more than two whole tones in width.

Men's voices are pitched on the average on lower C of the piano (the C below middle C) in ordinary conversation, and change in pitch occurs chiefly at the end of a sentence, where the voice may drop by a musical third, *i.e.*, two tones. But the most careful listening fails to reveal frequencies in higher regions, one, two, three or four octaves above this fundamental tone. Why then should we aim at possessing receiving sets capable of reproducing up to 10,000 cycles?

In this state of perplexity we turn to

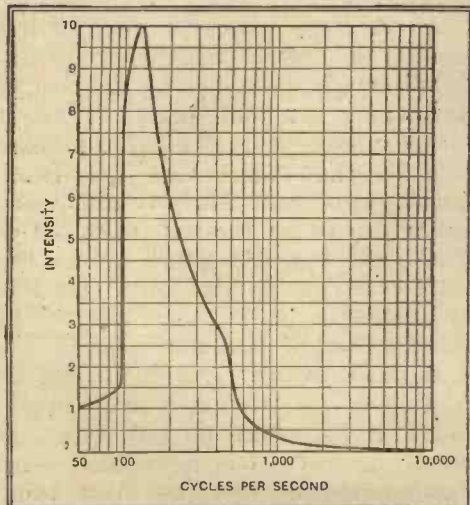


Fig. 1.—Normal male speech, showing how its intensity is distributed over the audio frequencies. This curve gives average intensity.

experiments which have been made on the distribution of speech power in the acoustic spectrum. Some workers have succeeded in mapping this spectrum by the

use of a series of band-pass filters, each of which transmits the power contained in a narrow region of frequencies: others have used a search tone which heterodynes the speech frequencies adjoining its own frequencies; after rectification the beat notes traverse a low-pass filter which cuts off above a frequency of, say, 100 cycles, so that an audio band 200 cycles in width is isolated. Thus by continuously changing the frequency of the search tone the whole spectrum is rapidly swept over and recorded. This device is an exact analogue in the audio region of a superheterodyne receiver in the radio region, which, as the local oscillator sweeps over the broadcast range, brings in one carrier wave after another, and could if desired be fitted with a recorder to map out the strengths of all broadcast stations.

A typical spectrum of the average male speaking voice is shown in Fig. 1. The power rises to a sharp peak at 130 cycles, which agrees with the observation that male voices are pitched on or about lower C (128 cycles), and falls precipitously at higher frequencies. At 1,000 cycles the power has dropped to 3 per cent. of the maximum, and it is apparent that beyond this point only a negligible residue remains.

Intensity *v.* Loudness

Negligible from the standpoint of power, certainly, but are we sure that the residue is negligible in our sensation of hearing? The fact is that sensations of loudness do not form a subjective scale similar to the power scale of Fig. 1. When we turn the volume control of a receiver to lift the loudness to a distinctly higher value, say, to a level which we judge to be twice as loud as the original one, we raise the intensity not to twice its former amount but more like ten times. In hearing, as in vision, it is percentage increase in intensity which counts as a step.

Let us accordingly redraw Fig. 1 to a new kind of vertical scale (Fig. 2 (a)). On this scale every horizontal line marks a level of power ten times as great as at the line immediately below. (It is in fact a scale of bels, or, if we multiply each figure by ten, a scale of decibels.) If we regard the horizontal lines as the rungs of a ladder each step upwards marks a tenfold increase in intensity, but a much

By R. T. BEATTY, M.A., B.E., D.Sc.

smaller rise in loudness. We have indeed practically a linear vertical scale of loudness, though from the aspect of power the scale is logarithmic.

Comparing Fig. 2 (a) with Fig. 1, we see that the prominent peak has become much less imposing, and the descent from it to the regions of higher frequency less abrupt. The curve to the right of 1,000 cycles, which in Fig. 1 fell to an inconsiderable height, now assumes an important aspect. Fig. 2 (a) is probably a closer approximation to the curve which we might imagine drawn by an intelligent being of microscopic dimensions stationed in the auditory brain centre, and observing for each frequency the corresponding

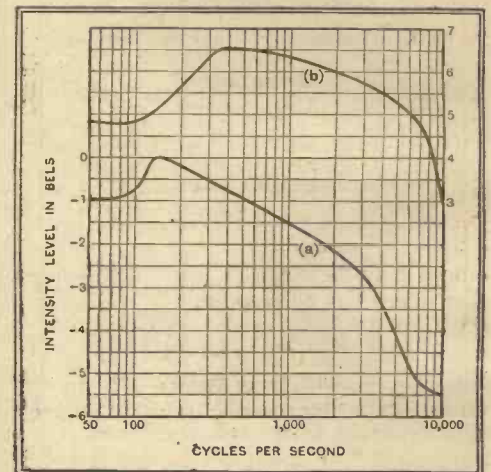


Fig. 2.—(a) The curve of Fig. 1 plotted on a scale of bels, where each vertical unit means a tenfold rise in intensity. (b) Distribution of maximum peak power in speech.

number of nerve impulses reaching the cortex per second.

High Peaks in Speech

But Fig. 2 (a) does not tell the whole story. The spectrum shown in it is an averaged spectrum, and tells us nothing about instantaneous peaks which may arise; peaks it may be of great intensity but of rare occurrence so that they contribute little to the average result. It is quite easy to obtain such a peak spectrum. Speech is received by a microphone, and any desired frequency region is isolated by a band-pass filter: the signal is then received by a peak voltmeter, a valve whose grid is biased negatively so that only signals in excess of a certain magnitude are transmitted. When the bias is increased to the point where signals just fail to pass, we have a measure of the peak intensity.

These peak values are shown in Fig. 2 (b). In comparing (a) with (b) we must

Those High Notes—

imagine the speech spectrum as changing from moment to moment, shifting abruptly from one outline to another as the speaker continues with his monologue. (a) Represents the average outline as it would be recorded by a sluggish instrument, while

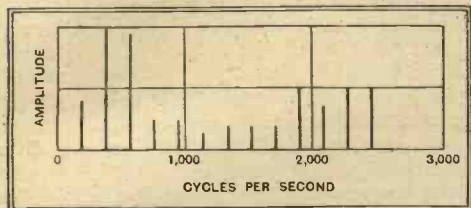


Fig. 3.—Analysis of the vowel "a" as in "hay," sung in a pitch of 192~.

(b) gives the high-water mark, the boundary which is occasionally reached during sporadic outbursts of energy. It is at once evident that the spectrum is profoundly modified when peaks are given their due recognition. The sharp summit of Fig. 1, already greatly smoothed by the change in scale of Fig. 2 (a), has completely disappeared, and the domain of high peak power is seen to extend with little diminution to frequencies of several thousand cycles per second.

The Production of High Frequencies

Every letter of the alphabet has its own acoustic spectrum by which it can be recognised and from which it can be reproduced, in the case of sustained vowel sounds by sounding a number of pure tones simultaneously with frequencies and intensities corresponding to the spectrum record. Thus the vowel "a" as in "hay" has the spectrum shown in Fig. 3. It may be seen that a number of the over-tones are stronger than the fundamental. But since in speech the fundamental of any letter is located at the note on which the voice is pitched, the effects add up to give the sharp maximum at low frequency shown for averaged speech in Figs. 1 and 2 (a). But when peaks alone are considered this maximum naturally disappears as in Fig. 2 (b).

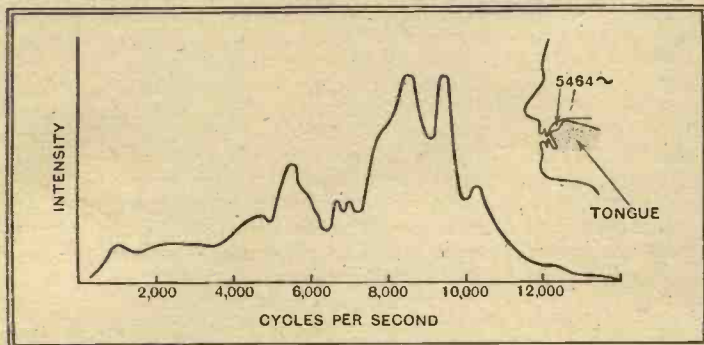


Fig. 4.—Analysis of the letter "s." The peak at 5,464~ is due to resonance in the small space between the tongue and the roof of the mouth.

In Fig. 4 the letter "s" is analysed. Here we have a continuous spectrum in addition to those peaks. The extent to which this spectrum spreads into the region of very high frequencies is remark-

able; even above 12,000 cycles some power is emitted. Evidently a faithful reproduction of "s" demands a receiving set of much higher quality than is practicable to-day.

The peak at 5,464 cycles has been traced by Sir Richard Paget to resonance in a small cavity between the tongue and the roof of the mouth; on lowering the rear part of the tongue, while the tip remains in the position shown, the volume of the resonant cavity increases and we get the sound of "th" with a peak at 1,625 cycles. This is what happens in lisping speech.

Explosive consonants such as "p" and "t" result from the sudden release of a volume of compressed air. Naturally the pressure gradient is very steep at the moment of release, and it is well known that when we try to build up a wave containing an abrupt change in pressure by adding together a number of sine waves whose relative frequencies are as 1, 2, 3, etc., a large number of sine waves is required. Hence of necessity high frequencies appear in the analysis.

We have now shown that high-frequency sounds exist in speech and have given some indication of how they are produced by the vocal organs. But the initial per-

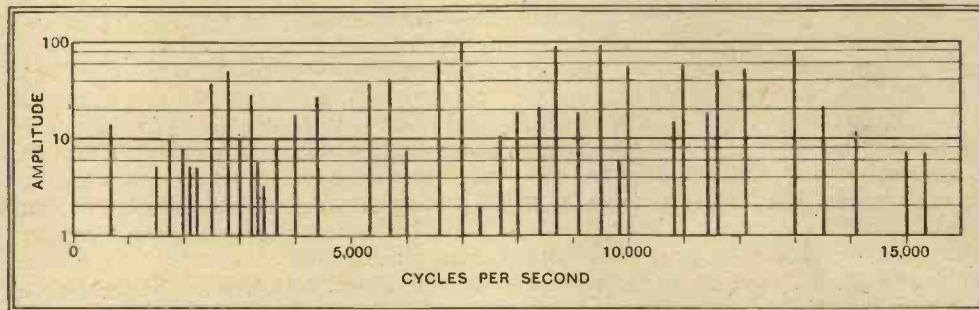


Fig. 6.—The spectrum of the triangle.

plexity still remains. How is it that we do not hear these sounds?

When a sustained note is played on a violin a musician can detect three or four of the accompanying harmonics, and the average listener can, with practice, acquire a similar power. Help can be given if the harmonic to be detected is lightly struck on the piano so as to guide the ear. A similar analysis can be made by ear when a vowel is sung, though it is more difficult in this case, probably owing to the large number of over-tones which are present. But in speech the whole picture is rapidly changing; the sustained vowels are interspersed between explosive consonants,

and a strong background of continuous spectrum serves to blur the outlines of the individual notes. There is not sufficient time to fix the attention on any particular note, and accordingly the high frequencies

fail to rise into the field of full consciousness, but instead, half apprehended, form a background which gives quality to speech, a colour which eludes analysis, but whose absence is immediately felt.

Whispering

When a sustained vowel sound is produced a fundamental tone is produced by

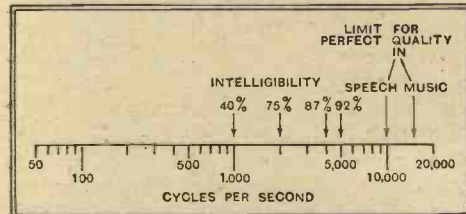


Fig. 5.—When a low-pass filter is used to cut off high frequencies the intelligibility of speech is decreased as shown. It is possible to get good intelligibility but bad quality by cutting off above 6,000~.

vibration of the vocal cords, and this tone is modulated by the resonant cavities of the throat and mouth just as a carrier wave is modulated by speech frequencies at a transmitting station. In whispering, the vocal cords are opened widely so that the fundamental tone is silenced, and in-

stead a stream of turbulent air excites the resonant cavities to give their special notes. In passing to a whisper the intensity drops to about 1/300th of its magnitude in fairly loud speech, and we have remaining a thin ghostly reproduction of the high frequencies which exist in the speaking voice but are masked by the dominating fundamental tone.

By the simple method of whispering we can accordingly realise that high notes exist in speech, but the power of further analysis by ear alone seems to be given to few people. In the sound of "a" in "hay" Sir Richard Paget is able to pick out two main frequencies, one at about the B above middle C, and another about three octaves above middle C.

When speech is received by a high-quality telephone set fitted with a low-pass filter which cuts off all frequencies above a certain value, it is found that when the cut is made at 1,000 cycles only 40 per cent. of a string of unconnected syllables can be understood. As the cut-off point moves to higher frequencies the reception improves as shown in Fig. 5, but even at 5,000 cycles the intelligibility is less than the 96 per cent. which is obtained when listening to the direct voice. Even

Those High Notes—

at the stage where intelligibility is practically complete, *quality* still remains imperfect till the cut-off is advanced to 10,000 cycles.

Reception of Music

High as is the limit for perfect speech, a still higher frequency region is required for music. In fact, the poet who wrote—
"I thought I could hear the curious tone
Of the cornet, clarinet, and big trombone,
Fiddle, 'cello, big bass drum,
Bassoon, flute and euphonium,"
must, if he savoured fully the curious tone, have been receiving frequencies up to 15,000 cycles, except in the cases of the

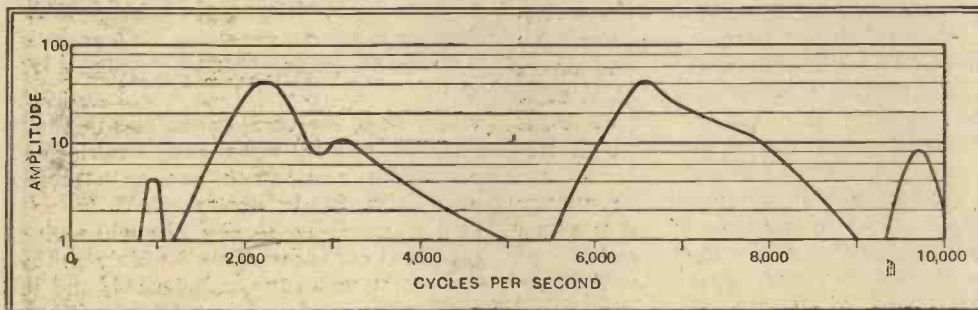


Fig. 7.—The spectrum of the castanets.

big bass drum and the big trombone. It is true that the purely musical components of the clarinet only reach 10,000 cycles, but blowing noises and reed noises make up the register to 15,000 cycles, and the same is true for the slapping of the keys of the bassoon.

Examples of percussion instruments are shown in Figs. 6 and 7, the rich spectrum of the innocent looking triangle being specially remarkable. It has been stated by Mr. Noel Ashbridge that musicians are less sensitive than ordinary listeners to high-frequency cut-off, but that they are more ready to detect alteration in the magnitudes of harmonics (frequency distortion). The first remark seems odd, but we must agree with the second, for it is by the magnitudes of harmonics that instruments playing the same keynote are distinguished from each other.

Improvements in Reception

Well, it would be delightful if we all had perfect hearing up to 15,000 cycles and if our receiving sets were equally efficient. We should then clamour for stations to be spaced not less than 40,000 cycles apart, and for a world in which thunderstorms were still, and industrial and domestic electrical disturbances were hushed.

Meanwhile, there are two serious obstacles to hinder perfect reception of the almost perfect transmissions which most of the world's stations emit; ghostly voices which by day and by night besiege our aerials crying for better reception than is possible for us to give them. The first obstacle is the overcrowding of the available wavelengths by an excessive number

of transmitters. Right and left of the illuminated tuning point of the receiving dial lie unwanted stations, edging in with undesirable noises and whistles. In order to silence these intruders we must sacrifice quality: the perfectly adequate band of wavelengths which the wanted station offers must be whittled down till it stretches no more than five kilocycles on either side of the carrier frequency.

This overcrowding is quite unnecessary, and could easily be put right if pure reason and scientific methods were dominant factors in human behaviour. Unfortunately, political prejudice and national pride have, in this case as in many others, succeeded in perverting the gifts which science has bestowed.

The second obstacle is one of expense.

Loud speakers with level response curves up to 9 or 10 kilocycles per second are on sale to-day—but the price is in the neighbourhood of £40. The quality given by such reproducers is a revelation. It is as if an acoustic fog had rolled away, leaving every instrument of an orchestra sounding clear and distinct, and every voice with its individuality restored. If public interest in high quality could be aroused there is no doubt that prices could be lowered to suit the purse of the average listener, and for the first steps in this direction we must insist on better quality in public address systems.

DISTANT RECEPTION NOTES

DESPITE the announcement that it was to be closed down forthwith, the Eiffel Tower still works spasmodically. I have had it on the last two Fridays during the evening at fair strength, though with nothing like the strength its transmitter normally gives when working at full power. As no call-sign was given, one wonders whether some other French station was temporarily using the wavelength for "experimental" purposes.

Two French stations are proving a real nuisance at the present time. These are Radio LL and Radio Vitus, both of which seem to adopt any wavelengths but those which belong to them. Certain French stations cause so much trouble to others more well-behaved than themselves that it is perhaps poetic justice that one French station should be almost completely jammed at times by the transmissions of another.

Radio-Paris has been particularly rich of late in eighth harmonic. Dividing eight into the 1,648 metres on which Radio-Paris works we have 206 metres, exactly the wavelength of Fécamp.

No official announcement has been made so far about the coming into action of the Lyons Tramoyes transmitter, but the Lyons transmissions on 463 metres are now received with such strength that it is difficult to believe that the 15-kilowatt Doua transmitter is still at work.

Both Beromünster and Söttens were silent for over a week at the end of October and the beginning of November without any explanatory announcement. When I say silent I mean that they were not, so far as I could ascertain, received in this country. Both have now returned to form, so that the cause of their eclipse, whatever it may have been, has now been removed.

The heterodyne which interfered with Leipzig's transmissions during the greater part of October has now mercifully disappeared, and the station is clear once more. Prague, on the other hand, has developed an occasional heterodyne, which is, I believe, due to the 15-kilowatt Lisbon station, working slightly off its wavelength.

I would like to register a strong protest against the use of names that are mere descriptive titles and not place-names for foreign broadcasting stations. At one time Beromünster appeared in the lists as Schweitzerischer Landessender, Söttens as Radio Suisse Romande, Fécamp as Radio Normandie, and so on. The great disadvantage of such names is that you cannot find them in any atlas, and, after all, they mean nothing to people outside the countries to which the stations belong.

Trying to be Helpful?

Beromünster has now become Beromünster again and Söttens is Söttens. But Fécamp tries hard to be Radio Normandie, and Zeesen wants to be the Deutschlandsender. The DX enthusiast does like to be able to spot stations on the map, and a name which means nothing more or less than German (National) Transmitter doesn't help him much.

Long-distance conditions are at the present time about as good as they can be. Except for the occasional jamming of Prague already mentioned, and for the interference by Radio-Paris with Fécamp, there is hardly a station of importance which cannot be well received on most evenings. The average number recorded in my log during the past fortnight is thirty-four an evening at good loud speaker strength, a number which surely provides sufficient alternative programmes for any reasonable person. Several stations not heard for a long time are now appearing again. Amongst the most interesting of these are Kaunas and Lahti on the long waves, and Brno, Rennes, Hörby and Genoa on the medium band.

So numerous are good transmissions that it is rather difficult to select the best dozen. However, for complete reliability I would give my vote to Radio-Paris, Kalundborg, Budapest, Beromünster, Stuttgart, Vienna, Florence, Lyons, Cologne, Rome, Munich, Leipzig.

It would be easy to pick another dozen very nearly as good; here they are: Brussels No. 1 and No. 2, Stockholm, Hamburg, Berlin, Milan, the Poste Parisien, Hilversum, Bordeaux, Frankfurt, Trieste, and Königsberg.

D. EXER.

Radio Interference Detector

The Post Office Portable Equipment

By A. MORRIS, A.R.C.Sc., M.I.E.E.

*I*N last week's article the need for a portable interference detector and locator of special design for radio servicing purposes was indicated. Reference was also made to the Post Office five-valve superheterodyne detector, of convenient shape, size and weight, provided with a search coil as well as a normal aerial and earth system for signal pick-up purposes. In this article technical details of this detector are given with an account of Post Office methods of investigation.

THE Post Office portable interference detector and locator, which is normally battery-operated, embodies one stage of signal-frequency amplification, a frequency-changing stage, one stage of intermediate-frequency amplification, a rectifying stage and two stages of audio-frequency amplification. A heptode is employed for the frequency-changing stage; the rectifier is of the copper-oxide type, whilst the final output valve, a pentode, furnishes input to the loud speaker, which is of the permanent-magnet moving-coil type.

The output from the first stage of the audio-frequency amplifier may be used for headphone reception by switching the headphones into the anode circuit of the first audio-frequency amplifying valve; the operation of the switch breaks, at the same time, the filament circuit of the final output valve.

The receiver is screened and is provided with adequate de-coupling arrangements; screened wiring is employed for connections wherever its use is effective.

There are no pronounced hand-capacity effects, and the receiver is very stable, with a good margin against parasitic radio-frequency and audio-frequency oscillations. A convertor may be used for mains-operation of the instrument. Photographs of the detector, with search coil, were given in last week's issue. The circuit diagram is reproduced in Fig. 1.

Outline of Investigation Procedure

The uses of the detector will be briefly outlined in relation to the investigation of interference complaints. After arrival at the listeners' home the first step is to confirm the existence of defective reception, after which the complainant's receiving equipment is tested and compared with the portable locator, the latter being used alternately with its own and with the complainant's aerial and earth system. The presence of elec-

trical interference being thus confirmed, an examination of the construction and arrangement of the aerial system is made, in order to ascertain whether or not the installation generally is unduly susceptible to interference. The mode of propagation and type of interference are subsequently determined and the source located. The



Enquiry officer locating "mains-borne" hum.

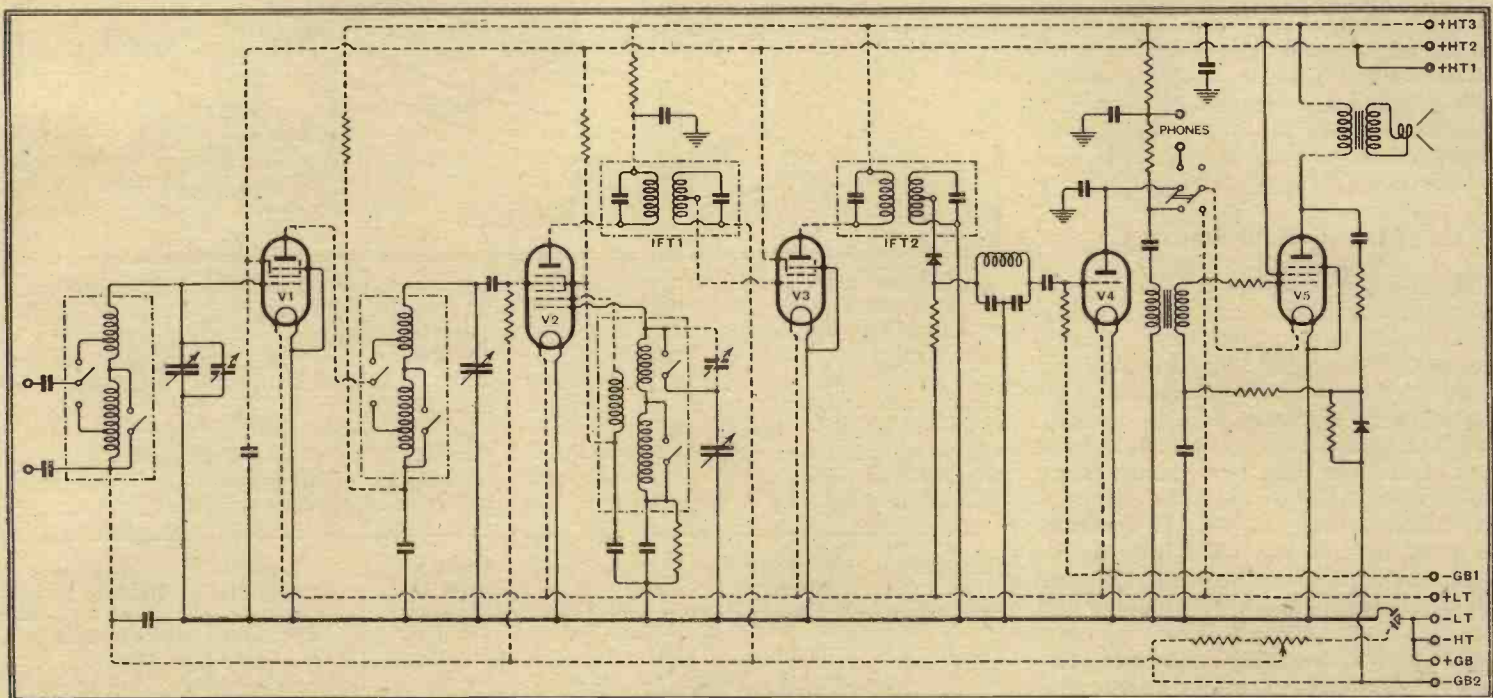


Fig. 1.—Circuit diagram of the Post Office radio interference detector and locator. All connecting wires shown dotted in the diagram are screened so as to reduce to a minimum the chance of direct pick-up of the interference.

Radio Interference Detector— photograph accompanying this article shows the detector in use in locating interference due to house wiring.

Conducted Interference

There are two means whereby interference may reach the receiver, namely, by conduction or by radiation. Interference of the conducted type, when present in modern radio equipments, is usually confined to receivers operated from DC mains, fed by mercury-arc rectifiers. The interfering currents are of audio-frequency, and are fed into the receiver along with its normal power supply. The interfering effect consists of a characteristic hum at a harmonic frequency of the supply; it will not be in evidence in the portable locator when battery-operated. Elimination of the interfering effect by means of additional smoothing of the normal operating current of the receiver furnishes positive evidence of the conducted type of interference. Such smoothing can be provided by fitting a smoothing unit, specially arranged for testing purposes, to the supply lead of the receiver.

Radiated Interference

The presence of interference in the portable locator confirms, in general, the existence of the radiated type of interference. This type is, in the majority of cases, radiated from house wiring after being mains-borne from the source. It may, however, be directly radiated from the source. The particular mode of propagation is readily ascertained. Thus, if when the search coil is used to explore the electrical supply system of the premises, particularly pendant wiring and switches, the noise output of the locator is considerably increased, then the radiation is mains-borne. Fairly definite confirmation may be obtained by disconnecting the supply system at the main switch or by connecting a radio interference suppression filter unit into the supply mains as near as possible to their point of entry to the premises. If negative results are obtained from these various tests, then direct radiation is indicated.

Location of Source

The final step is the location of the source of the interference. The mains-borne variety of the radiated type of interference can usually be located to its origin by tracing over the supply mains with the search coil of the detector. This process may be simplified by a knowledge of the class of electrical plant ordinarily giving rise to interference of the same nature as that which is being traced. In addition, the work may be expedited by observations made at other listeners' premises and by arrangement for the stopping and starting at pre-arranged times of suspected plant in the neighbourhood. The source of conducted types of interference may be located by the employment of similar measures.

The strength of the interference from sources of direct radiation falls off very rapidly with distance, especially in the near neighbourhood of the source. In addition, the interfering range of such sources, except in certain instances, is usually relatively short and of the order of from 50 to 150 yards. The interference detector is successfully employed for the location of such sources by making use of these features whilst moving the locator from place to place within the area of the listener's receiver. This method is impracticable for radiating sources of relatively long range. In such cases direction-finding methods may be necessary. The ordinary portable broadcast receiver with

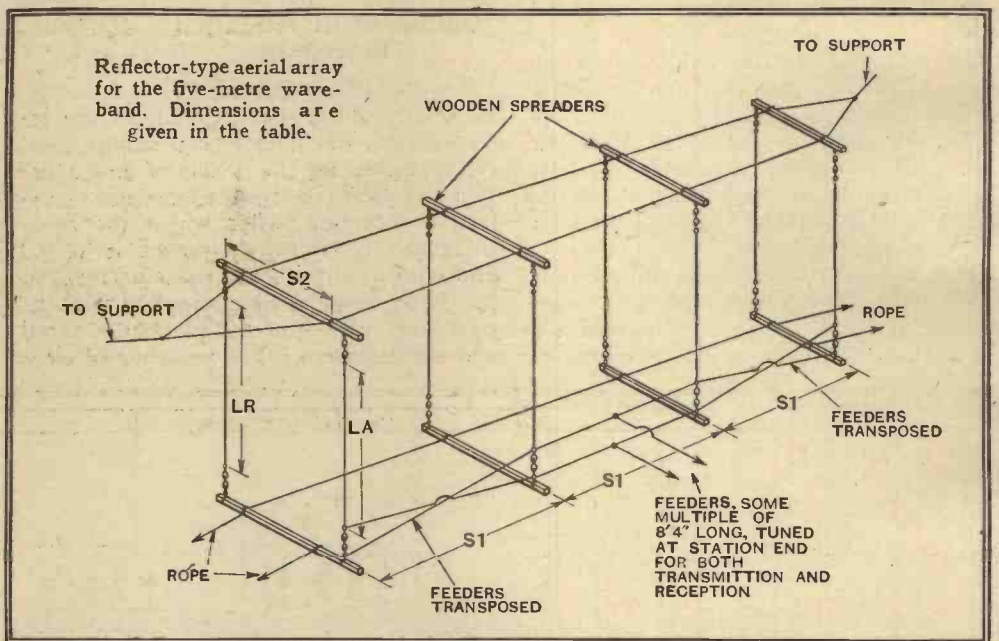
frame aerial is quite unsuitable for such purposes, and accurate direction-finding apparatus and field-strength equipment are required. The location of such interfering sources as high-tension transmission systems, high-frequency electric furnaces, electro-medical apparatus of high power, and illicit radio transmitters at times necessitates the use of such equipment. In conclusion, it should be mentioned that the normal inaccuracies of direction-finding work are increased in the case of the location of a source as the radiation is often picked up by other systems, such as overhead communication lines, and may be carried considerable distances and then re-radiated.

New Reflector-type Five-metre Aerial

DURING the latter part of August this year some interesting experiments were carried out by American amateurs with reflector-type aerials on five metres. A station hitherto having a range of ten to twenty miles was able to project its signals at R8 strength some 100 miles. Furthermore, reception was likewise improved and, although distant stations were still using the more orthodox systems, two-way communication was easily established. As reported in October Q.S.T.: "During

wisp. . . A directive antenna does not give one something for nothing. However, it does concentrate the radiation from the transmitter in one or more directions and hence provides great increase in effective power in those directions."

Details of the construction of the aerial are given, which is a box-like assembly, as shown in the drawing. The accompany-



the first few hours of operation, nine Boston-area amateurs (100 miles away) were contacted, R8 to R9 reports being received." This journal then goes on to state that "The sole aim in concentrating our attention on these contacts at distances of 100 miles and more has been to establish quite definitely that a good directive antenna can result in an almost unbelievable increase in range and that the increase is by no means a will-o'-the-

ing table gives the dimensions of the various elements of the system for the 56-megacycle wave-band.

Rigidity and the necessity to adhere strictly to the dimensions is emphasised, for it is stated that: "The failure of several individuals to obtain satisfaction from their directive arrays leads us to suspect that the adjustment of the system is considerably more critical than one might at first think."

Frequency mc/s.	Wavelength Metres.	Aerial Length LA.	Reflector Length LR.	Aerial Spacing S1.	Aerial to Reflector S2.
56	5.357	8 ft. 4 in.	8 ft. 7 in.	8 ft. 9 ins.	4 ft. 4½ in.
57	5.263	8 " 2¾ "	8 " 5½ "	8 " 7½ "	4 " 4¾ "
58	5.172	8 " 0½ "	8 " 3¾ "	8 " 5¾ "	4 " 2¾ "
59	5.085	7 " 10¼ "	8 " 2 "	8 " 4 "	4 " 2 "
60	5.0	7 " 9 "	8 " 0½ "	8 " 2½ "	4 " 1¼ "

Is Morse Passing ?

Amateurs to the Rescue

WHEN a time-honoured régime comes to an end, it is hard to deny it "the passing tribute of a sigh." Our contributor, while offering the tributary sigh over the discontinuance of morse operation on the Post Office Inland Telegraphs, urges wireless amateurs to keep the code alive for their own use.

IT was melancholy news that the last morse instrument was being superannuated from the Central Telegraph Office, London, and that the inland telegraph system of the country was in the final throes of going over to mechanised printing. No doubt, technically and economically, it is all justified, but what a pity! To think that morse should pass out with only a facetious reference in an evening paper. The servant of a hundred years—1837 saw its birth—and yet there is no poet to write an ode in praise of a rhythm approaching in its perfection to that of any hexameter. Going, if not gone, the rhythmic glide of smoothly flowing dots and dashes, each click significant, both in itself and in its context, to the sympathetic ear. Instead, the meaningless click of a typewriter and a callous translation into cold print!

This moan applies chiefly to line telegraphy for—Heaven be praised!—morse still remains the backbone of wireless telegraphy, and on a really "all-wave" receiver a vast amount of interest can still be got by listening to code. In these days, however, even commercial wireless morse is largely mechanised, and one must read very well even to follow it at the lowest Wheatstone speeds, which are so frequently used on wireless channels, not to mention trying, as a mild amusement, to write it down. But frankly, to anyone with a good morse upbringing the standard of wireless manual sending has always been appallingly low.

Individuality at the Key

Not that one sighs for the mechanical perfection of the Wheatstone transmitter; on the contrary, an automatic transmitter running at, say, 35 words per minute is usually not so pleasant to listen to as a good manual morse of the same speed. A surprising amount of individuality can be expressed in the operation of a key. There has been a time when one could distinguish an individual from any half-dozen senders working at the moment.

It is impossible to predict what system of commercial signalling may in future become standardised in wireless practice. So far morse holds the field in "getting the goods across." Facsimile systems as

a means of conveying intelligence—that is, the picture transmission of written or printed messages—are on trial and may become of considerable importance. So also may the telewriter systems of modern line telegraph practice. But these are



Sam. F. B. Morse

features rather of fixed station operation, and one of the outstanding values of wireless is its service under mobile conditions. Here it appears certain that morse will hold the field for many a day.

It has been interesting to watch the Admiralty's scheme for organising a volunteer body of morse operators for possible naval use. The work of wireless generally in the Great War was inestimable. Navy, Army and Air Force used it liberally and thousands of men were trained (and part-trained) for wireless duty. An invaluable nucleus of expert operators and instructors came from the Post Office, and many useful people came also from the ranks of pre-War wireless amateurs—the good old "Crystal Brigade."

Once again it rather looks as if the amateurs will have to keep the flag flying.

Independent amateurs still exist in plenty, and their numbers include many morse men accustomed to operating both ways in difficult conditions. The amateur wireless societies of to-day still have a priceless opportunity to keep morse fully alive, and it is to be hoped that they will not be slow to take advantage of it.

And what of the learning of morse? How to learn it is a subject on which opinions vary, and it is rather difficult to formulate a simple general prescription. Various mnemonic systems have been propounded, but it appears to the writer—and this is a personal opinion—that these systems are usually cumbersome and more difficult to remember than the morse itself. In the first place, the real value of a mnemonic lies in its giving an easy mental association between the usual and the unusual. In the case of learning morse this is a wrong view to start with. To learn morse by sound one must become as familiar with each combination as with the written or printed letter which it represents, for they are simply alternative methods of representing each letter of the words we use. Translation from the written letter to sound and vice versa must become automatic and practically unconscious; it certainly should not be a feat of memory. How, after all, does one learn to speak the mother tongue?

And just as facility in speech in any language—even the mother tongue—is acquired by guidance by experts, so, too, with facility at morse. Tuition in the first place must be by an expert. Self-practice can help, but the services of a guide are essential in working up real speed in reception and in correcting inevitable errors in acquiring speed of sending. Youth, too, is an advantage. The boy who really learns morse at 16 or 17 will never forget it.

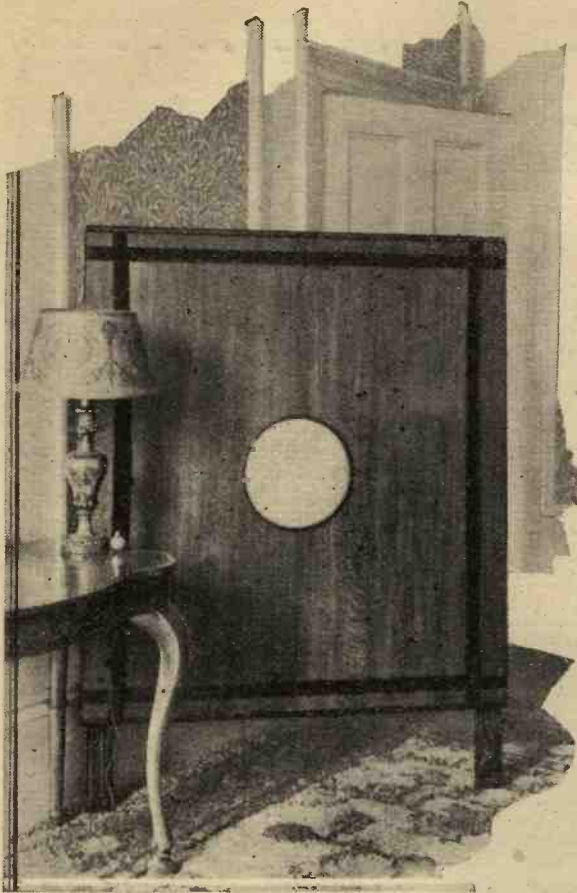
Instructional work of this kind is obviously best organised by amateur societies, and in most districts the services of an expert should not be too difficult to obtain. There must be many Post Office men who, deploring the passing of an old friend, would be glad to ensure that, though Sam Morse's body lies a-mouldering in the grave, his code goes marching on.

My Home Set—III.

A Local Station Receiver with Push-Pull Output

By W. MACLANACHAN

THE receiver described in this third article in the series dealing with readers' personal sets is unique in that the push-pull output stage is fed directly from a diode detector without intermediate LF amplification. Two stages of HF amplification are needed to provide the large input required by the detector



THE design of a set for constant home use is always a problem—whether it is to be a long-range superhet, a local-station quality set, or a compromise between the two. The ideal position is to have two separate sets, one for the reception of Continental broadcasts, and the other designed to give the best quality obtainable from the local transmissions.

As it is my good luck to have the choice of several efficient commercial sets, my only concern with a home set is to reproduce as faithfully as possible the emanations from the various studios and concert halls of the B.B.C. To achieve this I decided to use as little low-frequency amplification as possible, to employ a linear and distortionless detector, to obtain a straight-line response from 50 to 8,000 cycles (the breadth of the B.B.C. transmissions), and to make the set straightforward. By this last I mean without introducing resonant circuits in one stage to make up the deficiencies of another.

The Detector

The room in which I listen ordinarily measures 22ft. by 13ft., and is 13ft. high. Two PX4 valves in push-pull can provide sufficient volume for comfortable listening, even with a very low factor of room resonance.

As I did not want to introduce any more amplification than that of the push-pull valves I fed these from the cathode and anode of a high-voltage diode, the characteristics of which are given in Fig. 1, using the fact that the anode and cathode are in direct phase opposition at the ends of the diode load. There is a considerable dif-

ference in DC potential between the ends of the load resistance, and it is not practicable to feed the grids of the PX4s directly, so blocking condensers had to be inserted in the leads.

Fully to load the output stage an LF signal of 50 volts RMS is required, and at 80 per cent. modulation the diode curve shows that an HF signal of approximately 62 volts has to be provided. At first I decided to use two screen-grid valves in push-pull to obtain this voltage, but, due to the difficulty of keeping these matched, I discarded them in favour of a single HF pentode. The damping of the diode on the previous circuit is in the neighbourhood of 30,000 ohms, and the coil and condenser arrangement is also inefficient, so that when the valve is worked at the makers' rating, with 200 volts on the

factor of safety is provided; and, although this is in excess of the makers' rating, the valve does not show any appreciable loss of emission after a long period of use. This has another effect: it lowers the optimum output load impedance of the valve, and more nearly matches that of the tuned circuit.

Incidentally, experiments in tapping down on the diode input coil in an effort to decrease the damping produced no advantage, as the loss in voltage counteracted any increase in efficiency of the circuit.

A previous HF stage is necessary, and, as the amplification required is not great, an ordinary variable- μ screen-grid valve is used with flatly tuned circuits which help in the straightening of the overall response, as does the fact that volume is controlled by a variable resistance across the tuned-grid coil of the first valve, as shown in Fig. 2.

I decided to make the set a purely local station receiver (for London National and London Regional) and, as it was originally designed for two HF valves in push-pull, the intervalve coils had to be centre-tapped transformers and the tuning condensers had to be raised above earth potential. To do this I resurrected the original Colvern coils used in my *Wireless World Three*, and, after stripping the last two coils, re-wound them, for

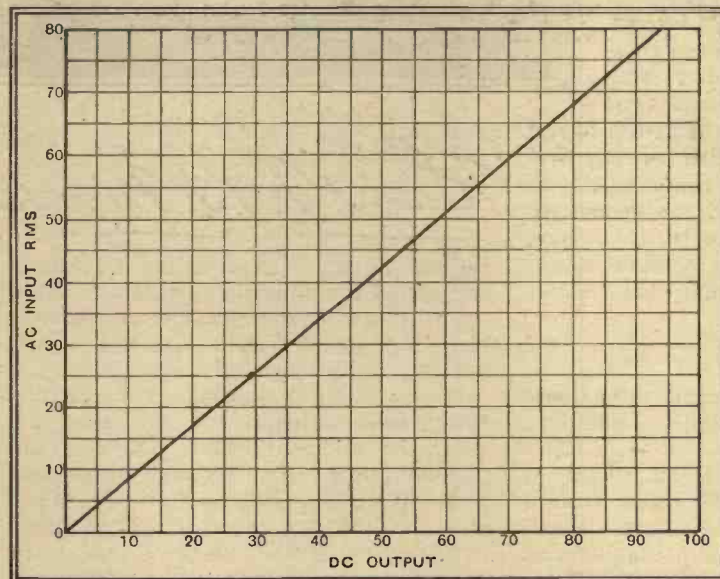


Fig. 1.—The input-output characteristic of the diode detector is practically a straight line.

anode and 100 volts on the auxiliary grid, it is just capable of giving the output without any reserve. By increasing the auxiliary grid voltage to 130 volts, and adjusting the bias to the optimum position, a fair

medium waves only, as centre-tapped HF transformers. The switch was not required for waveband changing, so that I used it to connect the loading condenser for London Regional across the National

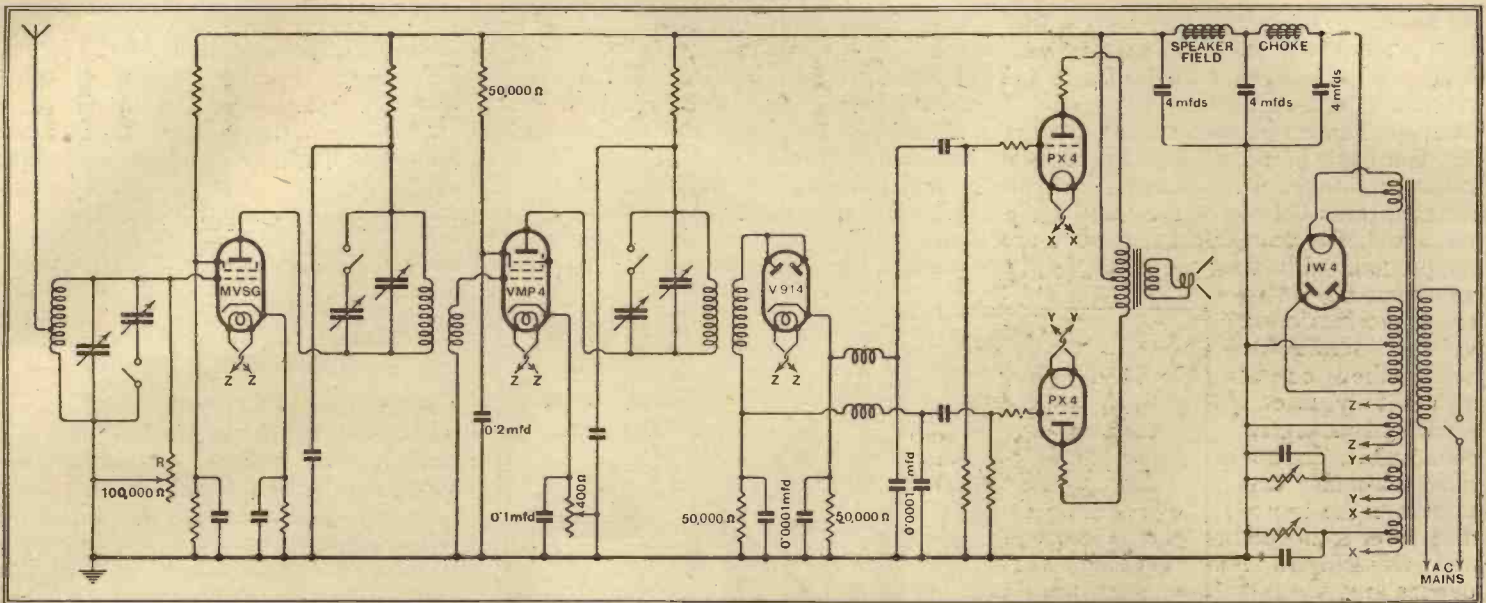


Fig. 2.—The circuit diagram shows that three flatly tuned circuits are used in the HF amplifier; volume control is obtained by the variable resistance R across the first tuned circuit.

tuning condenser. By cutting off the ends of the terminal screws of Colvern pre-set condensers it was possible to mount these inside the cans, as shown in the photograph. To avoid the risk of short circuit the cans were lined with Empire cloth.

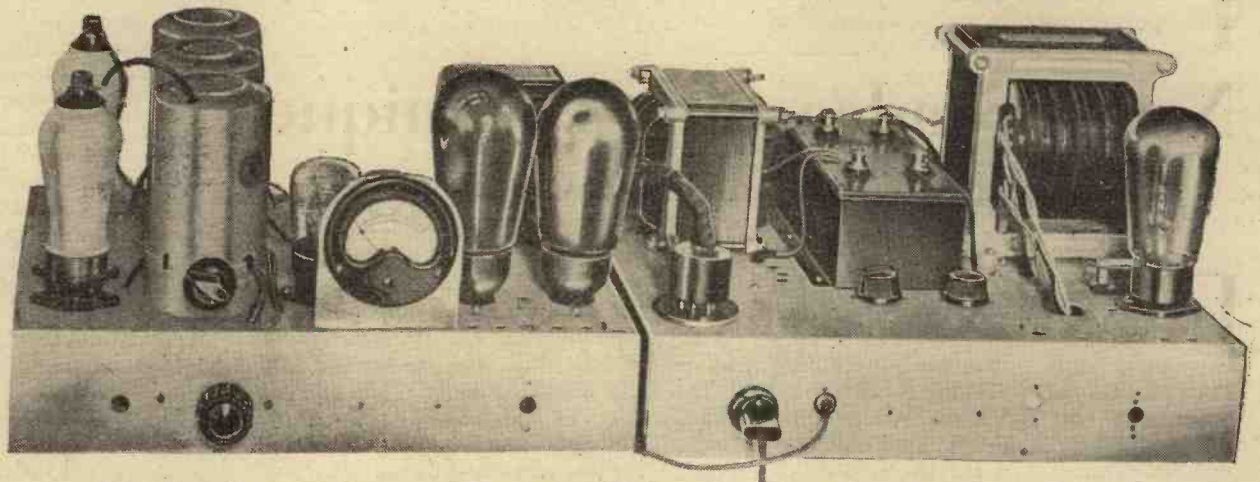
The chassis used were "manufacturers' surplus," obtained as the result of examining the "cabinets" section of the small advertisements at the end of the then current number of *The Wireless World*. These cost one shilling each, and, with the exception of a hole for the diode valve-holder and an unused one for one of the push-pull HF valves, they required no alteration.

On the set chassis the only important features are the resistance-capacity filter and the second HF valve. The diode load is 100,000 ohms in two accurate sections of 50,000 ohms each, and the coupling condensers are 0.05 mfd. A larger value for the condensers is un-

of distortion in the form of a "ghost," possibly due to the unsymmetrical arrangement of the grid leak and condenser time constants through the difference in DC potential on the diode side of the condensers. As the HF voltage across the wiring of the diode is considerable, HF filtering in the LF leads has to be complete, and consists of two Varley iron-core HF chokes with 0.0001 mfd. by-

nected permanently across the bias resistance. A slight decrease in the reading shows whenever overloading takes place. The curves taken show that the critical optimum value for the bias at 125 volts on the aux. grid is 1.8 volts, as 1.9 volts produces a curve similar to the 1.6 volts line.

The power unit is conventional, and contains the biasing resistances and by-



The receiver, amplifier and mains equipment are assembled on two metal chassis. The meter is used as a tuning indicator.

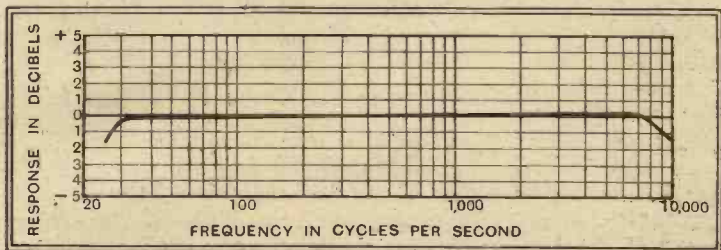


Fig. 3.—The overall fidelity curve of the receiver shows a loss of only 1.3 db. at 10,000 cycles.

necessary, as the response curve is straight down to 32 cycles, and increasing the value to 0.1 mfd. causes a peculiar type

pass condensers. connected to earth.

The HF pentode valve is the weak link in the amplifying chain, and this requires careful balancing. One or two microamps. of grid current cause no audible distortion, and I found that, by adjusting the bias so that grid current begins to flow at a point two or three volts below that at which anode rectification takes place, a good

visual indication of the overload point is afforded by a sensitive voltmeter (milli-ammeter with series resistance) con-

pass condensers for the output valves. The biasing resistances are of the variable type, and the range covers the value for PX4 and PX25 valves. It is possible to use the latter if a 1,000-ohms field coil is employed and the valves are slightly over-biased to avoid overrunning the IW4 rectifier. The bias resistance by-pass condensers are the 50 mfd. electrolytic type specified for *The Wireless World* Push-Pull Quality Amplifier. Smoothing is by choke and field coil, the 2,000-ohms field of the loud speaker providing the necessary voltage drop while taking 36 watts for excitation.

The curve shown in Fig. 3 was taken with an artificial optimum load across the PX4s, and shows that from 25 to 10,000 cycles there is no audible deviation from the mean volume at 400 cycles, and the

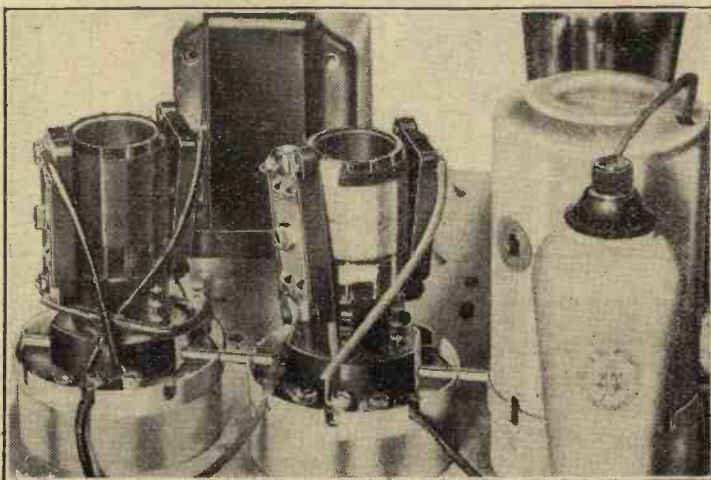
My Home Set—III—

final problem was to combine the set with a speaker which could do justice to the reproduction obtainable. I employ a Hartley Turner speaker mounted on a 4ft. 6in. baffle of oak one inch thick. This latter is further deadened by unsymmetrical cross battens of the same thickness, and, due to the fact that there are no pronounced resonances either in the speaker or the room, the maximum volume obtainable with the output valves fully loaded on a loud passage is comfortable. The two most noticeable features are the reproduction of transients and freedom from overloading.

On occasions when I want a somewhat greater volume of sound I use a special Celestion combination of speakers consisting of a 9in. diaphragm speaker, which has a fairly useful resonance between 55 and 60 cycles, and covers up to 5,000 cycles, while a "tweeter" extends the range to nearly 15,000 cycles. This latter speaker combination is mounted on

a 4ft. baffle in another room, and, as the room has various resonances and the hall between it and the drawing-room adds several more, the reproduction of symphony concerts and pianos is particularly full and realistic.

The principal complaint against a very high HF magnification (as against LF) is the increase in hiss and valve noise coupled with interference. The reproduc-



A close-up of the tuning coils with two of the screening covers removed to show the trimmers employed for adjusting the wavelengths.

tion from the set is particularly free from these, except for a frequent 9,000-cycle whistle, and only occasionally on London National are "chirrup" noticeable.

New Broadcasting Technique

Reducing Interference and Improving Contrast

From a Correspondent

FOR quite a long time it has seemed that broadcasting technique has become so standardised as to be a little dull. No really exciting developments have occurred either in transmission or reception. Generating and modulating methods have suffered very little change. A certain number of new aerial systems have been evolved in the attempt to reduce short-distance fading, and in receiving technique the variable-mu valve struck a new note. But, on the whole, progress has been orderly, leisurely, and a little uninteresting: the "ether" has been marked out in traffic lanes whose widths were worked out by apparently unimpeachable and immutable mathematics, and altogether it seemed that anyone who wanted a new thrill would have to wait for television.

Startling News from the Ionosphere Front

And then, as has so often happened in the history of Civilisation, utterly new and unexpected possibilities made their appearance—two of them in the course of the last few months. A "freak" observation, in 1933, of the quite uncalled-for appearance of the programme of one

station on the carrier of another has now been confirmed by many similar observations, as described in *The Wireless World* for September 28th, 1934, under the title "The Luxembourg Effect." Theoretical examination of this effect appears to reveal a hitherto undreamed-of complication in the field of radio propagation, and has led to the suggestion, backed by very high authority indeed, that the carefully laid down traffic lanes will be of no avail in preventing radio casualties unless vigorous steps are taken to limit the power of stations, or some device in addition to ordinary "tuning" comes to the help of the receiver.

Almost simultaneously comes the news of a new technique in transmission and reception, outlined by A. L. M. Sowerby in *The Wireless World* of August 24th in the article "Expanding the Music," which was based, apparently, on work in the United States. According to this article the object of the new process is to improve the naturalness of broadcast reproduction by allowing the loud speaker to give the full "light and shade" of the orchestra, from *pianissimo* to *fortissimo*, instead of only the reduced volume-range permitted at present by the regrettable but necessary restrictions imposed by the Con-

trol engineer. But a letter from D'Orsay Bell in *The Wireless World* for September 28th points out the possibilities of this new technique in reducing interference of all kinds, on the lines of his own suggestion in the same pages some five years ago. In this connection an article by a well-known German technician, W. Nestel, in the *Elektrotechnische Zeitschrift* of September 6th, 1934, is very illuminating.

"Multiplying" the Power of a Broadcasting Station

According to this article, entitled "Amplitude-Dependent Amplifiers," the principle of automatic compression and expansion of volume range has been tried out at the Berlin short-wave transatlantic broadcasting station, and it is the interference-reducing aspect of the method, rather than the improvement of "contrast," that the writer particularly stresses. He shows that by means of a special "compressor" circuit, using variable-mu valves, a low-frequency amplifier can be made which will magnify the smallest amplitudes by 2:1 and simultaneously diminish the largest ones in the ratio 1:0.84, so that an overall "compression" of 2.45:1 is obtained. With a similar "expansion" at the receiver (in this case a receiving station distributing its output, by cables, to a number of broadcasting stations) there would result—he points out—a reduction of the interference level in the same ratio. But more than this: there seems nothing to prevent the use of a double process—two stages of "compression" and "expansion"—which would increase this ratio to 6:1. This would mean that the Berlin station would then behave as if its actual aerial power of 8 kilowatts were increased to 288 kilowatts! The practicability of the scheme has, he says, been proved admirably by a series of tests to and from America.

Apart from this rather startling use of the contraction-expansion principle there is, of course, the simple and straightforward use of these "amplitude-dependent amplifiers" for the automatic regulation of volume level at present carried out manually by the Control engineer. But a still more interesting application is to the recording and reproduction of gramophone records. The writer states that tests on these lines have already been made; discs have been recorded with the intervention of a "compressor" and reproduced with the intervention of a corresponding "expander," with the result that needle scratch was greatly reduced. This is particularly interesting news to those of us who for years have complained that so little has been done to get rid of this defect, which takes so much off the pleasure of listening to certain types of music on the gramophone. Altogether, this new technique seems to present very important possibilities. And who shall say that these two new developments, the "Luxembourg Effect" and "Expanding the Music," have no other connection than the coincidence of their coming into prominence almost at the same moment?

Events of the Week in Brief Review

Current Topics

The King and Television

IT is understood that the H.M.V. high-definition system of television was recently demonstrated before His Majesty at Windsor Castle. The transmission was effected by means of ultra-short waves from Hayes.

Radio Beats Ennui

WORKERS in American cigar factories formerly paid a "reader" to beguile the tedious hours with tales of love and adventure. Now, according to a correspondent, they all use radios.

For Putney Fathers

MEETINGS of the Putney Fathers' Council have hitherto been devoted to child welfare, but for the next meeting on November 27th Mr. A. F. Marner, of the Mullard Wireless Service Co., Ltd., is to speak on "Why Your Wireless Set Works."

A cordial invitation is extended to all Putney fathers to turn up at 8 p.m. at 2, Clarendon Road to hear this address.

Fraud ?

SOVIET Government audit officers, going through the account-books of station Dnje-propetrovsk, found that royalty payments had been made to gentlemen of the name of Beethoven, Mozart and Chopin, and that the receipts had been duly signed. The station director expressed surprise that the three gentlemen were dead, and could not accordingly account for the strange fact that their signatures were on his file. According to the Swedish paper *Goteborg Handels*, he has been arrested on a charge of fraud.

Eiffel Tower Mystery

WILL the Eiffel Tower have closed down by Christmas? Since it was decreed that the Tower should cease transmission, the Government, including M. Mallarmé, the then Postmaster-General, has fallen.

The new Postmaster-General is M. Mandel, famous as the lieutenant of M. Clemenceau during the war, and an "old hand" in Parliamentary affairs. Whether the "old hand" is strong enough to quell the still older Eiffel Tower is still open to question. The station can still be heard on the familiar wavelength.

Rector of St. Andrew's

ALL wireless enthusiasts will congratulate St. Andrew's University on the election of Marchese Guglielmo Marconi as Rector. Marchese Marconi succeeds General Smuts in the Rectorship.

Silent Trolley Buses

TROLLEY buses which will shortly replace the trams on the West Croydon to the Crystal Palace route are to be fitted with anti-interference equipment following representations by South Norwood residents to the London Passenger Transport Board.

America and the Short Waves

SHORT-WAVE fever seems to be attacking America. Hitherto the ordinary broadcast listener has rarely exceeded the boundaries of the United States, but the introduction of the all-wave set has opened up new vistas on the short waves. As might be expected, Uncle Sam is showing special interest in

Radio Toulouse en Fête

ON Sunday next, November 25th, Radio Toulouse will broadcast its ten-thousandth programme. The occasion is to be celebrated by a week of special programmes.

Listeners as Judges

THE Danish broadcasting authorities, to placate the pianoforte industry, which accuses broadcasting of killing music in the home, is organising a competition for pianoforte compositions. Listeners will act as judges, the six best compositions in the opinion of a musical committee being broadcast. Listeners will be asked to record their votes. Additional prizes will be offered to listeners who come nearest to the winning voting.

The Milwr Mystery

THE *Flint County Herald* reports the strange case of Mr. and Mrs. T. Jones, of the Post Office, Milwr, who bought a 60-volt HT battery on October 18th, 1929. "The wireless set,"

Danish Television

THE first Scandinavian Television Company has been founded in Copenhagen. Known as the Dansk Radio-Fjernsyn, the new organisation will acquire foreign television patents for Denmark.

Germany Nearing Six Million

GERMAN licence figures rose by 2.7 per cent. during the month of October, and the total on November 1st was 5,725,394. It is believed that the sixth-million mark will be passed before the New Year.

State Receivers for Schools

FRANCE regards the supply of wireless sets to schools, hospitals and barracks as a social necessity, but the difficulty is to find funds for the purpose. It is suggested that the responsibility should be undertaken by the State, and that the radio industry should offer special terms in return for, say, an order for 100,000 sets. This, it is urged, would help to reduce unemployment and give a badly needed fillip to the French radio trade.

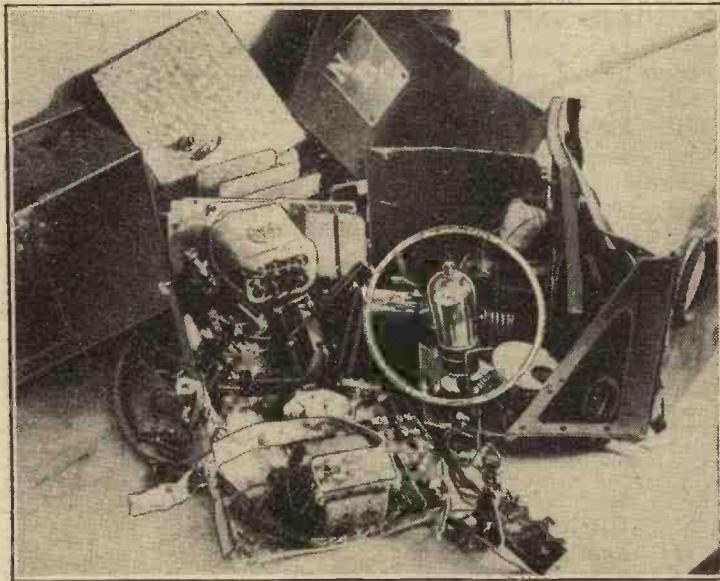
Best of Both Worlds

AUSTRALIA is well satisfied with the present combination of British and American systems of broadcasting throughout the Commonwealth, according to Mr. A. Parkhill, the Postmaster-General. At present there are twelve "A" or National stations run on B.B.C. lines and fifty-three stations licensed to private interests. These "B" class stations are permitted to advertise, though it is being urged that sponsored programmes should be limited to week-days.

Starting a Buzz Hunt

THE U.S. Federal Communications Commission is faced with a new task following the complaint of Governor Gifford Pinchot, of Pennsylvania, alleging "sabotage" during his recent radio election campaign, writes our Washington correspondent. Governor Pinchot, a Republican, states that loud buzzes ruined his speeches. These buzzes, he urges, did not begin until he mentioned the "sugar trust."

The Commission is now endeavouring to trace the connection between the buzzes and the "sugar trust."



IT STILL WORKS.—This is all that was left of the radio transmitter which was taken aloft during the recent stratosphere balloon ascent over Nebraska. Despite a fall of 15,000 feet one valve remained intact and still works.

short-wave transmissions in his own language, hence the popularity of the B.B.C. Empire transmissions from Daventry. Germany is including news bulletins and talks in English in the transmissions from the Nauen station.

says our contemporary, "has a loud speaker of the old-fashioned type. Although used daily the battery continues to give service." When the battery was four years old it registered 45 volts, and last week it still registered 30 volts."

Developing the Battery Receiver

The Latest Single-Span Technique with Economical Operation

DETAILS of a new aerial filter for single-span receivers appeared in last week's issue of "The Wireless World," and in this article will be found a discussion of the major points underlying the design of a battery-operated receiver of this type. Particular stress is laid upon the importance of economy in anode current consumption

IF a receiver is to meet the conditions imposed by the multiplicity of broadcasting transmitters now operating, it must be selective, while if it is to provide acceptable entertainment the quality of reproduction must reach a high standard. Owing to recent increases in the power of many stations, however, the sensitivity need not be as high as that required a few years ago in order to obtain numerous foreign transmissions.

It is not difficult to meet these requirements if no limit be placed upon the cost of the receiving equipment, and although this is a field of special interest to the technical, and is of considerable importance in the development of wireless, such apparatus can be used only by a few. The problem is much more difficult, however, when, as in the vast majority of practical cases, a definite limit is placed on the cost, and a solution must exercise all the skill of the designer.

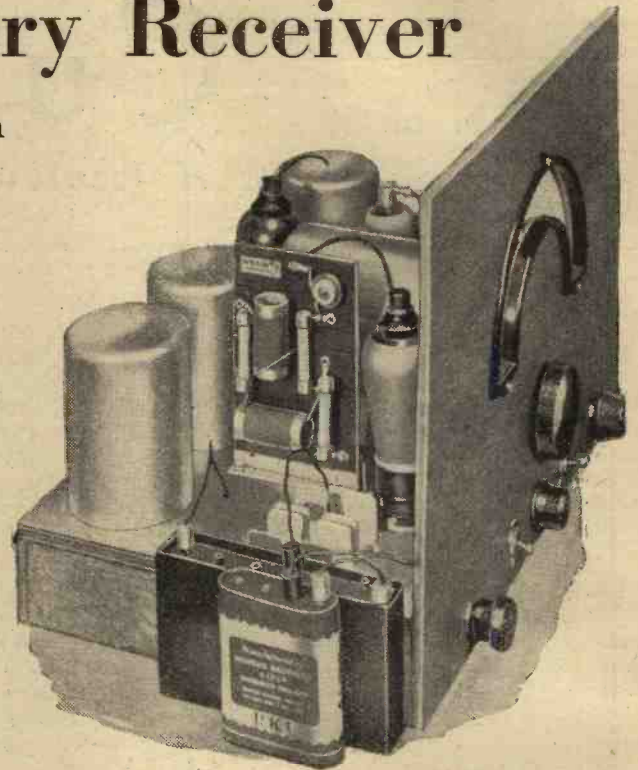
The difficulties are enhanced when a receiver must be operated from batteries, for with such a source of power supply the running costs may soon equal or exceed the initial cost. A large mains set may consume 100 watts, which means that it can be used for 10 hours for the price of one unit of electricity. The cost will vary in different districts, but an average figure will probably be around 5d. per unit for lighting and 1½d. for heating. Quite a large set, therefore, can be worked for about ¼d. an hour, or 0.15d. if a heating supply be available. If a set were built to operate from dry batteries and consume 100 watts, the cost would work out at something like 6s. 8d. an hour! It can be seen, therefore, that economical operation is of prime importance in a battery receiver, and it seems to be generally accepted that the consumption should not exceed 20 mA. at 150 volts, or 3 watts! Many sets take an even smaller power from the HT battery. The LT supply, of course, is not so important, for an accumulator is normally used, and this can be recharged at small cost.

If a reasonably loud volume of sound is to be obtained from the loud speaker and amplitude distortion kept at a low figure it is essential that a quiescent type of output stage be used if the current drain on the HT battery is not to be excessive.

By

W. T. COCKING

In this photograph the new aerial filter recently developed for single-span receivers can clearly be seen.



Two alternative types of valve vie for place in the output stage, Class "B" and QPP. Although with the valves now available the most obvious difference between the two systems is that the former employs triodes and the latter pentodes, this is not of great importance, since a triode under Class "B" conditions has characteristics similar to a pentode. The essential difference between them is that a QPP stage functions with negative grid bias and grid current is not permitted to flow, whereas a Class "B" valve functions with zero, or only a small negative, bias, and grid current is heavy. The valve has consequently a low impedance and its input must be supplied from a low impedance source if serious distortion is not to occur in the preceding stage. Class "B" amplification thus requires a driver stage for good results.

LF Amplification

At the present time the output obtainable with QPP is less than that with Class "B," but the distortion is also less, owing to the absence of the driver stage. The output, however, is sufficient for most domestic purposes, and we conclude that it seems the more suitable for general use. A typical valve will give an output of some 900 milliwatts and require a signal input of about 21 volts peak. In general, therefore, it is wise to use a high-ratio transformer for feeding the valve.

Such a transformer does not usually have as flat a characteristic as one of lower ratio, but, surprising as it may seem, this is an advantage in a receiver of limited output. Unless the volume exceeds a certain level, notes having frequencies below about 100 cycles cannot be heard even if they are passed perfectly by the apparatus. The output necessary for proper reproduction of the lowest frequen-

cies depends on the efficiency of the loud speaker, but is unlikely to be less than 3 watts. Where the output is limited to one watt, therefore, there is no point in trying to keep the frequency response of the receiver flat down to the lowest frequencies. In fact, it is disadvantageous to do so, for the output valve becomes partially loaded by the low frequencies, which contribute nothing to the audible effect, with the result that the undistorted output at higher frequencies is restricted.

It can thus be seen that where the output is limited the low-frequency response of the receiver should be deliberately restricted, and this is most conveniently done by using an LF transformer of only moderate primary inductance. With such a transformer it is usually possible to have also a high step-up ratio with a consequent gain in amplification.

The valve which feeds this transformer will usually be the detector, and there are two possibilities open to us—we can use a grid detector or a duo-diode-triode. The former is not very satisfactory if the no-signal anode current be kept low, for its output is very limited and it damps the tuned input circuit heavily. With a duo-diode-triode the amplifier section is operated with a fixed grid bias and it is not loaded with HF potentials, so that it is easy to obtain sufficient output with good amplification and economical operation. One of the diodes can be used as a detector, and although it does damp the preceding tuned circuit considerably, it does not affect it nearly as much as a grid detector owing to the absence of the Miller effect. The quiescent anode current consumption of LF equipment of this nature is likely to total some 4mA., which can hardly be said to be extravagant.

We have now to consider the pre-detector circuits, and the single-span system of tuning commends itself on account

Developing the Battery Receiver—

of its economy of apparatus and simplicity of adjustment. Complete waveband coverage is possible without coil changing or switching, and with a good aerial filter second channel interference is practically impossible. The new aerial filter described in last week's issue of *The Wireless World* has an average efficiency of about 100 per cent. and gives an attenuation in the second channel region of about 60 decibels. A typical heptode frequency-changer of the battery type has a conversion conductance of 0.2 mA/v., so that with a tuned circuit of 75,000 ohms dynamic resistance we should expect a stage gain of 15 times.

The Frequency-Changer

Considerations of selectivity, however, demand the use of a pair of coupled circuits between the frequency-changer and the IF valve, and to secure the maximum selectivity the coupling must be somewhat below optimum. The effective stage gain of the frequency-changer, therefore, is likely to be only about 5 or 6 times.

It can thus easily be seen that if adequate sensitivity is to be secured the frequency-changer must operate under conditions of maximum efficiency. This means not only that the operating potentials of the electrodes be properly chosen, but that the oscillator section function correctly. The valve makers' instructions state that there should be an oscillator frequency potential of 10 volts peak on the oscillator grid, but the writer has found that such a statement is alone insufficient.

The oscillator anode is outside the oscillator grid in the electrode assembly of the valve, but it lies in the main electron stream. This stream, therefore, is affected not only by the oscillator grid potential as it should be, but also by the instantaneous oscillator anode potential. The potentials of these electrodes vary in opposite phase, with the result that the oscillator anode reduces the *effective* grid voltage.

It can easily be seen that the greater the oscillator frequency voltage at the anode, the more it will tend to neutralise the effect of the grid voltage, and that the ratio of the two voltages depends upon the oscillator coil construction. Now the more turns that are employed for the reaction coil, the greater its reactance and the greater the voltage developed across it and applied to the oscillator anode. In constructing the oscillator coil assembly for the maintenance of a given voltage on the oscillator grid it is possible to use either a small reaction coil tightly coupled to the tuned grid circuit or a large coil loosely coupled. Although the grid voltage may be the same in the two cases, the use of a large reaction coil means a higher voltage on the oscillator anode which reduces the effect of the grid voltage on the electron stream to a greater degree. We can conclude, therefore, that the reaction coil should be as small as possible and coupled very tightly to the tuned circuit.

This reasoning is borne out by experiment, for it is possible to obtain a measured stage gain of some five times with a small reaction coil tightly coupled. With a large coil loosely coupled the stage gain falls to unity for the same oscillator grid voltage! This is a convincing demonstration of the importance of coil design.

We have now to consider the question of the IF stage, and experiment shows that an exact choice of operating voltages for the valve is necessary if high amplification is to be secured with a reasonable current consumption. It was soon found that for a given anode current higher amplification is possible when the valve is operated at zero grid bias and the correct current obtained by the adjustment of the screen-voltage than when the screen-grid is worked at a high potential and the current adjusted by varying the grid bias. It is permissible to work with zero bias with battery type valves so that this is obviously the condition to choose.

In developing the receiver, the coupling to the diode is the next point of importance, and it was found that maximum amplification was obtained with a 1:1 ratio transformer, but that the selectivity was distinctly poor—the effective coil magnification being less than 30 as compared with 85 for the tuned circuit alone. The use of a step-down transformer was found to increase selectivity more than it reduced amplification, and a 2:1 ratio was finally selected. With this a stage gain of 58.5 times was obtained with an effective coil magnification of 67.5. This is a great improvement, for

the selectivity of this circuit has been more than doubled for a loss of amplification of less than 20 per cent.

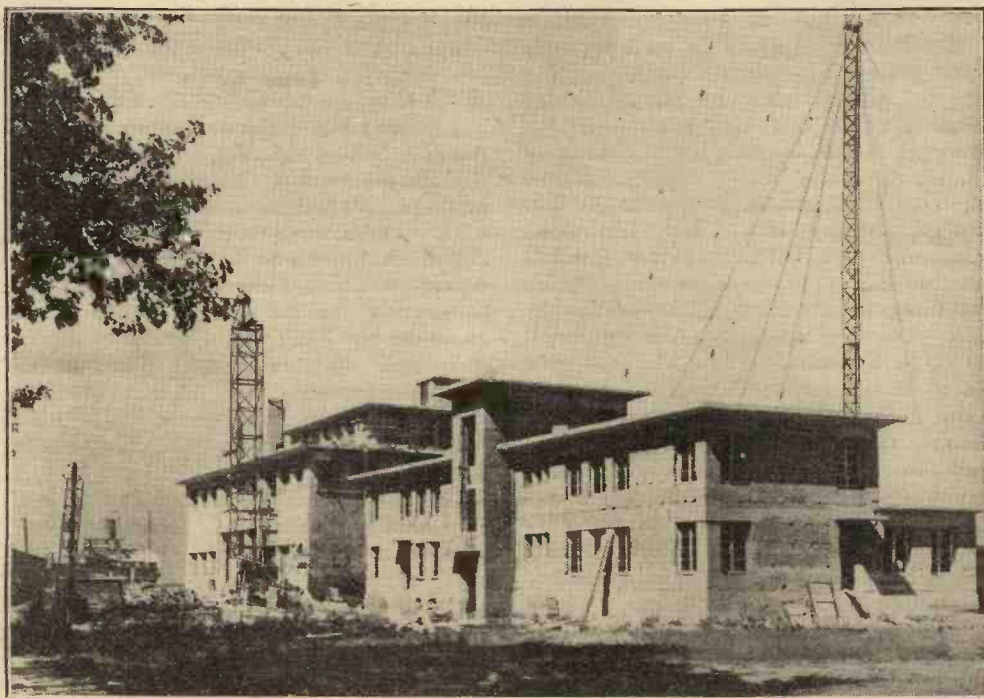
Our receiver now takes form as a single-span set with a frequency-changer feeding an IF valve through a pair of loosely coupled tuned circuits. This IF valve is coupled by a third tuned circuit to a diode detector, which feeds a triode LF valve coupled in turn by a transformer to a QPP output valve. Although only four valves are used, three of them are of the double type, so that to obtain an equivalent performance a few years ago seven valves would have been required.

Although the selectivity of the three tuned IF circuits is inherently fairly high it is not sufficient for adequate reception of distant stations, nor is the sensitivity. It is necessary to make some use of the properties of reaction, therefore, and at first this proved a serious drawback to the arrangement proposed, for no conventional reaction circuit would give the desired results. A scheme was at length devised, however, which overcame all the difficulties, and, in fact, proved better than the conventional methods, since in effect it applied reaction simultaneously to two tuned circuits. The circuit is extraordinarily simple and effective and will be described in detail in a forthcoming issue of this journal.

The total current consumption of the receiver proved to be about 8mA. at 150 volts, or 1.2 watts, so that the no-signal running costs should be about 0.8d. an hour and not more than double this on a strong signal—a figure which compares well with that for a mains receiver.

THE FRENCH REGIONAL SCHEME

A New High-power Transmitter



The chain of high-power transmitters throughout France is slowly nearing completion. Here is a recent picture of the Lyons-Tramoyes station which will shortly begin testing on 463 metres with a power of 90 kilowatts.

What's in a Name?



The introduction of the "mechanical horse" did not bring the term "horse-eliminator" into the vocabulary of the transport worker.

Radio Nomenclature Criticised

By "CATHODE RAY"

"AND you call it *wireless!*" How nauseatingly familiar is this remark to every wireless man—experimenter, operator or engineer—who is obliged to show off his stuff to the admiring and incomprehending crowd. One is expected to grin cheerfully each time and support the illusion of original wit.

It is a deserved rebuke. We have our joke at the expense of those responsible for making 5½ yards equal 1 rod, pole or perch, and patronisingly excuse the quaint absurdities of a bygone generation. We in our time are tremendously efficient and systematic and metric. Yet our own twentieth-century pursuit is quite as easily shot at as any mediæval magic. "Wireless" itself is both weak and absurd. Weak because it is a definition by the negative, just like calling a motor car a "horseless," and absurd because the wire manufactured per annum for "wireless" purposes would stretch from here to Mars (or is it Venus?).

An even more back-handed term is "eliminator." Applied to an insecticide or rat poison there might be some defence for it. Going back to our vehicular parallel, could one seriously go to the Motor Show to see the latest models of "horse-eliminator"? (Some people might call them pedestrian-eliminators, but that is another matter.) The main object in the life of a battery-eliminator is not the ruthless extermination of batteries (for there are far more in the world now than when it started), but the supply of power to receivers. Then why not give it a name that says so?

But perhaps it is too late, now that the separate eliminator is obsolete. We buy "all-electric" radio. That convenient fiction, "the man in the street," whose head is not distorted by the pressure inside, might ask what his portable set, bought before the days of all-electric radio, depends on for its motive force. Or will the idea spread, and we be supplied with all-greasy butter and all-wet water?

Of course, there are others who claim to run their sets off the mains. Personally, I deplore the exaggeration of people who scratch their fingers and declare they have

severed an artery. But perhaps all is fair in wireless.

Alternating current is in process of being made universal, and in a few generations we shall be without that curious term, "D.C. Current." My tuition in days gone by taught me that D.C. is a handy abbreviation of "Direct Current"; but as to the meaning of "D.C. Current" it remained silent. Readers who may have any secret information about this are urged to write to me in strict confidence. The only explanation I can think of is a well-bred shyness to use the expression "d. current," lest it be misinterpreted as referring to a particularly unpleasant sort of current.

Another favourite abbreviation, which may be seen scattered over circuit diagrams, terminal heads, and other places, is "HT." This is understood to signify "High Tension," and reference to a book of standard electrical terms shows that this is defined as a potential of 650-3,000 volts. The maximum voltage deemed safe for supply to the general public is 250. But, of course, wireless listeners are able to stand much more than ordinary people.

With this thought in mind we turn to consider "microphone." This is derived from two Greek words—*micros*, small, and *phone*, sound. Having been present in the studio while the microphone was being fed, I have come to the conclusion that my hearing is morbidly sensitive.

True News

At the ordinary listener's end, however, there is a *loud* speaker. I must confess that the outstanding characteristic of many of these instruments is undoubtedly *loudness*. Perhaps, therefore, I am hypercritical in desiring for an appliance a term which embodies some characteristic that is essential in the article named. For example, the daily Press has been known to include statements which have an inadequate foundation of truth. In spite of this, the term "newspaper" has quite rightly come into more authoritative use than "daily liar."

The ability to make the programme less than loud is provided in practically every receiver under the label "Volume Control," or a recognised abbreviation for the same, such as a dot or arrow. The purpose of the volume control is to be able to vary the volume to suit the need and desire of the listener. Lest I appear to emphasise the obvious, I set down beside it the purpose of *automatic* volume control, which is to prevent the volume varying.

Our man in the street may be pardoned for regarding radio as a difficult subject, when he is provided with two volume controls, one automatic and one worked by hand, which do opposite things.

A well-known sort of volume control is named in six splendid syllables, "potentiometer." In spite of all that the word is a hybrid, partly Latin and partly Greek. And it means "a measurer of potential" (i.e., volts). Actually, it is an extremely refined and accurate means of measuring volts, and costs a great deal of money—£100, for example. So, poor cross-breed though it is, the name has every right to resent doing duty for a strip of black-leaded paper behind a knob.

Thirteen years ago Dame Melba sang into a funnel at Chelmsford and was heard hundreds of miles away. Everybody (that is to say, about a thousand amateurs) thought it marvellous. One of the radio societies reported that several of its members had picked up the "Melba signals."

I remember wondering at the time whether the good lady would read this and appreciate the products of her golden voice being referred to as "signals." To an amateur fraternity steeped in Morse, there was nothing incongruous; and the distinction at the receiving end was, as a matter of fact, quite unimportant; but it seems strange that when, to the majority of the world, the ether exists to transmit crooners, no more suitable term should yet have been devised.

The ordinary listener, to whom the mental effort of changing to twenty-four-hour time by the arithmetical process known as simple subtraction is an intolerable exertion, is not likely ever to understand why the wavelength of London Regional can be given as 342.1 metres or 877 kc/s, and, if so, why Droitwich on 1,500 metres should be only 200 kc/s. Having been taught, however blankly, to associate the different stations he hears with numbers called "wavelengths," he can hardly be expected to unlearn them in favour of the system of kc/s, which all people must use who work with these mysteries for their living.

In the correspondence of the highbrow technical journals one can find argumentative letters about many other terms—"Variable-mu," "demodulation," "impedance," "capacit(at)ive." And we cannot forget the terrible "pick-up"!

Readers may be thinking that it is all very well for me to criticise, but what about being a spot more constructive? I reply that there have been many attempts to revive the famous old comedy "Canute," but that the title-rôle is one that does not greatly appeal to me.

HINTS and TIPS

Practical Aids to Better Reception

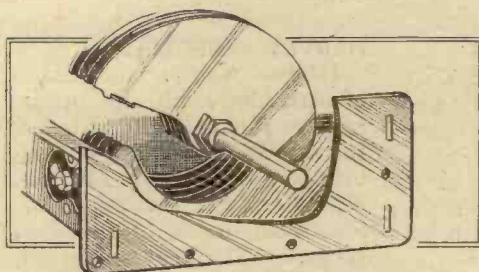
IT is not unknown for the builder of a "straight" set to make the mistake of fitting the special type of ganged variable condenser designed solely for use in a superheterodyne receiver, and *vice versa*. Externally both look the same,

Superhet and Straight Condensers

but they are by no means interchangeable, and the result of using the wrong type of condenser is disastrous, as proper circuit alignment cannot possibly be obtained.

Fortunately, a simple examination of the vanes will avoid the possibility of such mistakes. In a "straight" condenser both rotor and stator plates of any section are of precisely the same shape as the corresponding plates in any other section. But the modern superheterodyne condenser always has one set of plates (invariably the rotor) shaped so differently from the others that its identification is easy and certain. This section is, of course, used for tuning the oscillator circuit.

It may be added that some condensers are fitted with semi-circular rotor vanes with the object of reducing overall dimensions, and as a consequence the stator plates must be specially shaped to give the right tuning law. But again, there will be a sufficiently obvious difference in shape between the signal-frequency and oscillator sections to prevent confusion.



The oscillator section of a superhet tuning condenser can be identified by its specially shaped plates.

IT is generally appreciated that most of the man-made electrical interference that reaches the average receiver is borne from its source by the mains and re-radiated on to the aerial from the domestic wiring or even from water pipes, etc.

Dissemination of Interference

With the exception of tramways and trolley-buses, the majority of electrical appliances which cause the most serious disturbances are usually situated at such a distance from "desirable residential districts" that direct interference would be almost impossible.

We can assume quite logically—and experience bears out the assumption—that in some cases the aerial is affected only by re-radiation from a small section of the household wiring. This at once suggests the possibility of applying anti-interference measures to that section only; a particularly attractive possibility in cases where chokes must be used in addition to the more usual plain condenser filter.

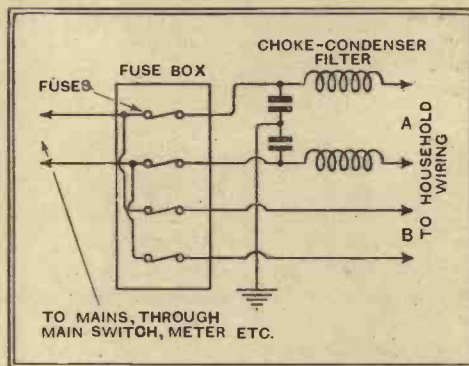


Fig. 1.—Insertion of an anti-interference filter in a section of the household electrical wiring.

Where chokes are inserted at the point where the mains enter the building, they must obviously pass all the current consumed in the house, and must therefore be of greater current-carrying capacity than if inserted in a single section of the wiring.

Where household wiring is well subdivided, it is an easy matter to ascertain whether the interference comes from the general wiring system or from a small part of it by removing, one by one, the pairs of fuses through which each wiring section is fed.

As an example of what may be done, we may take the simple case illustrated in Fig. 1, where it is assumed that the wiring of the house is divided at the distribution fuse-box into two sections only—upstairs and downstairs. In such a case it is at least possible that the interference would be radiated on to the aerial from the upstairs wiring only (section No. 2), and in these circumstances the insertion of a choke-condenser filter in the manner shown would be expected to effect a great improvement.

THOSE who have little experience of the operation of a continuously-variable tone control are sometimes puzzled by the fact that manipulation of the actuating knob makes no difference whatever to the pitch of a steady note,

Tone Control and Volume

but does alter its volume considerably (except, of course, in a set fitted with AVC). A moment's consideration of the matter will show that this is precisely what should happen, and

at the same time suggests a method that will demonstrate even to an ear that is relatively insensitive to changes in tone that the control system is working more or less effectively. Tests may be carried out while listening to a tuning note, to morse signals of pure tone, or to a heterodyne whistle.

IN a recent issue it was explained how the tapped matching transformers fitted to several loud speakers may be advantageously employed when more than one extension speaker is fitted to a receiver.

Changing Valve Characteristics

It is also worth while remembering that the judicious use of the matching control will also compensate to some extent for the deterioration in quality which takes place when the emission of the output valve has fallen off after a more or less lengthy period of service.

The result of declining emission is always an increase in valve impedance, and so the matching adjustment which was correct when the valve was new may need some alteration as it is approaching the end of its useful life.

Pifco Rotameter de Luxe

THE Provincial Incandescent Fittings Co., Ltd., Pifco House, High Street, Manchester, has introduced a new de luxe model Rotameter, which instrument is fitted with a moving-coil movement. It has eight ranges, four for DC voltages reading 0.5, 0.20, 0.100 and 0.400, and three for current, the ranges being 0.10 mA, 0.50 mA, and 0.250 mA. In addition, provision is made for measuring resistances and testing continuity of valve filaments, a five-pin socket being fitted on the top of the case.

The various ranges are brought into use by means of a switch on the right-hand side of the case; this is linked up with the scales, and the appropriate one is brought into



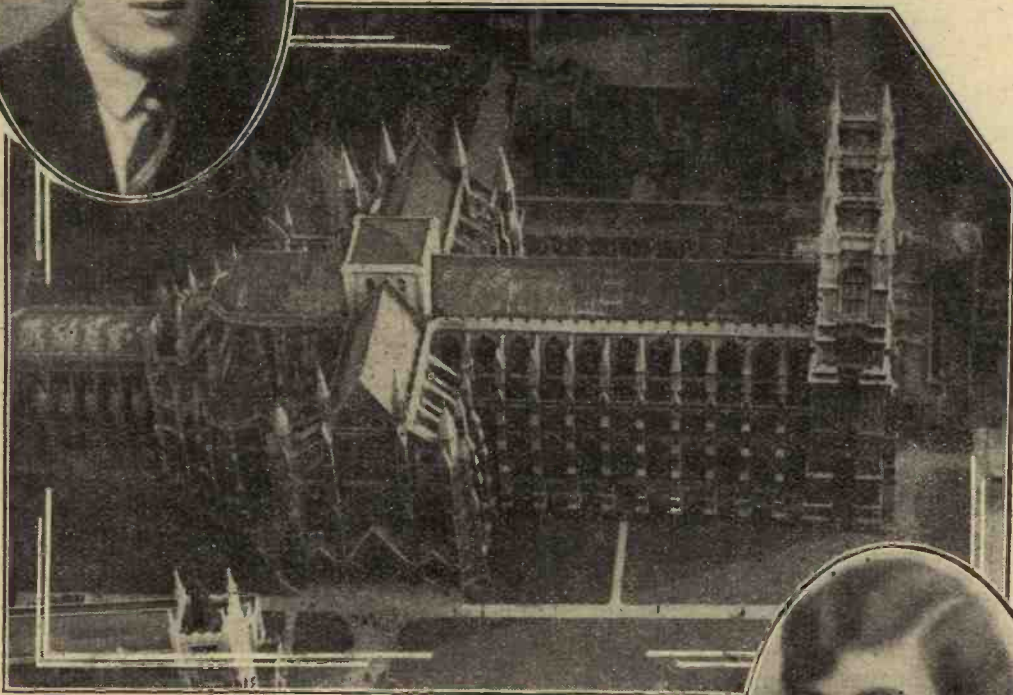
Pifco de Luxe model moving-coil Rotameter.

view behind the scale window on rotation of the switch.

The resistance on the voltage ranges is 500 ohms per volt, and the price is 42s.

★ ★ Listeners' Guide

Outstanding Broadcasts a



THE WEDDING OF H.R.H. the Duke of Kent, K.G., and H.R.H. Princess Marina of Greece takes first place in the week's broadcasts. The arrangements are described on this page.

THE ROYAL WEDDING.

NOT so very long ago the broadcasting of a Royal Wedding between 11 a.m. and 12 noon would have meant no more to the ordinary man than a landslide in Peru. Thanks to electrical recording, however, everyone should be able to hear the Abbey service and Howard Marshall's running commentary on Thursday next, November 29th.

The broadcast opens at 10.45 a.m., when Mr. Marshall, from his eyrie above Westminster Hospital, will describe the scene in and around Parliament Square, the arrival of the Royal Family, the Royal guests, and the Diplomatic Corps.

ELECTRICAL RECORDING.

At 11 o'clock listeners will be switched over to the interior of the Abbey to hear the procession of the Bride, introduced by the Dean. Then will follow the solemnisation of the marriage by the Archbishop of Canterbury. Psalm 67 (Bairstow) will precede the Lesser Litany and the Lord's Prayer, prayers by the Archbishop of York, and the Blessing by the Dean.

While Their Royal Highnesses are signing the register, Mendelssohn's Wedding March will be played, and, immediately afterwards, we shall hear Mr. Marshall's commentary on the departure from the Abbey.

An electrical recording will be broadcast during the evening.

GERMAN COMMENTARY.

MR. MARSHALL will not be alone on the roof of Westminster Hospital; near him will be a German commentator whose description of the scene will be relayed to a number of European countries. At the time of writing it is known that Denmark, Germany and Yugoslavia will relay the service. The American broadcasting networks will take the relay from the Empire transmitters at Daventry.

STRAVINSKY IN PERSON.

It is Stravinsky night at the Queen's Hall on Wednesday next, and the big item will be the first performance in England of "Perséphone," André Gide's melodrama, set to music by Stravinsky and conducted by the composer. Sir Henry



Photo.: Hugh Cecil.

Wood will conduct the Capriccio for pianoforte and orchestra, with the composer at the piano, and also Stravinsky's "Firebird" suite. The transmission is on the National wavelengths at 8.30.

SILLY SYMPHONY.

THE film complex has gripped the B.B.C., the latest symptom being an experiment in the Silly Symphony style of Walt Disney. The new feature, "Dotty Ditties," occurs in "Entertainment Hour" at 8.30 on Tuesday next, November 27th, the theme song being "Johnny's So Long at the Fair." This musical fantasy will have a background of Fair noises. Artists include Greta Keller, Stuart Ross, and Joe Sergeant. "Dotty Ditties" have been arranged by Max Kester and Austen Croom-Johnson.

CONCERT OF WALTZES.

GERMAN bands are unsurpassed in their playing of waltzes. Hamburg offers a gem of a concert at 8 p.m. on Wednesday next, when the station choir and orchestra, with the help of three pianofortes, will give "A Concert of Waltzes," directed by Dr. Eibenschutz.

FUN IN MUSIC.

SOME of the most tantalisingly attractive items occur in the afternoons when many people are unable to listen in. Who could resist, if they had the opportunity to tune in, the "Humorous Instrumental Concert" in the Berlin (Funkstunde) programme for Wednesday next, from 3 to 4.40 p.m.? In practice such concerts are not uncommon in the evening on the German wavelengths, for our Teutonic neighbours have long realised that music can be a laughable affair without the aid of words.

I wish such music were played in England. I should like to watch a Promenade audience holding its sides while Sir Henry Wood chased bassoons and piccolos from bar to bar.

HARVEY v. NEUSEL.

HE-MEN who are not afraid of hard blows will tune in the running commentary on the International Heavy-Weight Contest between Walter Neusel and Len Harvey, to be broadcast direct from the Wembley Stadium by Lionel Seccombe on the National wavelengths at 10 o'clock on Monday next.

BRIGHTER SUNDAYS.

WHAT would our grandparents have said if they could have seen the light and varied nature of next Sunday's broadcast programmes? Troise and his Mandoliers appear with Don Carlos the tenor at 12.30, and in the evening we shall hear Fred Hartley and his Novelty Quintet (10 p.m.).

The Sunday programmes are being divided up into shorter periods, the aim being to secure brightness by way of variety.

for the Week

Home and Abroad

ONE-MAN CONCERTS.

ONE-COMPOSER concerts do not suit everybody, though much depends on the choice of composer. There are several of these concerts from foreign stations this week, the most important, perhaps, being the Beethoven Symphony Concert to be given by the Basle Music Society and relayed by Beromunster tomorrow evening between 7 and 9 o'clock. The conductor is Weingartner.

Then, on Sunday evening, from 7 to 8.30, the Deutschlandsender offers a Brahms concert by the Station Orchestra and Choir, the German Oratoria Choir and the German Choral Society.

A lighter concert of this type comes from Cologne on Tuesday (3 to 4.30 p.m.) with a Johann Strauss concert by the Station Orchestra.

AN OPICLEIDE AT LARGE.

IF the special "Black Country" programme from Midland Regional at 8 o'clock on Thursday next were not packed with other promising items, it would still be worth tuning in for the sake of a recital on an ophicleide played in the Methodist Chapel at Upper Ettingshall. As Mr. Percy Edgar said in a recent talk, the ophicleide makes one sigh for the day when television will come to the aid of the "Microphone at

Large" series. It was invented during the Napoleonic wars by applying the keys to that fine old Elizabethan instrument, the Serpent. Some of the stops are as big as a five-shilling piece, and there are some gorgeous notes.

Other features in this Black Country programme, produced by Owen Reed, will be talks with an old nailer who specialises in the making of frost cogs (to prevent horses from slipping on ice-bound roads); a woman who has brewed beer at home for

AN OPICLEIDE, or Serpent, of the type which will be heard in the Midland Regional programme on Thursday next (November 29th).

about thirty years; a steel smelter; a trap-maker, and a woman who comes from Gornal and sells salt in the block.

BROADCASTING A MASTERPIECE.

DESPITE the questionable step which the B.B.C. has taken in regard to next week's radio play, "Wuthering Heights," I would recommend readers to listen to it. The play has been split into two parts, the first to be given on

the National wavelengths at 8 o'clock on Monday and the second on the Regional wavelengths at 8 o'clock on Tuesday.

Emily Brontë's masterpiece, packed with character and incident, must have presented a real problem to the radio producers. But was it necessary to serialise it in this way, and, worse still, transmit the two sections on different wavelengths? Some listeners depend



Photo: "Birmingham Gazette."

exclusively on the National wavelength, and will be unable to follow Part 2.

The novel has been adapted by Barbara Couper and Howard Rose, and the cast includes Hubert Gregg as Hindley Earnshaw; Laura Smithson as Mrs. Earnshaw; Joyce Bland as Catherine Earnshaw; and Matthew Boulton as Mr. Earnshaw.

"SACRED OPERA."

ITALIAN oratorio is more like sacred opera than the somewhat formal affair which oratorio has become in this country and Germany. As a typical example of Italian oratorio I would recommend "La resurrezione di Cristo," by Perosi, to be broadcast this evening at 7.45 from Milan. The Station Orchestra and Choir will be conducted by Tansini and Vertoba.

ALL-IRISH.

AFTER "In Town To-night" on Saturday next why not use the odd minute to tune in Athlone, which, at 7.31, begins a special feature programme "Around the Shows," presented by Mr. T. Madden and Company, with orchestra?

HIGHLIGHTS OF THE WEEK.

FRIDAY, NOV. 23rd.
Nat., 8.30, "Following in Father's Footsteps," featuring some famous children of famous fathers.
London and Midland Reg., 8.45, Concert of Works by Midland Composers.

Abroad.

Warsaw, 7.15, Symphony Concert by the Philharmonic Orchestra, relayed from the Conservatoire.

SATURDAY, NOV. 24th.

Nat., 8.30, "Music Hall."
London Reg., 7, Canterbury City Band.
North Reg., 9.15, Scout Show by 600 Scouts and Cubs in King George's Hall, Blackburn.

Abroad.

Budapest, 8.35, Hungarian Music by the Imri Magyri Cigany Band.

SUNDAY, NOV. 25th.

Nat., 12.30, Troise and His Mandoliers. 9, Albert Sandler and Park Lane Orchestra.
London Reg., 5.45, Ellan Vannin, a Manx Programme. 9.30, Sunday Orchestral Concert. 7, Conducted by Ildebrando Pizzetti and Adrian Boult.

Abroad.

Warsaw, 7, Classical Music by the Station Orchestra.
Berlin (Deutschlandsender), 7, Brahms Concert.

MONDAY, NOV. 26th.

Nat., 8, "Wuthering Heights," by Emily Brontë, Part I. Specially adapted for broadcasting. 10, International Heavy-weight Contest: Walter Neusel v. Len Harvey. Running Commentary from Wembley by Lionel Secombe.

London Reg., 9, "Merrie England," relayed from the Princes Theatre.

Abroad.

Cologne, 7.15, Humorous Musical Programme by Station Orchestra and soloists.

TUESDAY, NOV. 27th.

Nat., 8.30, "Entertainment Hour," including Dotty Ditties. 10, Sir James Jeans: "The Furthest Depths of Space."
London Reg., 8, "Wuthering Heights," Part II.

Abroad.

Berlin (Funkstunde), 3, "Round the World" Concert.

WEDNESDAY, NOV. 28th.

Nat., 8.30, B.B.C. Symphony Concert, conducted by Sir Henry Wood. Soloists: Ida Rubinstein, René Maison (Tenor), Igor Stravinsky (pianoforte).
London Reg., 8.30, The Kentucky Minstrels.

Abroad.

Hamburg, 8, Concert of Waltzes by Station Choir, Orchestra and Three Pianofortes.

THURSDAY, NOV. 29th.

Nat., 10.45 a.m. to 12 noon, Marriage of H.R.H. The Duke of Kent, K.G. and H.R.H. Princess Marina of Greece. Relay from Westminster Abbey and running commentaries by Herbert Marshall. 8, "The Show Goes Over," with Hermione Gingold, Jay Laurier and Dorothy Carless.
London and Midland Reg., 8, "The Black Country," a miscellany.

Abroad.

Kalundborg, 7.10, Concert by the Radio Symphony Orchestra. Soloist: Adolf Busch (violin).



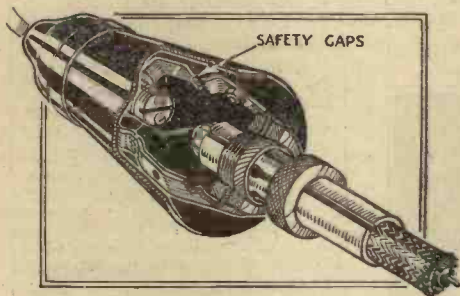
Photo: "The Times."

Withens, the "Wuthering Heights" of Emily Brontë's novel, is situated on a wild stretch of Yorkshire moorland. "Wuthering Heights" will be broadcast as a radio drama in two parts on Monday next (National, 8) and Tuesday (Regional, 8).

New Apparatus Reviewed

GOLTONE METOCCEL COWL AND LIGHTNING ARRESTER

THIS is a new addition to the Goltone screened aerial down-lead equipment, being an improved version of the aerial cowl connector which is used with their Metocel and Multi-Shell screened down-leads, and forms a weatherproof connection between the top of the down-lead and the aerial.



Goltone new model cowl incorporating lightning arrester for use with their screened down-lead cables.

The new model has combined with it a lightning arrester, and there are two spark gaps inside the cowl; one pole of each is joined to the aerial wire connector, and the other points are on an extension of the bracket supporting the bakelite cowl. With the Metocel cable having an external braided covering, it is necessary first to expose the metal sheathing below and fit a small lead sleeve so as to provide a direct earth connection for the lightning arrester. The price of the new cowl is 5s., the makers being Ward & Goldstone, Ltd., Pendleton, Manchester.

LISSEN CONDENSERS

LISSEN condensers are made in two styles; there is a series with mica dielectric for use in HF circuits, and a range of Mansbridge-type paper dielectric condensers mainly for LF and smoothing circuits, but suitable, also, as HF by-pass condensers.

The mica series are available in capacities of from 0.00005 mfd. (50 micro-mfds.) to 0.02 mfd., the prices ranging from 6d. to 1s. 6d. each, according to capacity. These are assembled in small moulded bakelite cases which can be screwed flat on to the baseboard or mounted in a vertical position, the terminals being placed on one side. Several specimens of this type have been tested, and their capacities show good agreement with the marked values, our specimens all being slightly high; the majority, however, were well within 15 per cent. of the values marked on the case.



Selection of Lissen condensers.

The Mansbridge type are available in sizes ranging from 0.01 mfd. to 2 mfd., the maximum working voltage being 250 DC. A generous margin of safety is allowed, as the several specimens sent to us have been tested

Recent Products of the Manufacturers

at 750 volts DC, and all successfully withstood the test.

This series is assembled in bakelite cases with terminals and soldering tags on the top, and they can be mounted upright or flat, as required. Prices range from 1s. 9d. to 3s. 6d. each.

The makers are Lissen, Ltd., Lissenium Works, Worple Road, Isleworth, Middlesex.

SCIENTIFIC INEXPENSIVE MICROPHONE

A SMALL microphone eminently suitable for home entertainment is obtainable from the Scientific Supply Stores (Wireless), Ltd., 126, Newington Causeway, London, S.E.1. It has a transformer built into the base, and the only additional item required



is a small 4½-volt flash lamp battery. When connected to the pick-up terminals of an ordinary broadcast set it provides the means for making amusing announce-

A home entertainment microphone obtainable from Scientific Supply Stores.

ments which can be used to good effect at children's Christmas parties. It is also a useful microphone for experimental work. Speech is clear and of good intelligibility, and the price is 8s. 6d.

MAXWELL WIRE-WOUND RESISTORS

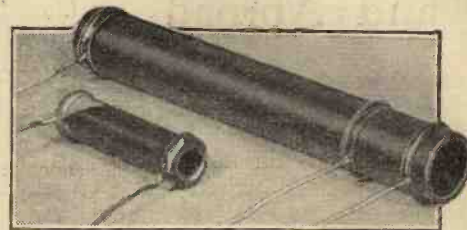
MAXWELL resistors are made in sizes ranging from one to fifty watts dissipation, and all types are wire-wound. A 4-watt specimen of 150 ohms, also one of the 20-watt size have been received for test. The former is wound on a 7/8 in. diameter glass tube measuring 1½ in. long; the resistance wire is protected by a coating of a special heat-resisting enamel and the standard colour code is adopted.

The 20-watt pattern is considerably larger, for to remain at a reasonable temperature under full load a large area is necessary for rapid heat dissipation. The tube on which it is wound is 5 in. long and ¾ in. in diameter. This style is described as the "Hiload" resistor, and they can be obtained with intermediate tapplings.

The specimens tested were not unduly hot under full load, so the radiating surfaces are quite adequate for each size. The enamel on the 20-watt model becomes slightly soft, but did not run or discolor. When it had cooled down the surface was as hard as before the test, so that the softening may be due only to its newness.

Prices of these resistances are very reasonable, especially as they are wire-

wound. The one-watt pattern costs from 6d. to 9d. according to value; 2 watts 9d. to 1s., and the 4 watts 1s. to 1s. 3d., with



Maxwell 4-watt and 20-watt wire-wound resistors.

prices increasing as the wattage goes up. The "Hiload" series cost 2s., 2s. 6d., 2s. 9d. and 3s. for 10-, 20-, 30- and 50-watt types respectively. One intermediate tapping adds 4d. to the price, while if several are required special rates will apply.

The makers are R. Roberts (B'ham), Ltd., 5-6, Aston Road, Birmingham, 6.

FLUXITE GUN

A HANDY receptacle for Fluxite soldering paste has been introduced by the makers, Fluxite, Ltd., Dragon Works, Bermondsey Street, London, S.E.1. It is described as the Fluxite Gun, and consists of two close-fitting cylinders, one of which is provided with a nozzle. One slides inside the other, and when filled with the paste it acts much in the same way as a grease gun; a light pressure on the two cylinders sliding the outer case nearer to the nozzle end projects the Fluxite on to the work to be soldered.

The paste is kept in a clean, fresh state, for it is difficult to avoid contamination when the paste is kept in an open tin, as dust and grit settle on the surface.

The gun can be used for several other

The Fluxite Gun keeps soldering paste clean and fresh and is economical in use.



purposes, such as to hold car grease or any similar substance required in small quantities from time to time. The price is 1s. 6d.

BOOKS RECEIVED

Making and Repairing Radio Sets, by W. Oliver.

A practical handbook for the amateur constructor which, as its name implies, deals thoroughly and in a practical manner with all aspects of the construction and maintenance of a wireless receiver. Pp. 123, with 30 diagrams. Published by Messrs. W. Foulsham & Co., Ltd., 10 and 11, Red Lion Court, Fleet Street, E.C.4. Price 1s. net.

Faraday, by Thomas Martin.

This book is one of a series of biographies entitled "Great Lives." It deals clearly and concisely with the work of Faraday and his contributions to scientific knowledge, and is written in very lucid style. Pp. 144. Published by Gerald Duckworth & Co., Ltd., 3, Henrietta Street, Covent Garden, W.C.2. Price 2s. net.

Foundations of Wireless

Part II.—Watts, Henrys, and Farads

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

CONTINUING his instructive series, the author in this instalment proceeds to explain some common terms which form the basis of measurement in electrical and wireless work.

(Continued from page 403 of last week's issue)

IT would be a commonplace to point out that to pump water along a horizontal pipe some small amount of power would be required to overcome the friction. It is equally true to say that if electricity is driven through a conductor some power is required to overcome the resistance of that conductor. A rise either in voltage (pressure), current (flow of water), or resistance (friction) will naturally increase the power necessary to maintain the flow. Since these three are related by Ohm's Law, the power needed can be expressed in terms of any two of them; using standard symbols, the power is: $W = I^2R$, or EI , or E^2/R .

Any of these expressions can be used for calculating the power expended in a circuit, according to whether current and resistance, voltage and current, or voltage and resistance are known. Once again the units to be used are ohms, amperes, and volts, while the unit of power is the *watt*. One watt is the power expended when a current of one ampere is driven by an EMF of one volt.

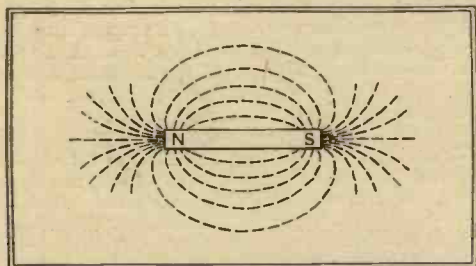


Fig. 3.—The lines of magnetic force round a permanent magnet NS. These lines mark out the magnetic field surrounding the magnet.

Take the case of an electric fire having a resistance of 20 ohms, connected to 200-volt mains. By Ohm's Law the current will be 10 amperes. The three expressions for power work out, for this case, as follows:—

$$I^2R = 10^2 \times 20 = 100 \times 20 = 2,000 \text{ watts.}$$

$$EI = 200 \times 10 = 2,000 \text{ watts.}$$

$$E^2/R = 200^2/20 = 40,000/20 = 2,000 \text{ watts.}$$

When electrical energy is consumed, some other form of energy must necessarily appear in its place (Law of Conservation of Energy). In the case given it is fairly evident that the electricity consumed is converted into heat. This is equally true

of any case where a current passes through a resistance, though if the dissipation of power is small the rise in temperature may not be noticed. For example, a 15,000-ohm resistance carrying 5 mA. only dissipates 0.375 watt.

It is important to note that the watt is a unit of power, which is rate of doing work, and not of simple work or energy. A ten-horse-power engine exerts ten horsepower, no matter whether it runs for a second or a day; if it continues for an hour the work done is ten horse-power-hours. Similarly, one coulomb per second under a pressure of one volt is one watt, no matter how long it flows. If the 2,000-watt fire were left on for eight hours the power would be 2 kilowatts at any moment during that time, and the total energy expended would be 16 *kilowatt-hours*. A kilowatt-hour is the "unit" charged for in the quarterly electric-light bill.

Inductance

If a piece of paper is laid on a straight "bar" magnet, and iron filings are sprinkled on this paper, they are found to arrange themselves in some such pattern as that indicated in Fig. 3. These lines show the paths along which the attraction of the magnet exerts itself, and so are called *lines of magnetic force*. As a whole, they map out the *magnetic field*, which is the area over which the effect of the magnet is felt.

An electric charge on a body represents, as we have seen, a certain amount of stored energy; a magnetic field contains stored energy in another form. This energy is limited in amount, and can only be made use of at the cost of destroying the field, just as the energy of a charged body can only be liberated by allowing it to drive a current through a circuit, and so dissipating the charge.

In an electro-magnet, which consists, as Fig. 4 shows, of a coil of wire surrounding an iron core, it is found that the magnetic effect is set up when the current is turned on, remains as long as the current through the coil continues, and vanishes when the current stops. The energy necessary to create this field has to come from somewhere—there being no other source, it must come from the current. This means that while the field is being built up the battery has to drive current against an

opposition greater than that due to the mere resistance of the wire, so that *while the field is growing* the electro-magnet behaves rather as though it contained extra resistance. But once the field is set up, no energy is required to maintain it. The current through the magnet then becomes, and remains, exactly what one would predict from the EMF of the battery and the pure resistance of the wire of the coil; the magnetic field plays no part in determining the magnitude of the current once it has settled down to a steady value.

It is a little difficult to visualise what happens on switching off the current, because of the rather uncertain nature of

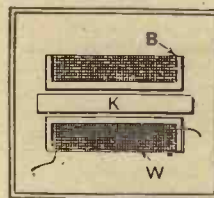


Fig. 4.—Section through an electro-magnet. K, iron core; B, bobbin fitting over K; W, winding of insulated copper wire.

a switch, which may spark across the contacts. Instead, we will imagine that the current is reduced to one-thousandth of its original steady value by opening a switch connected across a resistance of high ohmic value, as suggested in

Fig. 5. When the current drops, the magnetic field will collapse with it, and experiments show that the stored energy that is contained makes itself felt as an attempt towards maintaining the full current. Naturally, since the energy of the field is limited, this attempt will not succeed. The effect is that for an instant the current is higher than would be calculated from Ohm's Law by taking into account the EMF of the battery and the new, high value of the resistance of the circuit. It is in this way that the energy originally taken for building up the field is returned to the circuit when the field collapses.

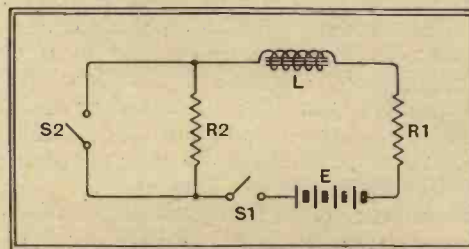


Fig. 5.—Current in inductive circuit. L, electro-magnet (inductance); R1, represents resistance of L; R2, high resistance switched into circuit by opening S2; S1, main circuit switch.

The effect of the field is thus to check the current when it is rising, and to maintain it when falling; in brief, *to oppose any change in the current*. So long as the current is steady the presence of the field does not affect it.

These points are shown graphically by

Foundations of Wireless—

the curves of Fig. 6. In these, time is plotted from left to right and current upwards; the dotted curves refer to a circuit containing only an ordinary resistance,

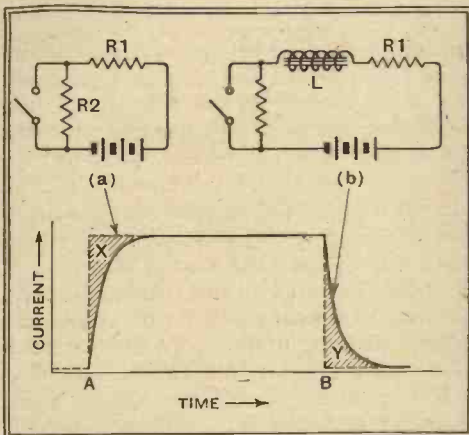


Fig. 6.—The rise and decay of current in a circuit which is (a) resistive (dotted line); (b) inductive (full line). In the presence of inductance the current takes a definite time to attain its new value.

while the full-line curves refer to a circuit containing an electro-magnet. In the circuit comprising only the battery and resistance (Inset a) the current rises instantaneously to full value at the exact instant of switching out the high resistance R_2 (A on the curve) as shown by the dotted line. At B, the instant of switching in the high resistance, it falls instantaneously to its new, very low, value. In the circuit including the electro-magnet (Inset b) the current rises more slowly, requiring, as the full line shows, an appreciable time to reach its full value. At B the retarding effect of the magnetic field, now returning energy to the circuit, makes the fall in current slow, the change again taking place according to the full line. The shaded area X represents the energy used in building up the field, while the area Y represents the energy returned in prolonging the current, when the field collapsed. The two areas are equal.

This property, by which an electrical circuit offers opposition to the change of a current flowing in it, is called *inductance*. It must always exist wherever a circuit has any physical dimensions, for there is a magnetic field round even a straight wire so long as it carries a current. In practice, the effect is seldom noticeable until the wire is made into a coil, so that the fields due to the different parts of the circuit can reinforce one another. The presence of an iron core enhances the effect immensely, since the lines of force can pass far more readily through iron than through air.

Inductance is measured in *henrys* (Symbol H). This unit is defined by the condition that if the current flowing in a circuit changes by one ampere when a potential difference of one volt is applied for one second, the circuit has an inductance of one henry.

We have seen that in an insulator the electrons are so firmly fixed to their parent atoms that they cannot drift

through the body of the material. Current, therefore, does not flow through an insulator. Nevertheless, the application of a potential difference still *tends* to drive a current, with the result that each electron moves a little way within the limits of its own atom, behaving rather as though it were tethered to its atom by a piece of elastic. This analogy, crude though it is, is expressive, for the extent to which they move depends on the voltage driving them, and they return forcibly to their original places when the voltage is removed.

Capacity

Suppose we have two metal plates separated by a thin layer of an insulating material D, such as mica or waxed paper. In Fig. 7 these plates are shown connected in series with a battery E and a lamp Q. On making the connection to the battery, Q will light up for an instant and then go out again, showing that although there is an insulating barrier breaking the circuit at D, electrons have flowed momentarily. This momentary current is the visible sign of the movement of electrons across their atoms under the urge of the applied voltage; it stops when the elastic forces within their atoms, which tend to

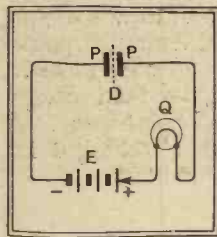


Fig. 7.—On touching the plug to the + terminal of E, the lamp Q will light momentarily only. The momentary current occurs because the dielectric D, although not permitting a continuous flow of electrons, allows a momentary displacement current to pass.

return them to their normal places, exactly counterbalance the driving force of the EMF applied.

The action is exactly analogous to that of a spring put under tension. The extension of the spring depends on the magnitude of the pull, the spring can be

broken by the application of sufficient force, and unless broken will return sharply to its original length when released. Similarly, the movement of electrons in D is greater for greater applied voltages, the insulation can be broken down, allowing a continuous current to flow, if the voltage is high enough, and the electrons revert to their usual places, thus producing a momentary current in the reverse direction if the voltage is removed. This reverse current can be made manifest by removing the leads from the battery in Fig. 7 and touching them together, when the lamp will again light for an instant.

The current passing by virtue of the displacement of electrons on the application of a voltage is called a *displacement current*, or, if it is momentary and unidirectional, as in our example, a *charging current*.

The two plates P, with the dielectric D separating them, form a *condenser*, which is the physical object devised to provide property of *capacity*. The capacity of a condenser is estimated by the magnitude of its charging-current, and the unit is the *Farad*. A condenser has a capacity of one farad when the application of a potential difference of one volt between its terminals drives one coulomb of electricity into it.

Since a condenser of capacity one farad would completely fill the average small room the farad is not a very practical unit. The wireless engineer works in microfarads and micromicrofarads (symbols μF and $\mu\mu F$) except for theoretical calculation, for which the unit is necessarily the full farad.

THE RADIO INDUSTRY

WHAT promises to be an exceptionally interesting loud-speaker demonstration is to be conducted by Voigt Patents, Ltd., at 7.30 p.m. on November 27th. Readers are invited to attend. Address: The Courts, Silverdale, London, S.E.26.

Partridge, Wilson and Co., Ltd., of Davenset Works, Evington Valley Road, Leicester, are to be congratulated on their latest list describing power transformers and chokes; the technical information given is exceptionally complete, and useful data tables are included. Copies are available on request.

Lissen, Limited, of Worpole Road, Isleworth, Middlesex, announce the introduction of a new series of low-priced batteries to be sold under the trade name of "Leader." Prices are: 120 volts 6s. 6d., 100 volts 5s. 6d., 66 volts 3s. 6d. Corresponding "Leader" accumulators are priced at 2s. 3d. and 4s. 6d. for the 20 and 40 A-H capacities respectively.

We have had a request from Associated Radio Laboratories, 264, Sixteenth Street, Costa Mesa, California, U.S.A., for information regarding types of microphones in use in Europe which are not generally known in the United States.

Any information which manufacturers or other readers can supply should be sent direct.

The manufacture and repair of Epoch loud speakers and microphones is now being carried out by the Radio Development Company, Aldwych House, Aldwych, London, W.C.2. Telephone: Holborn 9111.

NEXT WEEK'S ISSUE

SPECIAL
VALVE
NUMBER

Including a Supplement giving full practical data on all types of receiving valves. Invaluable to every serious reader.

The issue will also contain special articles on valves and their applications.

BROADCAST BREVITIES

By Our Special Correspondent

Biggest Task of All

THE glassy stare which the "O.B." engineers of the B.B.C. give one these days is not attributable to the excitement of preparing for next Thursday's big relay in Westminster Abbey. They are faced with a much more formidable task, viz., installing microphones and amplifiers in St. Paul's Cathedral.

Sir Christopher and the Committees

This masterpiece of Sir Christopher Wren has long been a nightmare to broadcasting and public address engineers. Actually, I believe, Wren had an uncanny knowledge of acoustics for a man of his time, as witness many of his smaller churches, but his plans for St. Paul's Cathedral were largely modified by committees, and we all know what havoc can be wrought by committees.

New Microphone Points

There are spots in St. Paul's within a hundred feet of the pulpit from which it is impossible to hear the preacher, and other spots, twice and three times as far, at which every word can be clearly distinguished.

Recently the engineers have carried out tests, and it is believed that reasonably good results can be obtained with microphones placed in the centre of the nave and the choir.

The New Canon

Let me disclose a secret. These tests are the result not so much of the technical arduous of

the engineers, as of the enthusiasm of a new Canon of St. Paul's—none other than the Very Reverend Dick Sheppard. Dr. Sheppard is anxious that London's Cathedral should figure more largely in the religious side of broadcasting. Before long, Evensong in St. Paul's may be a regular feature in the B.B.C. transmissions.

Those New Wavelengths

READERS are still asking me for information concerning the forthcoming wavelength changes. Although these remain undisclosed by the B.B.C., I may say that *The Wireless World* let the cat out of the bag as long ago as June 23rd, 1933, in giving first publication to the Lucerne Plan and disclosing exclusive figures regarding subsequent wavelengths.

General Post

Midland Regional is scheduled to take the wavelength of 296.2 metres; Scottish Regional will take over the Midland Regional wavelength of 391.1 metres, while the 373.1-metre wavelength vacated by the former will be taken by West Regional, leaving the wavelength of 307.1 metres free for the Northern Ireland high-power station.

Scottish National will eventually take over the London National wavelength.

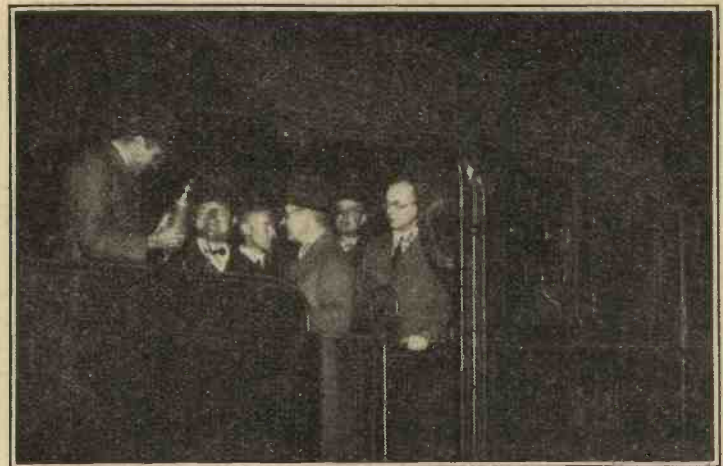
U.S. and British Drama

LESLIE BAILY, that bright star in the firmament of British radio drama, is now shedding his beams abroad. I hear that his radio play, "The Fantastic Battle," based on the story by C. R. Burns, was broadcast over the N.B.C. network in America on November

A Famous Trial

DURING the first week in December we shall hear the fourth of the "Famous Historical Trials" series, dealing with the court-martial of the unfortunate Admiral John Byng, who was found guilty of cowardice after engaging in an indecisive encounter with the French off Minorca in 1756.

There are two special points of interest in this broadcast. Mr. Anthony Ellis, who has prepared the broadcasting version, is himself to play the part of



The commentator interviews the driver during the recording of an item for later broadcast.

12th as part of their Armistice celebrations.

Such a broadcast in the United States is of special interest because American broadcasters have not hitherto taken much serious interest in radio drama; the broadcasting of a play of an hour's duration is something of a revolution.

"The Fantastic Battle" has been broadcast twice by the B.B.C., and also in Sweden and Ceylon.

Admiral Byng. He will be remembered by listeners for his radio adaptation of E. C. Bentley's detective novel, "Trent's Last Case."

The Execution

Secondly, in this reconstruction there is included not only the court-martial but the events which led up to it. And after the court-martial there is the execution.

The Committee Says Yes

SCOTTISH broadcasting took another step forward a few days ago when the Moray Roads Committee approved of plans for North Scottish Regional, which is to be erected beside Burghhead golf course on the outskirts of the town.

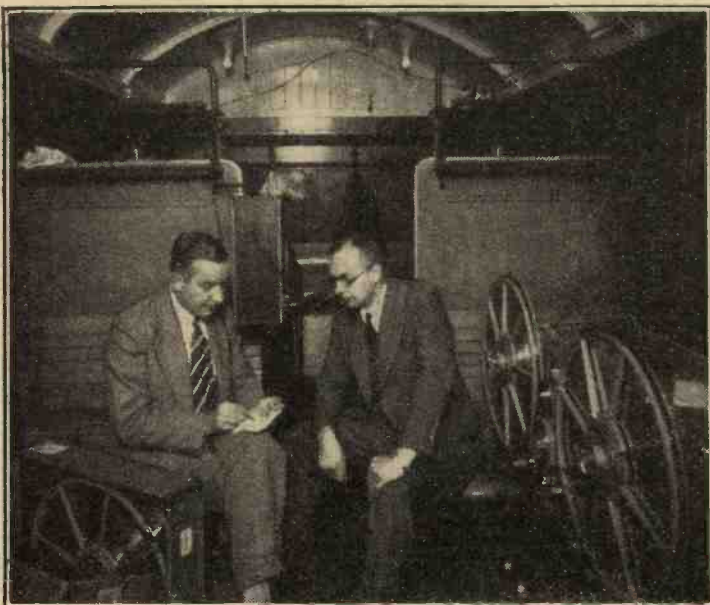
Ower Muckle

The only stipulation is that the B.B.C. should be prepared to sell a strip of the site, amounting to 286 square yards, which the County authorities desire to acquire for road widening at this point.

I hear that, in the opinion of the Committee, the B.B.C. is asking too much, and the town council has been asked to try for a better bargain.

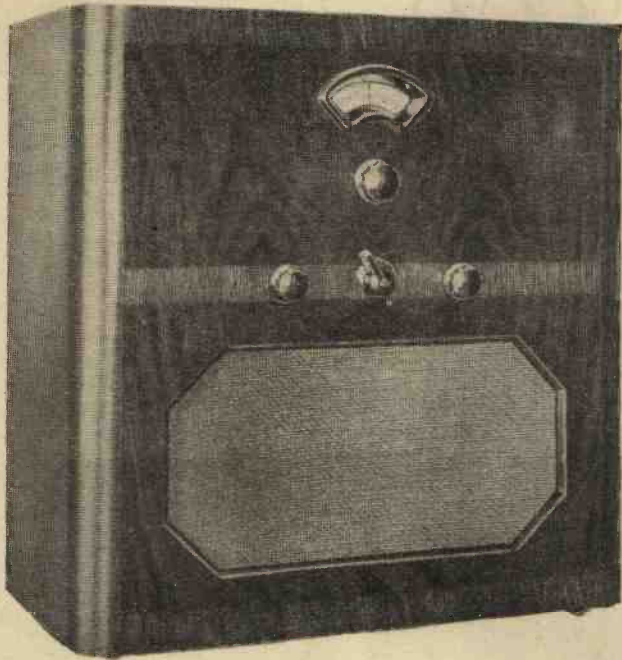
Commentary on a Billiard Match

IT is curious to note that, despite the persistent search for fresh programmes, a commentary on a billiard match does not seem to have been made so far. This omission will be made good on December 7th, when a half-hour's commentary on the match between Willie Smith and Sidney Lee will be relayed over the Scottish Region from the Nile Billiard Rooms, Glasgow. The match will have been in progress during the whole of the week, and it is expected that the game will have reached an interesting stage when the microphone is installed.



RECORDING A TRAIN JOURNEY. A mobile steel tape recording plant, manufactured by the Lorenz Company of Berlin, was recently employed to obtain a continuous "story in sound" of a train journey from Hamburg to Lübeck, for use in a special broadcast.

McMichael Twin Speaker Superhet



An AC Mains Receiver with Inter-station Noise Suppression

FEATURES.—*Type.*—Table model superheterodyne for AC mains. *Circuit.*—Triode-pentode frequency changer—two stages of IF amplification with var.mu pentodes—triode noise suppression valve and alternative LF amplifier—duo-diode-pentode second detector and output valve. Westinghouse full-wave rectifier. *Controls.*—(1) Tuning, calibrated in wavelengths. (2) Volume control and on-off switch. (3) Waverange switch. (4) Tone control. (5) Noise suppressor level switch. *Price.*—18 guineas. *Makers.*—McMichael Radio Ltd., Slough, Bucks.

THE makers of this receiver were among the first to adopt the principle of twin loud speaker units, and this policy has been continued in their "star" set this season. It cannot be denied that the tonal quality derived from dual loud speaker units properly matched and phased has a unique quality which is quite distinctive from that of receivers equipped with single loud speaker units. It can best be described by saying that the sound emitted appears to have depth as well as area and if it cannot be claimed that instruments in the orchestra appear to be in the same relative positions as they occupy in the studio, at any rate the effect of realism is very considerably enhanced.

The new cabinet is of simple modern design and is finished in figured walnut. The loud speaker grille occupies the lower

half of the front panel with the controls above. In the tuning scale modern practice is reversed in that the scale rotates while the pointer is stationary. The advantage of this is that a long open scale is provided without upsetting the character of the cabinet design, for the window through which it is viewed is quite small. Immediately below the tuning knob is the waverange control which has an exceptionally precise and positive action. The combined volume control and on-off switch is on the right and is matched on the left by the tone control.

Range and Selectivity

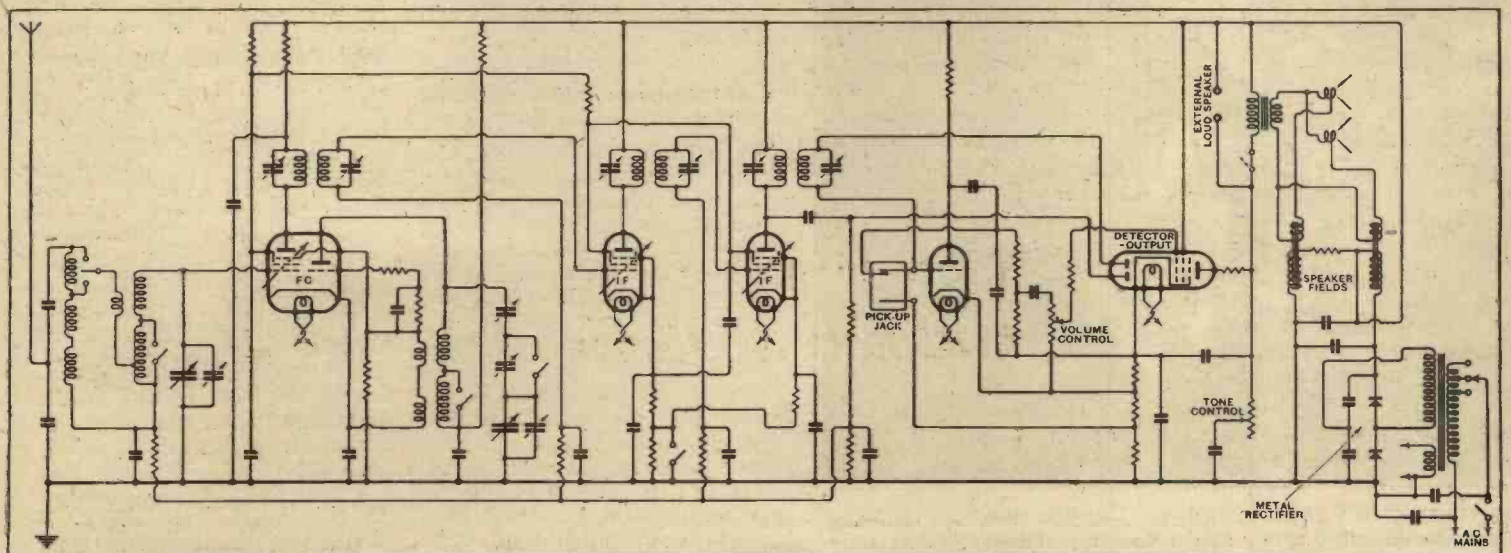
The set is sensitive and in daylight eight or nine foreign transmissions can be received on the medium waveband. In Central London the National and Regional transmitters at Brookmans Park occupy bands of approximately 30 and 50 kc/s respectively, while on long waves it is possible to receive the Deutschland-sender quite satisfactorily with both

Radio - Paris and Droitwich working.

The automatic volume control works exceptionally well and in London there is only a barely perceptible reduction of volume as the set is tuned in succession to the London, Midland and North Regional transmitters.

Special precautions have been taken to reduce background noise between stations and for this reason the high sensitivity of the set is not apparent until a station is encountered when searching round the dial. A slight time lag was noticed in the action of the automatic volume control and noise suppression circuits when atmospherics were encountered between stations, but this effect is absent when the set is tuned to any station of programme value.

It is interesting to note that the ganged tuning condenser has only two sections, one of which is used to tune the aerial and the other the aerial circuit. The possibility of second channel interference on the medium waveband, in view of the fact that only a single tuned circuit precedes the frequency-changer, is offset by the use of a balanced filter circuit in the aerial and the adoption of an intermediate frequency of about 410 kc/s.



Complete circuit diagram. A triode noise suppression valve is utilised as an LF amplifier for gramophone reproduction.

McMichael Twin Speaker Superhet.—

The greater part of the overall selectivity of the set is provided by the IF stages, of which there are two. The valves used are of the variable-mu pentode type, and the three double-tuned IF coupling transformers are of the dust-

speech coils are connected in parallel and hum-bucking coils are fitted to both units.

The chassis is conveniently arranged for servicing and may be lifted complete with loud speakers from the cabinet. The loud speakers are mounted in a metal sub-chassis which also carries the power

reply generally is "Yes, but only enough to identify it." He, I believe, would infinitely prefer a barely audible murmur from Timbuctoo to the most ravishing concert from, say, Radio-Paris. My preference is for those programmes which come through comparatively clearly and have good entertainment value.

On Thursday, November 8th, Prague, which I find rather a variable station and subject to fading, was coming in well and I listened with much pleasure to some chamber music by Schubert played by the Ondricek Octet. A symphony concert from Brussels No. 2 was the next programme to attract me, and I heard a good performance of Gilson's Overture to "Richard III" and Haydn's 'cello concerto in E. Thence to Radio-Paris for the National Orchestra and soloists in Fauré's opera "Penelope," but, not knowing the plot, I was unable to follow it with much interest, so turned to Kalundborg for Berlioz' "Damnation of Faust," performed by the Station Choir and Symphony Orchestra. Then farther east to Warsaw, where the Bodenski Dance Orchestra afforded a pleasing contrast.

On Friday I turned first to Sottens to hear the Radio Suisse Romande Orchestra conducted by Ansermet, and was rewarded with a good performance of Beethoven's violin concerto, in which the solo part was played by Adolph Busch.

A Danish Difficulty

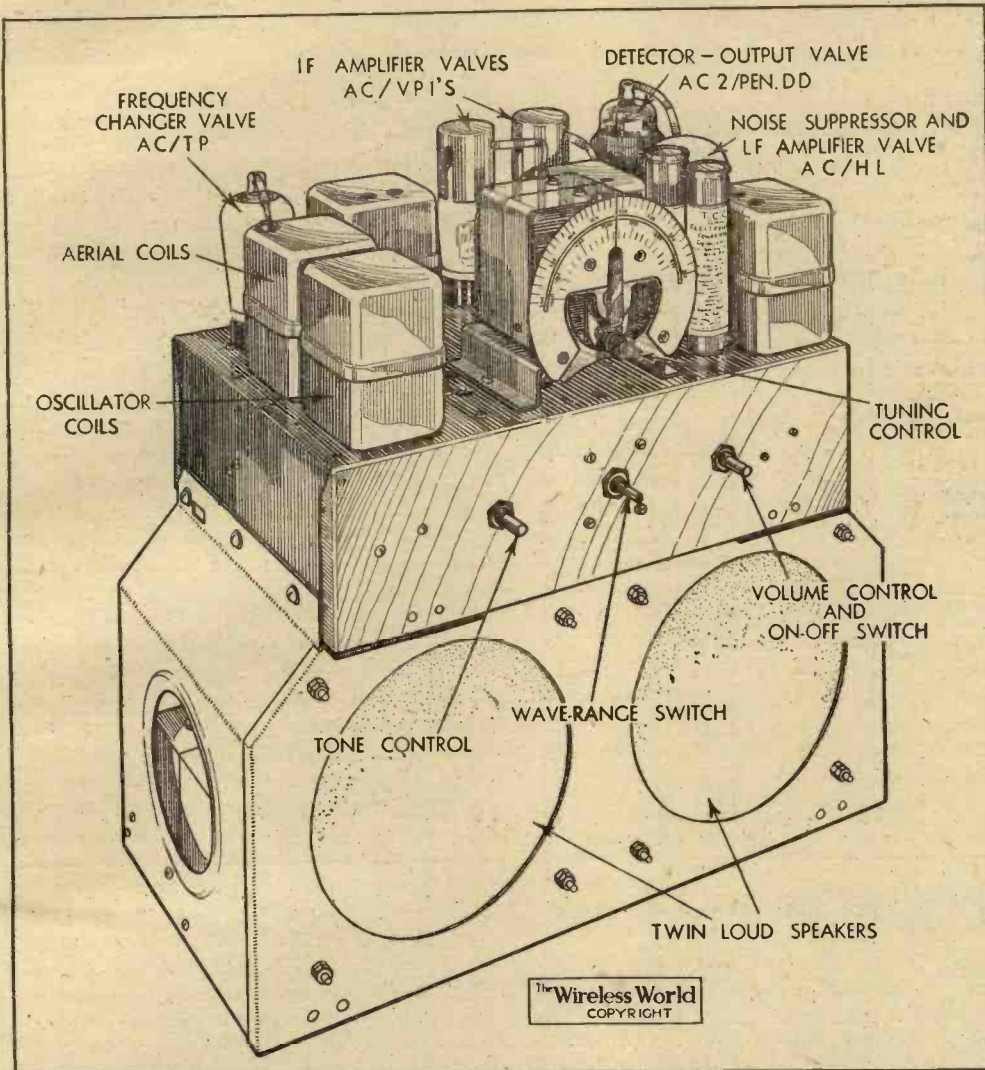
The Armistice Day Celebrations at the Albert Hall naturally engaged most of my attention on Sunday evening, but I was able to hear a part of the Handel concert from Sottens in commemoration of the 175th anniversary of the great composer's death. However, the station was not coming through at its best, so I could not get really satisfactory reception of the Sonata in B flat for violin and string orchestra.

On Monday I turned first to Kalundborg and Copenhagen for Act II of "La Tosca," and, this evening, I certainly found reception from Kalundborg better than from Copenhagen. I suppose the vagaries of the Heavieside Layer are responsible for the fact that sometimes the medium-wave station is far clearer than Kalundborg, and at other times Copenhagen is unsatisfactory while Kalundborg comes in strongly.

From Denmark I journeyed to Frankfurt for Russian music by the Station Orchestra, and heard the concluding movements of Glazounov's Pianoforte Concerto in F Minor and the stirring and vigorous Polovtsian Dances from Borodin's "Prince Igor." The French Post Office stations were giving a variety concert, and, from Bordeaux Lafayette, I heard an unusual quartet for four bagpipes—of the Continental type—played by the Huard Orchestra, the effect being quite pleasing. At Strasbourg I came in for a 'cello and pianoforte recital relayed from the Salle Braun, Metz, and listened with interest to Haydn's Sonata in C before going over to Berlin for Von Dittendorf's Sonata in E flat for viola and pianoforte, played by August Erherdt and Wolfgang Brugger. This composition seemed to me more like variations on a given theme than an ordinary sonata.

On Tuesday I did not sit down to my receiver until rather late in the evening. I switched over to Kalundborg for a concert of Eighteenth Century Chamber Music, and my ears were gladdened with Handel's Sonata in C Minor for flute, violin and harpsichord.

CALIBAN.



The receiver chassis is mounted on a sheet-metal framework carrying the twin loud speakers. The top chassis is readily removable for inspection.

cored type. A double-diode-pentode combines the function of second detector and output valve, while a separate triode is used both for inter-station noise suppression and as an initial amplifier when reproducing gramophone records. The function of this valve as a noise suppressor is to bias back the detector diode in the absence of a signal. The bias conditions are automatically changed when the specially designed pick-up jack is inserted.

Provision is made for the addition of an external loud speaker which is connected to a two-pin plug. By pushing this plug fully home the internal loud speaker is disconnected. It is important, therefore, to see that the external loud speaker connections are properly made before inserting this plug, otherwise the output valve may be damaged. The HT supply is derived from a Westinghouse rectifier and is smoothed by one of the loud speaker fields, the other being connected in parallel with the HT supply. The

supply equipment. The anodes of the IF amplifying valves are screened by neat aluminium caps and a heat-deflecting cowl attached to the removable back is mounted over the output valve.

The design and workmanship throughout are sound and every detail is in keeping with the McMichael reputation for high-grade products.

The Diary of an Ordinary Listener

LOOKING back through my recent notes I find that a certain limited number of stations seem to come in for most frequent mention, and perhaps I may be allowed a brief explanation of this fact. I have a neighbour, an enthusiastic long-distance man, who often asks if I have not heard such-and-such a station, to which my

SHORT-WAVE STATIONS OF THE WORLD

(N.B.—Times of Transmission given in parentheses are approximate only and represent G.M.T.)

Metres.	kc/s.	Call Sign.	Station.	Tuning Positions.	Metres.	kc/s.	Call Sign.	Station.	Tuning Positions.
58.31	5,145	OK1MPT	Prague (Czechoslovakia). (Experimental)		31.38	9,560	DJA	Zeesen (Germany). (Daily 11.45 and 22.00)	
50.26	5,969	HVJ	Vatican City (Daily 19.00, Sun. 10.00 also)		31.35	9,570	W1XAZ	Springfield, Mass. (U.S.A.). (Relays WBZ.) (Daily 11.00, Sun. 13.00.)	
50.0	6,000	RW59	Moscow (U.S.S.R.) (Relays No. 1 Stn.) (Daily 21.00)		31.32	9,580	GSC	Empire Broadcasting	
50.0	6,000	EAJ25	Barcelona (Radio Club) (Spain). (Daily 20.30.)		31.28	9,590	W3XAU	Philadelphia, Pa. (U.S.A.). (Relays WCAU.) (Daily 16.00.)	
49.83	6,020	DJC	Zeesen (Germany). (Daily 17.30 and 23.45)		31.28	9,590	VK2ME	Sydney (Australia). (06.00, 10.00 and 14.30.)	
49.67	6,040	W1XAL	Boston, Mass. (U.S.A.) (Daily ex Sun. 21.45, Sun. 00.00)		31.27	9,595	HBL	Radio Nations, Prangins (Switzerland). (Sat. 22.30.)	
49.67	6,040	W4XB	Miami Beach, Florida (U.S.A.) (Daily 12.00.)		31.25	9,600	CT1AA	Lisbon (Portugal). (Tues. and Fri. 20.30.)	
49.59	6,050	GSA	Empire Broadcasting		30.43	9,860	EAQ	Madrid (Spain). (Daily 22.30, Sat. 18.00 also.)	
49.5	6,060	W3XAU	Philadelphia, Pa. (U.S.A.). (Relays WCAU.) (Daily 00.00.)		28.98	10,350	LSX	Buenos Aires (Argentina). (Daily 20.00)	
49.5	6,060	VQ7LO	Nairobi (Kenya Colony). (Daily ex Tues. and Thurs. 16.00, Tues. 08.00, Thurs. 13.00.)		26.83	11,181	CT3AQ	Funchal (Madeira). (Sun. 15.30, Tues. and Thurs. 22.00.)	
49.5	6,060	OXY	Skamlebaek (Denmark). (Relays Katundborg.) (Daily 19.00.)		25.63	11,705	FYA	Paris, Radio Coloniale (France). (Colonial Stn. E-W. Daily 02.00, 19.00 and 22.15.)	
49.43	6,069	VE9CS	Vancouver, B.C. (Canada). (Sun. 16.00, Sat. 04.30.)		25.6	11,715	VE9JR	Winnipeg (Canada). (Daily 00.00)	
49.34	6,080	W9XAA	Chicago, Ill. (U.S.A.). (Relays WCLF.) (Daily ex Sun. 19.00, Sun. 15.30.)		25.57	11,730	PHI	Eindhoven (Holland). (Temporarily suspended.)	
49.22	6,095	VE9GW	Bowmanville, Ont. (Canada). (Sun. 16.00, Mon., Tues., Wed. and Thurs. 18.00, Fri. and Sat. 12.00.)		25.53	11,750	GSD	Empire Broadcasting	
49.18	6,100	W8XAL	Bound Brook, N.Y. (U.S.A.) (Relays WJZ.) (Mon., Wed. and Sat. 21.00.)		25.51	11,760	DJD	Zeesen (Germany). (Daily 01.45, 17.30, 22.00.)	
49.18	6,100	W9XF	Chicago, Ill. (U.S.A.). (Tues., Thurs. and Fri. 21.30, Fri. and Sat. 02.30.)		25.4	11,810	2RO	Boston, Mass. (U.S.A.). (Daily ex Sun. and Sat. 22.00, Sat. 23.30.)	
49.1	6,109	VUC	Calcutta (India). (Daily ex Fri. and Sat. 15.30, Fri. 14.30, Sat. 17.45.)		25.36	11,830	W2XE	Rome (Prato Smeraldo). (Italy) (Daily 15.00 and 21.00.)	
49.02	6,120	W2XE	Wayne, N.J. (U.S.A.). (Relays WABC.) (Daily 22.00.)		25.29	11,860	GSE	Wayne, N.J. (U.S.A.). (Relays WABC.) (Daily 19.00.)	
49.0	6,122	ZTJ	Johannesburg (S. Africa). (Daily ex Sun. and Sat. 04.45, 08.30, 14.00, Sun. 13.00, 17.30, Sat. 14.00.)		25.27	11,870	W8XK	Empire Broadcasting	
48.86	6,140	W8XK	Pittsburg, Pa. (U.S.A.). (Relays KDKA.) (Daily 21.30.)		25.25	11,880	—	Pittsburg, Pa. (U.S.A.). (Relays KDKA.) (Daily 21.18.)	
48.0	6,250	HJ3ABF	Bogota (Colombia)		25.0	12,000	RNE	Paris, Radio Coloniale (France). (Colonial Stn. N-S. Daily 15.45 and 19.00.)	
48.69	6,425	W3XL	Bound Brook, N.J. (U.S.A.). (Experimental)		23.39	12,825	CNR	Moscow (U.S.S.R.) (Relays No. 2 Stn.) (Sun. 04.00, 11.00 and 15.00.)	
45.38	6,610	RW72	Moscow (U.S.S.R.) (Relays Stalin Stn.) (Mon., Wed., Fri. and Sat. 21.00.)		19.84	15,123	HVJ	Rabat (Morocco). (Sun. 11.30)	
45.0	6,667	8KR	Constantine (Algeria)		19.82	15,140	GSF	Vatican City. (Daily 10.00)	
43.0	6,976	EAR110	Madrid (Spain) (Tues. and Sat. 22.00)		19.73	15,200	DJB	Empire Broadcasting	
40.3	7,444	HBQ	Radio Nations, Prangins (Switzerland)		19.72	15,210	W8XK	Zeesen (Germany). (Daily 05.35 and 12.45)	
38.48	7,797	HBP	Radio Nations, Prangins (Switzerland). (Sun. 22.30.)		19.68	15,243	FYA	Pittsburg, Pa. (U.S.A.). (Relays KDKA.) (Daily 15.00.)	
37.33	8,935	CNR	Rabat (Morocco). (Sat. 20.00)		19.64	15,270	W2XE	Paris, Radio Coloniale (France). (Colonial Stn. E-W.) (Daily 12.00.)	
36.65	8,186	PAR3	Rio de Janeiro (Brazil). (Daily 00.00)		19.56	15,330	W2XAD	Wayne, N.J. (U.S.A.). (Relays WABC.) (Daily 15.00.)	
31.55	9,510	VK3ME	Melbourne (Australia). (Wed. and Sat. 10.00.)		18.89	17,760	DJE	Schenectady, N.Y. (U.S.A.). (Daily 19.00)	
31.55	9,510	GSB	Empire Broadcasting		18.88	17,770	PHI	Zeesen (Germany)	
31.48	9,530	W2XAF	Schenectady, N.Y. (U.S.A.). (Relays WGY.) (Daily 23.35.)		18.87	17,780	W3XAL	Eindhoven (Holland). (Sun. and Sat. 12.00)	
					16.86	17,790	GSG	Bound Brook, N.J. (U.S.A.) (Relays WJZ.) (Daily 14.00.)	
					13.97	21,470	GSH	Empire Broadcasting	
					13.93	21,540	W8XK	Empire Broadcasting	
								Pittsburg, Pa., (U.S.A.) (Daily 12.00)	

Sound Wave Vagaries

Sound waves and their behaviour formed the subject of a demonstration by Mr. W. W. Syrett at a recent meeting of the Croydon Wireless and Physical Society. Using a stretched wire and sound box, together with blackboard diagrams, Mr. Syrett dealt with the vibration of strings

of musical instruments, explaining the setting up of fundamental notes and harmonics and also the movement of air columns as in organ pipes.—Hon. Secretary: Mr. H. T. P. Gee, 51-52, Chancery Lane, W.C.2.

CLUB NEWS

Home-made Transformers

The design of transformers and low-frequency chokes was dealt with in a recent lecture by Mr. J. C. Emerson, B.Sc., before the Golders Green and Hendon Radio Society. After discussing funda-

mental features, the lecturer gave a simple formula enabling the size of transformer stampings for a given output to be immediately determined. The construction work was carefully described.—Hon. Secretary: Mr. F. P. Hillier, 8, Denehurst Gardens, London, N.W.4.

Still Going Strong

A striking tribute to the way in which the affairs of the Croydon Radio Society have been managed during the past year was the unanimous re-election of President, Vice-President, Hon. Treasurer and Hon. Secretary to their respective offices at the annual general meeting. The Society has just celebrated its 10th anniversary with a decided increase in membership.—Hon. Secretary: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

Mixing Tea by Photo-cell

The many uses to which the photoelectric cell is put were interestingly dealt with by Mr. W. G. Stockton, of the General Electric Co., at a recent meeting of Slade Radio (Birmingham). The lecturer described, with the aid of lantern slides, how the cell is used for timing horse races, counting papers, tyres and steel tubes, in the control of town lighting, the operation of burglar alarms, and even in the mixing of tea.—Hon. Secretary: 110, Hillaries Road, Gravelly Hill, Birmingham.



A TYPICAL GATHERING of the London Chapter of the International Short Wave Club, which meets regularly at the RACS Hall, Wandsworth Road, S.W.8.

It is a gratifying fact that the only correspondence commenting on our advertising which we have had so far has been from W.B. "Stentorian" users who accuse us of understating our case.

As production has never quite caught up public demand, we are not unduly disturbed about that; and in this advertisement we shall content ourselves with reiterating our claims and inviting the reader to test them for himself:—

The exclusive magnetic material (prov. pat.) used in W.B. Stentorians provides nearly double the flux of any other at similar cost. Therefore sensitivity and range of reproduction are superior to those obtainable in any other way.

The new "Whiteley" speech coil brings crisper attack and better bass response. It has enabled us to place the bass resonance lower in the scale and obtain a more natural and colourful reproduction of low notes. Top response is adequate up to broadcasting limits.

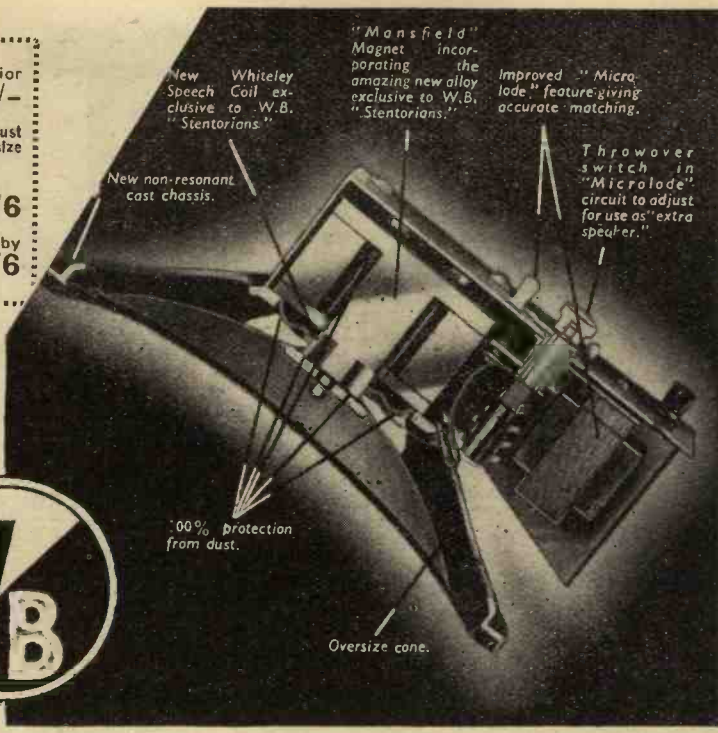
The improved "Microloade" device, giving accurate matching and also enabling the "Stentorian" to be used without alteration. As a low-impedance "extension" if desired brings better "balance" of reproduction (See "Wireless World," 9/11/34).

Many thousands of "Stentorians" are now being used in the homes of radio enthusiasts, and nine dealers out of ten stock them. We invite you to test one for yourself.

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Write for the New W.B. Stentorian leaflet.

- Stentorian Senior (PMS1) as illustrated **42/-**
- (100 per cent. dust protection. Oversize cone)
- Stentorian Standard (PMS2) - **32/6**
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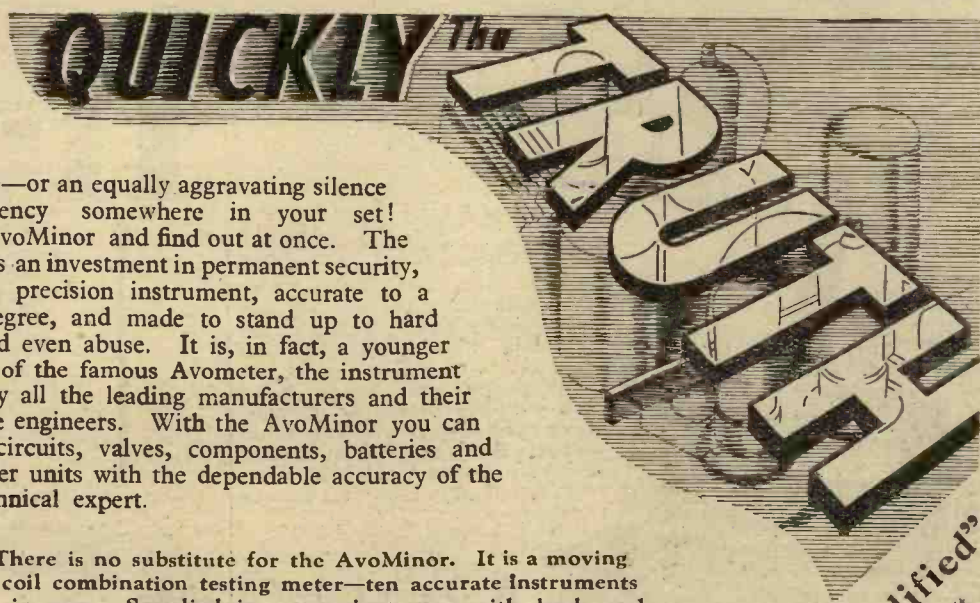
STENTORIAN

PERMANENT MAGNET MOVING-COIL SPEAKERS

Whiteley Electrical Radio Co., Ltd. (Dept. W), Radio Works, Mansfield, Notts.

Sole Agents in Scotland: Radiovision Ltd., 233, St Vincent Street, Glasgow, C.2.

Sole Agents in I.F.S.: Kelly and Shiel, Ltd., 47, Fleet Street, Dublin.



A sudden noise—or an equally aggravating silence . . . inefficiency somewhere in your set! Take your AvoMinor and find out at once. The AvoMinor is an investment in permanent security, for it is a precision instrument, accurate to a critical degree, and made to stand up to hard usage and even abuse. It is, in fact, a younger brother of the famous Avometer, the instrument used by all the leading manufacturers and their service engineers. With the AvoMinor you can test circuits, valves, components, batteries and power units with the dependable accuracy of the technical expert.

There is no substitute for the AvoMinor. It is a moving coil combination testing meter—ten accurate instruments in one. Supplied in convenient case with leads and interchangeable testing prods and crocodile clips, and complete instruction booklet adequately illustrated.

Fully descriptive Folder post free from:—

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD., Winder House, Douglas Street, London, S.W.1.
Telephone: Vic. 3404/7.

TEN ACCURATE METERS IN ONE

CURRENT	VOLTAGE
● 0-6 milliamps	● 0-6 volts
● 0-30 "	● 0-120 volts
● 0-120 "	● 0-300 "

RESISTANCE

● 0-10,000 ohms	● 0-60,000 ohms
● 0-1,200,000 "	● 0-3 megohms

40/-

Size 4" x 3" x 1 1/2".
Total Resistance: 100,000 ohms.
Full scale deflection on 3 milliamps.

Deferred Terms if desired.

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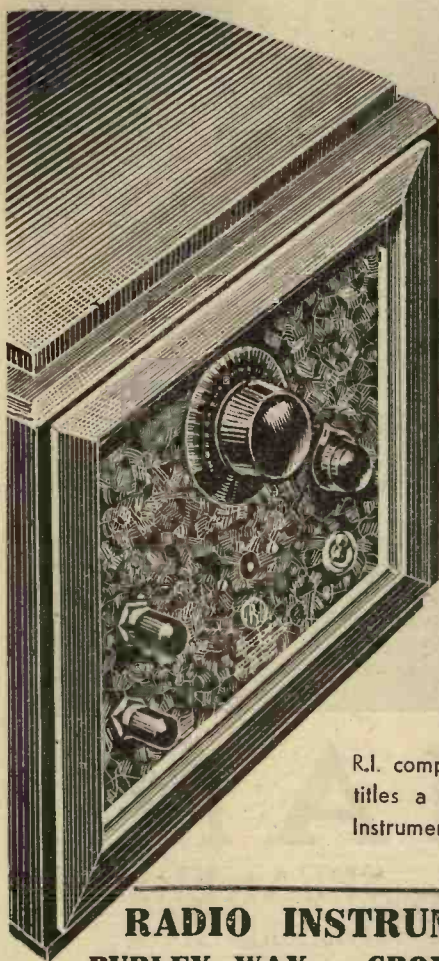
TELLS THE WHOLE TRUTH

"Radio Servicing Simplified"

Everyone should have this invaluable book. It explains every phase of fault-tracing step by step in non-technical language. The comprehensive information and numerous diagrams make testing a matter of straightforward procedure.

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Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.



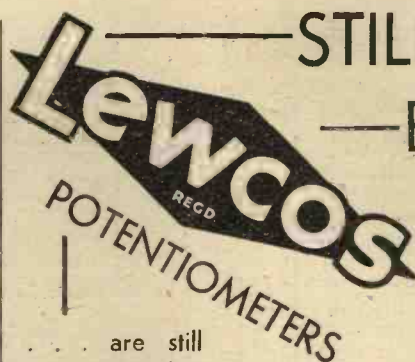
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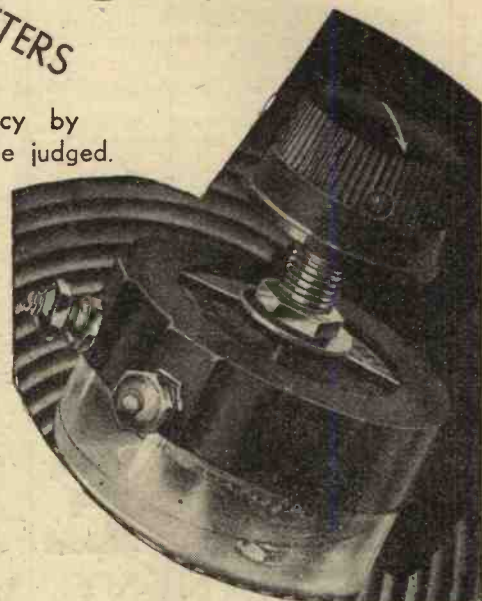
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2,000 to 50,000 ohms (graded)	- 3/6
100,000 to 250,000 ohms	- 4/6
100,000 to 200,000 ohms (graded)	- 5/-
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The LONDON ELECTRIC WIRE COMPANY AND SMITHS, Limited
Church Road - - - - Leyton - - - - London, E.10

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**AND HAVE THE BEST
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In these days the ordinary radio-gram quickly becomes obsolete. The Apollo bureau playing desk is always up to date. Plus a good set it costs about £3 less than a radiogram, and it has storage for 80 records, scoring in convenience as well as economy. It is a beautiful job in finely polished walnut. With latest silent running Garrard induction motor and Goldring weight-adjusted pick-up as standard.



**APOLLO
BUREAU
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DESK £5.19.6**

Any other motor or pick-up fitted by arrangement. Cabinet only, £2-10-0. Complete, 12 monthly payments of 11/-. Order direct or through dealer or write for further details.

BAXTER STAVRIDI & CRAIGS Ltd

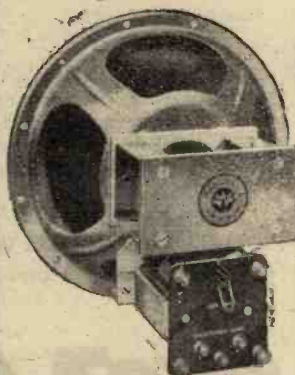
Perseverance Works, Commercial Road, Edmonton, N.18.

If-

- You like to have clear and incisive reproduction of speech—
- If you like to hear the "edge" of violin tone—
- If you like to hear the "ring" of the piano—
- If you want both the drums and the cymbals in orchestral music—

YOU MUST HEAR A

Wharfedale
MOVING COIL
SPEAKER



BRONZE or GOLDEN
and—what is more—buy one

CHASSIS

Bronze - 42/6 Golden - 58/6

CABINETS (with Volume Control)

Bronzian - 65/6 De Luxe - 92/6

Send for complete catalogue.

WHARFEDALE WIRELESS WORKS,
62, LEEDS ROAD, BRADFORD, YORKS.

MISCELLANEOUS ADVERTISEMENTS

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All letters relating to advertisements should quote the number which is printed at the end of each advertisement and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

"COMMERCIAL"

One of our customers told us, the other day that he was talking to a dealer who said that "Hartley-Turner sets are all right, but they aren't commercial." That is a very curious statement to make, and we feel constrained to ask "why not?"

We make a reasonable profit on our apparatus and we sell a lot of it, so we are satisfied. The prices of our sets show a close relation to the sum of the prices of the component parts and, almost alone among manufacturers, we do not charge an exorbitant premium because a man wants a radio-gramophone. We publish literature and price lists in which the cost of our apparatus is given as clearly as the technical performance is given, and a man can buy our apparatus without there being any suggestion of pigs in pokes. Wherein, then, are they uncommercial?

Can it be that they don't sound like "commercial sets"? If a "commercial set" is one which has been designed to give the maximum number of stations for the expenditure of a minimum number of pounds, then ours are certainly not commercial. If, on the other hand, a "commercial set" is one which gives the maximum amount of pleasure at the lowest possible cost, then they are very commercial indeed.

We do not believe it possible to get the degree of realism of reproduction characterising Hartley-Turner Radio at lower cost, but it is quite possible, and, in fact, easy to pay more than we ask and still not get quality as good as Hartley-Turner.

A further point: Hartley-Turner sets will get as many stations as other sets with equal number of valve stages. The difference is that Hartley-Turner reproduction of a good transmission is so outstanding that our customers simply don't bother about knob twiddling.

Illustrated literature free on request.

We have two good jobs for the right men. See "Situations Vacant."

HARTLEY TURNER RADIO LTD.,

Thornbury Road, Isleworth, Middlesex.

Telephone: HOUnslow 4488.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."

DEPOSIT SYSTEM.

Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Stamford Street, London, S.E.1, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post. When sending remittances direct to an advertiser, stamp for return should also be included for use in the event of the application proving unsuccessful.

Receivers and Amplifiers, Etc.—Contd.

FERRANTI "Arcadia Magna" Superhet, 3 months old, perfect; cost 20 guineas, bargain, 10 guineas.—Walker, 74x, 8th Avenue, Llay, Wrexham. [6976]

SHOP Soiled Battery Receivers for Sale, all types; free demonstrations and exceptionally low prices.—Call, Basement, 141, Victoria St., Westminster. [7017]

LISSEN Sky Scraper 7-valve Chassis, complete with valves, perfect condition, wonderful sensitivity; 65/- for quick sale, no offers.—Box 2251, d/o *The Wireless World*. [7033]

EMERSON and **CROSLY** 1935 Midgets, car radio, and all American valves, send for wholesale catalogue, importer.—Royal, 5, Buckingham Rd., South Woodford, London, E.18. [6890]

1935 Models 4-valve Superhet. Midgets, A.C. or D.C., M.C. speaker, £3/19/6; 5 valves, £4/19/6; car radio, £7/15, including valves.—Lovell Bros., 11, Avon Rd., Walthamstow, London, E.17. [6891]

POWER Amplifier, 100-watt, complete with 4 P.P.5/400, 1 M.H.4, 2 G.U.1 valves, 2 pick-ups, twin turntables and ladders, 4 Magnavox Magna speakers, Phillips microphone, etc.; £55, or offer, worth £150.—Banfield, Fore St., Newquay. [6986]

DEGALLIER'S Offer Few Brand New Receivers, every one guaranteed, S.A.E., all enquiries, all complete in walnut cabinet, moving coil speaker, valves (all replacements at any time, 7/6 each), pick-up terminals, A.V.C., illuminated dials other than in Emerson.

EMERSON 5 Valve Superhet. Midget, 10 1/2 x 7 x 5 1/2, A.C./D.C. 100-250v., 200-550 and 1,000-2,000 meters, £4/6/3 (approx. 35 stations).

THE Following all R.C.A. Victor (H.M.V. in America).

5 Valve Superhet. A.C./D.C. 100-250 Midget (10 1/2 x 7 x 5 1/2), tone control, 200-550 and 1,000-2,000 meters, can also be used on batteries with adaptor included; £6/5 (approx. 55 stations).

6 Valve Superhet. A.C./D.C. Midget, 11 1/2 x 7 x 5 1/2, as in 5 valve but more sensitive; at £7 (approx. 70 stations).

6 Valve 200-250 A.C./D.C., 13-2,000 meters, in three wave bands, delayed A.V.C., a periodic H.F. stage, 2 I.F. pentodes, heptode frequency changer, double diode triode Midget, 12 x 8 1/2 x 6; at £7/10 (approx. 75 stations).

5 Valve 7 stage Superhet, 190-550 and 1,000-2,000 meters, airplane dial, H.F. pentode, double diode triode, 8in. speaker cabinet (14 x 16 x 9 1/2), 3 watts undistorted output, Universal model A.C./D.C. 200-250, £6/12/6; A.C. model, £6/15 (approx. 75 stations).

6 Valve, 8 stage, 13-2,000 meters in three wave bands (see 6 valve 13-2,000 at £7/10), for valve specification, etc., airplane dials, 8in. speaker, 3 watts undistorted, cabinet 19 x 16 x 10 1/2, Universal A.C./D.C. 200-250v., £9/5; A.C. model, £9/10 (approx. 85 stations) sensitivity 1 microvolt absolute.

DE Luxe Model 6 Valve, 8 stage, world's first double intermediate superhet., by the revolutionary system, maximum efficiency over whole wave band coverage, 12-2,000 meters, in four wave bands, extra large airplane dials, valve and other data as in £9/5 model, 3 1/2 watts undistorted output, cabinet (21 x 11 1/2 x 17), sensitivity better than 1/2 microvolt absolute, in A.C. 200-250v.; only £16.

DEGALLIER'S, 6, Coryton House, 21, Upper Marylebone Street, London, W.1. Museum 7795. Nearest stations, Oxford Circus, Goadge Street and Great Portland Street. [6996]

Set Manufacturers' Surplus, Clearance and Bankrupt Stocks offered in any of these columns may not be Manufacturers' current lines. Radio components advertised at below the list price do not carry any manufacturer's guarantee.

RECEIVERS AND AMPLIFIERS, ETC.

ULTRA 6-stage A.C. Superhet. 1935 Model 22, list £12/12, clock face tuning; £8.

KOLSTER-BRANDEN 4-valve A.C. Superhet., list £12/12, perfect condition; £7/7.

CENTURY 7-valve Superhet. Car Radio, listed £14/14, as new, complete; £7/7.

FOX 4-valve A.C. Superhet., listed £13/13, complete, as new; £7.-58 Flat, Mantell St., N.1. [7043]

FIRST S.S. Complete, Osram valves, Celestion speaker; £9.-5, Westminster Rd., Leicester. [7011]

SEVERAL A.C. Wireless Sets, complete; from £2; taken for debt.—After 7 p.m., "Oakdene," Caunden Rd., Carshalton. [7042]

MICHAEL Superhet Mains, transportable, recently cost 16 guineas; accept £8; perfect condition.—Box 2243, c/o *The Wireless World*. [6983]

OUR Kit of Parts for "Wireless World" Quality Amplifier, complete in every detail, including valves; amplifier only, £8/10; feeder unit, 36/-.

OUR Kit of Parts for "Wireless World" Olympic S.S. Six, complete in every detail, including valves and loud-speaker; £14/10.

OUR Kit of Parts for "Wireless World" Standard A.C.3, complete with valves and speaker; £11/10.

SEND for Detailed List of Components for Either of the Above Kits; carriage paid, cash with order.

WARD, 45, Farringdon St., London, E.C.4. Phone: Holborn 9703. [6907]

ARMSTRONG Latest Luxury Radiogram Battery Chassis, Class "B"; full bandpass, Litz wound coils, 3 tuned circuits, chassis incorporates 2 Mullard H.F. Pentodes and Mullard Class "B" valves; results equal good electric receiver; £5/18/6, including valves; royalties paid.

ARMSTRONG—Latest 5v. bandpass superheterodyne chassis, with fully delayed A.V.C., 7 highly efficient tuned circuits, bandpass input, Marconi Heptode frequency changer, combined 1st detector and oscillator, bandpass I.F. coupled to Marconi H.F. pentode, bandpass coupled to Cossor Double Diode, giving distortionless detection and A.V.C., resistance coupled to Mazda high slope pentode, Marconi bi-phase rectifier, full vision illuminated tuning, calibrated in wavelengths, combined radio and gramophone volume control, corrected pentode output, giving exceptionally good reproduction; £9/18/6, with valves, royalties paid.

ARMSTRONG Universal Superheterodyne chassis works on A.C. or D.C. mains, specification as superheterodyne model above; £6/18/6, complete with valves, royalties paid.

ARMSTRONG Senior Universal A.C.-D.C. Chassis, 3 tuned circuits, full bandpass tuning, 3 1/2 watts double pentode output, massive construction, with valves; £5/18/6.

ARMSTRONG A.C.4 Chassis, incorporating 3 pentodes, 3 tuned circuits, full band-pass, 3 watts output; £5/18/6, with valves.

ALL Armstrong Chassis are Constructed of the Highest Grade Components Throughout, carry 12 months' service free guarantee, and are sent on 7 days' approval, carriage paid.

ARMSTRONG MANUFACTURING Co., 100, King's Rd., N.W.1. Phone: Gulliver 3105. [6942]

Receivers and Amplifiers, Etc.—Contd.

BARGAINS in Slightly Used D.C. Receivers, district changing to A.C. H.M.V. 436 Columbia 355, G.E.C. Nomad, Pye D.C.4D Twintriple, Columbia 310 radiogram, Ultra Tiger Superhet, Lumphon Consolette, all at £3 each—Gardners Radio, Ltd., West Southbourne, Bourne-mouth. [7012]

PUBLIC Address Amplifiers and High-quality Receivers, Amplifiers A.C. mains 21 watts, undistorted output, £15; 9 watts, £10; A.C.D.C. 9 watts, £11; 3½ watts, £9; trade supplied; deferred terms.—D. E. Clarkson, B.Sc. (Eng.), 10, Park Rd., Wallington, Surrey. Phone: Wallington 3953. [6974]

CHAL-ELECTRIC Offer (75 only) Brand new (sealed cartons) Midget Receivers, exporters' samples, all guaranteed spares and valves also made in this country, operating on D.C.-A.C. 100-250 volts, complete in every detail ready to plug in, M.C. speakers, 200-550 and 1,000-2,000 metres, delayed A.V.C. R.C.A. valves, real station getters. [6974]

TWATER-KENT 5-valve Superhet. (specification exactly as above), handsome walnut cabinet 10x5½x4½; at £4/5, carriage 1/6.

COLUMBIA Radio Corporation 5-valve Superhet, tone control (specification as above), illuminated dial, adaptable for car use with adaptor included, in massively constructed walnut cabinet 11½x8x6½; at £6/10, carriage 2/-. [6974]

STROMBERG Carlson (10 only) 6-valve Superhet. (specification as above), tone control, illuminated dial, covering 13-50, 200-550, and 1,000-2,000 metres, America guaranteed, cabinet 12x8½x6; at £7/17/6, carriage 2/3; stamp with all enquiries.

CHAL-ELECTRIC, No. 6, Conduit St., Regent St., London, W.1. [7027]

£7/7—Alba 5-valve superhet, 200-250 volt, Plessey chassis, Magnavox moving coil, complete with valves in futuristic walnut cabinet, listed £16/16, brand new, c.o.d., carriage paid; ditto radiogram for £9/9; ditto Band Pass Four, 200 to 250 volts, either A.C. or D.C. complete with valves, Magnavox speaker, in walnut cabinet, for £4/19/6.

27/6—Screen Grid Three Cresley Radio battery receiver, 2-gang Polar, metal chassis, screened coils, Ormond loud-speaker, in futuristic walnut cabinet, similar to Lotus; c.o.d., carriage forward.—Kay, 167, City Rd., London, E.C.1. [6908]

INTERFERENCE and All Unwanted Noises Definitely Cut Out by Using "Bifo" Static Cut-outs; can be fitted to any set simply and without technical knowledge; does not decrease volume; brand new and boxed, with instruction leaflet; 2/3 each (listed 12/6)—Southern Radio, 323, Euston Rd., London, N.W.1 (near Warren St. Tube), Museum 6324; and branches. See Components, Etc., column. [7043]

FIRST Consignment of Emerson 1935 "Round the World" 6-valve Superheterodyne, 19-2,000 metres, 3 separate wavebands, acclaimed by trade as the best all-wave receiver yet produced, aeroplane dial tuning, "Duo-Lite" band switching, pick-up speaker, automatic volume control, gramophone, pick-up, walnut cabinet 16½in. high, 13½in. wide.—Write for wholesale catalogue to Importer, Royal Radio Co., 5, Buckingham Rd., South Woodford, London, E.18. [7016]

SUPER Power Amplifier, designed for A.C./H.L. S.A.C./P. and D.O.60, resistance coupled throughout, Varley power transformer and 10-watt resistances, Ferranti 2,000v. condensers in power pack, Dubilier mica coupling condensers, with 2 American rectifiers only, £14; complete with all valves, £22; also Garrard induction motor, cost £5/5, for £3; B.T.H. 45/- pick-up, £1, suitable for large hall, in conjunction with R.K. Senior speaker, or similar; sent carriage paid.—Stanley Brown, Meliden Rd., Prestatyn, Flint. [7014]

SOME Cheap Sets.—Pye G.B. receivers, H.F., det., Q.P.P., moving coil, new batteries, complete, £5/15; Ekco 10gn. M.C. receiver, D.C. mains, £5; Philco 14gn. superhet. for A.C. 220-230 mains, new, £8; Portadyne 13gn. portable, new, £9; Pye O.B. portable, £8; Ekco 11gn. superhet., A.C. mains, new, £9; Marconiphone 12gn. superhet. for A.C. mains, £9; Lissen 2-valve sets, new batteries, complete, £3; less batteries and valves, 20/-; all perfect; carriage paid.—Walbro Cycle and Motor Co., Wireless Dept., Salford Walden. Phone: 45. [7028]

5-VALVE Superhet Chassis (7-stage), complete, wired, ready to switch on, speaker the only extra required, 9 kc. separation, A.V.C., all components by world-famous British manufacturers—Polar, T.C.C., Wearite, etc., B.R.V.M.A. valves, 12 months' guarantee, ideal for fitting to existing cabinet, bookcase, grandfather clock case, and other attractive housings; A.C. model £6/18/6, universal model £7/7 carriage paid; 7 days' approval; deferred terms if required; fullest particulars on request.—Westminster Chassis Co., Ltd., 4 Westminster Palace Gardens, London, S.W.1. [6981]

MAINS EQUIPMENT.

TANTALUM for A.C. Chargers, H.T. and L.T.—Blackwell's Metallurgical Works, Ltd., Garston, Liverpool. [6470]

BATTERY Chargers.—The "N.P." (late Nash Products) is still the best charging plant for all purposes; trade list.

BATTERY Chargers.—"N.P." chargers from 52/- to £17, complete ready for use; lists.

BATTERY Chargers.—"N.P." give 12 months' guarantee on all instruments; state your exact requirements.

BATTERY Chargers.—"N.P." allow free trial.—N.P. Electrical Co., 514, Alum Rock Rd., Birmingham. [6980]

100 m.a. Ferranti A.C. 240 volts Eliminator, perfect condition throughout; cost £13, £2 for quick sale, no offers.—Box 2250, c/o The Wireless World. [7032]

14/11—Battery chargers, 1 amp., 2-6v., incorporating Westinghouse L.T.4 rectifier, ½ amp., 11/9; 7 days' cash approval; postage 9d.; list free.—Arden Agency, Wollaston, Wellingborough. [6881]

LESDIX Chargers, all steel, A.C. and D.C. mains, 2 to 200 cells at low prices; state requirements; dynamos and rotaries in stock, all sizes; battery supersiders for 2-volt input, 80-volt output, 37/6; fractional H.P. and sewing machine motors, 25/-.—Below.

LESDIX Measuring Instruments, 2½in. bakelite case, flush panel, any reading, A.C. or D.C.; from 6/- each; ask for full range instrument list.—Below.

LESDIX Microphone.—We are makers of 25 types for all uses; Home Radio mikes, solid bakelite body, 5/6; G.P.O. microphones, on stand, with mouthpiece, 7/6; P.A. mikes, 50/-; list free.—Electradix Radios, 218, Upper Thames St., London, E.C.4. [0398]



What are you to believe?

IT'S STRANGE, isn't it, that if somebody introduces themselves to you as being very honest, you immediately wonder why they mentioned it, and a shadow of doubt in your mind seems to indicate that they are not all that they should be.

NOW, EVERY advertisement (including our own) in this or any other paper, claims to be a statement of truth without exaggeration and nothing but the truth. Therefore, what are you to believe? This is especially applicable to Amplifiers. The advertisement indicates that you judge by the claims made therein—in other words, by YOUR EYES; yet an Amplifier, more than anything else, is something that should be JUDGED BY EAR. IT CAN BE NO BETTER THAN IT SOUNDS.

TO CONSOLIDATE our slogan "BETTER THAN THE ADVERTISEMENT," we are demonstrating the SOUND SALES "WIRELESS WORLD" 4/12 watt QUALITY AMPLIFIER at our factory. We appreciate you have not the advantage of a West End Showroom, and that it probably takes 15 minutes to get to our factory by Train. Tram or Bus—Highgate Underground being the quickest and most direct method; but surely you would rather have a demonstration, together with any technical advice you may require, under normal household conditions in an ordinary room. At the same time, we would emphasise the fact that perfectly standard equipment is used, and you can buy the demonstration outfit as it stands.

SOUND SALES LTD., Contractors to the G.P.O., etc. TREMLETT GROVE, JUNCTION ROAD, LONDON, N.19. Telephone: Archway 1661.

EVERY TEST A.C. CURRENT & VOLTAGE & D.C. CURRENT, VOLTAGE & RESISTANCE WITH ONE INSTRUMENT No External Shunts or Multipliers

The Avometer is the world's most widely used combination measuring instrument. It holds pride of place, not only for its compact convenience, but also for its precision, which is used as a standard by which other instruments are judged. The prices of "AVO" instruments are the lowest at which it is possible to produce meters of such dependable accuracy. BRITISH MADE 12 Gns. Deferred Terms if desired.



THE 36 RANGE UNIVERSAL AVOMETER THE MASTER SERVICING INSTRUMENT 13-range D.C. Avometer 8 Gns. Write for descriptive Folder:—The Automatic Coil Winder & Electrical Equipment Co., Ltd. Winder House, Douglas St., London, S.W.1. Telephone: Victoria 3404-7.

Mains Equipment.—Contd.

V. VORTEXION Specified.

STANDARD A.C.3 Transformer, polished die cast, shrouding guaranteed 5 years; £1; chassis 6/-, choke to match, 12/3; see also displayed advertisement on page 9, November 9th.

STANDARD A.C.2 Transformer, 18/-; choke to match, 10/6; 5 years' guarantee.

VORTEXION Specified Olympic S.S. 6 Transformer. S.S.352, 5 years' guarantee, 25/-; less terminals and guarantee, 21/-; power chassis, £3/17/6; choke, 12/6; Single Span model, 25/-; power chassis, £3/10.

VORTEXION—Quality Amplifier or Super Monodial. 425-0-425, 120 m.a., 4v. 6-8a. C.T., 4v. 3a. C.T. 4v. 1a., 4v. 1a., super shrouded, core size 2½in.x1½in., 2½% regulation primary engraved insulated terminals, weight 14lb., 26/-, carriage 2/-; normal shrouded, 22/-; open type, 20/-, post 1/3; speaker field replacement choke, 16/-; special output transformer to "W.W." specification, 12/6, post 9d.; state valve and speaker; "W.W." universal output transformer, £1; normal 40h. 50 m.a. primary output transformers, 10/6, post 9d.

VORTEXION 7.30h 120 m.a. Choke, 215 ohms, in die cast shrouding to match; 12/6.

LIMITATED, but unequalled. Good enough for a "Wireless World" specification is good enough for you.

VORTEXION Cost Little More than the Cheapest, but unequalled by the dearest.

VORTEXION A.C./34, used by author in construction of A.V.C. Three, as illustrated; 18/-.

GUARANTEED 12 Months, and within 5% normal and 2½% super models, neat shrouding, with detachable feet, as used by Government Departments, etc., etc., any model guaranteed 5 years at extra cost of 2/-.

ALL Secondaries Centre Tapped.

VORTEXION.—250-0-250 60 m.a., 4v. 1 to 2a., 4v. 2 to 4a., open type, 10/-; shrouded, 12/6, post 9d.

VORTEXION.—Ferrocart III 350-0-350, 60 m.a., 4v. 2.5 C.T., 4v. 3.5 C.T.; open type 13/6, shrouded 16/-; post 9d.

VORTEXION.—Super model for H.T.8 or 9 or 10, 4v. 1 to 2, 4v. 2 to 4, open type 14/6, shrouded 16/6; post 1/-.

VORTEXION.—350-0-350, 120 m.a., 4v. 2 to 5a., 4v. 2 to 4a., 4v. 2.5a.; open type 14/6, shrouded 16/6; super shrouded model, weight 11lb., 4 filaments to specification, 21/-; post 1/3.

VORTEXION.—400 or 450 or 500v., 120 m.a., 4v. 2 to 5, 4v. 2 to 5, 4v. 2.5a.; open type 19/-, shrouded 23/-.

VORTEXION.—400 or 450 or 500, 150 m.a., 4v. 4a., 4v. 2.5, 4v. 2, 4v. 2, 4v. 2, core size 2½x1½in., a super job 2% regulation 35/-, shrouded, with terminals; less terminals, 30/-; open type, 26/-; post 1/3.

VORTEXION Auto Transformers to B.E.S.A. Specification, 100, 110, or 120v. to 200, 220, or 240 volts, 60 watts, 9/-; post 9d.; 120 watts, shrouded 12/6, open type 10/6, post 1/-; 200 watts, shrouded 16/6, post 1/-; 2,000 watts, £4/10.

VORTEXION 1,000-watt Transformers; £4/10, carriage free.

VORTEXION 30h at 60 m.a., Chokes, 5/6; 40h. at 60 m.a., 8/6; 30h. at 150 m.a., 200 ohms, 10/6 open type, 12/6 shrouded.

VORTEXION Transformers Made to Your Specification; price according to wattage, 6v. filaments same price unless wattage grossly exceeded; special quotations by return.

VORTEXION (S. A. BROWN), 182, The Broadway, Wimbledon, S.W.19. Tel.: Liberty 2814. [6954]

HOYNE'S Transformers are Manufactured by Engineers with 14 Years' Experience in Radio Transformer design.

HOYNE'S Transformers, fitted with tapped and screened primaries, filaments, all centre tapped, stout cast aluminium clamps and clearly marked terminal strips are fitted to all models; write for list.

HOYNE'S Components are Guaranteed for One Year; one type only manufactured, the best, as used by many well-known set manufacturers after testing all others.

HOYNE'S—"W.W." transformers wound strictly to specification of author: "W.W." test reports, June 22nd. "The insulation is particularly good throughout... the transformer is satisfactory in all respects."

HOYNE'S.—Push-pull quality amplifier transformer, 25/-, post 1/3; 7/30 henrys choke, 9/6, post 9d.; 20 henrys, 7/6, post 9d.

HOYNE'S.—Single span, 15/-, post 1/-; choke, 10 henrys, 7/6, post 9d.

HOYNE'S.—Everyman A.C. super transformer, 12/6, post 1/-; choke, 10 henrys, 7/6, post 9d.

HOYNE'S.—A.V.C. Straight Four transformer, 18/-, post 1/3; choke, 26 henrys, 12 m.a., 140 ohms, 9/6, post 9d.

HOYNE'S.—Push-pull quality amplifier, complete to "W.W." specifications, wired and fully tested, less valves, £5/12/6; complete kit of components, including metal chassis, £5/2/6; field replacement choke, 1,250 ohms, 13/6, post 1/-; output transformer, 12/6, post 1/-.

HOYNE'S.—250-0-250v. 60 m.a., 4v. 1 to 2a., 4v. 2 to 4a., 10/-, post 9d.; with extra 4v. 1 to 2a. winding, 12/6, post 1/-.

HOYNE'S.—Ferrocart III, 350-0-350v., 60-70 m.a., 4v. 2 to 3a., 4v. 2 to 4a., 12/6, post 1/-; with extra 4v. 1 to 2a. winding, 13/6, post 1/-.

HOYNE'S.—350-0-350v., 120 m.a., 4v. 2 to 3a., 4v. 4 to 6a., 4v. 1a., 4v. 1a., 18/-, post 1/3.

HOYNE'S.—400 or 450 or 500v., 120 m.a., 4v. 2 to 3a., 4v. 2 to 5a., 4v. 1 to 2a., 18/-, post 1/3.

HOYNE'S.—500-450-0-450-500v. 140 m.a., 4v. 2 to 4a., 4v. 4 to 6a., 4v. 2a., 4v. 2a., 27/6, post 1/3; weight 11lb.

HOYNE'S Transformers, built to specifications, keenest prices, best materials and workmanship; quotation by return.

M. J. HOYNE, ALL-POWER TRANSFORMER, Ltd., Offices and Works, 8a, Gladstone Rd., Wimbledon, S.W.19. Tel.: Liberty 3303. [6488]

Mains Equipment.—Contd.

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PARTRIDGE Transformers.—"Certainly above the average... very soundly constructed transformers."—*Wireless Trader*.
PARTRIDGE Transformers.—"Runs perfectly cool... sound electrical job... represents very good value."—*Wireless World*.
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PARTRIDGE Transformers.—Guaranteed 12 months, screened primaries, 200-250v., 50 cycles, all L.T.s centre tapped.
SPECIFIED by *The Wireless World* for the Standard A.C. Two:—"Partridge" transformer, 12/9; "Partridge" choke, 7/3.
PARTRIDGE Transformers.—250-0-250v., 60 m.a., 4v. 1a., 4v. 2-4a., 11/-; 350-0-350v., 60 m.a., 4v. 2-2½a., 4v. 2-4a., 13/6.
PARTRIDGE.—350-0-350v., 80 m.a., 4v. 2-2½a., 4v. 2-4a., 4v. 1a., 16/6; 350-0-350v., 120 m.a., 4v. 2-2½a., 4v. 3-5a., 4v. 1-2a., 18/6.
PARTRIDGE.—425-0-425v., 120 m.a., 4v. 2-2½a., 4v. 3-5a., 4v. 2a., 20/6; 500-0-500v., 100 m.a., 4v. 2-2½a., 4v. 3-5a., 4v. 2a., 21/-.
PARTRIDGE.—500-0-500v., 120 m.a., 4v. 2-4a., 4v. 3-6a., 4v. 1-2a., 4v. 1-2a., 27/6; larger types supplied to order.
PARTRIDGE.—0-7½-9-11v., 1-3a., 10/-; 0-15-18-22v., 1-2a., 10/-; 240v. (tapped 200v.), 200 m.a., 4v. 2-4a., 12/6.
PARTRIDGE.—Step-up or step-down auto transformers, tapped 0-100-110-200-230-250v., 60w., 10/-; 100w., 12/6.
TRANSFORMER for "W.W." Single-Span, 18/6; for "W.W." P.P. Quality Amplifier, 27/6; for "W.W." Olympic S.S. Six, 18/6; for Standard A.C. Three (specified), 13/6.
PARTRIDGE Transformers.—Wound to any specification, accuracy of output guaranteed, competitive prices, quick delivery.
OUTPUT Transformers.—"Partridge" officially recommended by Messrs. Tungram for their 21w. output valves.
OUTPUT Transformers.—Sw. to 100w. speech, no audible distortion, 32-10,000 cycles, designed for any conditions for relay of P.A. work; see "W.W." test report, Oct 19, 1934.
PARTRIDGE Chokes.—Give rated inductance at full-current; curves supplied on request.
PARTRIDGE Chokes.—140H., 60 m.a., 2,500 ohms, 13/6; 75H., 25 m.a., 1,400 ohms, 7/6; 25H., 60 m.a., 560 ohms, 7/3.
PARTRIDGE Chokes.—22H., 120 m.a., 350 ohms, 9/9; 13H., 200 m.a., 160 ohms, 12/-; 8H., 120 m.a., 225 ohms, 6/9.
PARTRIDGE Chokes.—6H., 500 m.a., 50 ohms, 19/6; 3H., 250 m.a., 70 ohms, 6/6.
All Advertised Lines Supplied from Stock
PARTRIDGE.—Trade enquiries solicited.
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PARTRIDGE, N., Kings Buildings, Dean Stanley St., London, S.W.1. Tel.: Vic. 5035. [6749]
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PARAMOUNT Ferrocart III, 350-0-350v. 75 m.a., 4v. 2-5a., 4v. 3 to 5a., open type, 12/-; shrouded, 14/-; post 9d.
PARAMOUNT Transformers Made to Your Own Specification; price according to wattage; quotations by return.
PARAMOUNT 350-0-350v. 120 m.a., 4v. 2-5a., 4v. 4a., 4v. 5a., open type, 14/-; shrouded, 15/6; post 1/-.
WE are Proud of our 5-valve Super Inductance Receiver; write for details; price £9, complete in walnut cabinet.
PARAMOUNT 490v., 450v. or 500v. 120 m.a., 4v. 2-5a., 4v. 4a., 4v. 5a., open type 17/-, shrouded 19/-, post 1/3; 150 m.a. with 2 extra filaments (not exceeding wattage), open type 22/6, shrouded 25/-, post 1/3.
PARAMOUNT Super Models.—H.T.B. 9 or 10, 4v. 1 to 2a., 4v. 2 to 4a., open type, 14/-; shrouded, 15/6; post 1/-; don't pay high prices for your mains components.
PARAMOUNT Auto Transformers, 100-120v. to 200-250v. or vice versa, 60-watt, 8/-; 120-watt, 9/6; shrouded, 1/- extra; post 9d.
PARAMOUNT Mains Chokes. 30 h. 60 m.a., 5/6; 20h. 120 m.a., 8/-; post 9d.
PARAMOUNT Guaranteed Electrolytic Condensers, 4-4 mfd., 500 peak; price 3/6; post 3d.
PARAMOUNT Mains Transformers Manufactured by R. H. Salter, 66, Hartfield Rd., Wimbledon, S.W.19. Tel.: Liberty 3226. [6929]
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R. [7020]

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STUPENDOUS Purchase of Set Manufacturers' Stock.—All electric 3-valve (S.G. det. pen.) set, in walnut cabinet, with moving coil speaker, 200-250 volt 40-60 cycles, chassis built, 200-2,000 metres, with 4 valves; £4/19/6.

ALL-ELECTRIC 3-stage Amplifiers, 200-250v. 40-60 cycles, 10 watts undistorted output, complete with 5 valves, and Magnavox Super 66 energised speaker; £12/10.

ELIMINATOR Kits, including transformer, choke, Westinghouse metal rectifier, condensers, resistances, and diagram, 120v. 20 m.a., 20/-; trickle charger, 8/- extra; 150v. 30 milliamps, with 4v. 2.4 amps. C.T., L.T., 25/-; trickle charger, 6/6 extra; 250v. 60 milliamps, with 4v. 3.5 amps. C.T., L.T., 30/-; 300v. 60 m.a., with 4 volts 3.5 amps., 37/6; 200v. 50 m.a., with 4v. 3.5 amps. L.T., 27/6.

PREMIER Chokes, 40 milliamps, 25 hys., 4/-; 65 milliamps, 30 hys., 5/6; 150 milliamps, 30 hys., 10/6; 60 milliamps, 60 hys., 2,500 ohms, 5/6; 25 milliamps, 20 hys., 2/9; 250 milliamps, 30 hys., 20/-.

ALL Premier Guaranteed Mains Transformers Have Engraved Terminal Strips, with terminal connections, input 200-250v., 40-100 cycles, all windings paper interleaved.

PREMIER H.T.7 Transformer, output 135v. 80 m.a., for voltage doubling, 8/6; 4v. 3-4a., C.T., L.T., 2/- extra; with Westinghouse rectifier, giving 200v. 30 m.a., 17/6.

PREMIER H.T.8 and 9 Transformers, 250v. 60 m.a. and 300v. 60 m.a. rectified, with 4v. 3-5a. and 4v. 1-2a., C.T., L.T., and screened primary, 10/-; with Westinghouse rectifier, 18/6.

PREMIER H.T.10 Transformer, 200v. 100 m.a., rectified, with 4v. 3-5a., and 4v. 1-2a., C.T., L.T., and screened Primary, 10/-; with Westinghouse rectifier, 19/6.

PREMIER Mains Transformers, output 250-0-250v. 60 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

PREMIER Mains Transformers, output 350-0-350v. 120 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

PREMIER Auto Transformers, 100-110/200-250v., or vice versa, 100-watt; 10/-.

WESTERN Electric Mains Transformers, 300-0-300v. 65 m.a., 4v. 1-2a., 4v. 2-3a., 6/6; 500-0-500v. 150 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 2-3a., 4v. 1a., C.T., 4v. 1a. C.T.; 19/6.

SPECIAL Offer of Mains Transformers, manufactured by Philips, input 100-110v. or 200-250v., output 180-0-180v. 40 m.a., 4v. 1 amp., 4v. 3 amps., 4/6; 200-0-200v., 4v. 1a., 4v. 3a.; 4/6.

PREMIER L.T. Charger Kits, consisting of Premier transformer and Westinghouse rectifier, input 200-250v. A.C., output 8v. 1/2 amp., 14/6; 8v. 1 amp., 17/6; 6v. 2 amp., 27/6; 30v. 1 amp., 37/6; 2v. 1/2 amp., 11/-.

B.T.H. Truessed Induction Type (A.C. only) Electric Gramophone Motors, 100-250v.; 30/- complete.

SPECIAL Offer B.T.H. Gramophone Motors, A.C. and D.C., 100-250v.; 30/-, listed £3/3.

COLLARO Gramophone Unit, consisting of A.C. motor, 200-250v. high quality pick-up and volume control, 49/-; without volume control, 46/-.

EDISON BELL Double Spring Gramophone Motors, complete with turntable and all fittings, a really sound buy, 15/-.

SPECIAL Offer of Wire Wound Resistances, 4 watts. any value up to 50,000 ohms, 1/-; 8 watts, any value up to 15,000 ohms, 1/6; 15 watts, any value up to 50,000 ohms, 2/-; 25 watts, any value up to 50,000 ohms, 2/6.

CENTRALAB Potentiometers, 400 ohms, 1/-; 50,000, 100,000, 1/2 meg., any value, 2/-; 200 ohms, wire wound, 1/-.

POLAR Star, manufacturers' model, 3-gang condensers, fully screened, 7/6, with trimmers; unscreened, 5/-.

AMERICAN Triple Gang 0.0005 Condensers, with trimmers, 4/11; Utility bakelite 2-gang 0.0005, screened, with unknob trimmer, 3/6; Polar bakelite condensers, 0.00035, 0.0003, 0.0005, 1/-.

ORMOND Condensers, 0.0005 2-gang semi-shielded, 2/6; brass vanes with trimmers, 3/6.

MAGNAVOX DC. 152, 2,500 ohms, 17/6; D.C. 154, 2,500 ohms, 12/6; D.C. 152 magna., 2,500 ohms, 37/6; all complete with humbucking coils; please state whether power or pentode required; A.C. conversion kit for above types, 10/-; Magnavox P.M. 7in. cone, 16/6.

RELIABLE Canned Coils with Circuit Accurately Matched, dual range, iron cored, £2/11.

UTILITY 3-gang Condensers, 0.0005, fully screened, with trimmers, ball bearing straight or superhet., 6/9, complete; with disc drive, 7/11; the best 3-gang available.

T.C.C. Condensers, 250v. working, 1 ml., 1/3; 2 ml., 1/9; 4 ml., 3/-; 4 ml., 450v. working, 4/-; 4 ml., 750v. working, 6/-; 2 ml., 750v. working, 3/-.

VARLEY Constant Square Peak Coils, band-pass type B.P.7, brand new, in maker's cartons, with instruction and diagram, 2/4.

VARLEY H.F. Intervalve Coils, B.P.8, band-pass, complete with instructions, in original cartons; 2/6.

SCREENED H.F. Chokes, by one of the largest manufacturers in the country; 1/6.

PREMIER British-made Meters, moving iron, flush mounting, accurate, 0-10, 0-15, 0-50 m.a., 0-100, 0-250 m.a., 0-1, 0-5 amps.; all at 6/-.

(This advertisement continued on next page.)

Components, Etc., for Sale.—Contd.

(This advertisement continued from previous page.)

WESTERN Electric Condensers, 250v. working, 1 mf., 6d.; 2 mf., 1/-; 4 mf., 2/-; 400v. working, 1 mf., 1/-; 2 mf., 1/6.

WIRE-WOUND Potentiometers, 1,000, 2,500, 15,000, 20,000, 50,000, 90,000, 120,000, 200,000, 500,000, 2/- each; 1,000 ohm, semi variable, carry 150 m.a., 2/-.

PLESSEY Pick-up and Arm, 15/-; Cosmocord pick-up, with arm and volume control, 10/6.

RELIABLE Intervalve Transformers, 2/-; M.C. Multi-ratio output transformers, 2/6; 2:1 or 1:1 output transformers, 2/6; microphone transformers, 50 and 100-1, 2/6.

A LARGE Selection of Pedestal, table and radiogram cabinets, by best manufacturers at a fraction of original cost, for callers.

THE Following Lines 6d. Each or 5/- Per Dozen: Chassis valve holders, 5-, 6-, or 7-pin, screened screen-grid leads, any value 1-watt wire resistances, wire end condensers, 0.0001 to 0.1, 3 amp. main switches, Cydon capacitors, double trimmers.

SUPER Moving Coil Speakers, handle 10 watts, energised directly from A.C. mains, manufactured by world-famous radio and gramophone company; 40/-.

LISSEN Mains Receivers, A.C. 200-250 volts, complete with 3 valves, with self contained speaker; 59/6.

SCOTT Aerial and Anode Coils, dual range, complete with 8.G.3 circuit; 2/6 per pair.

BLUE SPOT 29D.C. Moving Coil Speaker, with multi-ratio output transformer, 7in. cone, 2,500 ohms, 9/11; ditto 29P.M., permanent magnet, 18/9.

ELPHRO Volume Controls, 10,000, 12,000 or 15,000 ohms, complete with mains switch; 1/-.

T.C.C. Electrolytic Condensers 8 mf. 440v. working 3/-; 4 mf., 440v. working, 3/-; 15 mf., 50v. working, 1/-; 50 mf., 12v. working, 1/-; 15 mf., 100v. working, 1/3; 6 mf., 50v. working, 6d.; 2 mf., 100v. working, 6d.; 8+4 mf., 450v. working, 4/-.

DUBILIER Dry Electrolytic Condensers, 8 or 4 mf., 450v. working, 3/-; 12 mf., 20v. working, 6d.; 50 mf., 50v. working, 1/9.

CONDENSER Blocks, H.M.V., 400v. working, 4+2+1+1+1+0.5, 3/9; 2+2+1+1+1+0.5, 3/-; Dubilier, 300v. working, 4+4+2+0.1, 3/-; Phillips 6+4+2+1+1, 4/6; 9+3+2, 3/-.

RADIOPHONE Logarithmic Wire Wound Potentiometer, with mains switch, 2/-; S.W. H.F. chokes, 10-200 metres, 9d.

CELESTION P.P.M.19 P.M. Moving Coil, with multi-ratio transformer; listed 48/-, at 25/-.

BRITISH RADIOPHONE 2-gang Condensers, fully screened, with trimmers, and disc drive with Uniknob trimmer; 5/6.

SPECIAL Offer.—American Midget sets, A.C./D.C., 100-250v. 25-60 cycles. 4 valves, including rectifier, superhet, moving coil speaker, £39/6; 200-550 metres, same as above but 200-2,000 metres, £47/6.

PREMIER SUPPLY STORES Announce the Purchase of the Complete Stock of a World-famous Continental Valve Manufacturer, all the following standard mains types, fully guaranteed, 4/6 each; H.L., L., power, medium, high, low mag. and variable mu screen grids, 1-, 3- and 4-watt A.C. output, directly heated pentodes, 250v. 60 m.a., full wave rectifiers, D.C. types, 20v. 18 amp., filaments, screen grid V.M., H., H.L., power.

THE Following Types, 5/6 each; 350v., 120 m.a., full wave rectifier, 500v. 120 m.a., full wave rectifier, 2½-watt indirectly heated pentode.

THE Following American Types, 4/6: 250, 112, 171, 210, 245, 226, 47, 46, 24, 35, 51, 57, 58, 55, 37, 80, 6A7, 2A7, 27.

THE Following Types, 6/6 each: 42, 77, 78, 25Z5, 36, 38, 83, 39, 44, 53, 6B7, 2A5, 2A6, 2B7, 5Z3, 6C6, 6A4, 6D6, 6F7, 43, 59. Send for catalogue of above types.

PREMIER SUPPLY STORES,
20-22, High St., Clapham, S.W.4. Phone: Macaulay 2188. Nearest Station: Clapham North (Underground). [6957]

MAINS RADIO DEVELOPMENT COMPANY.
MORE Startling New Offers, all perfect, carriage paid, stamp for list, free with order, trade enquiries invited.

ROTHERMEL Permanent Magnet, moving coil speakers, 7in. cone, Universal output transformer, brand new and boxed; 15/-.

SONOCHORDE Energised Speakers, new, pentode transformer, 2,500 6,500 ohms; 11/6.

EMICOL Universal Meters, as last week, 8/9; last few Limit pick-ups, 10/6.

MERSON 8 mfd. Electrolytics, 500v. peak working, 2/6; T.C.C. 25 mfd., 25v. electrolytics, 1/3.

BRITISH Standard Tubular Condensers, brand new, wire ends, 400v. working, 0.01, 0.02, 0.05, 0.1 mfd., 6d.; 0.25, 0.5 mfd., 8d.

COLVERN 25,000 Ohm Wire Wound Potentiometers, 1/3; 50,000 ohm potentiometers, 1/3.

STUPENDOUS Clearance of Manufacturer's Surplus H.F. Chokes, highly efficient; 4d.

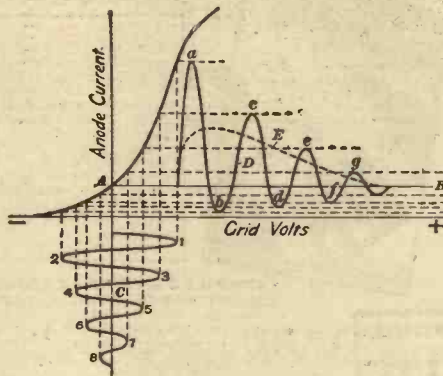
CHASSIS Valve Holders, latest type, 4-pin, 1½d.; 5-pin, 2d.; 7-pin, 5d.; Radiophone toggle switches, three-point, 7d.; on-off, 5d.; Mikado 0.001, 0.002, 0.0005 mfd. fixed, 9d. per 12.

FRANKLIN One Watt Wire Wound Resistors, colour coded, 100 to 100,000 ohms, your choice; 4d. each, 3/6 per dozen.

MAINS RADIO DEVELOPMENT COMPANY, 4-6, Muswell Hill Road, London, N.6. Tudor 4046. [6991]

FERRANTI A.F.5. 15/-; A.F.3. 9/-; O.P.M.5. 10/6.—21, Musgrove Rd., S.E.14. [7006]

Do You Know What This Graph Means?



The man who can analyse these curves and understand what they indicate knows his job. But if they do not convey to him perfectly definite information, it would appear that he needs more training than he has had. He is not competent to fill a responsible position in wireless.

Radio has developed so rapidly throughout the last ten years that it has now greatly outgrown the supply of technically qualified men required for the better posts. Moreover, it continues to develop with such speed that only by knowing the basic principles can pace be kept with it.

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- WIRELESS OPERATORS
- EXAMINATION (state which)

Name Age

Address

Components, Etc., for Sale.—Contd.

MILDMAY RADIO EXCHANGE.
MILDMAY RADIO EXCHANGE Offers the Following, sound and perfect; cash with order or c.o.d.

FERRANTI A.F.3, 10/6; A.F.4, 7/6; A.F.5, 18/-; A.F.6, 18/-; A.F.7, 18/6; O.P.M.1, 10/-; O.P.1, 1-1 ratio, 7/6; O.P.2, 25-1 ratio, 7/6; O.P.3c, 1-1 P.P. ratio, 7/6; O.P.M.2, 10/-; O.P.M.3, 10/-; O.P.M.4, 12/-; B3 chokes, 6/- each.

METERS—Elliott, 0-10 m.a., 14/-; Seimens 0-5 m.a., 14/-; Weston 306, 0-150 volts, 8/-; Sifam 0-50 m.a., 10/-; 0-5 m.a., 10/-; Weston 301, 0-100 m.a., 20/-; Weston 301, 0-5 amps., 15/-; Weston 0-250 volts A.C., 15/-.

FERRANTI Band Pass Kit, 40/-; Colvern K.G.C., 4/- each; Colvern K.M.S.1, K.M.S.2, K.M.S.3 (band pass superhet), 12/-; Ferrocart F10-F3, 12/6 pair; Wearite superhet coils, 4/- each; Telsen short wave coils, 1/6 each; Wearite I.F. transformers, 126 K.C., 5/- each.

COLLARO Type 32 Combined A.C. Mains Gramophone Motors, with pick-up and volume control, fitted with fully automatic stop and start plate, 12in. turntable, 50/- each, listed £4.

SPECIAL Offer.—Regentone A.C. mains units, type W5a, brand new and in sealed boxes, output 150 volts 20 m.amps., having 4 tapings, 2 variable, also trickle charger, for 2-, 4- or 6-volt accumulator; listed at £4/12/6, our net price 39/- each.

B.T.H. Nickel Type Pick-up, 15/-; Junior B.T.H. pick-ups, 17/6 each; Marconi 1934 K17 pick-ups, 22/6 each; Radiophone 3-gang condensers, 9/- each; R.I. 14-28 L.F. chokes, 140 m.a., 10/-; Varley D.P.10 choke, 10/-.

VARLEY Pentode Output Transformer, 8/-; Lewcos B.P.1, 4/-; Varley 100 m.a. chokes, 10/- each; Varley filament transformer, 4v. 5 amp., 8/-; Varley transformer for Westinghouse H.T.3-4, 6/6.

HEYBERD 100 m.a. Choke, 7/6; Heyberd 150 m.a. choke, 9/-; pair R.I. push-pull transformers, 9/6 pair; 20H. Parmeko L.F. chokes, 5/- each; R.I. Pentonite L.F. chokes, 6/6.

HEYBERD L.T. Choke, 1 amp., 4/-; Hypercore L.F. chokes, 8/- each; pentode type, 7/6; Ferranti mains transformer for Westinghouse H.T.1, 7/6; Clydon 0.0005 condensers, 3/6 each; Varley 3-henry choke, 5/-; Varley push-pull output transformer, 6/6.

SPECIAL Clearance Offer Telsen L.F. Chokes, 40 henry, brand new and in sealed boxes; 1/6 each; limited number.

ALL the Above Post or Carriage Paid.

WE are Open all Day Thursday.

PHONE Terminus 6751.

6 Pentonville Rd. (near Angel), London, N.1 (2 minutes from Euston and King's Cross). Callers invited. [7041]

SOUTHERN RADIO'S Wireless Bargains.

RECEIVERS—G.E.C. Osram 4-valve (actual) sets, complete with 4 Osram valves, permanent magnet moving coil speaker, magnificent pedestal cabinet, ready to use on all voltages A.C., all Osram proprietary components in original sealed cartons; £6/15 (list £15/15); an exceptional bargain.

CROMWELL 3-valve Battery Sets, complete with three Osram valves, permanent magnet moving coil speaker in magnificent walnut console cabinet, brand new, in original sealed cartons; £3/12/6 (list £8).

COILS—Igranic superhet, set of four (1 Osc., 2 L.F. with pigtails, 1 L.F. plain), 12/6 (list 50/-); Lissen superhet, 3-coil kit, screened, ganged on base with switch, type L.N.5181, 9/6; same description for band pass or any straight circuit, type L.N.5162, 7/-; Varley constant square peak coils, B.P.5, complete with all accessories in sealed cartons, 2/3; Lewcos B.P.F./R., B.F., O.S.C./126 (extension) T.O.S./R., all at 3/6 each.

PICK-UPS—Marconi model K.25 (1935 issue), 21/- (list 32/6).

CONDENSERS—Lotus 3-gang, 12/6; 2-gang, 8/6; single dyblock, 4/6; all capacities 0.0005, fully screened with trimmers, complete with dials, knobs and escutcheons; special bargain line, Plessey 4-gang condensers, superhet type, fully screened with trimmers (less dials) (standard dial will fit), 10/6 (list 45/-); Dubilier type condensers 4 mfd. (2x1xL), 1,000v., 2/9; 4.5 mfd. (2.25x2.25), 3/-; T.C.C. (0.1x0.01), 1/3 each.

SPEAKERS—Blue Spot 66R. units, brand new and boxed, 10/6 (list 35/-); complete, mounted on Blue Spot chassis, 16/6 (list 45/-).

MISCELLANEOUS—Set manufacturer's surplus skeleton type Westinghouse metal rectifiers, H.T.6, 7, 8, 9/3; morse tapping keys with flash signal and buzzer, complete with battery and bulb, 2/-; Lissen general purpose output chokes, 20-28 henries, 18-60 m.a., L.N. 5301, 6/- each; Lewcos superhet. dual wave frame aerials, 9/-; utility midget condensers, 0.0005, complete with dial, knob escutcheon, 2/6; Biffo static cut-outs, definitely cuts out all electrical interference and all unwanted noises without decreasing volume, listed at 12/6, our price 2/3 each; brand new and boxed, with simple instruction leaflet; please state whether A.C., D.C., or battery set; note price, 2/3 (listed 12/6).

THOUSANDS of Bargains for Callers at our Various Shops. We have enlarged and reconstructed our 46, Lisle St. premises, and it is now the largest wireless depot in the West End, with a full range of 1935 receivers, components, etc., at keenest prices.

ALL Goods Guaranteed and Sent Post Paid.

BRANCHES at 46, Lisle St., W.C.2; 16, Leicester St., W.; 271-275, High Rd., Willesden Green, N.W.10; all mail orders to 323, Euston Rd., N.W.1.

SOUTHERN RADIO, 323, Euston Rd. London, N.W.1 (near Warren St. Tube). Phone: Museum 6324. [7038]

PEARL and **PEARL** Bargain List A Free.—190, Bishopsgate, London, E.C.2. [0421]

RADIOLAB, perfect, cost 12 guineas, 3 months old; £8.—Viner, 11, Birchfield Av., Peverell, Plymouth. [7007]

FERRACART Coils, ganged condenser, other parts; cheap.—Legge, Lyndhurst, Newbridge Av., Wolverhampton. [7008]

Components, Etc., for Sale.—Contd.

UTILITY Sales.—This week's selection of new lines; all perfect good values.

ROTOROHM Volume Control, 5-, 10-, 15-, 25,000, with switch, 3/-; 50,000, without switch, 2/6.

MOVING Coil Speaker, standard full size, universal transformer, Rothermel's latest model; 15/-.

SYNCHRONISED Electric Clock, 200-250 A.C., beautiful finish, with cord, plug (50 cycles); keeps correct time with B.B.C. signals; 15/-.

EMISSION Tester Kit of Parts, with circuit, milliamp. meter, switch, panel, valveholder, etc., test grid, grid plate, filament; 12/6.

UTILITY SALES, Featherstone Corner, 57, Praed St., London. Paddington 0251. [7026]

WOBBURN RADIO Offer Following Bankrupt Stock and Manufacturers Surplus:—

T.C.C. Condensers: Blocks, 20 mfd. (12 mfd. x 4 x 2 x 2 mfd.), 5/6, 14 mfd. (2 mfd. x 2 x 4 x 1 x 1), 5/-; 12.01 mfd. (4 x 4 x 2 x 1 x 1 x 0.01), 4/6; 6 mfd. (4 x 2), 2/6; 6.5 mfd. (2 mfd. x 9.5), 3/-; 11 mfd. (4 x 4 x 2 x 1), 3/6; 9 mfd. (4 x 4 x 1), 3/-; 5.35 mfd. (4 x 1 x 0.1 x 0.25), 2/6; 3.1 mfd. (1 x 1 x 1 x 0.1), 2/-; 1.2 mfd. (1 x 0.2), 1/-.

ELECTROLYTICS: 6 mfd. 50v. working, 15 mfd. 100v. working, 25 mfd. 25v. working, 50 mfd. 12v. working, 1/3 each.

T.C.C. Mic Tag Condensers, type "8" and "M." 4d. each; values, 001, 0015, 003, 006, 0001, 0002, 0003, 00025, 0003, 0005, 0007, 0008, 0009.

DUBILIER Dry Electrolytics, 4 mfd., 8 mfd., 500v. working, 3/-; 50 mfd. 50v. working, 3/-; Mershom wet electrolytics, 500v. 8 mfd., 2/9.

FORMO 1 mfd., 1,000v. test, Bakelite, 1/-; 2 mfd. 1,000v. test, 1/3; Wego 4 mfd. 750v. test, 2/3; Tubulars: 0.1, 0.01, 0.02, 6d.; full range of T.C.C. tag condensers at 4d. each including unusual sizes, all types M.

BRITISH Radiophone Two Gang Condensers with Trimmers, 0005, 5/9; New Polar Midget 0005, 2-gang, 6/6; 3-gang, 9/9; Radiophone curved dials with escutcheon and dial lights, 3/9.

ESTON Iron Cored Canned Coils, with circuit, 2/6; Radiophone toggles, 6d.; binocular chokes, 1/2; H.F. chokes, 10d.; Columbia L.F. transformers, 3/1 and 5/1, 2/9; J.B. air spaced condensers, 0005 with escutcheon, dial light and drive, 3/3; Class B driver and choke, 8/6; with B.V.A. and 7-pin holder, 17/-; chassis mounting valve holder, 4-5 pin, 1/3 half dozen; 7-pin, 5d.; Edison condensers, 005 and 006, 4d.; Sistofox, 7 yds. 6d.; screened sleeving, 3d. yd.

SONOCHORDE Speakers, D.C. energised, 2,000 ohms, new and boxed, 12/6 (carr. 1/-); Rothermel Midget P.M. speakers, power transformers, 12/-.

ROTHERMEL Piezo Electric Pick-ups, new model, boxed, listed 42/-, 30/-; Marconi K.25 pick-ups, boxed, 21/-.

WESTINGHOUSE Rectifiers, set manufacturers surplus skeleton type, H.T.8 and 9, 8/11; transformers for same with L.T. winding, 6/9; few only H.T.5 and 6 at 4/9.

G.P.O. Relays, magnificent instruments, few only, 10/- each.

W.R.C. Eliminators: 150v. 30m.a., A.C. model, 21/-; A.C. with trickle charger, 2v., 4v. or 6v., 1/2 amp., 32/6 (carriage 1/- extra on each).

TRADE List Ready, send heading and stamp.

TO Avoid Delay Send Orders Without Money, we pay c.o.d. charges on orders over 5/-.

WOBBURN RADIO Co., 9, Sandland St., W.C.1. Holborn 7289. (Second floor, nearest stations, Holborn or Chancery Lane). [7046]

CHASSIS, aluminium or steel, cellulosed, supplied to any specification; aluminium, heavy gauge, any size, 2/- sq. ft.

INTERFERENCE Suppressors for Mains Receivers, 4/6; essential on D.C.—Wilson Radio Electric, Newson St., Ipswich. [6999]

WARD for Unparalleled Bargains in Set Manufacturers' Surplus; all goods are guaranteed perfect; immediate delivery.

OLYMPIC S.S. Six Coils, complete to specification, 45/-; A.C. and D.C. eliminators, first class make, tappings S.G., detector and power (150v.), 25 m.a.; A.C. type, with Westinghouse rectification, 25/-; D.C. type 12/-.

DUBILIER Resistances, 1-watt type 7d., 2-watt type 1/2, 3-watt type 1/9, Dubilier or T.C.C. dry electrolytic condensers, 8 mfd. or 4 mfd., 500v. peak, 50v., 50 mfd. or 200 mfd., 10v. peak, 3/6.

MARCONI K19 or K25 Pick-ups, 21/-; Rothermel piezo electric, 30/-; Cosmocord, 12/-; B.T.H. needle armature pick-ups, 29/-; B.T.H. pick-up tone arms, 3/-; Clix chassis type valve holders, 5-pin 5d., 7- or 9-pin 6d.; T.C.C. type "M" fixed condensers, any size up to 0.001 mfd., 6d.

SET Manufacturer's Surplus.—Skeleton type Westinghouse rectifiers, H.T.8 9/6, H.T.9 10/-, H.T.10, L.T.4, L.T.5, 10/9; transformers (Regentone) for H.T.8 or H.T.9, with 4v. 4a. L.T. 7/-.

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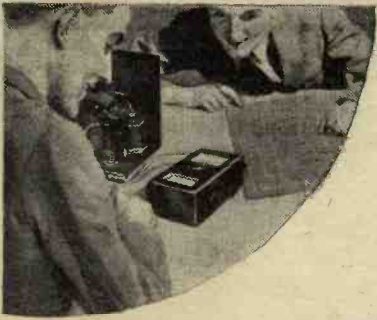
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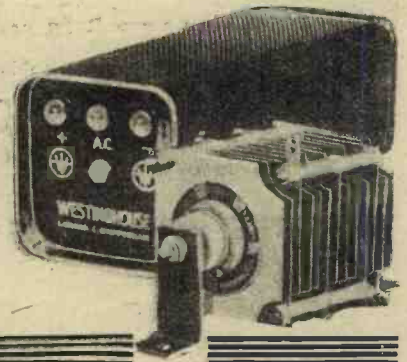
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(A) APPRECIATION; (B) CRITICISM

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Mr. Gordon E. Ward (Managing Director, "C.A.C."),
Major W. I. G. Page (Designer of "Austin" Receivers),
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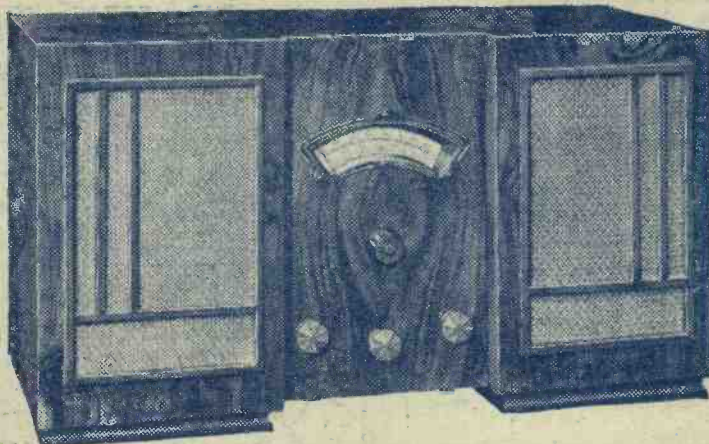
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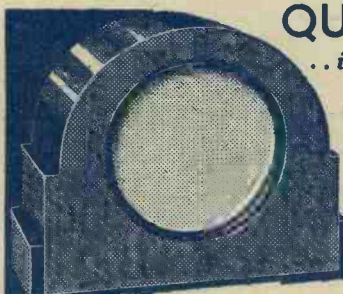
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The Wireless World

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PRACTICAL RADIO
JOURNAL
24th Year of Publication

No. 796.

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

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EDITORIAL COMMENT

Valves

How to Cultivate a More Liberal Use

IT has been our practice now, for some years, to publish each autumn, a list of current receiving valves with all the data which the designer or user requires concerning them concisely expressed. The number and variety of valves is steadily increasing and the preparation of the Valve Supplement included with this issue has been a task of no small magnitude.

In last week's issue we urged the more generous use of valves in receiver design. It was pointed out that the valve is no longer a component of the set which should be used as sparingly as possible. All but one of the old objections to employing a large number of valves have now disappeared, and there is no doubt that improved efficiency and greater reliability of sets would result if the present "valveshy" attitude could be removed. The removal of the remaining objection is in the hands of the valve manufacturers, who could at once bring about this desirable change in outlook by making a really substantial reduction in the price of the common types. The increase in sale of valves should cover the loss in revenue derived, and the public would benefit by better sets at no greater cost. But the first move must come from the valve manufacturers, for set manufacturers and set builders will go on trying to make one valve do the work of two, even at the cost of a less efficient set, so long as additional valves tend to put up the cost unduly.

If the number of valves required for an efficient receiver for broadcast sound reception is large, this is yet small by comparison with what will be needed for television receivers. We

cannot hope for popular television sets until valves are cheaper, because of the large number which are required in an efficient design.

There is another aspect of the question of more valves which should not be forgotten. We refer to the matter of fault tracing and servicing of receivers. If the general principle of using one valve for each job in a set is followed, the problem of finding faults becomes far easier than when valves are performing two or more functions at a time. Faults can be more easily localised, and although the wiring of receivers may become somewhat more elaborate, at least the distribution can be less congested and, therefore, more accessible than under present conditions.

We do not wish to put it to the valve manufacturers that they should bring down the price of valves as a favour to the industry and the public. We ask them to look at the matter from an economic standpoint and see whether they cannot satisfy themselves that the cultivation of a more generous attitude on the part of designers to the use of valves would not prove to be of direct benefit to those who manufacture them.

Three Special Issues

Guide to the Choice of Sets

THE next three issues of *The Wireless World*, December 7th, 14th and 21st, will contain additional pages devoted to an illustrated description of the season's wireless receivers and radiogramophones.

Receivers will be divided up into price classifications and the special points of each receiver will be set out, in addition to a comprehensive summary of the general features.

These issues will also contain articles of special interest on components and their design for particular requirements.

New Valves for Old Receivers

Points to Observe in Revalving an Existing Set

By F. E. HENDERSON

ONE of the problems of the listener to-day is to know how to keep up to date. It is easy to say relegate to the scrap-heap any set when it begins to get obsolete, but considerations of economy often decide otherwise, and it then becomes necessary to see what can be done, even if we may have to compromise a little, to effect improvements. The purpose of this article is to guide the listener and discuss valve changes which are permissible whilst giving warning of changes which might result in trouble.

THERE are a vast number of listeners unwilling to scrap the receiver which they know how to handle, gives them satisfactory service, and adequately meets their particular requirements. On these occasions the user feels that the introduction of one or two more modern types of valves should give the set an increased efficiency either by a saving in running costs or better performance. Perhaps also such a receiver has been prone to microphonic or ringing noises associated with the design and types of valves available at the time the set was produced, and some improvement is called for in this respect.

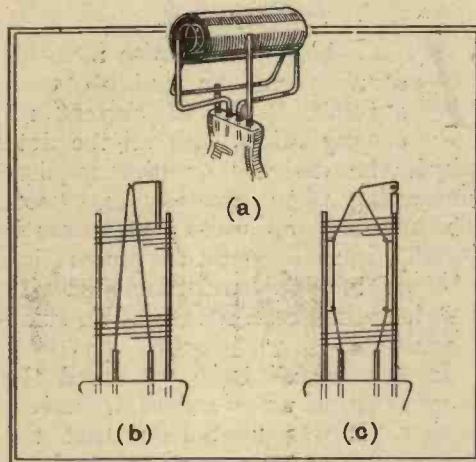
It is seldom practicable or possible to introduce new features in the way of components in bringing an old set up to date, with the exception of the valves. Batteries, in the case of a non-mains driven receiver, are, of course, calling for constant renewal if the receiver is to be kept up to a certain standard of efficiency, but how often is the other replaceable component, namely, the valve, allowed to deteriorate before serious attention is paid to the renewal of this essential part.

Most valves give an exceedingly long working life if treated kindly, but, even so, are not everlasting, and sooner or later it is false economy to keep them in service, and the question of new valves calls for urgent attention. The problem then becomes whether to fit a valve of identical type and make to the original, or whether to attempt to use the higher working efficiencies of more modern types.

In the first place there is usually a greater flexibility in the choice of valves for a home-constructed receiver or kit set than for a manufactured receiver. This is because the set manufacturer usually designs rigidly around a given combination of valves both on account of physical size and electrical characteristics, and often for either of these reasons a departure from the types specified is dangerous or impossible. In any case it is usually good policy to refer the matter to the actual manufacturer concerned, or to the valve manufacturers, who can usually recommend a type suitable for the particular receiver in question.

In the case of the home constructed outfit or kit set it is certainly worth some consideration before revalving, and to

assist in this it may be helpful to analyse the various changes which have taken place in the design or characteristics of receiving valves during the past eight or nine years.



Illustrating (a) simple construction of original DER triode. The low efficiency and heavy filament enabled simple design to be used, without danger of introduction of microphony. (b) Early design of "hairpin" filament which led to microphonic troubles as the efficiency increased. (c) Modern design of battery valve filament, employing anchored and sprung supports to shorten length of free filament and maintain constant tension.

The principal features which affect the replacement of one type of valve by another are:

Size, type of fitting (base, pins, etc.), filament voltage, filament current, mutual conductance, grid bias, anode feed current, grid current characteristic, interelectrode capacity, nature of characteristic—triode, tetrode, pentode, etc.

Apart from the first two considerations, which are purely physical and obvious

ones, any or all of the remainder may take part in determining whether a replacement valve of another type may improve a set or render it unworkable.

Let us consider how each of these points in turn will affect performance and review the major changes in each instance over the past decade of valve manufacture.

Filament Voltage

Although now probably representing only a small minority, there are still users of battery sets who employ a 6-volt accumulator, this being a relic of the days when 6-volt valves were used in order to get a performance not then possible with valves of lower voltage. By the improvement of filament technique enabling a greater electron emission to be obtained from a modern 0.2 watt filament than was possible for a 1½ watt filament of ten years ago, manufacturers, by common consent, have ceased the production of Broadcast battery valves with filament voltages exceeding 2. It is, therefore, false economy to continue the use of 6-volt battery valves with consequent heavy bulk and heavy charging costs of the accumulator, and a change to 2-volt valves would be a good one.

Owing to the improvement in filament technique, actually a better performance can be obtained from a set of modern 2-volt valves providing the correct types are carefully chosen.

A striking example of this improvement is given in the table which compares a popular line of 6-volt battery valves in 1925 with 2-volt types of modern design which will replace them.

A similar argument applies to 4-volt battery valves which can be replaced by modern 2-volt types with a reduction in the size and charging costs of the accumulator.

In the case of mains-driven receivers the filament, or, in this case, the heater voltage is, of course, fixed by the transformer incorporated, which normally would be wound for 4 volts, being the figure standardised in this country for AC valves.

Filament Current

Since the introduction of the oxide-coated or barium technique to replace the thoriated filament, which in its turn re-

CHARACTERISTIC COMPARISONS BETWEEN 1925 AND 1934 BATTERY VALVES

Type	Filament			Emission Efficiency mA/Watt	Working Grid Bias	Mutual Conductance
	Volts	Current	Watts			
DE5	6	0.25	1.5	30	-9	1.0 mA/Volt
P215	2	0.15	0.3	100	-9	1.4 mA/Volt
P2	2	0.2	0.4	200	-9	3.5 mA/Volt
DE5B	6	0.25	1.5	30	-1.5 to -3	0.6 mA/Volt
HL2	2	0.1	0.2	200	-1.5 to -3	1.5 mA/Volt

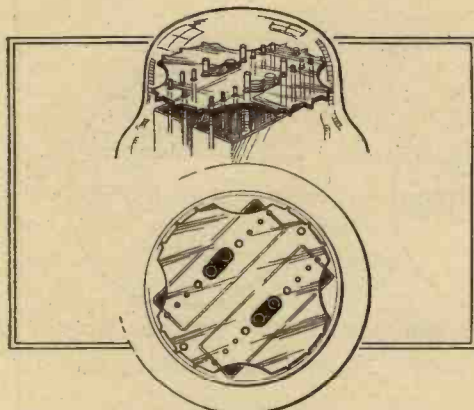
New Valves for Old Receivers—

placed the bright emitting filament, there has not been any marked change in the filament current taken by any particular class of battery valve. Very few sets of to-day will be employing bright emitter types of valves, but there still may be users who have valves fitted with the thoriated filament. Such valves were often exceedingly long-lived, and may even yet be giving good service. It would, however, be an economical move to replace these with modern valves, but, here again, very great care must be taken in the choice of valve and characteristics owing to the greater efficiency of these over the old thoriated types. To minimise the chances of instability a modern valve of moderately low impedance and low amplification factor should be chosen and worked at a fairly low HT voltage (except in the output stage), or disappointment may result.

A striking instance of the improvement in filament current efficiency resulting from changes in filament technique is afforded by a comparison of the types shown below:

Type	Filament		Emission Efficiency mA/Watt	Mutual Conductance
	Volts	Current		
Bright Emitter, type B	4.0	0.7	5	0.2
Thoriated Dull Emitter, type DER	2.0	0.4	30	0.28
Oxide Coated type L21	2.0	0.1	200	1.8

In certain sets the volume control is effected by means of a variable resistance in the filament lead. Should a valve of lower filament current replace an older type the voltage drop across this resistance will be less and the control of volume may be adversely affected. The remedy is, of course, to utilise a higher value of variable resistance.



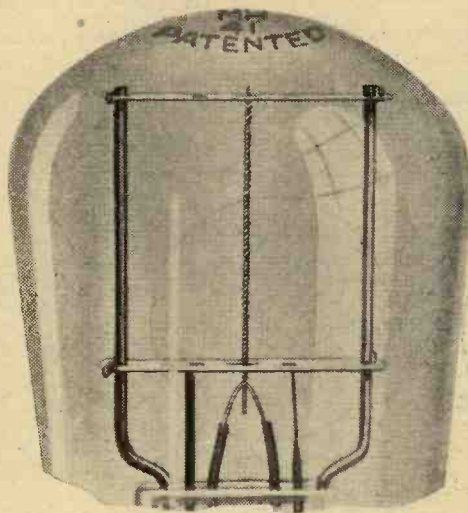
The form of bulb shaping and mica electrode support anchored to bulb shown in this sketch is adopted in many modern valves to ensure rigidity and characteristic consistency.

In the case of DC mains-operated sets where the valve heaters are wired in series at a constant current it is not practicable to introduce any change in this direction owing to the constants of the heater circuit.

With AC valves the heater current is more or less standardised and no economy is worth considering in this direction.

Perhaps the most striking change in valve characteristic over the past decade is the rapid climb in mutual conductance which applies to every class of valve and is directly the result of improved emission efficiencies. This, while affording a means to greatly improve efficiency in performance when treated with discrimination, represents also the biggest difficulty in the way of introduction of modern improved valves to replace valves of older types. The reason is, of course, that the improvement in mutual conductance will probably result in an increased overall gain per stage and unless the receiver is designed with adequate screening and decoupling of the various stages this increased gain is reflected in feedback, giving rise to uncontrollable oscillation either of radio or audio frequency.

Great care must, therefore, be observed in the choice of modern valves, and in the case of most earlier set designs it is not practicable to take full advantage of the increased amplification that they offer.



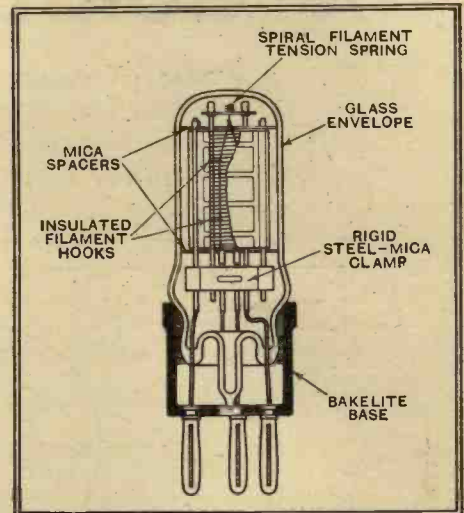
A modern type of double helical spiral heater for mains valves, to minimise hum.

Most valve makers, however, have a range of valves having modern characteristics in every other respect but so designed as to give the advantages of present-day technique in an older type set without introducing instability. This question is best considered under two heads:

- (a) Valves for radio frequency, i.e., HF and detector stages
- (b) Valves for audio frequency, i.e., LF and power stages.

On the radio-frequency side the effect of increased mutual conductance must be considered in conjunction with the value of anode-grid capacity. To take as an example a triode used as an HF amplifier (common practice until recent years) any attempt to introduce a valve in which the product of factors representing mutual conductance and capacity is increased will undoubtedly lead to instability. In a triode valve this state of affairs cannot be avoided, and hence with HF amplifiers using triodes (either aperiodic or neutralised tuned circuits) any improvement in the mutual conductance of the valve types hitherto used is impracticable.

In the case of the detector stage, the effect of any increase in the mutual conductance x capacity factor will have its



Illustrating a modern development in battery valve design—the HL2/K triode—primarily intended to reduce microphony, increase uniformity, and economise in space. The type is suitable as detector in practically all battery sets using triodes

effect on the reaction circuit—usually an important section of older type sets, and if ganged circuits are used some retrimming of the condensers will probably be necessary.

Renewal of the detector valve is, however, a move with strong recommendation and very often results in markedly improved range-getting properties. A valve of medium impedance is generally preferable, and the increase in sensitivity often allows a reduction in HT voltage, with resulting saving in HT current.

With screen grid valves, the problem of attempting to improve results with a modern valve is more complicated as so much depends on the lay-out and degree of screening provided in the set. It is usually impracticable to attempt the introduction of a valve having more than 1½ times the mutual conductance of the original, unless the screening is very complete, but modern design screen grid valves with a restricted gain can be used, such valves often showing a reduction in HT current at the same time.

The following summary of advice may be helpful:—

- Detector.**
Use medium impedance valve.
Reduce HT volts if reaction too fierce.
Reduce value of grid leak if reaction "ploppy."
- HF Amplifier Triode.**
Use valve of similar mutual conductance as in type originally specified.
- HF Amplifier Screen Grid. One stage.**
A higher mutual conductance may be beneficial. Decrease screen volts if instability experienced.
- HF Amplifier Screen Grid. Two or more stages.**
Use valve of similar mutual conductance unless otherwise recommended by makers.

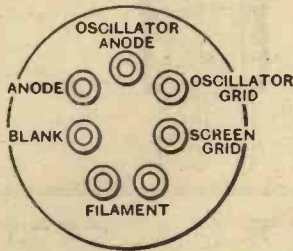
A material improvement can often be effected in a single-stage HF amplifier, but the advice of the manufacturers should be obtained before revalving a multi-stage HF amplifier.

(To be concluded.)

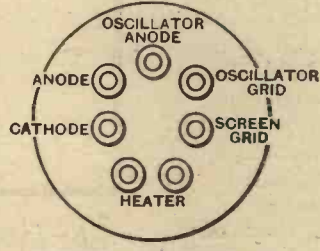
A GUIDE TO VALVE BASES

MODERN valve development has led to an increase in the number of external connections to a valve with the result that many different types of bases are now used. The connections for forty-one valve bases are given in these pages and it is particularly important to note that the view is of the valve base itself or the underside of the valve holder

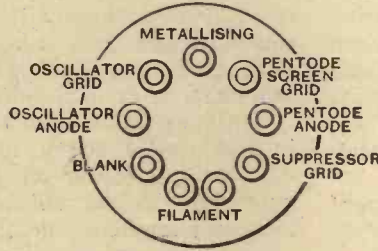
FREQUENCY-CHANGERS



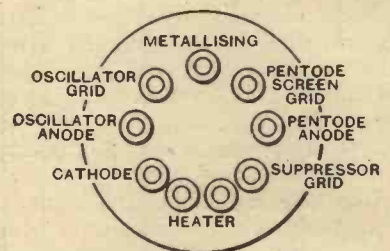
TOP CAP = CONTROL GRID
Battery Heptode or Triode-hexode.



TOP CAP = CONTROL GRID
IH Heptode, Octode, or Triode-hexode.

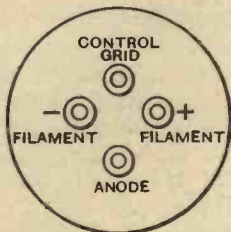


TOP CAP = CONTROL GRID
Battery Triode-pentode.

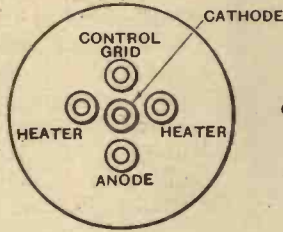


TOP CAP = CONTROL GRID
IH Triode-pentode.

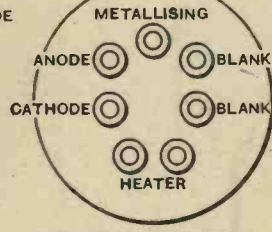
TRIODES



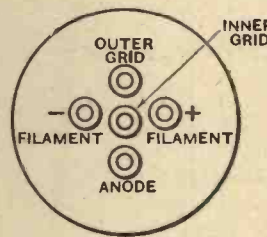
Battery or DH Mains Triode.



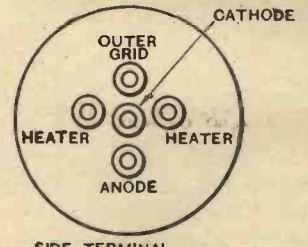
IH Triode (5-pin type).



TOP CAP = CONTROL GRID
IH Triode (7-pin type)

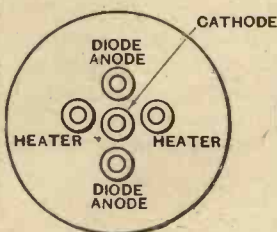


Battery Bi-grid.

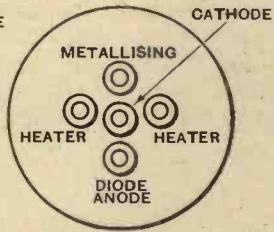


IH Bi-grid.

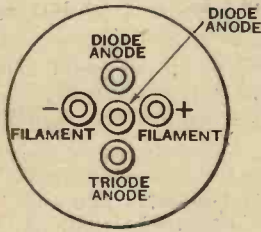
DIODE TYPES



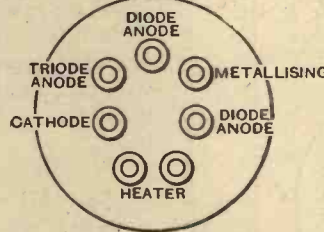
IH Duo-diode.



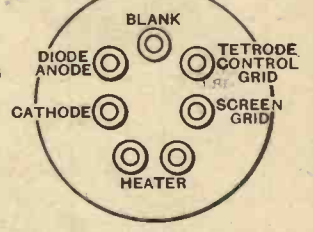
TOP CAP = DIODE ANODE
IH Duo-diode (top-cap type).



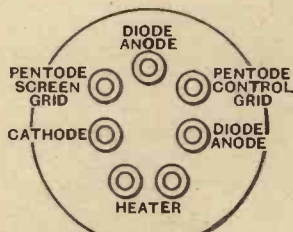
TOP CAP = TRIODE GRID
Battery Duo-diode-triode.



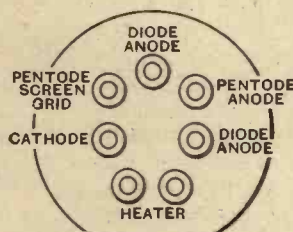
TOP CAP = TRIODE GRID
IH Duo-diode-triode.



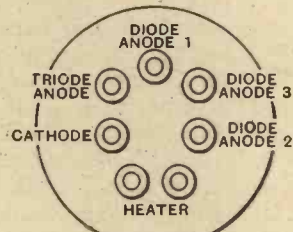
TOP CAP = TETRODE ANODE
IH Single-diode-tetrode.



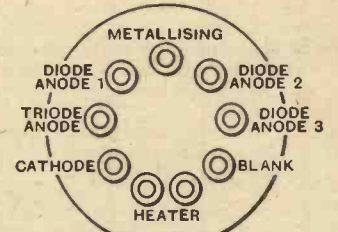
TOP CAP = PENTODE ANODE
IH Duo-diode-HF Pentode



TOP CAP = CONTROL GRID
IH Duo-diode-output Pentode.

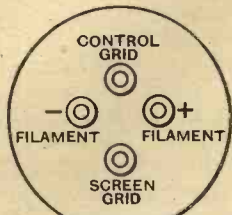


TOP CAP = CONTROL GRID
IH Triple-diode-triode (7-pin type).

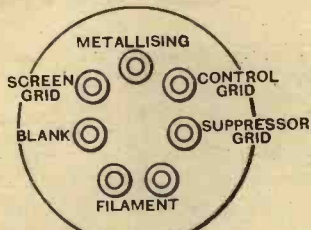


TOP CAP = CONTROL GRID
IH Triple-diode-triode (9-pin type).

SCREEN-GRID AND VARIABLE-MU

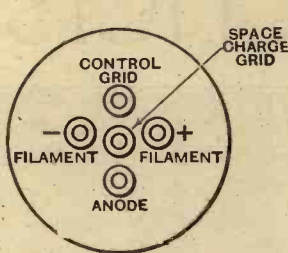


TOP CAP = ANODE
Battery SG Valve.

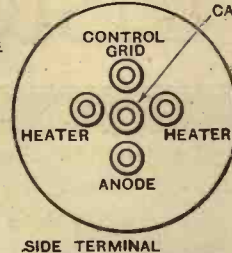


TOP CAP = ANODE
Battery HF Pentode.

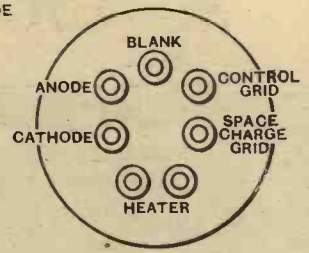
OUTPUT PENTODES



Battery or DH Output Pentode.

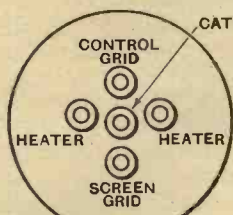


SIDE TERMINAL = SPACE CHARGE GRID
IH Output Pentode (5-pin type).

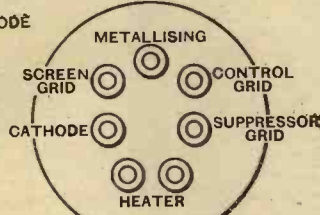


IH Output Pentode (7-pin type).

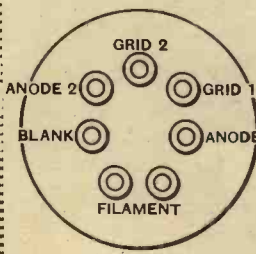
QUIESCENT OUTPUT VALVES



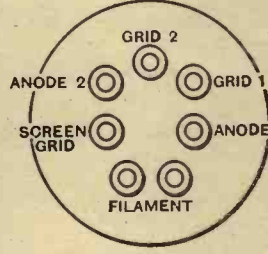
IH SG Valve or HF Pentode (5-pin type).



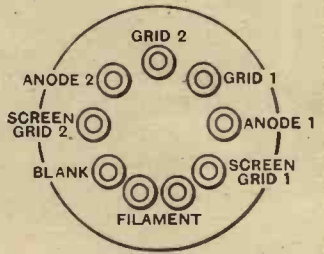
IH HF Pentode (7-pin type).



Battery Class "B" Valve.



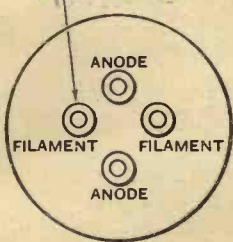
Battery QPP Valve (7-pin type).



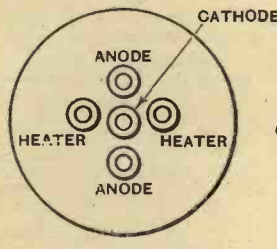
Battery QPP Valve (9-pin type).

RECTIFIERS

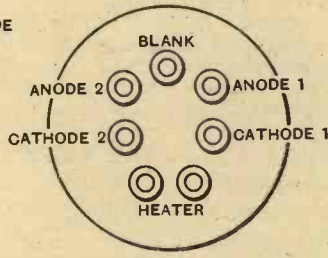
IN INDIRECTLY HEATED TYPES ALSO CATHODE



Full-wave HT Rectifier.

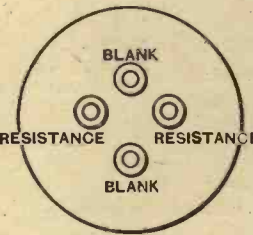


IH Rectifier (5-pin type).

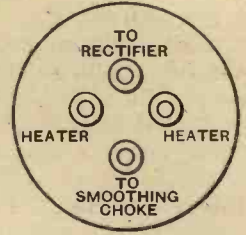


IH Rectifier (7-pin type).

MISCELLANEOUS

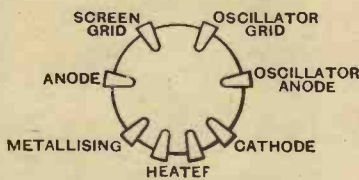


Barretter.

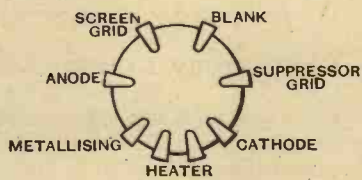


Thermal Delay Switch.

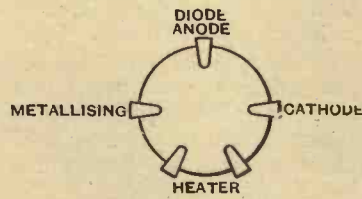
MULLARD SIDE CONTACT TYPES (UNIVERSAL)



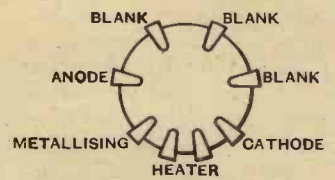
TOP CAP = CONTROL GRID
IH Octode.



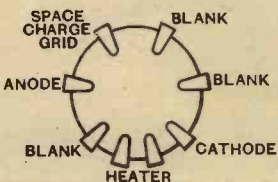
TOP CAP = CONTROL GRID
IH HF Pentode.



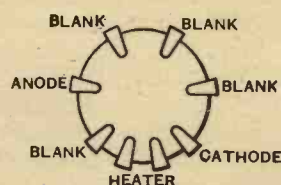
TOP CAP = DIODE ANODE
IH Duo-diode.



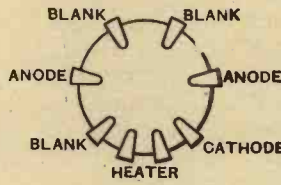
TOP CAP = CONTROL GRID
IH Triode.



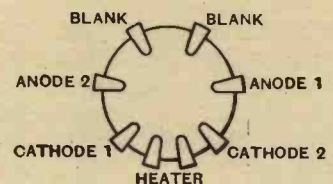
TOP CAP = CONTROL GRID
IH Output Pentode.



IH Half-wave Rectifier.



IH Full-wave Rectifier.



IH Voltage-doubler.

★ ★ Listeners' Guide for Outstanding



A SCOTTISH WEEK.

NOR since the appointment of Sir John Reith as Director-General of the B.B.C. has Scotland enjoyed such a week. Today (St. Andrew's Day) at 8.30 p.m. the National wavelengths will undulate with "News out of Scotland"—a dramatic contrasting of music and "remembered recollections" on the theme of modern Scotland, the whole devised by Mr. George Blake, that famous teller of tales and runner of commentaries.

Then, to-morrow night Dr. Adrian Boult, music director of the B.B.C., himself mounts the platform of St. Andrew's Hall, Glasgow, to conduct the concert of the Choral and Orchestral Union of Glasgow (Scottish Region, 9 p.m.).

A SCOTCH SABBATH.

SUNDAY is a Scottish Sabbath for Londoners. At 3 p.m. comes the Scottish Festival Service in St. Columba's, Pont Street, relayed by London Regional, which also radiates a Scottish religious service at 7.55 p.m. from Mayfield North Church, Edinburgh.

The Caledonian strain resounds again on Tuesday with a feature programme over the London and Scottish Regions—"The Tail o' the Herrin',"

"MUSIC HALL" to-morrow night (Saturday, 8.30) brings to the stage of St. George's Hall such favourites as Elsie and Doris Walters, Norman Long and Billy Merson. This "backstage" photograph shows the B.B.C. control room on right and a portion of the Saturday night audience.

which will be broadcast from the decks of the steam drifter "Mary Herd" in Fraserburgh Harbour to celebrate the return of the Scottish fleet from English waters. We in England must take this in the right spirit. Time: 8 p.m.

STORMY WEATHER.

How the Germans love to paint pictures in music! Stuttgart on Monday next, December 3rd, at 8 p.m. offers a concert of "Winter Storms" which should bring many arm-chairs closer to the fireside and benefit the coal trade.

VICTORIAN BALLADS.

ALTHOUGH the Victorian drawing-room ballad has been a good stand-by of the comedian in recent years, it is still taken seriously by many people. On Wednesday evening at 7.30 Phyllis Scott, soprano, and John Rorke, baritone, are to give some "Victorian Reminiscences," including many old favourites which have nothing to fear from modern styles. Phyllis Scott will be at the piano. This recital will be broadcast by London Regional.

THE WEEK'S OPERAS.

OPERAS are fewer this week, but the "bill" is, nevertheless, good. Radio-Paris offers us on Sunday both "La Bohème" (Puccini) and "Cavalleria Rusticana" (Mascagni) relayed from the National Theatre (8 p.m.). On Wednesday, Verdi's tuneful opera "Rigoletto" will be broadcast from the Rome studio (7.45 p.m.).

SHORT STORY TO MUSIC.

SETTING short stories to music—is there scope for a new industry here? Some tales would defy the art of a super-genius, but there are others like "New Lamps for Old" which cry aloud for musical treatment. Compton Mackenzie's well-known romance has been musicalised by Harold Scott and dramatised by Denis Freeman for broadcasting on Wednesday next, December 5th (London Regional 8.50). The tale concerns the 1890's and the scene is laid in the Ionian Club, Piccadilly, the Trident Theatre, Westminster Bridge Road, and at 14, Gardenia Terrace, Lambeth. One can almost smell the gas lamps!

A MASTER CONCERT.

WHEN all the German stations have the same programme it is usually a good one. Tune in any German station at 8.30 p.m. on Sunday, December 2nd, and you will hear a "Master Concert" conducted by Dr. Jose Eibenschutz, the *Generalmusikdirektor*, or Adrian Boult, of the Fatherland.

"G.B.S." PLAY.

BERNARD SHAW's little play "Village Wooing" should make excellent material for broadcasting, there being only two characters. It is to be relayed from the Malvern Festival Theatre on Monday next, December 3rd, at 8.45 (National), with R. Lindsell Stuart as "A" and Phyllis Gill as "Z."

The play was first performed in Texas. It consists of three conversations between a novelist and a strong-minded young woman and has two scenes—the deck of a liner and a village shop.

Very few plays are suitable for broadcasting from the boards of the theatre, but Shavian drama, which depends as much upon the words as upon the action, usually "gets over" the microphone very successfully.



ERNA BERGER, German celebrity singer, who takes the part of Gabriel in Haydn's "Creation" to be broadcast from Copenhagen-Kalundborg on Thursday next.

the Week

Broadcasts at Home and Abroad

HOMAGE TO PUCCINI.

THE tenth anniversary of the death of Puccini is to be celebrated at Danzig to-night (Friday) at 8 o'clock, when a one-act opera "Il Tabarro" will be relayed by Königsberg.

FIVE HOURS OF DANCE MUSIC.

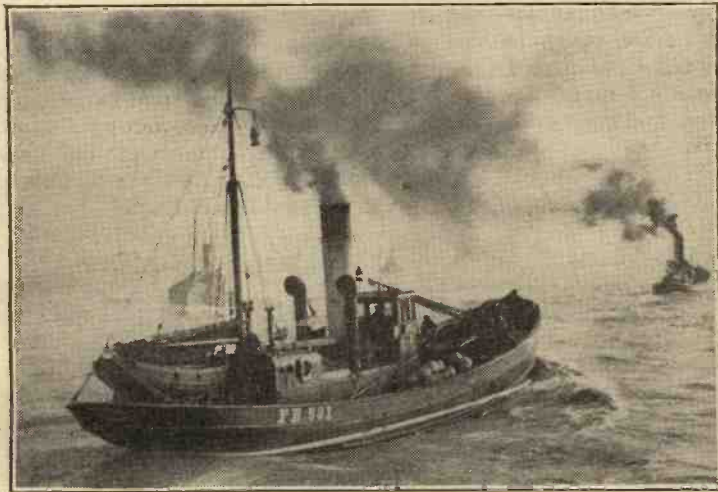
A FIVE-HOUR "Radio Ball" is offered by the Danish stations on Wednesday next, December 5th. The fun begins with a concert at 8 p.m. by the Danish Wireless Dance Band directed by Louis Preil. At 10.15, listeners will be taken over to the "Valencia" dance hall where Otto Lington's band will be heard.

whirl us through the stately pageantry of the last century. The music is taken from "The Bartered Bride," "Die Fledermaus," "Martha," "The Daughter of the Regiment," and Offenbach's "La Belle Hélène."

The singers will include Elena Danieli, Esther Coleman, Jan van der Gucht, and Frank Sale. The programme will be broadcast on Thursday from London Regional at 6.30. May it be the forerunner of many like it!

FOREIGN FUN.

I AM one of those who believe that a sense of fun can be communicated without the aid



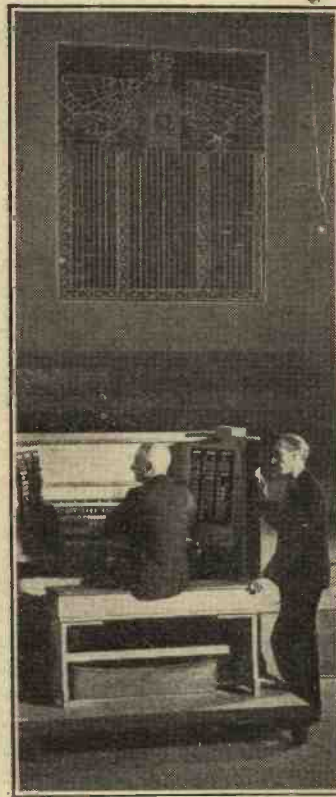
"THE TAIL O' THE HERRIN" is a feature programme coming from the deck of a steam drifter in Fraserburgh Harbour on Tuesday at 8 p.m. Above is a Fraserburgh boat returning with its catch.

Next follows, at 11 o'clock, a relay from the National Scala where Aage Juhl-Thomsen's Whispering Band plays. From midnight to one o'clock, Jens Warny's band will be heard from the "Nimb" restaurant. Here is a good chance to compare Denmark's best dance orchestras in one evening.

BRIGHT AND EARLY.

HATS off to Denis Freeman and Mark Lubbock for inaugurating a "bright and early" regime at the B.B.C. A feature programme at 6.30 in the evening seems too good to be true. But true it is, for "Music at Court" is a feature programme if ever there was one. This Ballad of Bohemia will

of language, and have proved this to my own satisfaction by tuning in various comic programmes all over Europe. When a Frenchman becomes funny he is, to me, quite unintelligible, yet some of the farces and sketches given at the Paris stations have an infectious laughter, and this, blended with the music and general *joie-de-vivre*, compensates the foreigner for his ignorance of the lingo. Similarly those boisterous German variety programmes could make any one chuckle, so I shall not miss the opportunity of tuning in Frankfurt at 7.15 to-morrow evening (Saturday) to hear "Laughing Through Germany" with the Hauck band and comedy artistes.



SIR WALTER ALCOCK (at console) and Mr. Berkeley Mason, both of whom are giving recitals on the Concert Hall organ during the week under review.

SOMETHING DIFFERENT IN ORGAN MUSIC.

"LIGHT organ music" usually suggests the cinema organ, which always stirs violent emotions—either of love or hate. But Mr. Berkeley Mason's "light organ music" recital on Tuesday next (National, 8 p.m.) on the B.B.C. Concert Hall organ lacks the hot-house atmosphere and promises us the fresh breezes of Hollins, Bernard Johnson, Wolstenholme and Lemare.

Light organ recitals fulfil a want; hitherto the art of selection has made very little headway in the organ department, though this branch calls for just as much light and shade as other musical departments.

YOUR PREFERENCES.

WHAT are your preferences in broadcast programmes? It would help to make this "Guide" more valuable to a greater number of readers if the tastes of the majority were known. Given an hour at your receiver, would you choose opera, orchestral concerts, dance music, pianoforte or organ recitals, chamber music or some other radio entertainment? Europe can be scoured for items to suit your taste, so mark your preferences (1, 2 and 3) on a postcard and send it to THE AUDITOR.

HIGHLIGHTS OF THE WEEK

FRIDAY, NOV. 30th.
Nat., 7.30, Kentucky Minstrels.
8.30, "News out of Scotland."
London Reg., 8.15, B.B.C. Organ Recital—IV, Sir Walter Alcock.
9, "The Show Goes Over," a musical production.

Abroad.

Königsberg, 8, Opera: "Il Tabarro" (Puccini).

SATURDAY, DEC. 1st.
Nat., 8.30, "Music Hall." 10, B.B.C. Theatre Orchestra.
London Reg., 8, Rachmaninov Pianoforte Recital by Frank Laffitte.

Abroad.

Brussels, 8.30, Programme by the Liège Conservatoire Concert Society.

SUNDAY, DEC. 2nd.
Nat., 1.30, Medvedeff's Balalaika Orchestra. 5.30, Pianoforte Recital by Josef Hofmann. 9, Leslie Jeffries and Orchestra at the Grand Hotel, Eastbourne. 10, Alfredo Campoli and his Band.

London Reg., 9, Sunday Orchestral Concert. B.B.C. Orchestra with Lionel Tertis (viola).

Abroad.

Vienna, 7.30, Music from Viennese operettas.

MONDAY, DEC. 3rd.
Nat., 6.30, "Science in the Making," by Gerald Heard. 8, Caroll Gibbons and the Savoy-Hotel-Orpheans. 8.45, "Village Wooing," by G. Bernard Shaw.

London Reg., 8, "The Gypsy Baron," by Johann Strauss.

Abroad.

Hamburg, 8, Schubert Songs, Dances and Marches.
Berlin Reichssender, 7.40, Nineteenth-century Dance Music.

TUESDAY, DEC. 4th.
Nat., 7.30, "The Gypsy Baron." 10, Debate between Julian Wylie and Mack Sennett: "Pantomime v. Films." 10.15, The Wireless Singers, with Alice Ehlers (harpischord).

London and Scot. Reg., 8, "The Tail o' the Herrin."

Abroad.

Brussels No. 1, 8, Gala Concert from Théâtre Royal de la Monnaie, in memory of King Leopold III.

Warsaw, 7.15, Opera: "The Devil and Catharine," by Dvorák.

WEDNESDAY, DEC. 5th.
Nat., 6.30, "Books in General," by G. K. Chesterton. 7.30, Concert by B.B.C. National Orchestra in the Free Trade Hall, Manchester.
London Reg., 8.50 "New Lamps for Old."

Abroad.

Warsaw, 8, Chopin Recital.

THURSDAY, DEC. 6th.
Nat., 8, Harold Ramsay and his Rhythm Symphony Orchestra. 8.30, Hughie Green and His Gang.

London Reg., 6.30, "Music at Court." 8.15, Famous Trials—IV: Admiral John Byng. Reconstructed by Anthony L. Ellis, produced by Val Gielgud.

Abroad.

Kalundborg, 7.10, Oratorio: "The Creation" (Haydn).
Warsaw, 8, Concert of Finnish Music.

UNBIASED

More Victims of Progress

YOU can hardly pick up a newspaper nowadays without finding figures and facts quoted as evidence of the very welcome return to this country of industrial prosperity, and I am pleased to say that the radio trade is no exception to the rule, business being everywhere booming.

There is, however, one tragic aspect of the radio industry which was brought to my notice the other day, and by an ironic paradox this unfortunate feature is due to the increasing foolproofness and reliability of modern wireless sets. It so happened that I had been to a reunion dinner of old wartime comrades, and after an extremely convivial evening we had broken up the party rather late, with the result that my last train had gone.



Familiar to many of you.

Naturally, therefore, I turned my footsteps in the direction of a taxi rank and gave the name of a well-known hotel. Having arrived there I found to my chagrin that I had only twopence on me. An offer of my cuff links as security merely brought forth a torrent of abuse.

Suffice to say, however, that an hour later found me wandering disconsolately down towards the Embankment with intent to while away the time by the simple expedient of reposing upon a bench.

Brother, Spare a Dime

To my astonishment I found considerable difficulty in finding a vacancy, most of the available accommodation being in use. At length, however, I did manage to squeeze in and began to look around me. My interest was considerably aroused when I noticed that from the jacket pocket of one of my sleeping companions there dangled an electric soldering iron, while a well-known commercial test-meter was being used as a pillow.

Needless to say, I lost no time in entering into conversation with the owner of these interesting treasures, and was dismayed to find, on closer inspection, that he was a radio service man whose name, were I at liberty to disclose it, would

sound very familiar to many of my readers.

It was indeed an astonishing tale which he told me—of the gradual decline of his business as sets grew better and more reliable, until now they were so free from trouble that he had been brought to this state. Nor was this all, for stirring up a sleeping companion with his boot, he revealed to me yet another well-known service man. I explained the cause for my presence and how I had found some difficulty in finding a vacant bench, and was soon shown the reason why, for my new-found companions quickly took me on a tour of the benches, nearly all of which I found peopled with unfortunate service men who had been broken on the wheel of wireless-set evolution.

The memory of that night haunts me still, and it is with somewhat mingled feelings that I contemplate the unhappy plight of the service engineers, for I cannot help feeling that in some small measure I am personally responsible for their present wretched condition owing to the many times in the old days that I urged upon the manufacturers the necessity of mending their ways and their sets.

Shocks in the Cinema

RECENTLY I have been trying out one of the new scientifically designed deaf aids, and must confess myself astounded at the remarkable progress which has been made in the sensitivity of this type of apparatus. Such progress is, of course, doubly interesting since, like talkies, public address apparatus and similar adjuncts to civilisation, it is due to intensive research work in connection with radio, of which it is a by-product.

Although I have been married a good many years, my hearing is still good enough to enable me to dispense with one of these things under normal conditions, but as the result of some revelations which



Impassioned terms of endearment.

came to me during my tests I doubt if I shall be content to do so in future. It so happened that, without any adequate reason and urged on solely by that instinct or "hunch" which has resulted in so many epoch-making discoveries, I took the instrument along with me to a well-known cinema. Needless to say, the ordinary vocal emanations from the screen were amplified to quite an unnecessary extent, and I was just about to switch off when I became aware of voices in my headpiece which did not, at first, appear to come from the screen. I was amazed to find myself the unwitting and unwilling listener to impassioned terms of endearment.

By FREE GRID

Eventually I realised that they emanated from members of the crowd of "supers" who formed a background for the leading performers on the screen. It is true that the voices continued even when the screen was occupied by only a couple of characters, but I concluded that the *sotti voci* might still come from members of the chorus waiting outside the range of the camera's eye, but near enough for their endearments to be faintly impressed on the sound-track.

Backstage Whispers

These whisperings are, I presume, reproduced by the back-screen loud speakers, but are too faint to be heard by the audience, and it was only the super-sensitiveness of the new deaf aid which rendered them audible to me. I have subsequently made tests in several other cinemas and find that it is just the same wherever I go. There is, however, one curious feature for which I can find no explanation, and that is that the voices sound more numerous and more pronounced when sitting in the back seats of the cinema, whereas one would naturally expect the reverse to be the case. Doubtless, however, it is due to some peculiarity of acoustics which one of my readers who is an expert in that science may be good enough to explain.

At any rate, I think it a disgrace that film-producers cannot arrange for their employees to desist from love-making during working hours. It is true, of course, that, unless equipped with a deaf aid or some similar amplifying apparatus, these "noises off" are unheard by the audience, but it must be borne in mind that there are certain people among cinema habitués (and unfortunately they are far from being in the minority) who, once they learn that these "extras" are obtainable, will not hesitate to equip themselves with the necessary apparatus for overhearing them.

CURRENT TOPICS

Events of the Week in Brief

Marconiana

THE Pope has coined a new word, namely Marconiana—things pertaining to wireless—which His Holiness used when saluting in Latin the Buenos Aires Eucharistic Congress in a broadcast from Rome.

Police Radio Interference

INTERFERENCE with broadcast reception has been caused by the Newcastle City police transmitter (GTT), but according to an official of the Post Office Engineering Department only very unselective sets are troubled.

When Listeners Broadcast

DANISH listeners having relatives or friends in Greenland are to be allowed to broadcast messages on short waves during the Christmas week. These special broadcasts will also be radiated by the medium-wave transmitters of Copenhagen-Kalundborg. Listeners are now responding to the invitation by booking "time on the air."

Sponsored Programmes from the Isle of Man?

ACCORDING to the *Newspaper World*, a well-known advertising agency has made arrangements for the erection of a broadcasting station in the Isle of Man from which sponsored programmes will be radiated to Great Britain.

The Isle of Man is under the control of the Post Office for all post and telegraph purposes, and is specifically mentioned as one of the territories controlled by the B.B.C. in the Corporation's Charter.

Lord Selsdon and Television

THE British Television Commission to America was feted by private and Government radio officials in New York and Washington. Lord Selsdon, the Chairman (writes our Washington correspondent), expressed the conviction that television is about ready but awaits giant financing before it can emerge into popular use. He also said that the British licence system would make it easier to finance television than the American system of sponsored programmes.

In Iceland

NO fewer than 84 per cent. of the population of Iceland listens in. At the end of September there were 9,357 listeners, an increase of 1,327 in the course of nine months.

Russian Television

THE Soviet Radio Committee in Moscow, which has been broadcasting television programmes for some time, now transmits them in the form of a Telechronique or television newspaper. The transmission is by means of specially prepared sound films.

Shock for Mr. Borgbjerg

RAIDING the radio funds is the charge levelled at Mr. Borgbjerg, the Danish Minister

Money from South Africa

THE sum of £1 5s. has been received by the Berlin short-wave station from a German listener resident in South Africa. In his letter he states that he preferred sending the fee to the station in the homeland to which he listens regularly, rather than to the local broadcasting organisation.

New Ultra-shorts Theory

THAT a damp atmosphere improves the performance of

Medical Talks at Mealtimes

CONTINUING its campaign against the broadcasting of unsavoury talks during mealtimes, our Paris contemporary, *Haut Parleur*, describes in vivid terms a broadcast address by a well-known doctor who recently dealt with pathological transformations of tissues during the dinner hour in such a way that "listeners learnt much more than they ate."

German Radio Drama

GERMAN radio drama is copying B.B.C. methods by at last adopting the multi-studio method. Work is now in progress at the Berlin Funkhaus for constructing separate sets of studios for dramatic productions. Hitherto the only move in the direction of multi-studio production has been the use of "tents" in various parts of a big studio.

400 Dealers

SOME 400 radio dealers have now been appointed to the Approved Register of the Wireless League.

In an open letter to listeners the League states that the Wireless League Approved Traders' workshops have all been examined and that the League can vouch for the fact that its dealers possess the necessary apparatus to carry out all repairs likely to arise.

"Cathode Ray"

THE "Cathode Ray" film which was shown at the Radio Research Board stand at Radiolympia was shown before the Film Society last Sunday at the Tivoli, Strand. The film, which illustrates the operation of the cathode ray, has been declared by a special committee of the British Film Institute to be the most perfect scientific film so far produced.



RADIO ON TRANS-PACIFIC FLIGHT. Captain C. T. P. Ulm in the Airspeed "Envoy" in which he will attempt a flight from Vancouver to Melbourne. The apparatus shown is (left to right) the Marconi "homing" device, Marconi medium- and short-wave transmitter (above) and receiver, and the switchboard for wireless and lighting current, which is derived from a wind-driven generator.

of Education, who has suggested the allocation of 500,000 kroner from licence fees to subsidise the Royal Theatre. The listeners' associations are up in arms.

Wireless in Hospitals

THE *News-Chronicle*, associated from the earliest days with the installation of wireless in hospitals, is to be congratulated on launching a national appeal for funds to ensure the installation of up-to-date wireless in every hospital throughout the country. The appeal is sponsored by a Council formed by the journal in co-operation with the Radio Manufacturers' Association.

The subscription list was opened by a cheque for £150 from the King and Queen.

Radio Amateur Call Book

THE price of the "Radio Amateur Call Book" magazine, referred to in our issue of November 9th, is 5s. 6d. post free and not as stated.

ultra-short waves is the considered opinion of the American Radio Relay League following research at the headquarters laboratory. According to Ross A. Hull, director of the work, experiments between West Hartford laboratory and various observation points in New England over a period of three months show that when the humidity is high—short of actual rain—transmission conditions are much better.

THREE SPECIAL NUMBERS

December 7th, 14th and 21st

These issues will contain, in addition to the usual matter, extra pages devoted to a comprehensive, illustrated guide to the season's receivers and radiogramophones. The features of each set will be summarised and special attention will be drawn to those points which are distinctive.

Other special articles in these issues will deal with recent improvements in the design of components.

How Valves Fail

Some Common Symptoms of Old Age

By W. T. COCKING

THE rapid growth in the number of valves employed in a modern receiver makes it increasingly difficult to locate a defective specimen. At one time the death of a valve was obvious, for its filament ceased to light, but the introduction of dull-emitter valves made matters more difficult. Although the valve no longer gave out enough light to read by, the glowing filament was easily discernible. Users found, however, that the valve became useless long before the filament burnt out, since after a period the filament ceased to emit electrons in sufficient quantity for the valve to function correctly.

It was at this stage that the use of the milliammeter for valve testing came to the fore, since it provided the only means of determining the state of a valve. The emission of the cathode or filament varies throughout the life of a valve, and the tendency is towards a continual fall. This is reflected by a gradually dropping anode current, so that if a note be kept of the anode current of a new valve it is easy to see when the emission is failing by measuring the anode current periodically. Providing that the voltages applied to the valve are kept constant, a drop in anode current can only be due to failing emission. The precise amount by which the anode current can be allowed to fall depends largely upon how great a deterioration in performance one is prepared to tolerate.

Anode Current v. Performance

In cases where the highest quality of reproduction is required the anode current should not be allowed to fall by more than some 25 per cent. below its initial value, and this applies particularly to the output valves. It is hardly ever permissible to operate a valve the anode current of which has dropped to less than one-half its original value if one wishes a receiver to give any pretensions to a good performance.

When testing the valve anode currents it is important to make sure that the voltages are maintained at their correct value. If it be found, for instance, that all the valves in an AC set pass low anode current it is more probable that the rectifier is failing and causing low voltages throughout the set than that all the valves are defective.

At one time the life of a valve was set either by the breakage of its filament or by the loss of emission, and this is still true of most battery valves, and, indeed, of directly heated valves in general. With indirectly heated valves, however, it is

THE end of the useful life of a modern valve is not usually set by the breaking of its heater or filament, but more often by a deterioration in the performance of the receiver. In some cases the valve may become microphonic, in others hum may appear. Some of the commoner symptoms shown by valves of various types are discussed in this article.

often found that the end of the useful life is marked rather by the appearance of defects rather than by falling emission. Noisy or intermittent reception is a common occurrence when valves are failing; the precise nature of the symptoms, however, varies, not only according to the use to which a valve is put but with its make.

Thus, when an indirectly heated triode is used as a detector or LF amplifier it is probable that the end of its useful life will be marked by the appearance of hum if it be a Mullard valve. This hum is usually of quite a high pitch and is intermittent, continuously varying in frequency and intensity. With a Mazda valve, however, it is more probable that a very deep, steady hum will appear, and the valve may become very microphonic. A Cossor valve will often give warning of its approaching decease by becoming noisy and giving a gentle background of crackles to reception, which will often temporarily cease if the valve be gently tapped. With a Marconi or Osram valve, however, the symptoms are less definite, and where low emission does not set the limit to its usefulness the end of its life may be marked by noisy reception whenever the valve is subject to vibration. If the valve be tapped when it is in this state there will usually be a single crash from the loud speaker.

It should be understood that these remarks are based upon the valves sold over a year ago, so that they may apply only to such valves. Changes in construction are continually being made, and it is by no means improbable that the valves now supplied do not exhibit the symptoms just described. It is yet too early to say how this year's valves behave, simply because insufficient time has elapsed for them to have reached the end of their lives with normal use.

The Broken Heater

There are other valve failures, however, which are likely to be found at times with any valve. One of these is a broken heater in an indirectly heated valve, and this is not as easy to diagnose as one might suppose. With a broken heater it often happens that the two ends remain in con-

tact, so that no defect is revealed when the heater is tested for continuity. When the set is switched on the heater warms up normally and the set functions. When the heater has reached its full temperature, however, it expands to such a degree that the broken ends part company. This interrupts the current, the heater cools, and reception gradually ceases. When the heater has cooled sufficiently the ends again make contact, and current again flows, so that reception recommences. The cycle repeats itself indefinitely, and the continual interruption of the programme makes the defect particularly irritating.

Insulation Breakdown

Broken-down heater cathode insulation is another defect which can be very puzzling, particularly if it be intermittent. If it occurs in an LF valve it usually causes poor quality of reproduction, since it short-circuits the bias resistance. It is, however, a rare fault in such a valve, if only because the difference of potential between heater and cathode rarely exceeds about 6 volts. This applies also to an HF valve in a set fitted with AVC, but when it does occur the symptoms are usually instability and motor-boating.

In cases where volume control is obtained by biasing the cathode positively by some 20 to 40 volts, and this means in most sets fitted with variable- μ valves and a *pre-detector* volume control, a breakdown in the heater-cathode insulation will almost invariably render the volume control inoperative. Instability and severe distortion may also appear, and are highly probable in a sensitive receiver. This defect is often intermittent, which naturally increases the difficulties of diagnosis, but a voltmeter connected across the bias supply will usually speedily reveal the fault, for its reading will drop whenever it manifests itself. It should be noted that a test of the heater-cathode insulation with the heater cold is of no value whatever.

Poor heater-cathode insulation, as distinct from a complete breakdown, may cause modulation hum which does not respond to the usual remedies. This is more likely to occur with high-voltage Univer-

How Valves Fail—

sal-type valves than with the ordinary AC specimens on account of the greater AC potential between heater and cathode.

The Output Stage

Output valves are usually directly heated, and it is quite rare for them to develop any defect until the emission falls. Occasionally, however, grid emission or some similar defect occurs, and the symptoms are so violent that it is impossible to overlook them. The writer has several times met with valves of the 2.5 watts output class which caused the loud speaker to emit a sound which can only be described as a scream. At the same time the anode current rose to several times the maximum rating for the valve, and the voltage developed across the bias resistance fell to zero—an apparently impossible

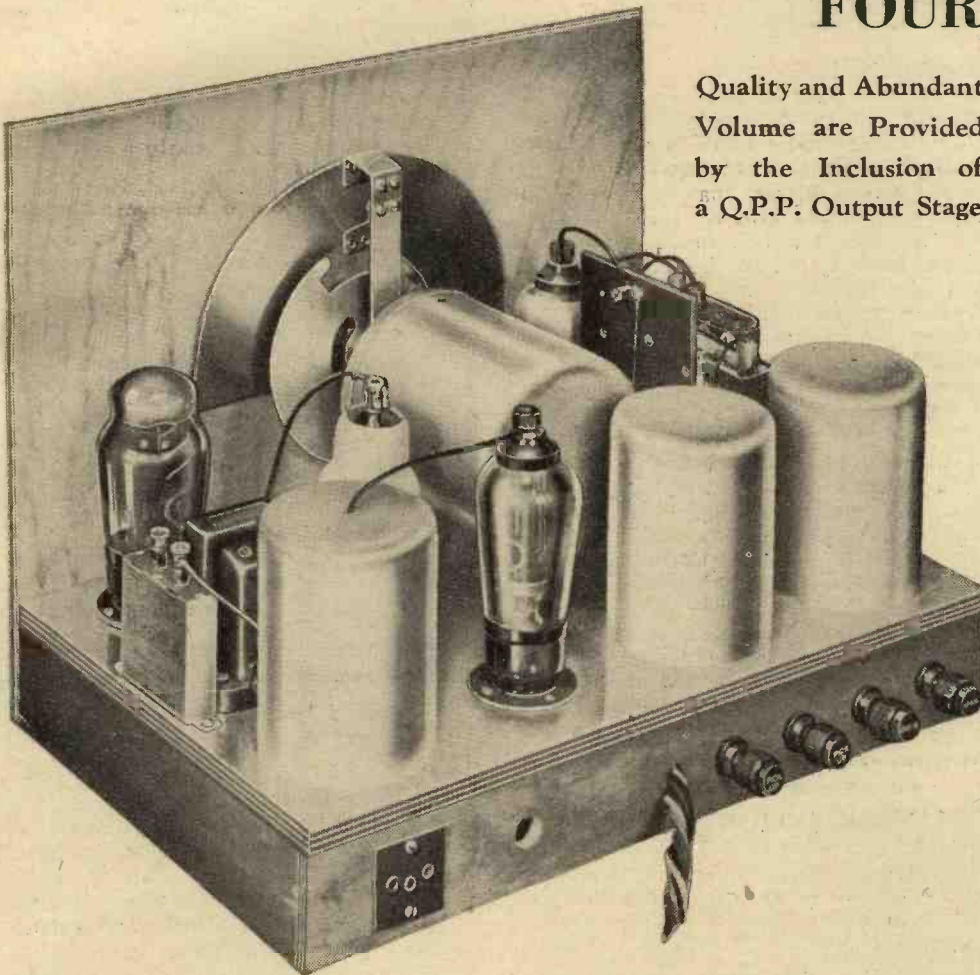
condition which can only be accounted for by reverse grid current equal in value to the anode current! This effect is rather rare, and it must be two years since the writer has met with a case.

Before concluding, some mention should be made of modern multiple valves. It is not uncommon for one-half of a double QPP pentode or Class "B" valve to fail before the other. The result is that the receiver continues to function, but very serious distortion appears. It is well, therefore, to test the anode currents of such valves separately. The diode sections of duo-diode-triodes do not usually cause much trouble, but it is as well to remember that a severe overload may cause that portion of the cathode which feeds the diodes to lose its emission, with the result that the efficiency may fall and distortion appear, while AVC may not function correctly.

In Next Week's Issue:—

**NEW SINGLE-SPAN BATTERY
FOUR**

Quality and Abundant
Volume are Provided
by the Inclusion of
a Q.P.P. Output Stage



Improved Design for Superhet Receiver

RECENT articles in *The Wireless World* have dealt with the latest developments in single-span tuning, and these are included in the receiver to be described in next week's issue. Only four valves are used, and these are

arranged as a heptode frequency-changer, a single IF stage, a combined diode detector and LF amplifier, and a QPP output stage. Three tuned IF circuits are included, together with a novel reaction system, and the improved aerial filter vir-

tually eliminates the possibility of second channel interference.

The single-span system of tuning is embodied and complete waveband coverage of 200-2,000 metres is obtained without switching or ganging.

The sensitivity and selectivity are adequate for general distant reception and the quality of reproduction is unusually good, the output being adequate for most purposes and the frequency response even over a wide range. A volume control is fitted which operates on both radio and gramophone. Economy in current consumption has been carefully considered, and the receiver draws only 10mA. from the HT battery.

LIST OF PARTS

- 1 Aerial filter Wearite
- or set of parts comprising:
 - 2 Paxolin tubes, 3/4 in. dia. x 1 1/4 in. long
 - 1 bobbin (see text)
 - 2 resistances, 300 ohms, 1 watt
 - 1 resistance, 700 ohms, 1 watt
 - 1 condenser, 0.000125 mfd. Accurate to within plus
 - 1 condenser, 0.0001 mfd. J or minus 5 per cent.
 - Quantity No. 38 DSC and 42 DSC wire
 - Mounting board, brackets, etc.
- 3 IF coils Wearite
- or 3 Paxolin tubes, 1 in. dia. x 1 1/4 in. long Wearite
- Quantity No. 32 DSC and 36 DSC wire
- 1 Oscillator coil assembly Wearite
- or 1 Paxolin tube, 3/4 in. dia. x 2 1/4 in. long Wearite
- Quantity No. 36 DSC wire
- 1 Tuning dial Eddystone 973
- 1 Variable condenser, 0.00016 mfd. Polar Type "E"
- 1 Compression condenser, 0.0001 mfd. Colvern
- 3 Variable condensers, 0.0001 mfd. Eddystone 900
- 3 Knobs Bulgin K6
- 3 Screening cans, 2 1/2 in. dia. x 3 1/2 in. height Goltone R9/321
- (Mains Power Radio)
- 1 Screening can, 3 1/2 in. dia. x 4 1/2 in. height Goltone R9/322
- (Colvern)
- 1 Variable resistance, 50,000 ohms Haynes Radio
- (Bulgin, Colvern, Watmel)
- 1 Variable resistance, wire-wound. 50 ohms, with knob Kabi—F. W. Lechner & Co., Ltd.,
- 61, Spencer Street, London, E.C.1.
- 1 Tapered volume control potentiometer, 250,000 ohms Ferranti Type "P"
- (Claude Lyons, Magnum, Rothermel)
- Resistances:
 - 1, 10,000 ohms, 1 watt Erie
 - 1, 25,000 ohms, 1 watt Erie
 - 1, 100,000 ohms, 1 watt Erie
 - 1, 150,000 ohms, 1 watt Erie
 - 1, 250,000 ohms, 1 watt Erie
- (Bryce, Dubilier, Ferranti, Graham Farish, Claude Lyons, Polar-NSF, Watmel)
- Fixed condensers:
 - 1, 0.1 mfd. tubular TMC Hydra T24
 - 1, 0.01 mfd. tubular TMC Hydra T17
 - 2, 0.005 mfd. tubular TMC Hydra T15
 - 3, 0.0001 mfd. tubular TMC Hydra T3
 - 1, 1 mfd. TMC Hydra 26
 - 1, 2 mfd. TMC Hydra 25
- (Dubilier, Graham Farish, Peak, Polar-NSF, T.C.C., Telsen)
- 2 Valve holders, 5-pin Clix Chassis Mounting Standard Type
- (Goltone)
- 2 Valve holders, 7-pin Clix Chassis Mounting Type
- (Goltone)
- 1 Screened HF choke Bulgin HF8
- (Wearite)
- 1 QPP transformer, ratio 1:8 Lissen LN5308
- (Graham Farish, Multitone)
- 1 QMB toggle switch, DPDT Bulgin S89
- 1 QMB toggle switch, 3-point Bulgin S87
- 1 Speaker plug and socket, 3-way Belling-Lee 1119
- 4 Ebonite shrouded terminals, A., E., Pick-up (2) Belling-Lee "B"
- 1 Connector, 6-way Bryce
- 1 Battery cable, 6-way, with terminals and spade ends Goltone R59/472
- 5 Wander plugs, 2 GB+, 1 GB-, 1 GB-1, 1 GB-2 Clix "A"
- 1 GB battery, 4 1/2 volts
- 1 GB battery, 9 volts
- 2 GB battery clips Bulgin No. 2
- 1 HT battery, 150 volts
- 1 LT accumulator, 2 volts
- 1 length Screened sleeving Goltone
- 1 oz. No. 22 tinned copper wire, 6 lengths Systodex, wood, etc.
- Wood panel, 14 in. x 10 1/2 in.
- Plymax baseboard, 9 x 14 x 3/4 in. Peto-Scott
- Screws: 20 1/2 in. No. 4 R/hd.; 20 1/2 in. No. 4 R/hd.; 4 3/4 in. No. 4 R/hd.; 1 3/4 in. No. 6BA with nut and washers.
- Valves: 1 Ferranti VHT2; 1 Osram or Marconi VS24; 1 Osram or Marconi HD22; 1 Osram or Marconi QP21
- Loud speaker with universal or QPP transformer WB.PMS2 Stentorian
- Cabinet G.A.C. Cabinets, Ltd.

Readers' Problems

A "Live" Aerial

THE user of a DC mains set has found out accidentally that his aerial is "live," as a shock is obtained on touching it. This reader is at a loss to understand how a large difference of potential between aerial and earth can exist, as "the usual isolating condenser is connected in the earth lead."

This experience serves to emphasise the fact that the whole external aerial-earth system of a DC set should be metallically isolated from all parts of the receiver that are connected to the mains; an earth condenser alone is not sufficient, but should be supplemented by another in the aerial lead.

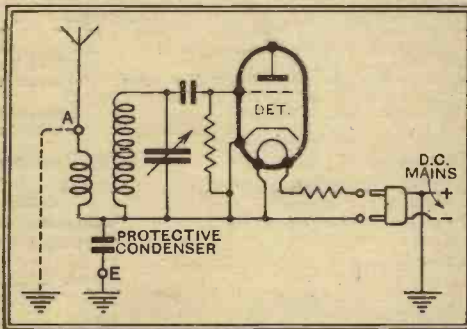


Fig. 1.—Explaining the need for isolation between aerial and mains in a DC set.

This point will be evident after a consideration of Fig. 1, which shows in skeleton form the circuit arrangement of the simplest possible single-valve DC set. The positive pole of our correspondent's mains is evidently earthed, and on tracing through the circuit it will be seen that the aerial terminal A is at full mains potential with regard to earth, in spite of the presence of a condenser in the earth lead. A connection made between terminal A and earth (as shown in dotted lines) will therefore impose a short-circuit across the mains.

Just Bad Luck

A CORRESPONDENT tells us that the IF valve of his superheterodyne has failed twice within a period of a few months; naturally enough, he has become suspicious that some defect in the receiver is responsible, and asks our opinion. It is added that the anode current of each of the valves which have failed has been checked periodically, and has always been found to be within 20 per cent. at least of the rated figure.

It is logical to suspect that the valve in question may have been receiving an excessively high heater voltage, but, as it is fed from the same LT winding as three other valves which have given no trouble, this is hardly possible. We can therefore only assume that our correspondent has been unfortunate in his valves, and that both the specimens that have come to an untimely end have been defective.

Battery Sets and Eliminators

THERE are exceptions, but the average battery eliminator does not give sufficient output for operating a receiver in which "mains set" technique is followed. As a

consequence, those who wish to retain their eliminators are usually compelled to use battery-fed valves, and generally to follow battery-set practice in design as far as possible.

For the benefit of several readers who have lately written to us on this subject, it should be put on record that the output circuits of modern battery sets are seldom designed to be used with an eliminator. Class "B," QPP, and other "quiescent" systems require a more perfectly regulated source of anode current supply. The plan recommended, therefore, is to follow the design as far as the output valve, and at that point to substitute either a pentode or triode with the greatest output capacity compatible with the limitations imposed by the eliminator.

"Single-Span" Instability

ONE of the advantages of the single-span system of tuning is that it is inherently simple, and so the difficulties of getting a receiver including the principle into a state of satisfactory operation should be extremely small. In particular, instability should seldom give trouble, and we suggest to a constructor of the Olympic S-S Six that the uncontrollable self-oscillation that he describes is probably curable quite easily by re-arranging the anode leads of the two IF valves, or by screening them in low-capacity metal-braided sleeving.

If this proves to be ineffective, he should assure himself that the by-pass condensers are in order, and that all earthing connections to the chassis are making good contact. As a last resort, it would be permissible to remove between 10 and 20 turns from the primary of the transformer L7.

Circuits for Selectivity

THE user of a high-quality local-station receiver (the Power Radiogram, described several years ago in this journal) wishes to replace the existing two-circuit aerial tuner by a more modern single-circuit arrangement, and asks for our advice on this subject.

Our correspondent is apparently under the impression that he will obtain at least as good, if not better, selectivity from single-circuit condensers employing a modern type of coil. This is a mistake; even the best

The Wireless World INFORMATION BUREAU

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

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1. and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

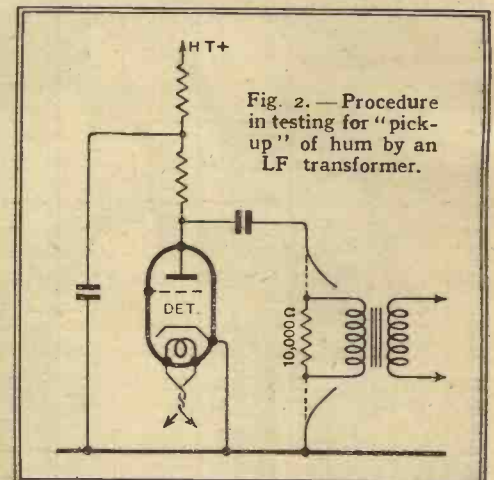
of modern coils, when used in a single-circuit tuner, cannot possibly provide as much true selectivity when used alone as a pair of coupled circuits of reasonable efficiency.

There exists a possibility, however, that the performance and general handiness of the receiver could be improved appreciably by modernising the tuner by fitting good iron-cored coils and an up-to-date ganged condenser.

Tracing Hum

IF the smoothing system can be assumed to be free from suspicion, the most usual cause of hum in an AC mains receiver is inter-action between the power transformer and the LF transformer. Fortunately the cure for this form of trouble is usually not difficult; the position of the LF transformer is merely changed experimentally until the hum disappears.

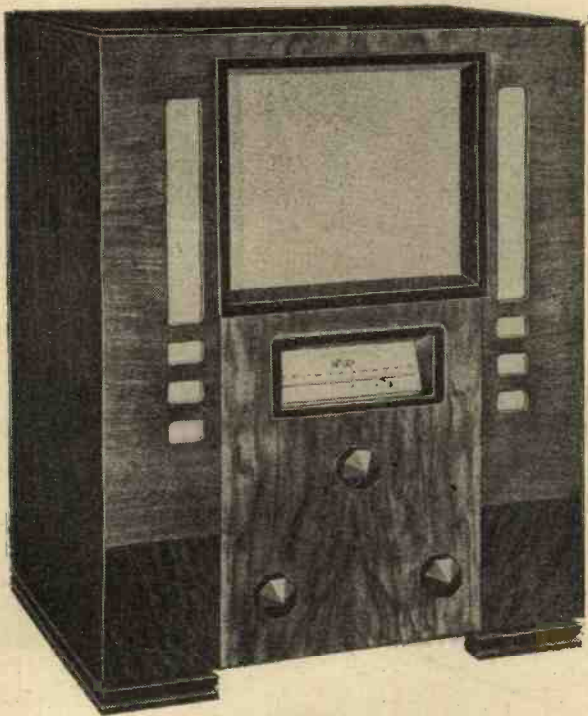
Before doing this, it is, of course, as well to assure oneself that interaction of the type in question is really responsible for the hum. A reader asks us to describe a simple method of testing that will settle the matter definitely.



It is usually recommended that the leads normally joined to the LF transformer primary should be disconnected, and that a resistance of about 10,000 ohms should be temporarily joined across the primary terminals. If the hum still persists, but disappears on short-circuiting the transformer secondary, it may be assumed quite definitely that interaction is responsible for it. The procedure is illustrated diagrammatically in Fig. 2; this diagram applies to a resistance-fed transformer, but in essentials the same arrangement is applicable when the component is inserted directly in the anode circuit of the detector valve. In such circumstances, however, it is as well to join together the two leads originally connected to the primary, in order that anode current may still pass to the detector valve, and thus avoid any appreciable disturbance of the normal voltage and current distribution throughout the set.

AMPLION "RADIOLUX" RECEIVER

An Unusual Circuit Incorporating a Neon Tuning Indicator



FEATURES.—*Type.*—Table model superheterodyne for A.C. mains. *Circuit.*—Var.mu pentode HF amplifier—octode frequency changer—IF coupling transformer—screened pentode second detector—pentode output valve. Full-wave valve rectifier. *Controls.*—(1) Tuning with neon indicator. (2) Volume and on-off switch. (3) Waverange switch. (4) Aerial trimming control. **Price.**—12 guineas. **Makers.**—Amplion (1932) Ltd., 82-84, Rosoman Street, Rosebery Avenue, E.C. 1.

signals to the screened pentode second detector. A Westinghouse metal-oxide rectifier, fed through a small condenser from the anode of this valve, provides delayed AVC to the grid of the input HF amplifier.

Resistance coupling is employed between the second detector and the three-watt pentode output valve. There is provision for an external loud

speaker in parallel with the primary of the output transformer, and by means of a switch at the back of the chassis the internal loud speaker may be disconnected if desired. The field of the moving-coil loud speaker is used for smoothing, and the speech coil circuit includes a hum-bucking coil.

The chassis is of oxidised steel with an attractive transparent cellulose finish. An unusually attractive feature is the provision at the back of an aerial trimming control which is fitted with a large-sized instrument knob. This is a great improvement over the usually inaccessible set-screw, and rightly encourages the user to give careful

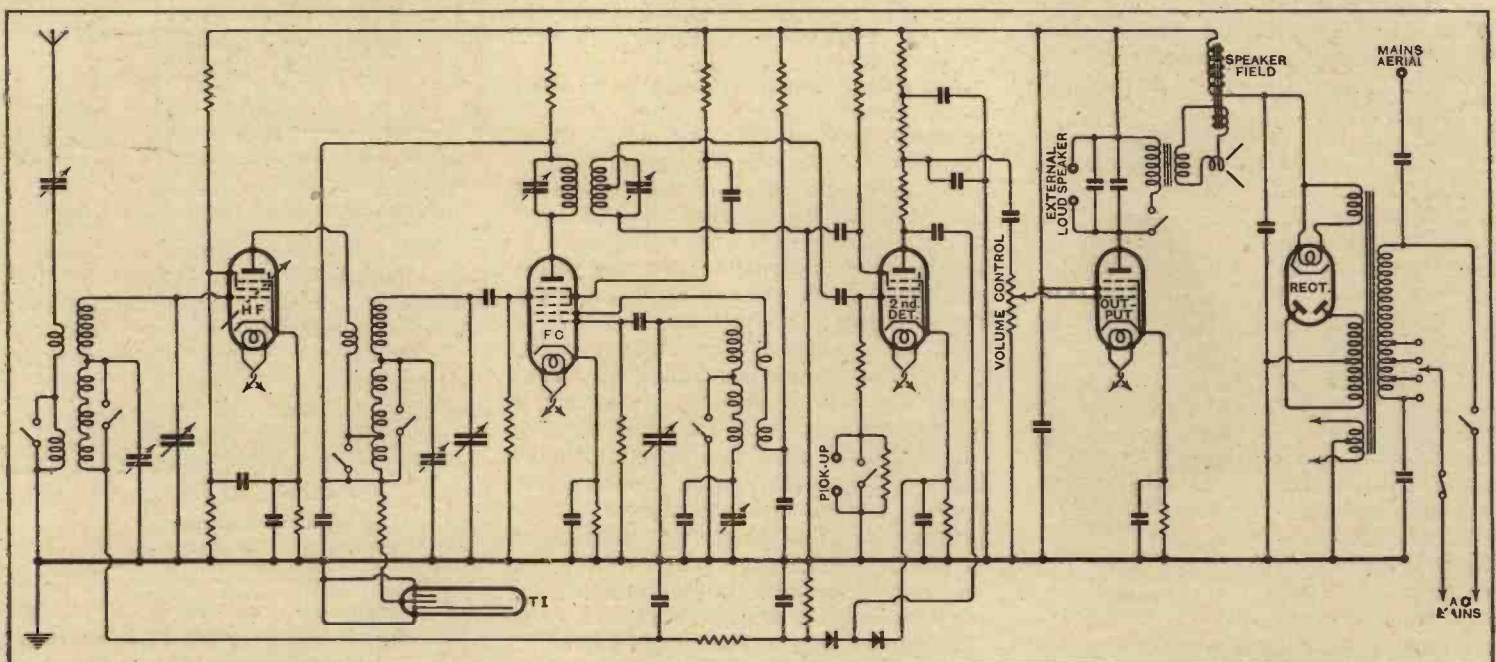
attention to the proper adjustment of his set. It is true that the aerial trimming may be accidentally knocked out of adjustment, but, on the other hand, an occasional check of the aerial adjustment is, in any case, desirable, as condensers of the pre-set type are frequently liable to variation of capacity due to temperature changes.

ALTHOUGH this receiver properly belongs to the four-valve class of small superheterodynes, it is very far from being stereotyped in design. Whereas the majority of receivers of this class rely upon the IF stage to provide the greater part of the selectivity and signal amplification, in the "Radiolux" receiver an efficient variable-mu pentode HF stage performs the bulk of the work. With it are associated two tuned circuits, one in the input and one in the coupling between the HF stage and the octode frequency changer. There is no separate IF valve, but a double-tuned IF transformer adds its quota of selectivity in transferring

Tuning Indicator

Another useful feature is the neon tuning indicator. This is viewed through a horizontal slit above the tuning scale, and indicates exact tuning by the length of the glow discharge as it proceeds along a wire electrode at the back of the lamp. In our opinion, the neon lamp might have been better shielded from the glare of the tuning scale pilot light, but no great difficulty should be experienced when one has become accustomed to the appearance of the glow discharge.

We were most impressed with the quality of reproduction, which was much over the average for this type of receiver. A very good balance of tone was obtained,

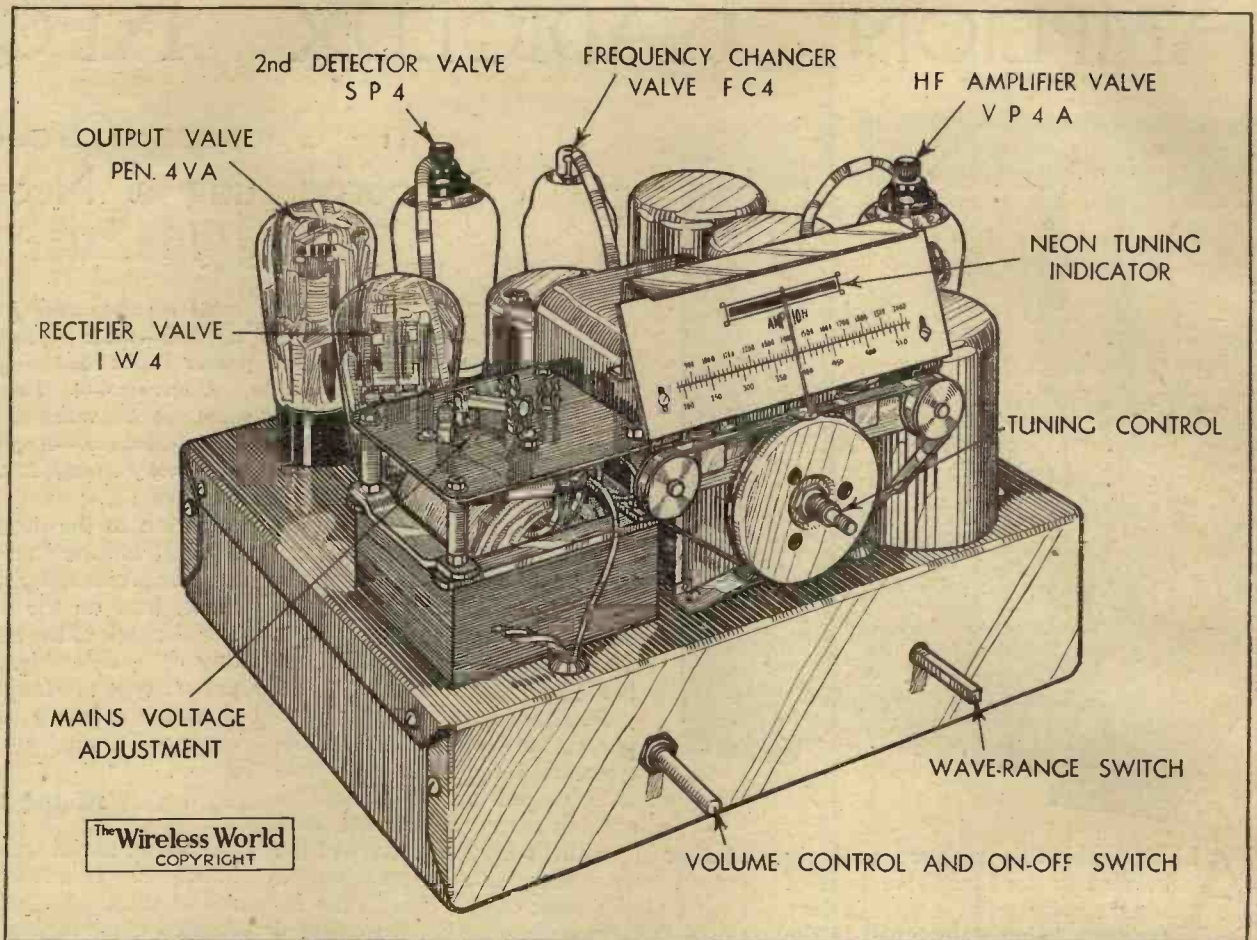


The IF coupling consists of a tuned transformer without valve amplification, but an initial signal-frequency amplifier is provided.

Amplion "Radiolux" Receiver—

and reproduction had a solid foundation of bass with very clear-cut reproduction in the middle and upper registers. No resonance could be detected which would be in the least likely to be noticed even after one had lived with the set for several weeks.

The range is adequate without being sufficient to accentuate background noise between stations, and the four or five foreign programmes which were received during the hours of daylight gave promise of a good performance in the matter of range after sunset. The selectivity enabled the Brookmans Park transmitters to be cut out in Central London at a separation of 20 to 25 kc/s (two to three channels) on either side of their normal settings. On long waves there was not sufficient interference from Droitwich and Radio-Paris to de-



A slow-motion drive free from backlash and a neon tuning indicator are notable features of the chassis.

prive the Deutschlandsender of programme value. In the matter of second-channel interference the set was decidedly above the average, and any whistles arising from this cause would have to be

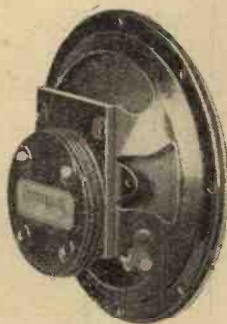
searched for deliberately to be noticed. This receiver creates a general impression of neatness and efficiency, and is of the type which one would judge as likely to be free from minor servicing troubles.

An Inexpensive "Tweeter"

New Rothermel-Brush Crystal Unit for the Experimenter

IN view of the interest which is now being taken in the extension of the range of audio response in the upper register, the introduction by R. A. Rothermel, Ltd., of a piezo-electric "tweeter" is particularly opportune.

This unit has been specially designed to meet the requirements of the experimenter and can be used in conjunction with existing moving-coil units. It is of the cone type and is driven by a specially designed small Rochelle salt crystal. The cone diameter is only 4in., and this is one factor contributing to a sharp acoustic cut-off below about 3,000-4,000 cycles. The great advantage of this sharp cut-off is that complicated electrical filters are unnecessary and all



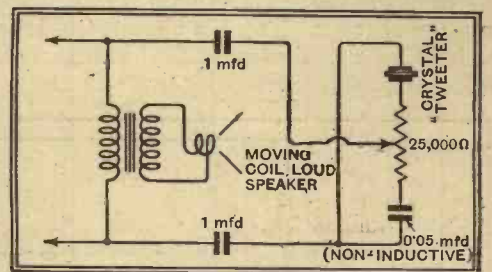
Rothermel-Brush type R155 crystal "tweeter."

that is required is a simple capacity coupling.

The makers recommend the provisional circuit shown, which also allows for adjustment between the relative outputs from the moving-coil and crystal units. Incidentally, the efficiency of the crystal unit is much higher than that of most moving-coil loud speakers, and there will be a reserve of output at the top which with care can be used to compensate for high note loss in the receiver.

An exploration of the frequency response showed that the output rises from practically nothing at 3,000 cycles to full value at 4,500 cycles. This level is maintained without audible irregularity until 8,500 cycles is reached, at which point there is a slight rise and then a steady decrease as the frequency is further increased. At 12,500 cycles (the highest frequency tested) the output was a little less than half that at 4,500 cycles.

There can be no doubt that this is an ideal unit for attachment to existing moving-coil loud speakers, and at the very reasonable price of 21s. should bring high



Suggested circuit for coupling the crystal unit to an existing moving-coil speaker.

quality reproduction within the reach of all, provided, of course, that the high frequencies are reaching the primary of their output transformers.

There are few sounds which are not better reproduced with the high-frequency unit in the circuit, and the improvement in string tone, oboe, cymbals, and other sounds rich in harmonics will come as a revelation to most people.

Foundations of Wireless

It is regretted that owing to pressure on the available space in this Special Valve Number, Part III of the series under the above title has unavoidably been held over.

A field-strength measuring set, as used by the G.P.O.



The Technique of Radio Interference

Disturbances on a Quantitative Basis

THE subject of radio interference is receiving considerable attention and much investigation work has been carried out, the ultimate object of which is to specify and subsequently secure a limitation to the magnitude of the disturbances set up by electrical plant. International agreement upon a suitable technique for dealing with this disturbance has not yet been reached, but a settlement of this matter is expected to result from tests to be carried out in Berlin in December. The purpose of this article is to outline the problem which has to be faced.

By

A. MORRIS

A.R.C.Sc., Wh.Ex.

M.I.E.E.

In the case of broadcasting, however, with its continual variation of programme level and wide range of possible average loudness to suit various listening conditions, the annoying effect of noise or its impairment of the æsthetic value of the received programme is an additional and perhaps a more important aspect of HF disturbance. The first matter upon which agreement is required is therefore that of the method of expression, prin-

INTERFERENCE with radio reception results from the sudden variation or interruption of the normal operating current of electrical appliances, which are thereby caused to generate radio-frequency disturbances. In the case of plant which produces, in a radio receiver, noise of a uniform character, such as humming and buzzing, as distinct from impulsive noises, such as clicks and crashes, the periodic changes of operating current have a fundamental frequency, usually within the audio range.

Interference and Its Dissemination

The manner in which HF disturbances produce noise in a broadcasting receiver will now be considered. Such disturbances, generated in the manner described above, give rise, in general, to a complex variation of electrical potential in the space surrounding the plant, and eventually, whether conducted or radiated from the source, in the space surrounding the aerial of the disturbed receiver.

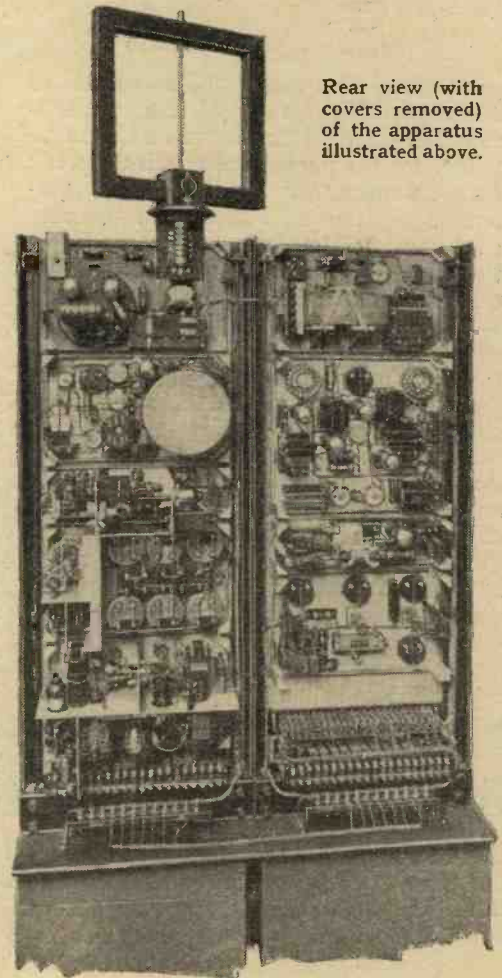
J. W. Alexander has shown ("Hochfr. Techn. u. El. Ak.," Vol. 40, 1932) that for purposes of investigation such disturbances may be analysed into a voltage spectrum of non-continuous or line structure, of spacing equal to the fundamental interruption frequency, and of differing

intensity throughout. Simply stated, the disturbance may be regarded as consisting of an infinite series of component radio-frequency disturbing EMF's, distributed over the whole range of radio-frequencies.

These components combine with the broadcast carrier in the aerial circuit of the radio receiver, and when passed through the detector give rise to an infinite series of beat notes. Of these beat notes, those which are audible and within the acceptance band of the audio-frequency amplifier appear at the output terminals of the receiver and produce noise in the loud speaker. If the broadcast carrier is modulated, then the noise exercises an interfering effect upon the programme. This effect may be expressed numerically in accordance with the various methods to be described.

The basis of all proposed methods of expressing HF disturbance is that of the interfering effect of the resulting noise upon programme reception. The importance of the relative amplitude, frequency and phase of the component frequencies, and of the general level or loudness of reproduction of the noise, in regard to its interfering effect, or the manner in which such effect is to be judged and measured has not been authoritatively defined.

In the operation of commercial radio telephone circuits the degradation of intelligibility is the most important interfering effect arising from disturbance to such circuits.



Rear view (with covers removed) of the apparatus illustrated above.

The Technique of Radio Interference—

ciples of measurement, and numerical value of the interfering effect of noise upon a broadcast programme. The second matter is that of the measurement and expression of the HF disturbance.

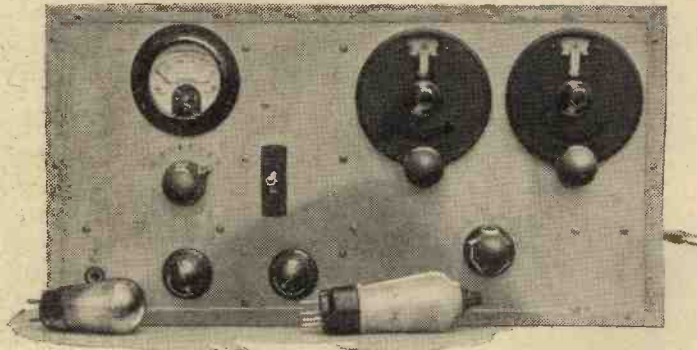
One method of stating the interfering effect of noise upon a broadcast programme is that in which the numerical expression is in terms of the relative audio-frequency power magnitudes of the noise and programme respectively. In this manner the ratio of the mean square signal current in the absence of the disturbance to the mean square noise current in the presence of the unmodulated carrier is referred to as the Signal/Noise power ratio, the reciprocal of which represents the audio power aspect of the interference with programme reception produced by radio disturbance. This method forms part of the British radio interference technique, the advantage of which, as will be seen later, lies in the fact that the Signal/Noise ratio of any broadcast transmission, subjected to a particular radio disturbance, can be calculated from a direct measurement, by means of radio field-strength measuring equipment, of such disturbance and a knowledge of the field strength and modulation ratio of the transmission.

Signal-to-Noise Ratio

An audio-frequency measurement of the Signal/Noise ratio of any transmission subjected to noise can of course be made, for the purpose of which a Speech Power Indicator is employed and embodied in the field-strength measuring equipment. The frequency response of this instrument when used with its associated amplifier is uniform to within ± 1 db. over the band 100 to 3,000 c/s, whilst between 50 and 5,000 c/s the variation from uniformity is only ± 2 db. The indicating meter has definite ballistic characteristics.

In the French technique (Ministerial Decision of April 20th, 1934) some allowance is made for the relative interfering effects of the various component frequencies. In order to do this the noise is passed through a frequency weighting network which attenuates the lower frequency components to a much greater degree than the higher. Thus, whereas for the band 600 to 3,200 c/s, the attenuation of 600 c/s frequencies is greater than that of 3,200 c/s frequencies, by not more than 4 db., yet for the band 25 to 600 c/s, the attenuation of 25 c/s frequencies is some 52 db. greater than that of 600 c/s frequencies. The characteristics of this network are identical with those of the C.C.I.R. "aural sensitivity network."

The level of the output of the network compared with that of a standard tone is determined by means of a measurement of the root mean square voltage of the residue. The result is expressed as the "aural interfering effect of the noise." The time constant of the indicating instrument is 200 milli-seconds.



A works testing set for estimating the strength of interference.

Equivalent noise value. The German method aims at an estimation of the character of noise so far as its loudness effect upon the ear is concerned. Steudel ("Z.f.H.u.E.," Vol. 41, 1933), has observed that the human ear has a different loudness perception, which is not synonymous with total annoying effect, for noises of the same effective amplitude, but of different time value. Thus there is a difference in the respective perception of the ear for uniform and impulsive noises and also for single and repeated noise impulses. These characteristics of the ear are simulated in an instrument, known as a "Noise Value Meter," which measures the equivalent noise value voltage of a noise.

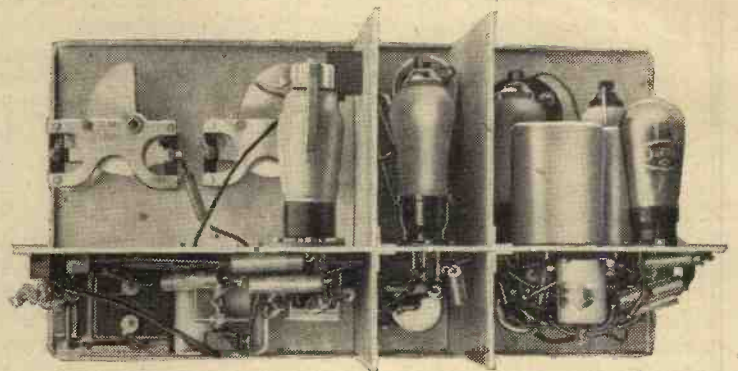
Consider a broadcasting receiver, tuned to the incoming carrier E.M.F., of mean square carrier value (M.S.C.) and modulation ratio M , in the presence of a disturbance. If those component disturbing EMF's which are distributed over the band of radio-frequencies to which the receiver is tuned, are of mean square disturbance value (M.S.D.), then at the output of a quadratic detector of constant S , the approximate numerical value of the audio-frequency power of the noise has been shown (G.P.O. Radio investigations) to be proportional to the product (M.S.C.) (M.S.D.); the value of the Signal/Noise power ratio being approximately equal to M^2 (M.S.C.) (M.S.D.). From this latter value it is evident that the audio interfering effect (at least the total power aspect of it) of an HF disturbance depends only upon the magnitude of the disturbance and of the strength of the signal carrier and its

modulation. Now the RMS value of the band of disturbing EMF's can be measured at the mid-band frequency by means of suitable equipment of the field-strength measuring type, and expressed as an equivalent disturbing carrier EMF. It follows therefore that this radio frequency technique for the terms of expression and means of measurement of HF disturbance furnishes a rational method whereby the radio interfering effect of such disturbance on any particular transmission can be readily calculated and expressed in terms of the Signal/Noise ratio. This technique has been proposed for use in Britain.

Simple Measuring Equipment

Field-strength measuring equipment of conventional design, intended for purposes of standardisation in connection with the above, is available. Portable apparatus, suitable for the works testing of electrical equipment has also been constructed. This works testing set is of simple construction, and makes use of thermal agitation effects in its input circuit for the provision of a calibrating EMF.

It is of interest to note that at the Paris Conference of the I.E.C., held in June last, it was agreed that the desirable, although not necessarily economic, objective, was the protection of signal fields of 1 millivolt per metre, modulated 20 per cent., to an extent represented by a Signal/Noise ratio of 40 decibels. The realisation of such an objective would, in terms of the British technique, ensure a limitation of the magnitude of RF dis-



Chassis of the works testing set.

turbance in the neighbourhood of receivers, to a value of 2 microvolts per metre.

The German technique is directed towards a measurement of the radio disturbance generated at the terminals of electrical plant, or in certain cases, e.g., HT power systems, electric traction systems, etc., in an aerial system of stated dimensions, located at a stated distance from the plant. Unlike the British technique in which the RMS value of the disturbing EMF's is directly determined, the German method expresses radio disturbance in terms of an equivalent noise voltage, the measurement of which is carried out by special equipment embodying the German noise value meter

The Technique of Radio Interference—

at its output terminals. The remainder of the equipment consists of a rejector and potentiometer input circuit, a tuned HF amplifier, a detector operating linearly, an LF filter, cutting off at 4.5 kc/s, and an LF amplifier. In order to provide for an unmodulated carrier, in the presence of which the HF disturbance can be measured as noise at the output of the detector, the equivalent embodies an HF oscillator whose output is connected to the input of the HF amplifier.

An audio-frequency technique has been developed whereby the effect of radio disturbance may be compared at low-frequency with the effect of the local signal. In accordance with the methods so far published, the local signal may take the form of either (a) a carrier modulated by a single-frequency tone, as in the method employed by the French Administration, or (b) a multi-frequency carrier, such as for example, the output from a multivibrator of low fundamental frequency, as in the method employed by the National Electric Lighting Association of America.

In the French method, the level of the aural effect of the radio disturbance is compared with the level of the aural

effect of a carrier of stated field-strength (1 millivolt/metre) and modulation (800 c/s, 30 per cent.). The measurement is carried out with a calibrated receiver of specified radio-frequency selectivity, employing linear detection, an antenna of definite type and dimensions, and a meter. The audio-frequency response is that of the frequency-weighting network previously referred to and which is employed for the measurement of the aural interfering effect.

A meter-reading carrier-frequency curve is furnished with the equipment, such meter readings representing a level of 3 Nepers below that of the aural effect of the signal defined above. In this manner a reading of the aural effect of the disturbance only need be taken.

It is important to notice the feature to which attention has previously been drawn, namely, that the level and character of the noise output of a receiver subjected to radio disturbance will depend upon the simultaneous absence or presence of a carrier. On this account, therefore, an unmodulated carrier ought to be present when a reading of the aural effect of a disturbance is being taken with the French or any other audio-frequency comparison equipment.

The Diary of an Ordinary Listener

TWO concerts conducted by Toscanini on consecutive evenings afforded a good start to the week's Continental listening, though perhaps they made the programmes for the remainder of the week seem somewhat flat by contrast. There was, in fact, so much to occupy one's attention on Thursday, November 15th, that I found myself wishing that the various programme directors could agree to broadcast their special features on different days, though, even if this could be done, I suppose few would agree on which was actually the special feature of the week.

I began the evening with the Station Orchestra, conducted by Fritz Busch, broadcast from Kalundborg and Copenhagen. The medium-wave stations seemed on their best behaviour, and there was very little fading, so, on the whole, I found reception more satisfactory from Copenhagen, and every note of Brahms' Academic Festival Overture, the aria from Mozart's "Il Seraglio," and Haydn's "Oxford" Symphony in G came through clearly; so well, in fact, that I could hardly tear myself away from Denmark to listen to the Amsterdam Concertgebouw Orchestra, conducted by Bruno Walter, and relayed from Hilversum. I heard Schubert's Symphony in B Flat and part of the ballet music from his "Rosamunde" before it was time to go over to Radio-Paris for the concert from the Théâtre des Champs Elysées, conducted by Toscanini. The first items I heard were Brahms' Hungarian Dances and the first movement of Debussy's suite, "En bateau," in which the clear, round tone of the brass was very noticeable. This is generally a marked feature in the best French orchestras.

During the interval I went over to Huizen for an organ recital, which included a tuneful Fantasia of Old Dutch Songs, returning to Radio-Paris for the overture to Rossini's

"Echelle du soie," which I do not recollect having previously heard, and Brahms' 4th Symphony in E Minor, with its beautiful second movement.

The following day did not prove quite so satisfactory, as there was considerably more fading among the medium-wave stations. I had, in fact, to dodge about among the German stations to get the best reception of Schumann's "Rhenish" Symphony, and found that, on the whole, it came through best from Cologne; Frankfurt and Munich were generally stronger, but there was usually a perceptible background, though I found no difficulty, that evening, in keeping the Langenberg station quite clear of North Regional. I then turned to Radio-Toulouse and came in for a good 'cello recital, which included the "Star of Eve" from "Tannhäuser," a minuet by Mozart and Glazounov's "Serenade Espagnole." It was then time for Toscanini's second concert from the Champs Elysées, broadcast this time by Paris P.T.T. and Strasbourg, but reception proved rather disappointing.

On Sunday the K.R.O. Symphony Orchestra, which is always well worth hearing, gave a good performance from Huizen of Schumann's "Manfred" overture followed by three of Schubert's songs well sung by Herman Schey. The Danish stations had an attractive programme, and again I found Copenhagen clearer than Kalundborg. The excellent station orchestra played an overture from one of Handel's many forgotten operas—"Rodelinde."

The programmes I struck on Monday evening seemed mainly to comprise the works of Brahms and Beethoven, and for what better music could one wish? From Munich the Philharmonic Orchestra ended its concert with Brahms' 4th Symphony in E Minor, which I had heard a few days before from Radio-Paris. CALIBAN.

BURGOYNE "2P-COMET"

Three-valve Battery Set with a Pentode HF Stage

DESIGNED to fill the gap between the simple "det.-LF" set and the super-heterodyne, this receiver has just that extra selectivity which is required in view of the increase in power output of many of



The new Burgoyne "2P-Comet" battery receiver.

the leading transmitting stations. The two tuned circuits are accurately ganged, and no external trimming control has been found necessary. The pentode HF stage is followed by a triode leaky grid detector with reaction, which in turn is coupled through a parallel-fed transformer to the pentode output valve.

A handsome walnut veneer cabinet houses the chassis and a PM moving-coil loud speaker, and the tuning dial is of the popular "clock-face" type. The price including batteries is 6 gns., and the makers are Burgoyne Wireless (1930), Ltd., Great West Road, Brentford, Middlesex.

IMPORTED RADIO GOODS

THE Board of Trade announce that in pursuance of Section 7 of the Merchandise Marks Act, 1926, a draft Order-in-Council was laid before Parliament on November 20th, 1934, requiring imported radio goods of the following descriptions to bear an indication of origin:—

Radio receiving sets, radio-gramophones, electrical gramophones, electrical audio frequency amplifiers, the preceding whether imported complete or in parts.

Loud speakers, loud speaker units, battery eliminators, chokes, condensers, drives for variable condensers, electrical gramophone pick-ups, volume controls, electrical gramophone motors, gramophone turntable units comprising an electric motor and a turntable, headphones, resistances, valve-holders and adaptors, transformers, tuning coils, resistance capacity coupling units, choke capacity coupling units, chassis or frame carrying or adapted to carry a collection of components.

The draft Order has been published, and copies may be purchased from H.M. Stationery Office, either directly or through any bookseller.

Letters to the Editor:—

The Radio-minded Household

Real v. Recorded Programmes : Film Recording : Push-pull Quality Amplifier

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

A Pioneer's Domestic Installation

MY good friend Richard Arbib has many times suggested that I should visit his new Radio Equipped House. My omission to accept his invitation in the past few months has been accidental. Now it will be intentional. When I want to talk to him I shall make an appointment at Frascati's—there will probably be less noise there.

When does Mr. Arbib think? How does he make up for that priceless quick ten minutes in the bath, and how about the moment when, lathering your face before the glass, you realise that such a blot on the landscape requires a day of real good work to justify its existence. Perhaps, though, he is like another good friend of mine who happens to be a mathematician engaged in tracking $\sqrt{-1}$ to its ultimate home in the n th dimension. He tells me he works better with the blare of music in his ear, his only trouble being that he has to get up and tune to another station when anybody starts to talk, and that when jazz music is on he must perforce give up the sliderule and take to logs.

Seriously, though, I must enter a protest, not against Richard Arbib's ingenuity, but against the point of view which it indicates—a love of noise.

Broadcasting, either of speech or music, is a thing which can only be properly appreciated when the whole mind is given to it. If an item coming through is not worth the whole attention it is worth nothing at all.

In a radio-equipped house the chances are that the switches will be on more often than off. The art of conversation will be completely neglected, social amenities will be relegated to the scrap heap and the frayed nerves of the inhabitants will lead them ultimately to the police court, the asylum, or both.

Very solemnly I warn Richard Arbib and all those who would follow him. Properly used, radio is a great blessing. Abused, as a very great number of people now tend to abuse it, it may prove a curse of monstrous dimensions.

ERNEST H. ROBINSON.

Pirbright, Surrey.

The Author's Reply

WHEN I wrote "The Radio-Minded Household" I prophesied to myself that comments such as my friend Captain Robinson has made would be forthcoming as soon as the article appeared in print. You stated in your headline to the article that it was "A Pioneer's Domestic Installation," and it seems that this phrase was no exaggeration.

It appears to me to be perfectly logical that one should be able to enjoy radio or gramophone programmes in every room of the house. I agree whole-heartedly with Captain Robinson that many listeners do not take full advantage of symphony con-

certs, operatic broadcasts, etc., by devoting their uninterrupted attention to them. When listening to items such as these I insist that the lights shall be turned out, and that other people in the room should not talk. This is not always practicable when there is only one radio set or loud speaker in a house; it is selfish for one member of a family to insist on this mode of listening if others wish to play bridge, read a book or write letters. I have said previously that by having parent switches on the sets, and loud speakers in the rooms, an individual programme can be listened to by one member of the family without troubling the others.

I can assure your correspondent, and your readers, that I do not shave every morning to music, but it was very useful to be able to listen to the broadcasts of the Test Matches from Australia last year whilst having one's morning bath.

Captain Robinson seems to be one of the multitude of people who believe it is impossible to listen to radio whilst performing another action. This argument has often been advanced when discussing the merits of car radio. There is no reason why one cannot carry on a conversation when dressing, driving a car, having lunch, knitting or other occupations which are practically mechanical. If one is alone it is sometimes companionable to use the radio as a substitute for the other person.

There are many broadcast programmes which really do while away the hours when one is greasing a car, or even de-carbonising it.

I am afraid your correspondent is, in my opinion, one of the "uneducated" as far as radio in the home is concerned. Because he has a radio set in his sitting room why shouldn't he let his maid have one in the kitchen, or provide a loud speaker operating from his own instrument. He surely knows the boon wireless can be to the sick, when loud speakers in the bedrooms of his house would really be appreciated if, and I hope they are not, any members of his family are confined to bed.

I know Captain Robinson feels my house must be a medley of noise, but I can assure him he is mistaken. I can guarantee that the amount of entertainment heard in any one room is not greater than that in the average family's sitting room, where the wireless set is usually installed. My aim has been to allow any member of the household to have radio or record entertainment when he or she desires it.

RICHARD ARBIB.

London, N.W.

Real v. Recorded Programmes

I note that you invite correspondence on the subject of the respective merits of short-wave transmissions of "real" programmes and recorded ones.

In my opinion, based on experience of reception conditions in Uganda, there is no doubt that the directly transmitted pro-

grammes are of more entertainment value than the recorded ones. For instance, announcements made with regard to a recorded talk that is to follow are invariably of a higher standard of quality than the talk itself, which will most probably verge on the edge of unintelligibility. And the explanation is not an elocutionary one.

Newton Abbot. L. W. G. ALFORD.

Film Recording

WITH reference to Lt.-Comdr. G. W. Harper's question on variable area versus variable density film-recording: the former is slightly more difficult from the technical point of view as it involves greater movements. It is much safer, however, from the photographic point of view, because the results of over and under exposing or developing and similar faults in the prints are far less serious. Once the developing labs. have introduced harmonics on a variable density film, nothing the operator can do is of the slightest avail. If, however, harmonics are introduced into variable area by dirt in the light slit, the remedy is obvious and at the operator's command.

With regard to the interesting question of cinema quality, I think the B.B.C. transmissions of film are most enlightening. I listened carefully to the third hour of the film transmissions recently radiated by the B.B.C. and made notes of each film in turn. Some had no bass, others no top, most of them were rough (blasting) in places, and my concluding comment was: "If these films had been gramophone recordings most of them would have been scrapped."

I hope that the various recording companies will soon adopt a standard frequency characteristic, work to it and let those responsible for reproduction know what it is. They should also bear in mind that the elimination of harmonics in recording is equally important. When these matters have been dealt with improvement in cinema quality should become general.

London, S.E.19. P. G. A. H. VOIGT.

"The Wireless World" Quality Amplifier

I HAVE just completed the Push-Pull Quality Amplifier, and I think a word of praise is surely due for this design, which is really very simple and yet gives such superlative quality of reproduction.

I would like to suggest, however, that you describe an HF detector unit for use with the amplifier,* and I feel sure a great many readers would appreciate what would undoubtedly be a first-rate radiogramophone for the quality man at a very minimum of expense, and also simplicity for local use only. I have in mind the radio gramophone which you described some years ago and which I made with great success.

Putney. LESLIE J. DAVIS.

[* This is being done at an early date.—Ed.]

Broadcast Brevities

By Our Special Correspondent

Midland Regional Anomaly

THE tragedy of Midland Regional, which has a reputation of being one of the most go-ahead of the B.B.C. centres, is that it lacks a portable recording apparatus.

Programmes via London

A friend who has just visited the Birmingham studios tells me that when Midland Regional wished to re-broadcast in the evening the "O.B." of a quarry explosion the same morning, the event was relayed by land-line to Broadcasting House, recorded on the Blattnerphone apparatus, and fed by land-line to the Birmingham transmitter during the evening programme.

Has Midland Regional no right to a recording equipment of its own?

Does Droitwich Please?

EVEN the B.B.C. engineers must begin to think there must be "something in this Droitwich business." Letters continue to reach me from disgruntled listeners for whom Droitwich has worsened rather than improved matters.

Night Distortion

This is what a Jersey correspondent has written in his local paper: "Davertry at the worst only gave us slight fades and we never suffered from night distortion to the extent of the human voice from the studio becoming unintelligible."

During the second news bulletin on November 7th there were two periods when, owing to distortion, it was quite impossible to understand a word that was being read, and the reader might have been speaking an unknown tongue with his mouth full of puff biscuits."

The Only Way

My correspondent goes on to relate the experience of a Jersey dealer, one of whose clients, wishing to get the National programme last week, was forced to take it from *Scottish National*!

Fading in N. Ireland

A correspondent in Northern Ireland returns to the charge with these words: "Before the Regional scheme came into being it was possible in N. Ireland to get a programme from any of four transmitters,

namely, 2ZY, 5SC and 5XX or Belfast. To-day Belfast is the only station which does not fade here."

Is the Aerial Right?

There can be no doubt that Droitwich is not fulfilling the high hopes of its sponsors. Quality is at times exceptionally good, but fading and distortion are very real obstacles to its success as a genuinely National transmitter.

Are the engineers satisfied that the aerial arrangement is irreproachable? Is the ground ray strengthened at the expense of the indirect ray?

Strange Sounds

GERALD COCK, the "O.B." director, is to try our wits with another problem in "Entertainment Hour" during the week beginning January 20th. His contribution will consist of six broadcasts of well-known sounds, and to help listeners to

The Clue is Here

Here is the quatrain identifying the voice:—

"When on the air experiments are made,

Conservatives are apt to air their views.

And so it came about the woman paid

And then the name and not the voice made news."

If this does not help, the only thing is to wait for the broadcast.

Composition of New Variety Orchestra

READERS of *The Wireless World* take a special interest in the composition of the various broadcasting orchestras and dance bands. Such knowledge assists in gauging the quality of reception.

I hear that the new B.B.C. Variety Orchestra, which made its *début* on November 16th, numbers sixteen players. It is made up as follows:—



MUSIC FOR THE DEAF. Radio methods are now employed at the Manchester Royal Schools for the Deaf. This class of deaf boys is being taught Christmas carols by means of an amplifier and microphone mounted on the piano. Moving-coil headphones are used.

guess where these outside broadcasts are coming from, quatrains containing clues to the sounds will be read by an unknown voice.

The voice will have a quatrain all to itself, and is one of the queries to be solved. Who is the unknown voice? Actually it is well known to millions of listeners.

Piano, four violins, 'cello, double bass, flute (doubling banjo and guitar), oboe, first clarinet (doubling first alto sax. and second alto sax.), second clarinet (doubling first alto sax. and second alto sax.), bassoon (doubling first alto sax., second alto sax., baritone sax. and tenor sax.), two trumpets, trombone, drums.

"Secret" Plans

IT was stated in the Press last week that the B.B.C. was "secretly planning" brighter programmes for Sundays. This was unalloyed truth, but it is worth mentioning that the word "secretly" might well have been omitted. Naturally all plans are first discussed privately; no one expects the Director-General and his advisors to set up chairs and tables in the entrance hall of Broadcasting House to discuss matters of policy there. Nor have the most trenchant critics of the B.B.C. argued that the Governors should hold forth in Hyde Park.

The Night Sky

FOLLOWING upon Sir James Jeans' series of talks, just ended, a distinguished astronomical amateur, Dr. Waterfield of Guy's Hospital, will give talks on the "Night Sky" on December 11th and 14th and on a date in January. Approaching the subject from the angle of the man-in-the-street, he will describe what he sees on certain nights.

Dr. Waterfield was made a Fellow of the Astronomical Society, while still at school, for the discoveries he submitted to the Society.

Mr. Mais and the Other Half

MR. S. P. B. MAIS, realising that his listeners have shared the predicament of the Queen of Sheba, has just published the half that had not been told us about his visits to the islands around Britain. "Isles of the Island" (Putnam, 7s. 6d. net) gives, with illustrations, the text of those vivid talks by reason of which Mr. Mais must accept considerable responsibility for instilling the "island complex" into many listeners.

What He Left Out

Between each talk he inserts an additional chapter, "What I Left Out"—for, in the time the B.B.C. put at his disposal, Mr. Mais could not speak of half of what he did or saw.

This is a great little book, with its tales of wanderings in Skye, the Isle of Man, the Scillies and the Channel Islands; every page brings a whiff of the sea.

Short Waves and the Amateur

The Design of Aerial Systems

By G2TD and G5KU

IN the early history of short-wave development it was soon realised that, apart from their chief virtue of covering enormous distances, short waves offered additional advantages in that they could be radiated, by the aid of reflectors, to give "beam" transmission so that nearly all the radiated energy would be directed to the distant receiver resulting in increased effectiveness of transmission. Since short waves are comparable with the dimensions of easily erected aerial structures, it is economical for a commercial undertaking to erect a beam radiator instead of the usual single aerial system.

Early experiments showed that even when transmitting to the antipodes the beam was advantageous, although a first consideration would give the impression that omnidirectional transmission would be quite suitable. It was found for a given wavelength that the energy arriving at the antipode is conveyed by a path in a suitable grade of daylight, so that by concentrating it in a beam along this path the transmission is at its best. The early beam transmission was effected by the arrangement of a vertical aerial at the focus of an array of vertical wires hung

a suitable feeder circuit they are all fed with current which oscillates along each wire in the same phase, much the same as the current might oscillate in a sheet of copper, fed at one edge. It will be realised that for directive radiation to left or right in the plane of the array the currents must be reversed in sign (alternately antiphased) as depicted in (1b); the sign wave traced along the direction of the plane will help in elucidating this point.

So far, only the radiation along the earth's surface has been considered. We have also to consider the vertical distribution of energy, owing to the fact that the waves must not travel far along the surface of the earth or they will be quickly absorbed; neither must they leave the aerial at a large angle with the horizontal plane or they will be incapable of reflection by the ionised layer. If reflection did occur for a high angle ray, the necessary high penetration into the layer, to find sufficient density for bending, would result in a serious attenuation of the ray.

It is therefore good practice to keep the radiation within well-defined vertical

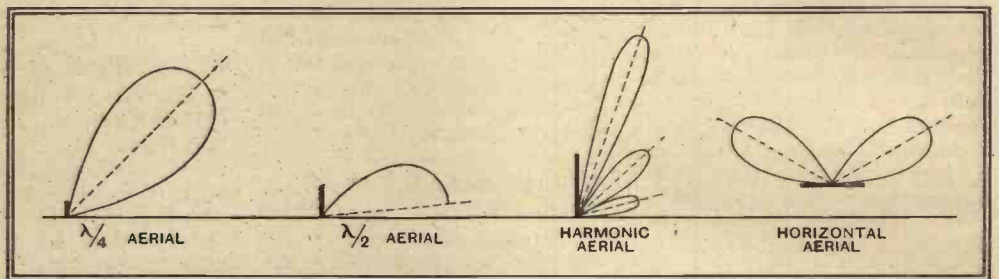


Fig. 2.—Maximum energy is radiated in directions shown by largest lobes from short-wave aerials having length in relation to wavelength shown above.

Thus, by suitably feeding all wires in phase (1a) or alternate wires in antiphase (1b) the array radiates in directions perpendicular to, or in the plane of, the array.

Case (a) is usually used, and in order to prevent radiation in one of the perpendicular directions, a similar row of reflectors is arranged on the blind side of the main aerial at a distance of a quarter wavelength (1c). Energy radiated from the main aerial at a given instant covers a distance of $\lambda/2$ in passing to the reflector wire and back again, so that it is found to be in phase with, and therefore assists, energy radiated in the required direction after an interval of time corresponding to a half-cycle of oscillation.

In the unwanted direction the reflector-radiated energy cancels the radiated energy of this next half-cycle. In commercial arrays the reflector is usually energised in the correct phase to cause radiation in the desired direction. It is then possible to reverse the direction of such a broadside beam by changing over the functions of radiator and reflector wires,

angles, usually between 6 and 45 deg., depending on the transmission conditions. The first consideration shows that, provided other conductors are not arranged above or below the radiating system, the vertical distribution of energy will be entirely due to the net effect of the various reactions between the currents flowing in the aerial wire. The only approximation to the classical electromagnetic radiator is obtained with a small dipole short compared with a half a wavelength, when the electric field is distributed between the ends of the dipole and the magnetic field in similar circles around the dipole as an axis. The use of an aerial comparable with a wavelength and situated near the earth, which may be considered as a partial reflector, leads to distributions which are anything but spherical.

Short-wave Aerials

Dealing briefly with the usual types of aerials encountered on short wavelengths, the vertical polar distribution is shown in Fig. 2 for various arrangements. In this respect it must be pointed out that, correctly used as a receiving aerial, the signals received will be at a maximum when arriving from the "maximum radiation" directions. The lobes indicate maximum effect in the direction of the longest line from aerial to circumference. Thus, in the case of the quarter-wave aerial, maximum radiation is at an angle of approximately 45 deg. to the earth's surface, and appreciable high angle radiation is attained. On the other hand, the half-wave aerial gives a distribution approximately equal to $\cos^2\theta$, where the

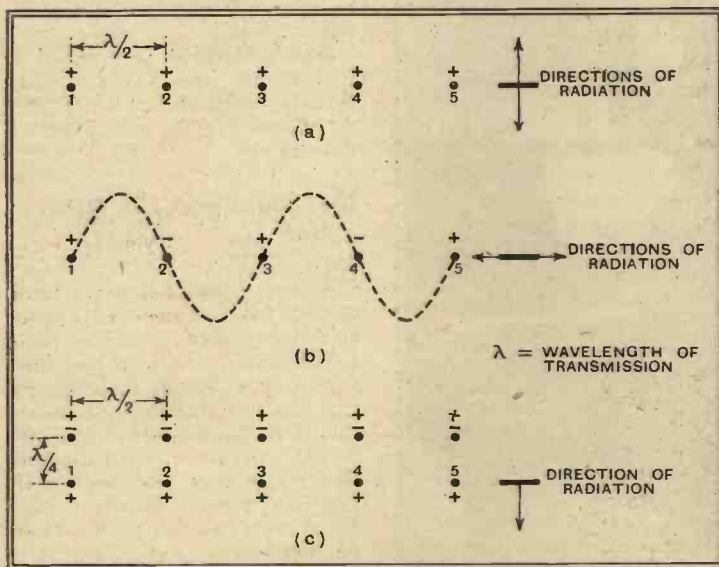


Fig. 1.—Plan view of broadcast aerial arrangements showing direction of radiation for (a) vertical aerials fed in same phase, (b) alternative aerials fed antiphase and (c) simple directional array.

in a parabolic sheet. This was the forerunner of the "Broadside Array" and several other beam aerials, for it was not found necessary to make a practically closed network of reflecting wires in order to prevent radiation in undesired directions. A simple type of broadside array is depicted in plan in Fig. 1. The numbered wires represent vertical aerials arranged half a wavelength apart and preferably half a wavelength in height. By

Short Waves and the Amateur—

angle is measured from the vertical, and a distribution shaped like a "square law" condenser vane is obtained. This aerial has very small radiation at high angles,

a plan view of the development of such an arrangement, the lobes here representing the horizontal polar distribution. In general, as the height of an aerial is raised, without altering its electrical

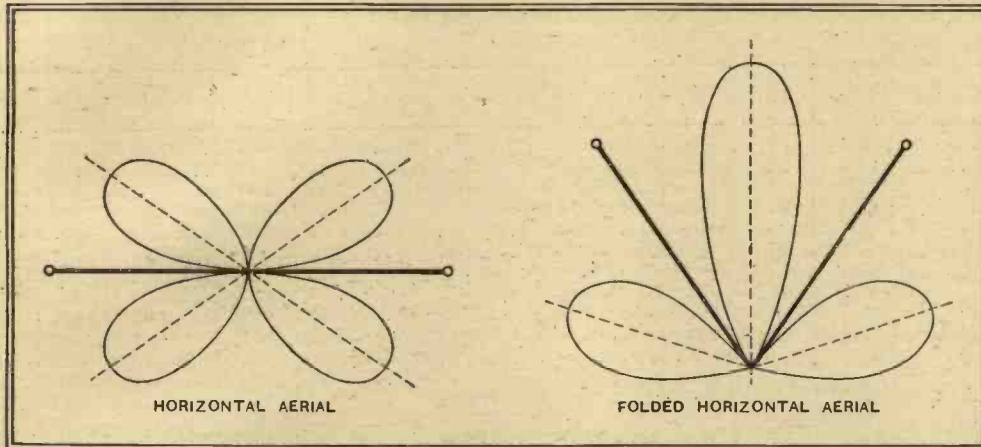


Fig. 3.—Typical polar curves in plan of radiation from horizontal short-wave aeri-als.

and gives one of the best low angle diagrams found among the less complicated types of radiators. The harmonic aerial which may be several half-wavelengths high is extremely bad in that it has innumerable lobes and no redeeming low angle radiation.

The horizontal aerial has lobes directed in the form of two cones, apex to apex, so that a North-South horizontal aerial will give good low angle radiation from almost due West to North-West, North-East to East, East to South-East and South-West to West. Along the direction of the aerial the radiation from each cone is at rather a high angle and usually unsuitable for long-distance work. By making such an aerial several half-wave-lengths along the cones become narrow and radiation is more in the direction of the length of wire. By bending such an aerial at a suitable angle in the horizontal plane two lobes may be made to coincide, producing an effective beam effect along the bisection of the angle. Fig. 3 gives

length, so is low angle radiation improved, resulting in improved effectiveness at long distances.

DX Notes

For Northern latitudes the skip distance at night for 20 m. should now be infinite, due to low ionisation density of the F layer. Although the band does seem completely dead it should be carefully searched, as even at midnight LU, PY and CX signals have been heard. Also very good reception from these countries and also VK and ZL has been possible between 8-9 a.m. It is estimated that at about 14.00 g.m.t. (6 a.m. Pacific time) communication with American west coast station should be possible. Low-power commercial stations in this district have been heard at this time, a 2 kW. station being R7-8 with high speed fading not excessive. Our American friends appear to be closing down until next summer on the 10 m. band, reports received indicating negative results.

SHORT - WAVE
BROADCASTING

DURING some ten years' observations on short waves, the writer has always noted that a spell of good conditions is immediately preceded by an extremely unreliable week or so. In other words, the transition from "bad" to "good" is usually by way of a week of freaks, during which conditions may change completely from one hour to the next.

As these notes are being written, conditions are certainly freakish, and it seems as though we may expect a change for the better. One of the sun-spot peaks beloved of short-wave listeners is due very shortly.

W3XAL on 16.87 metres has, rather unaccountably, been coming in later and later each day. The time of fade-out, naturally, should be a few minutes earlier, but this seems to have been off-set by changing conditions.

It often happens that this station and W8XK on 19.72 metres are radiating the same programme, and these occasions are valuable when a really fair check on comparative strength and reliability is desired. The general run of things recently has tended to make the 16-metre station the more reliable of the two.

Perhaps someone will be able to explain, before short waves develop much more, how it is that a 200-watt amateur telephony station can seriously rival in strength a 10- or even 20-kW. broadcast station. Some of the American amateur telephony on the 20-metre band seems to be received here at an amazing strength. This refers to stations using the normal power, not W2GOQ, which is almost a fully-fledged broadcasting station, or W2ZC, which uses 1,000 watts.

A Modest Announcement

The world's record for low-power broadcasting must surely be held by the owner of "little station TI-4NRH, in Heredia, Costa Rica." How many readers have heard this announcement, on either the 31- or 19-metre bands? TI-4NRH used to be listed as using 7½ watts, and yet his broadcasts covered the world.

Many short-wave enthusiasts are longing to hear him again, but he does not appear to be active at the moment.

The writer has been asked to mention some of the broadcast stations that work outside the official short-wave broadcast bands. Many of these so-called "broadcasters" are, of course, commercial and experimental stations that just happen to transmit test records from time to time. Among the actual broadcast stations, however, are the following:

Guayaquil, Ecuador (HC2RL), 45 metres; Barranquilla, Colombia (HJ4ABB), on 42 metres; Bogota, Colombia (HKE), on 41.55; Bogota (HJ3ABD), on 40.57; Geneva (HBP), on 38.5; Tokio (J1AA), on 38.1; Rabat (CNR), on 37.3; Havana (COH), on 31.8.

Then comes the 31-metre band, below which we have Madrid (EAQ) on 30.4; Brussels (ORK) on 29.1; and then the 25-metre band. Between 25 and 19 metres are the following:—

Moscow (RNE) on 24.9; Lisbon (CT1CT) on 24.53; Rabat (CNR) on 23.38; Little America (Byrd's station KFZ) on 22.68; and last but not least, Cartago, Costa Rica (T1R), on 20.69. MEGACYCLE.

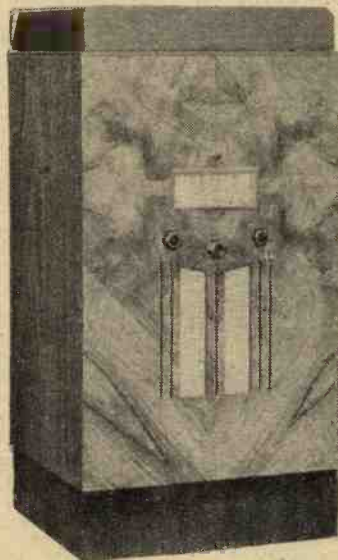
NEW FERRANTI
RADIO-GRAMOPHONES

FERRANTI, LTD., announce the introduction of a new series of radio-gramophones based on their well-known "Lancastria" and "Arcadia" receivers.

The "Lancastria Radiogram," selling at 24 guineas, is housed in a veneered walnut cabinet of simple yet well-proportioned modern design. A similar model with automatic record changer is available at 33 guineas.

In the "Arcadiagram" and the new "Arcadia Autogram" the panel carrying the controls and loud speaker is inset and inclined to give better sound distribution. The prices of these instruments are 30 guineas and 39 guineas. While the general lines of the cabinet are similar to those of the "Lancastria" models, the finish is in walnut and macassar ebony with chromium-plated fittings.

High-grade gramophone components are employed, and a combined tone control and scratch filter is provided.



The new "Lancastria Radiogram."

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.	Station.	kc/s.	Tuning Positions.	Metres.	kW.
Kaunas (Lithuania)	155		1935	7	Poznan (Poland)	868		345.6	16
Brasov (Romania)	160		1875	20	London Regional (Brookmans Park)	877		342.1	50
Huizen (Holland). (<i>Until 3.40 p.m.</i>)	160		1875	7	Graz (Austria). (<i>Relays Vienna</i>)	886		338.6	7
Kootwijk (Holland) (<i>Announced Huizen</i>). (3.40 p.m. onwards)	160		1875	50	Limoges, P.T.T. (France)	895		335.2	0.5
Lahti (Finland)	166		1807	40	Helsinki (Finland)	895		335.2	10
Moscow, No. 1, RW1 (Komintern) (U.S.S.R.)	174		1724	500	Hamburg (Germany)	904		331.9	100
Paris (Radio Paris) (France)	182		1648	75	Toulouse (Radio Toulouse) (France)	913		328.6	10
Istanbul (Turkey)	185		1621	5	Brno (Czechoslovakia)	922		325.4	32
Berlin (Deutschlandsender Zeesen) (Germany) (S.-w. Stns., 16.89, 19.73, 25.51, 31.38 and 49.83 m.)	191		1571	60	Brussels, No. 2 (Belgium). (<i>Flemish Prog'mme</i>)	932		321.9	15
Ankara (Turkey)	200		1500	7	Algiers, P.T.T. (Radio Alger) (Algeria)	941		318.8	12
Droitwich	200		1500	150	Göteborg (Sweden). (<i>Relays Stockholm</i>)	941		318.8	10
Minsk, RW10 (U.S.S.R.)	208		1442	35	Breslau (Germany)	950		315.8	60
Reykjavik (Iceland)	208		1442	16	Paris (Poste Parisien) (France)	959		312.8	100
Paris (Eiffel Tower) (France)	214		1395	13	Grenoble, P.T.T. (France)	968		309.9	20
Motala (Sweden). (<i>Relays Stockholm</i>)	216		1389	30	West Regional (Washford Cross)	977		307.1	50
Novosibirsk, RW76 (U.S.S.R.)	217.5		1379	100	Cracow (Poland)	986		304.3	2
Warsaw, No. 1 (Raszyn) (Poland)	223		1345	120	Genoa (Italy). (<i>Relays Milan</i>)	986		304.3	10
Luxembourg	230		1304	150	Hilversum (Holland). (7 kW. till 6.40 p.m.)	995		301.5	20
Kharkov, RW20 (U.S.S.R.)	232		1293	20	Bratislava (Czechoslovakia)	1004		298.8	13.5
Kalundborg (Denmark) (S.-w. Stn., 49.5 m.)	238		1261	75	North National (Slaitwhaite)	1013		296.2	50
Leningrad, RW53 (Kolpino) (U.S.S.R.)	245		1224	100	Barcelona, EAJ15 (Radio Asociación) (Spain)	1022		293.5	3
Tashkent, RW11 (U.S.S.R.)	256.4		1170	25	Königsberg (Heilsberg Ermland) (Germany)	1031		291	60
Oslo (Norway)	260		1154	60	Paredo (Radio Club Português) (Portugal)	1031		291	5
Moscow, No. 2, RW49 (Stichelkovo) (U.S.S.R.)	271		1107	100	Leningrad, No. 2, RW70 (U.S.S.R.)	1040		288.5	10
Tiflis, RW7 (U.S.S.R.)	280		1071.4	35	Scottish National (Falkirk)	1050		285.7	50
Rostov-on-Don, RW12 (U.S.S.R.)	355		845	20	Bari (Italy)	1059		283.3	20
Sverdlovsk, RW5 (U.S.S.R.)	375		800	50	Tiraspol, RW57 (U.S.S.R.)	1068		280.9	4
Geneva (Switzerland). (<i>Relays Sottens</i>)	401		748	1.3	Bordeaux, P.T.T. (Lafayette) (France)	1077		278.6	12
Moscow, No. 3 (RCZ) (U.S.S.R.)	401		748	100	Zagreb (Yugoslavia)	1086		276.2	0.7
Voroneje, RW25 (U.S.S.R.)	431.5		726	10	Falun (Sweden)	1086		276.2	2
Oulu (Finland)	436		696	2	Madrid, EAJ7 (Union Radio) (Spain)	1095		274	7
Ufa, RW22 (U.S.S.R.)	436		688	10	Madona (Latvia)	1104		271.7	50
Hamar (Norway) (<i>Relays Oslo</i>)	519		578	0.7	Naples (Italy). (<i>Relays Rome</i>)	1104		271.7	1.5
Innsbruck (Austria). (<i>Relays Vienna</i>)	519		578	0.5	Alexandria (Egypt)	1122		267.4	0.25
Ljubljana (Yugoslavia)	527		569.3	5	Belfast	1122		267.4	1
Viipuri (Finland)	527		569.3	13	Nyiregyhaza (Hungary)	1122		267.4	6.2
Bolzano (Italy)	536		559.7	1	Hörby (Sweden). (<i>Relays Stockholm</i>)	1131		265.3	10
Wilno (Poland)	536		559.7	16	Turin, No. 1 (Italy). (<i>Relays Milan</i>)	1140		263.2	7
Budapest, No. 1 (Hungary)	546		549.5	120	London National (Brookmans Park)	1149		261.1	50
Beromünster (Switzerland)	556		539.6	100	West National (Washford Cross)	1149		261.1	50
Athlone (Irish Free State)	565		531	80	Kosice (Czechoslovakia). (<i>Relays Prague</i>)	1158		259.1	2.6
Palermo (Italy)	565		531	4	Moravska-Ostrava (Czechoslovakia)	1158		259.1	11.2
Stuttgart (Mühlacker) (Germany)	574		522.6	100	Monte Ceneri (Switzerland)	1167		257.1	15
Riga (Latvia)	583		514.6	15	Copenhagen (Denmark). (<i>Relays Kalundborg</i>)	1176		255.1	10
Vienna (Bisamberg) (Austria)	592		506.8	120	Kharkov, No. 2, RW4 (U.S.S.R.)	1185		253.2	10
Rabat (Radio Maroc) (Morocco)	601		499.2	6.5	Frankfurt (Germany)	1195		251	17
Sundsvall (Sweden). (<i>Relays Stockholm</i>)	601		499.2	10	Prague, No. 2 (Czechoslovakia)	1204		249.2	5
Florence (Italy). (<i>Relays Milan</i>)	610		491.3	20	Lille, P.T.T. (France)	1213		247.3	5
Cairo (Abu Zabal) (Egypt)	620		483.9	20	Trieste (Italy)	1222		245.5	10
Brussels, No. 1 (Belgium). (<i>French Programme</i>)	620		483.9	15	Gleiwitz (Germany). (<i>Relays Breslau</i>)	1231		243.7	5
Lisbon (Bacarena) (Portugal)	629		476.9	15	Cork (Irish Free State) (<i>Relays Athlone</i>)	1240		241.9	1
Trøndelag (Norway)	629		476.9	20	Juan-les-Pins (Radio Côte d'Azur) (France)	1249		240.2	2
Prague, No. 1 (Czechoslovakia)	638		470.2	120	Rome, No. 3 (Italy)	1258		238.5	1
Lyons, P.T.T. (La Doua) (France)	648		463	15	San Sebastian (Spain)	1258		238.5	3
Cologne (Langenberg) (Germany)	658		455.9	100	Nürnberg and Augsburg (Germany) (<i>Relay Munich</i>)	1267		236.8	2
North Regional (Slaitwhaite)	668		449.1	50	Norwegian Relay Stations	1276		235.1	0.5
Sottens (Radio Suisse Romande) (Switzerland)	677		443.1	25	Dresden (Germany) (<i>Relays Leipzig</i>)	1285		233.5	1.5
Belgrade (Yugoslavia)	686		437.3	2.5	Aberdeen	1285		233.5	1
Paris, P.T.T. (Ecole Supérieure) (France)	695		431.7	7	Austrian Relay Stations	1294		231.8	0.5
Stockholm (Sweden)	704		426.1	55	Danzig. (<i>Relays Königsberg</i>)	1303		230.2	0.5
Rome, No. 1 (Italy) (S.-w. stn., 25.4 m.)	713		420.8	50	Swedish Relay Stations	1312		228.7	1.25
Kiev, RW9 (U.S.S.R.)	722		415.5	36	Budapest, No. 2 (Hungary)	1321		227.1	0.8
Tallinn (Esthonia)	731		410.4	20	German Relay Stations	1330		225.6	1.5
Madrid, EAJ2 (Radio España) (Spain)	731		410.4	3	Montpellier, P.T.T. (France)	1339		224	5
Munich (Germany)	740		405.4	100	Lodz (Poland)	1339		224	1.7
Marseilles, P.T.T. (France)	749		400.5	5	Dublin (Irish Free State) (<i>Relays Athlone</i>)	1348		222.6	1
Katowice (Poland)	758		395.8	12	Milan, No. 2 (Italy) (<i>Relays Rome</i>)	1348		222.6	4
Midland Regional (Daventry)	767		391.1	25	Turin, No. 2 (Italy). (<i>Relays Rome</i>)	1357		221.1	0.1
Toulouse, P.T.T. (France)	776		386.6	2	Basle and Berne (Switzerland)	1375		218.2	0.5
Leipzig (Germany)	785		382.2	120	Warsaw, No. 2 (Poland)	1384		216.8	2
Barcelona, EAJ1 (Spain)	795		377.4	5	Lyons (Radio Lyons) (France)	1393		215.4	5
Lwow (Poland)	795		377.4	16	Tampere (Finland)	1420		211.3	1.2
Scottish Regional (Falkirk)	804		373.1	50	Newcastle	1429		209.9	1
Milan (Italy)	814		368.6	50	Béziers (France)	1429		209.9	2
Bucharest (Romania)	823		364.5	12	Paris, (Radio LL) (France)	1429		209.9	2
Moscow, No. 4, RW39 (Stalina) (U.S.S.R.)	832		360.6	100	Miskolc (Hungary)	1438		208.6	1.25
Berlin (Funkstunde Tezel) (Germany)	841		356.7	100	Fécamp (Radio Normandie) (France)	1456		206	10
Bergen (Norway)	850		352.9	1	Pecs (Hungary)	1465		204.7	1.25
Valencia (Spain)	850		352.9	1.5	Bournemouth	1474		203.5	1
Simferopol, RW52 (U.S.S.R.)	859		349.2	10	Plymouth	1474		203.5	0.3
Strasbourg, P.T.T. (France)	859		349.2	15	International Common Wave	1492		201.1	0.1
					Liepāja (Latvia)	1737		173	0.1

The Quality Loud Speaker

High Flux Density in a Gap of Generous Diameter

By F. H. HAYNES.

WHY is the performance of one loud speaker better than that of another? Each comprises a diaphragm, a moving coil and a magnet. Yet for one there may be extravagant claims, whilst for another little may be said. Prices, too, vary widely and in some instances we see the evidence of good mass production involving costly plant and in others a degree of finish revealing individual construction. Briefly, loud speaker performance is governed by the following three factors:—

1. *The properties of the diaphragm and its surround.* Thickness, weight and the nature of the material used primarily control the ability of the loud speaker to produce a reasonably uniform sound output over the working frequency range of 30 to 10,000 cycles. By a series of tests using diaphragms of varying weight and thickness and composed of different materials combined with the several forms of surround, a specimen may readily be chosen which will produce the best results. There is conclusive evidence revealed by the practice of the majority of loud speaker manufacturers that the most suitable diaphragm is a seamless one, moulded from paper pulp with the aid of press tools, thickened and stiffened towards the centre and possessing increasing pliability as the surround is reached. Measurements for determining performance must necessarily be carried out with the associated output transformer. If considerations of cost prohibit a generous design for this

component, it may have inadequate primary inductance but will possess the merit of low leakage. In consequence, the characteristic of a well preserved upper register with a comparatively poor bass will be imparted to the loud speaker, a condition which may be quite effectively off-set by the adoption of a diaphragm which tends towards the exclusion of the higher frequencies while producing a marked resonance in the region of 120 cycles.

2. *The diameter of the moving coil.* This is not dependant upon the ability of the coil to handle the applied speech watts without overloading, for although some five watts of sustained alternating current would quickly destroy the usual 1½ in. coil, such a value is only delivered from the amplifier intermittently and the heating effect is not the same as when five watts of direct current are dissipated across a fixed resistance. Experience shows that the larger the moving coil in relation to the size of the diaphragm it has to drive, the better will be the performance. This is due to the improved facility of the diaphragm correctly to follow the spontaneous changes met.

3. *The density of the magnetic flux in which the coil moves.* The maximum possible flux must be created necessitating careful choice and examination of the iron used for the magnet. It must be practically carbon-free and without contamination by nickel, cobalt and, particularly, manganese. As iron to this specification cannot easily be

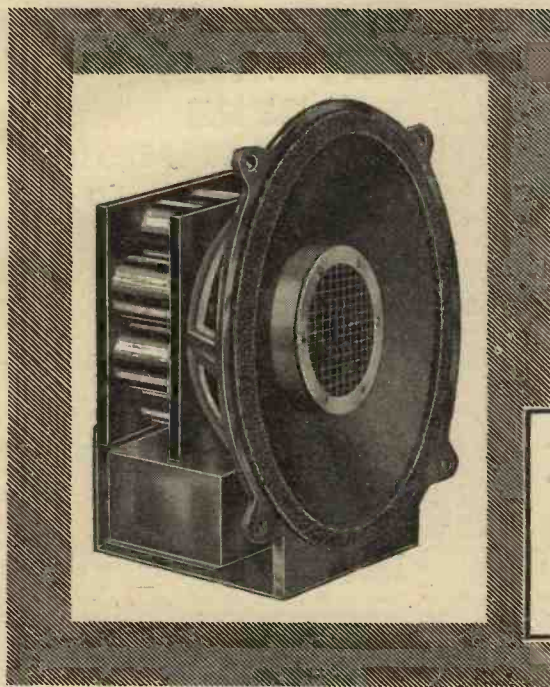
cast we see the use of built-up magnets using pressings or forgings, the front plate being a strip of metal in which the flux pours in from two of the sides producing a far from uniform flux distribution in the gap. A heavy cylindrical form of magnet construction would seem to be essential and in the Haynes loud speakers this is cast from pure iron which is subsequently carbon-freed by prolonged heat treatment. In this way a uniform flux density is obtained all round the gap and its value far exceeds that present in any form of permanent magnet.

In choosing a loud speaker for quality reproduction one must look for good transient response, the result of careful choice of diaphragm, the use of a not over-supple surround and a magnet producing the highest possible flux density in all parts of the gap. An overall frequency characteristic, assuming that it can be taken with reasonable accuracy, conveys but part of the story.

The home constructor was quick to appreciate the merits of the moving-coil loud speaker, and it was a Haynes design in 1927 which first rendered available the necessary castings from which the early loud speakers were built.

Full details of the Haynes Standard and Senior loud speakers are given in a free 32-page booklet, which includes specifications of Haynes Quality Receivers and Amplifiers in chassis form or as complete radiograms. Sets are demonstrated every Friday at the Enfield Factory, between 7.30 and 9.30 p.m.

Announcement of Haynes Radio, Queensway, Enfield, Middlesex. Enfield 2726.



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This model presents many attractive features. Tracking error is reduced to the minimum. The head lifts back for needle changing, eliminating risk of damage to records. Perfect reproduction of all frequencies without overloading. Screened leads. An earth connection provided. Special Volume Control giving silent and distortionless adjustment.

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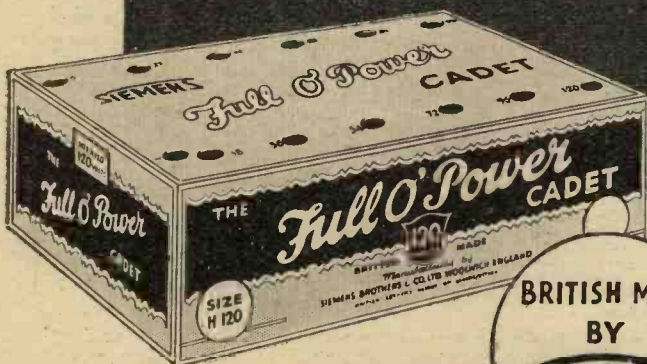
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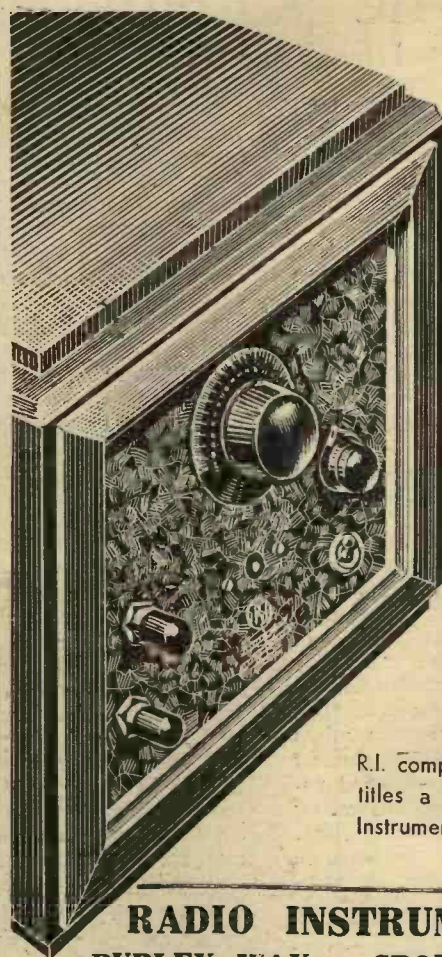
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- The above prizes are being offered by the Manufacturers of "Austin" Receivers for the best opinions regarding the performance and appearance of this year's models.
- The public are invited to visit their local Dealer for a demonstration of either of the two "Austin" models, viz. the "A.C. Super" or the "Battery Super" and at the same time to obtain from him a free Competition entry form. This entry form should be filled up, as requested thereon, giving the competitor's name and address, the Dealer's name and address, and the date on which the demonstration was given.
- The competitor is then required to write two paragraphs, each not exceeding 50 words, on (A) APPRECIATION; (B) CRITICISM of the instrument.
- The above prizes will be awarded, in order of merit, to the 73 competitors whose entries, in the opinion of the judges, are the most useful and valuable to the Manufacturers.
- A prize of £10 will be awarded to the Dealer whose name and address appear on the entry form of the First, Second and Third Prize Winners. Competitors who already possess an "Austin" Receiver are only required to give the chassis number of the instrument in place of the date of demonstration. In the event of such an entry being awarded the First, Second or Third Prize, the Dealer Prize of £10 will be awarded to the Dealer from whom the set was originally purchased.
- An order for an "Austin" Receiver to be delivered free of charge will be forwarded to the next 20 Prize Winners. This order must be placed with the Dealer whose name appears on the entry form.
- The 50 competitors whose entries are awarded next in order of merit will each receive a voucher value £10 to be used in part payment for any "Austin" Receiver, either Battery, Mains or Radio-gram. This voucher must be used with the Dealer whose name appears on the winning entry form.
- The Competition will be adjudicated by the following: Mr. Hugh S. Pocock (Editor "The Wireless World"), Mr. Gordon F. Ward (Managing Director "C.A.C."), Major W. I. C. Page (Designer of "Austin" Receivers).

and their decision on all matters relating to this Competition must be accepted as final.

9. No correspondence (with the sole exception of applications for entry forms) can be entered into in regard to this Competition.

10. The closing date of the Competition is December 31st, 1934, and the results, giving the Prize Winners' names and addresses and the winning entries, will be published in our advertisement in "The Wireless World" and general press before the end of January, 1935.

If your local dealer is unable to demonstrate, send direct to us for Entry Form and name and address of nearest Approved "Austin" Dealer.

We offer a most cordial invitation to members of the trade and public alike, to visit our Showrooms and Factory at any time between 10 a.m. and 6 p.m. (or later by appointment) and on FRIDAYS UNTIL 9 P.M. to hear a demonstration of the "Austin" Range of Receivers and to inspect the superb Cabinet-work which is a unique speciality of this Company. We are also giving special demonstrations of the well-known "Wireless World" Push-pull Quality Amplifier. Major W. I. C. Page will be in attendance during the above hours.

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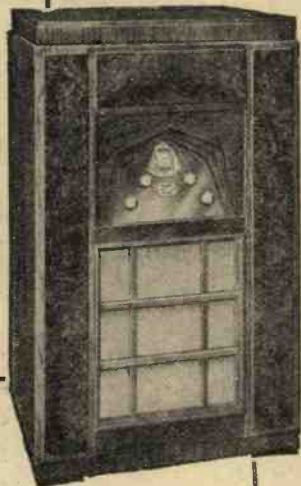
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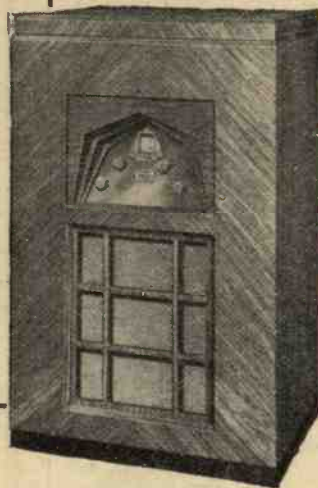
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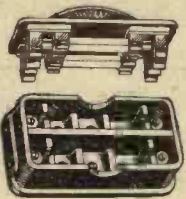
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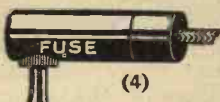
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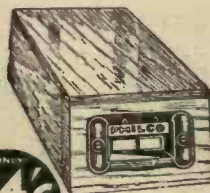
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W.W.48

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Set Manufacturers' Surplus, Clearance and Bankrupt Stocks offered in any of these columns may not be Manufacturers' current lines. Radio components advertised at below the list price do not carry any manufacturer's guarantee.

RECEIVERS AND AMPLIFIERS, ETC.

ARMSTRONG.—1935 Radio Chassis Programme.

ARMSTRONG.—Latest 5v. bandpass superheterodyne chassis, with fully delayed A.V.C., 7 highly efficient tuned circuits, bandpass input, Marconi Heptode frequency changer, combined 1st detector and oscillator, bandpass I.F. coupled to Marconi H.F. pentode, bandpass coupled to Cossor Double Diode, giving distortionless detection and A.V.C., resistance coupled to Mazda high slope pentode, Marconi bi-phase rectifier, full vision illuminated tuning, calibrated in wavelengths, combined radio and gramophone volume control, corrected pentode output, giving exceptionally good reproduction; £5/18/6, with valves, royalties paid.

ARMSTRONG.—Universal superheterodyne chassis, A.C. or D.C. mains, specification as superheterodyne described above, complete with Mullard valves, royalties paid.

ARMSTRONG.—Latest 4-valve, 3-pentode, Radiogram chassis, A.C. mains, incorporating 3 tuned circuits, full band-pass tuning, horizontal drive calibrated in wavelengths, combined radio and gramophone switching, 3 watts output; this well designed chassis has good selectivity with noiseless background; £5/18/6 complete, ready to switch on with the addition of a speaker.

ARMSTRONG.—Universal 4-valve A.C. D.C. Radiogram chassis, specification as above; £5/18/6 complete.

ARMSTRONG.—Class "B" Radiogram battery chassis; £5/18/6, including Mullard valves, royalties paid.

ALL Armstrong Chassis are Constructed of the Highest Grade Components Throughout, carry 12 months' service free guarantee, and are sent on 7 days' approval, carriage paid.

ARMSTRONG MANUFACTURING Co., 100, King's Rd., N.W.1. 'Phone Gulliver 3105. [7076]

GOOD but Cheap.—230 A.C. 3v. set.—Box 2327, c/o The Wireless World. [7090]

ULTRA 6-stage A.C. Superhet, 1935 Model 22, list £12/12, clock face tuning; £8.

KOLSTER-BRANDES 4-valve A.C. Superhet, listed £12/12, perfect condition; £7/7.

CENTURY 7-valve Superhet Car Radio, listed £14/14, as new, complete; £7/7.

FOX 4-valve A.C. Superhet, listed £13/13, complete, as new; £7.—58 Flat, Mantell St., N.1. [7114]

BATTERY Band-Pass S.G.3 Ferranti, etc., perfect; £4/10.—"Ramleh," White Horse Drive, Epsom. [7055]

FERRANTI Class B.4 Chassis and Valves, as new; cost £14, accept £7.—Box 2294, c/o The Wireless World. [7056]

PARMEKO 10-watt Amplifier, steel case, 2 speakers, nearly new, cost £65; best offer.—17, Renters Av., Hendon, N.W.4. [7078]

SEVERAL A.C. Wireless Sets, complete; from £2; taken for debt.—After 7 p.m., "Oakdene," Camden Rd., Carshalton. [7042]

20 BELMONT Sets, 5-valve superhet., all mains, listed £10/10; what offers?—Box B.399, c/o Dawson's, 129, Cannon St., E.C.4. [7108]

Establishing Prestige

We are delighted to see that our plea for truth in advertising is taking effect. We are, at the same time, chagrined at not being the first to point out that correspondents are constantly telling us that our advertising is too modest. But—here's a new one for you, and quite true:

The diaphragm of the HARTLEY-TURNER speaker is so freely suspended that the currents of air resulting from the cone movement are strong enough to BLOW THE DUST OUT OF THE GAP.

As we go gaily forward we are surprised to find, being modest, how much the world thinks of our products. We have just heard that a prominent technical official of a very well known firm of set makers states that he considers the Hartley-Turner speaker as the finest on the market.

Several British manufacturers and technical periodicals use the Hartley-Turner speaker as a laboratory standard.

Broadcasting organisations in many countries use the Hartley-Turner speaker for monitoring high-quality transmissions; they also use our sets and baffles.

Government scientific departments, as well as Universities, use our apparatus because precise exceptional performance is required.

Luxury liners turn to Hartley-Turner for luxury band repeating.

Hotels use Hartley-Turner reproduction to entice customers from rival establishments.

And—of course—the music-lover comes to us to give him the real thing at home. It is interesting to find many people buy our sets who have never before had a radio.

Illustrated literature free on request.

HARTLEY TURNER

RADIO LTD.,

Thornbury Road, Isleworth,
Middlesex.

Telephone: HOUNslow 4488.

The situations offered last week are now filled.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."

DEPOSIT SYSTEM.

Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Stamford Street, London, S.E.1, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post. When sending remittances direct to an advertiser, stamp for return should also be included for use in the event of the application proving unsuccessful.

Receivers and Amplifiers, Etc.—Contd.

OUR Kit of Parts for "Wireless World" Quality Amplifier, complete in every detail, including valves amplifier only, £8/10; feeder unit, 36/-.
OUR Kit of Parts for "Wireless World" Olympic S.S. Six, complete in every detail, including valves and loud-speaker; £14/10.

OUR Kit of Parts for "Wireless World" Standard A.C.3 complete with valves and speaker; £11/10.
SEND for Detailed List of Components for Either of the Above Kits; carriage paid, cash with order.

WARD, 46, Farringdon St., London, E.C.4. 'Phone: Holborn 9703 [6907]

EDDYSTONE All-wave Four A.C. Receiver, coils 13, 2,000 metres, Power Pack, valves, perfect condition £12.—Box 2319, c/o The Wireless World. [7065]

MIDGET Receivers.—Chal-Electric offer brand new exporters' 1935 samples, every one guaranteed, complete in every detail, with moving coil speaker.

ATTWATER-KENT 4-valve T.R.F., 200-550 metres, A.V.C., cabinet 9x5½x7, approximately 20 stations; at £3/5.

CLARION or R.K.A. (two models), 4-valve (A.V.C.), T.R.F., 200-550 and 1,000-2,000 metres, A.V.C., cabinet 10x7x5½; £3/15.

LUCILLE 5-valve Superhet, A.V.C., illuminated dial tone control, 200-550 and 1,000-2,000 metres. Note.—This has 3-gang condenser, not 2; cabinet 10x8x5½, approximately 80 stations; at £6/5.

LUCILLE Compact 5-valve Superhet, A.V.C., pretty little cabinet, 13-50, 200-550 and 1,000-2,000 metres; at £6/10.—Chal-Electric, No. 6, Conduit St., London, W.1. Museum 7795. [7100]

H.M.V. Auto Radiogram, original price 55 guineas, D.C. mains (200-250), perfect condition; £15, with records.—W. F. Collins, 29, Portpool Lane, Holborn, E.C.1. [7115]

NEW Monodial A.C. Super, Monodial Power Pack, Ferranti M.1 speaker, complete and working in Console cabinet; nearest offer £11 accepted.—Peel, 20, Woodland Av., Borecumb. [7069]

EMERSON and **CROSLLEY** 1935 Midgets, car radio, and all American valves, send for wholesale catalogue, importer.—Royal, 5, Buckingham Rd., South Woodford, London, E.18. [6899]

1935 Models 4-valve Superhet. Midgets, A.C. or D.C. M.C. speaker, £3/19/6; 5 valves, £4/19/6; car radio, £7/15, including valves.—Lovell Bros., 11, Avon Rd., Walthamstow, London, E.17. [6891]

W.W. Baby Super A.C. Radiogram De Luxe, Collaro motor, pick-up, in polished mahogany cabinet, with doors and lid, 24in.x18in.x39in.; £12; cabinet worth half.—2, Montbelle Rd., New Eltham. [7071]

1935 Manufacturer's Stock, 4-valve A.C. Band-pass receivers, walnut cabinets, Mazda valves, Rola speakers; £5/10; satisfaction or money refunded; cash with order.—Maude, 1, Martin St., Brighouse. [7116]

ALL-WAVE A.C. Kit of Parts, 12 to 2,000 metres, Mazda A.C. valves, blue print, cost £9; Regentone A.C. eliminator, cost £7/15; Rola F.6P.M., second-hand, cost £2/9/6; lot £9/10.—Particulars, Wakefield, 98, Manley Rd., Whalley Range, Manchester. [7109]

PUBLIC Address Amplifiers, A.C. mains, 21 watts undistorted output, £15; 9 watts, £10; A.C.-D.C., 9 watts, £11; 3½ watts, £9; high quality receivers, £12; trade supplied; deferred terms.—D. E. Clarkson, B.Sc.(Eng.), 10, Park Rd., Wallington, Surrey. 'Phone: Wallington 3953. [7079]

Receivers and Amplifiers, Etc.—Contd.

DEGALLIER'S Offer Few Brand New Receivers, every one guaranteed, S.A.E. with all enquiries (illustrated lists of sets over £6); complete in walnut cabinet, with moving coil speaker and valves (almost any replacement valve at 7/6 each).

EMERSON 5-valve Midget, A.V.C., 200-550 and 1,000-2,000 metres, D.C.-A.C. 100-250v., approximately 30 stations; at £4/6; 3 cabinets, 10 1/2 x 7 1/2 x 5 1/2.

The Following All R.C.A., Victor, Majestic, Stromberg, etc.

MIDGET 5-valve Superhet. A.C.-D.C. 100-250v. A.V.C., tone control, illuminated dials, pick-up terminals, 200-550 and 1,000-2,000 metres, can also be run from batteries, with adaptor included (approximately 60 stations); at £6/10.

MIDGET 6-valve Superhet. 1 1/2 x 7 x 5 1/2 A.V.C., but incorporating 3-gang condenser, illuminated dials, pick-up terminals, 200-550 and 1,000-2,000 metres, approximately 90 stations; at £7.

MIDGET 6-valve A.C.-D.C., 200-250v., 13-2,000 metres, in 3 wave bands, A.V.C., illuminated dials, tone control, pick-up terminals, aperiodic H.F. stage, 2H.F. pentodes, Heptode frequency changer, double diode triode (approximately 100 stations); at £7/10.

TRANSPORTABLE Receiver, 14x16x9 1/2, 3 watts undistorted, 7-stage superhet., 5-valve, A.V.C., tone control, airplane dial, 8in. speaker, approximately 100 stations, A.C.-D.C. model, £7; A.C. model £7/10; carriage 4/.

TRANSPORTABLE Receiver, 19x16x10 1/2, 3 watts undistorted, 6-valve 8-stage superhet., 8in. speaker, airplane dial, tone control, A.V.C. 13-50, 200-550, and 1,000-2,000 metres; A.C.-D.C. at £9/5. A.C. £9/10; carriage 4/ (sensitivity 1 microvolt absolute).

TRANSPORTABLE De Luxe Model, 21x11 1/2 x 17, 6-valve 8-stage superhet., maximum efficiency over whole wave band coverage, 12-2,000 metres, in 4 wave bands, extra large airplane dials, A.V.C. tone control, double intermediate, 3 1/2 watts undistorted, sensitivity better than 1/2 microvolt absolute, in A.C. 200-250v. only; £15.

Also a Number of 1934 Brand New Midgets: Kadette, Crossley, Halcyon, Atwater-Kent, Lucille, Clarion, etc.; between £3 and £5; these available to callers only.

DEGALLIER'S, 6, Coryton House, 21, Upper Marylebone St., London, W.1. Museum 7795. (Nearest stations: Oxford Circus, Goudge St., and Great Portland St.) [7102]

7-VALVE Superhet. Alba Chassis (by Plessey), 7 tuned stages, delayed, A.V.C., local distance switch, 7 kc. separation, Mullard valves, A.C. 200-250 volts; demonstration daily at 94, High Holborn; chassis complete with Mullard valves, brand new, less speaker and cabinet, £7/10.—Radio Clearance, 94, High Holborn, W.C.1.

INTERFERENCE and All Unwanted Noises Definitely Cut Out by Using "Bifo" Static Cut-outs; can be fitted to any set simply and without technical knowledge; does not decrease volume; brand new and boxed, with instruction leaflet; 2/3 each (listed 12/6).—Southern Radio, 323, Euston Rd., London, N.W.1 (near Warren St. Tube). Museum 6524; and branches. See Components, Etc., column. [7097]

FIRST Consignment of Emerson 1935 "Round the World" 6-valve Superheterodyne, 19-2,000 metres, 3 separate wavebands, acclaimed by trade as the best all-wave receiver yet produced, aeroplane dial tuning, "Duo-Lite" band switching, dynamic speaker, automatic volume control, gramophone pick-up, walnut cabinet 16 1/2 in. high, 13 1/4 in. wide.—Write for wholesale catalogue to Importer, Royal Radio Co., 5, Buckingham Rd., South Woodford, London, E.18. [7016]

AMPLIFIER, by Public Address Corporation, 25-watt, brand new, original price £42, my price £13; Edison Bell amplifier, less valves and transformer, brand new, 45/-; amplifier, brand new, 2 1/2 watt, £4/10; 5-valve Radiogram chassis, brand new, with valves, £6/10; "Wireless World" Quality Amplifier, brand new, £6/10; Crypto convertor, 200-watt, D.C.-A.C., £4/15; Brown's Cubist public address speaker, in oak cabinet, 25/-; valves: Amplifier M.C. 1-60, rectifier D.C. 1-60, £5 pair, new.—M. Donovan, 167, City Rd., E.C.1. [7118]

MAINS EQUIPMENT.

PARTRIDGE, B.Sc., A.M.I.E.E., A.I.Rad.E.

PARTRIDGE Mains Transformers.—"Certainly above the average... very soundly constructed."—"Wireless Trader."

PARTRIDGE Output Transformers.—Officially recommended by Messrs. Tungram for their 21w. output valves.

PARTRIDGE.—See last week's detailed advertisement; delivery from stock; trade enquiries invited.

PARTRIDGE, N., King's Buildings, Dean Stanley St., London, S.W.1. Tel.: Vic. 5035. [6598]

TANTALUM for A.C. Chargers, H.T. and L.T.—Blackwell's Metallurgical Works, Ltd., Garston, Liverpool. [6470]

BATTERY Chargers.—The "N.P." (late Nash Products) is still the best charging plant for all purposes; trade list.

BATTERY Chargers.—"N.P." chargers from 52/- to £17, complete ready for use; lists.

BATTERY Chargers.—"N.P." give 12 months' guarantee all instruments; state your exact requirements.

BATTERY Chargers.—"N.P." allow free trial.—N.P. Electrical Co., 514, Alum Rock Rd., Birmingham. [6880]

DEGALLIER'S Offer Brand New Surplus, all guaranteed 12 months, carriage paid, cash with order or c.o.d.: Smoothing condensers, Government surplus, 1,500 test, 500 A.C. working, 800 peak, 2 mfd. 2/6, 4 mfd. 4/-; eliminators, A.C. 200-250 volts, 150 volts at 30 m.a. output, on load tappings. S.G., Det., Power, hum-free as 16 mfd., smoothing with Westinghouse rectifiers, these units will operate ordinary, Q.P.P., Class B, or short-wave receivers, at 26/- each, or, incorporating trickle charger, 2 volts 1/2 amp., 32/- each; static interference cut-out, can be used with any set, theoretical circuit with full instructions included; list 12/6, at 2/3 or 26/- per dozen.—Degallier's, 21, Upper Marylebone St., London, W.1. Museum 7795. [7103]

Important Notice

The Radio Development Co. has taken over the manufacture of

EPOCH

REPRODUCERS & MICROPHONES

All Ranges of Speakers are still being manufactured as usual and the same high Standard of Quality and Finish is being maintained. Deliveries can be given from stock of current models, together with spares for older types.

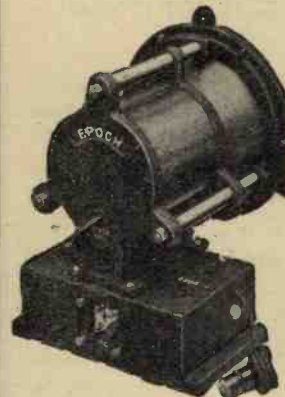
MOVING COIL MICROPHONE

This is a great advance over Carbon Condenser and other types of microphones having much greater sensitivity. The quality is perfect at ALL frequencies, and is free from external and internal noises. It is a robust and high-class engineering job.



- Type 44. On swivel table stand, without input transformer. £4.4.0
- Type 44T. Ditto, with input matching transformer. £5.5.0
- Floor Stand. Extra. £1.1.0

QUALITY MOVING COIL LOUDSPEAKERS



Type 99K (de luxe) P.M.

The latest improved version of the original Epoch 66. Given a fair amplifier, the reproduction is as perfect as is possible at present. Interchangeable diaphragms in three tonal characteristics and 40 impedances 35% cobalt steel.

Price £5.10.0

Type 99F. ENERGISED for D.C. MAINS, £4.12.6

"DOMINO" Model—ENERGISED

The finest and most sensitive domestic speaker obtainable. It has a 10 in. interchangeable diaphragm and its handling capacity is one-tenth to 10 watts.

- Type 101E. Unit for 4-12 volts - £5.15.0
- Type 101F. Unit for D.C. mains - £6.15.0
- Type 101J. A unit for A.C. and D.C. by a quick change-over device - £9.5.0

"TWENTIETH CENTURY" Model P.M.

A popular, low-priced unit for those requiring good reproduction at an economical price. 8 1/2 in. diaphragm. Capacity one-tenth to 4 watts.

- Type 20C. With 5-ratio transformer - £1.15.0
- Type 20CB. Ditto, for Class B. - £1.15.0

FREE

Upon application fully illustrated catalogue will be sent by return.

Trade Enquiries invited

EPOCH REPRODUCERS & MICROPHONES

Made and Distributed by THE RADIO DEVELOPMENT CO., Aldwych House, Aldwych, London, W.C.2

Telephone: Holborn 9111

Mains Equipment.—Contd.

VORTEXION Specified.

STANDARD A.C.3 Transformer, polished die cast, shrouding guaranteed 5 years; £1; chassis 6/-, choke to match, 12/3; see also displayed advertisement on page 9, November 9th.

STANDARD A.C.2 Transformer, 18/-; choke to match, 10/6; 5 years' guarantee.

VORTEXION Specified Olympic S.S. 6 Transformer, S.S.352, 5 years' guarantee, 25/-; less terminals and guarantee, 21/-; power chassis, £3/17/6; choke, 12/6; Single Span model, 25/-; power chassis, £3/10.

VORTEXION—Quality Amplifier or Super Monodial, 425-0-425, 120 m.a., 4v. e-8a. C.T., 4v. 3a. C.T., 4v. 1a., 4v. 1a., super shrouded, core size 2 1/4 in. x 1 1/4 in., 2 1/2% regulation primary engraved insulated terminals, weight 14lb., 26/-, carriage 2/-; normal shrouded, 22/-; open type, 20/-, post 1/3; speaker field replacement choke, 16/-; special output transformer to "W.W." specification, 12/6, post 9d.; state valve and speaker; "W.W." universal output transformer, £1; normal 40h. 50 m.a. primary output transformers, 10/6, post 9d.

VORTEXION 7.30h 120 m.a. Choke, 215 ohms, in die cast shrouding to match; 12/6.

IMITATED, but unequalled. Good enough for a "Wireless World" specification is good enough for you.

VORTEXION Cost Little More than the Cheapest, but unequalled by the dearest.

VORTEXION A.C./34, used by author in construction of A.V.C. Three, as illustrated; 18/-.

GUARANTEED 12 Months, and within 5% normal and 2 1/2% super models, neat shrouding, with detachable feet, as used by Government Departments, etc., etc., any model guaranteed 5 years at extra cost of 2/-.

ALL Secondaries Centre Tapped.

VORTEXION.—250-0-250 60 m.a., 4v. 1 to 2a., 4v. 2 to 4a., open type, 10/-; shrouded, 12/6; post 9d.

VORTEXION.—Ferrocort III 350-0-350, 60 m.a., 4v. 2.5 C.T., 4v. 3.5 C.T.; open type 13/6, shrouded 16/-; post 9d.

VORTEXION.—Super model for H.T.8 or 9 or 10, 4v. 1 to 2, 4v. 2 to 4, open type 14/6, shrouded 16/6; post 1/-.

VORTEXION.—350-0-350, 120 m.a., 4v. 2 to 5a., 4v. 2 to 4a., 4v. 2.5a.; open type 14/6, shrouded 16/6; super shrouded model, weight 11lb., 4 filaments to specification, 21/-; post 1/3.

VORTEXION.—400 or 450 or 500v., 120 m.a., 4v. 2 to 5, 4v. 2 to 5, 4v. 2.5a.; open type 19/-, shrouded 23/-.

VORTEXION.—400 or 450 or 500, 150 m.a., 4v. 4a., 4v. 2.5, 4v. 2, 4v. 2, 4v. 2, core size 2 1/4 x 1 1/4 in., a super job. 2% regulation 35/-, shrouded, with terminals; less terminals, 30/-; open type, 26/-; post 1/3.

VORTEXION Auto Transformers to B.E.S.A. Specification, 100, 110, or 120v. to 200, 220, or 240 volts, 60 watts, 9/-; post 9d.; 120 watts, shrouded 12/6, open type 10/6, post 1/-; 200 watts, shrouded 16/6, post 1/-; 2,000 watts, £4/10.

VORTEXION 1,000-watt Transformers; £4/10, carriage free.

VORTEXION 30h. at 60 m.a., Chokes, 5/6; 40h. at 60 m.a., 8/6; 30h. at 150 m.a., 200 ohms, 10/6 open type, 12/6 shrouded.

VORTEXION Transformers Made to Your Specification; price according to wattage, 6v. filaments same price unless wattage grossly exceeded; special quotations by return.

VORTEXION (S. A. BROWN), 182, The Broadway, Wimbledon, S.W.19. Tel.: Liberty 2814. [6954]

PARAMOUNT Mains Transformers Lead in Price and Quality.

PARAMOUNT Transformers are Suitable for all "W.W." Circuits.

PARAMOUNT Transformers Guaranteed for 2 Years, and the best British materials, 2 1/2 mils. thick insulating paper between each layer, with standard primaries, 200-250v. 50 cycles, all secondaries C.T.

PARAMOUNT 250-0-250v. 60 m.a., 4v. 1 to 2a., 4v. 2 to 4a., open type, 9/-; shrouded, 11/-; post 9d.

PARAMOUNT Ferrocort III, 350-0-350v. 75 m.a., 4v. 2.5a., 4v. 3 to 5a., open type, 12/-; shrouded, 14/-; post 9d.

PARAMOUNT Transformers Made to Your Own Specification; price according to wattage; quotations by return.

PARAMOUNT 350-0-350v. 120 m.a., 4v. 2.5a., 4v. 4a., 4v. 5a., open type, 14/-; shrouded, 15/6; post 1/-.

WE are Proud of our 5-valve Super Inductance Receiver; write for details; price £9, complete in walnut cabinet.

PARAMOUNT 400v., 450v. or 500v. 120 m.a., 4v. 2.5a., 4v. 4a., 4v. 5a., open type 17/-, shrouded 19/-, post 1/3; 150 m.a. with 2 extra filaments (not exceeding wattage), open type 22/6, shrouded 25/-, post 1/3.

PARAMOUNT Super Models.—H.T.8, 9 or 10, 4v. 1 to 2a., 4v. 2 to 4a., open type, 14/-; shrouded, 15/6; post 1/-; don't pay high prices for your mains components.

PARAMOUNT Auto Transformers, 100-120v. to 200-250v. or vice versa, 60-watt, 8/-; 120-watt, 9/6; shrouded, 1/- extra; post 9d.

PARAMOUNT Mains Chokes, 30 h. 60 m.a., 5/6; 20h. 120 m.a., 8/-; post 9d.

PARAMOUNT Guaranteed Electrolytic Condensers, 4+4 mfd., 500 peak; price 3/6; post 3d.

PARAMOUNT Mains Transformers Manufactured by R. H. Salter, 66, Hartfield Rd., Wimbledon, S.W.19. Tel.: Liberty 3226. [6929]

BARGAINS in D.C. Eliminators, district changing to A.C.; Ecco 15-25, Philips 3005, Regentone D.C.1, slightly used; all at 10/- each.—Gardners Radio, Ltd., West Southbourne, Bournemouth. [7074]

14/11.—Battery chargers, 1 amp., 2-6v., incorporating Westinghouse L.T.4 rectifier, 1/2 amp., 11/9; 7 days' cash approval; postage 9d.; list free.—Arden Agency, Wollaston, Wellingborough. [6881]

Mains Equipment.—Contd.

HOYNE'S Transformers are Manufactured by Engineers with 14 Years' Experience in Radio Transformer Design.

HOYNE'S—The acknowledged finest value in transformers and chokes.

HOYNE'S—Used exclusively by many established set manufacturers, relay stations, transmitters, and Government Departments.

HOYNE'S—Section wound, paper interleaved, filaments, centre tapped, aluminium clamps and terminal strips to all models.

HOYNE'S—Specified by "Wireless World," and wound strictly to the specification of the author.

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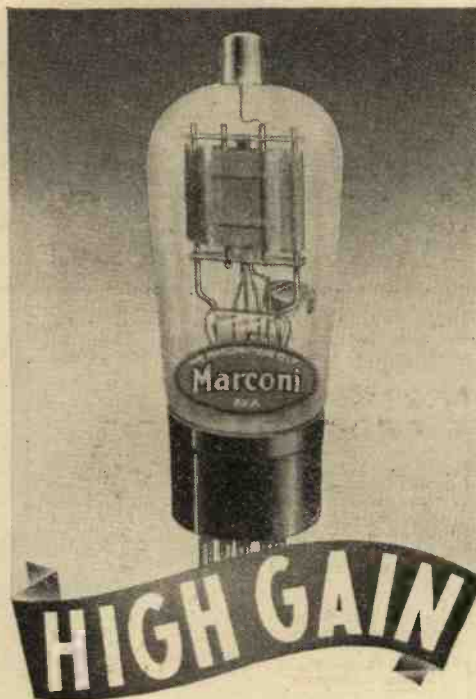
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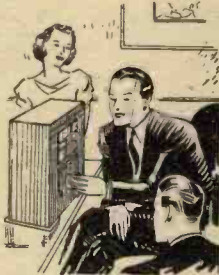
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PREMIER H.T.8 and 9 Transformers, 250v. 60 m.a. and 300v. 60 m.a. rectified, with 4v. 3-5a. and 4v. 1-2a., C.T., L.T., and screened primary, 10/-; with Westinghouse rectifier, 18/6.

PREMIER H.T.10 Transformer, 200v. 100 m.a., rectified, with 4v. 3-5a., and 4v. 1-2a., C.T., L.T., and screened primary, 10/-; with Westinghouse rectifier, 19/6.

PREMIER Mains Transformer, output 250-0-250v. 60 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

PREMIER Mains Transformers, output 350-0-350v. 120 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary; 10/-.

PREMIER Auto Transformers, 100-110/200-250v., or vice versa, 100-watt; 10/-.

WESTERN Electric Mains Transformers, 300-0-300v. 65 m.a., 4v. 1-2a., 4v. 2-3a., 6/6; 500-0-500v. 150 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 2-3a., 4v. 1a., C.T., 4v. 1a., C.T.; 19/6.

SPECIAL Offer of Mains Transformers, manufactured by Phillips, input 100-110v. or 200-250v., output 180-0-180v. 40 m.a., 4v. 1 amp., 4v. 3 amps., 4/6; 200-0-200v., 4v. 1a. 4v. 3a.; 4/6.

PREMIER L.T. Charger Kits, consisting of Premier transformer and Westinghouse rectifier, input 200-250v. A.C., output 8v. 1/2 amp., 14/6; 8v. 1 amp., 17/6; 6v. 2 amp., 27/6; 30v. 1 amp., 37/6; 2v. 1/2 amp., 11/-.

B.T.H. Trusped Induction Type (A.C. only) Electric Gramophone Motors, 100-250v.; 30/- complete.

SPECIAL Offer B.T.H. Gramophone Motors, A.C. and D.C., 100-250v.; 30/-, listed £3/3.

COLLARO Gramophone Unit, consisting of A.C. motor, 200-250v. high quality pick-up and volume control, 49/-; without volume control, 46/-.

EDISON BELL Double Spring Gramophone Motors, complete with turntable and all fittings, a really sound job; 15/-.

SPECIAL Offer of Wire Wound Resistances, 4 watts, any value up to 50,000 ohms, 1/-; 8 watts, any value up to 15,000 ohms, 1/6; 15 watts, any value up to 50,000 ohms, 2/-; 25 watts, any value up to 50,000 ohms, 2/6.

CENTRALAB Potentiometers, 400 ohms, 1/-; 50,000, 100,000, 1/2 meg., any value, 2/-; 200 ohms, wire wound, 1/-.

POLAR Star, manufacturers' model, 3-gang condensers, fully screened, 7/6, with trimmers; unscreened, 5/-.

AMERICAN Triple Gang 0.0005 Condensers, with trimmers, 4/11; Utility bakelite 2-gang 0.0005, screened, with unknob trimmer, 3/6; Polar bakelite condensers, 0.00035, 0.0003, 0.0005, 1/-.

ORMOND Condensers, 0.0005 2-gang semi-shielded, 2/6; brass vanes with trimmers, 3/6.

MAGNAVOX D.C. 152, 2,500 ohms, 17/6; D.C. 154, 2,500 ohms, 12/6; D.C. 152 Magna., 2,500 ohms, 37/6; all complete with humbucking coils; please state whether power or pentode required; A.C. conversion kit for above types, 10/-; Magnavox P.M. 7in. cone, 16/6.

RELIABLE Canned Coils with Circuit Accurately Matched, dual range, iron cored; 2/11.

UTILITY 3-gang Condensers, 0.0005, fully screened, with trimmers, ball bearing straight or superhet., 6/9, complete; with disc drive, 7/11; the best 3-gang available.

T.C.C. Condensers, 250v. working, 1 mf., 1/3; 2 mf., 1/9; 4 mf., 3/-; 4 mf., 450v. working, 4/-; 4 mf., 750v. working, 6/-; 2 mf., 750v. working, 3/-.

VARLEY Constant Square Peak Coils, band-pass type B.P.7, brand new, in maker's cartons, with instruction and diagram, 2/4.

VARLEY H.F. Intervalve Coils, B.P.8, band-pass, complete with instructions, in original cartons; 2/6.

SCREENED H.F. Chokes, by one of the largest manufacturers in the country; 1/6.

PREMIER British-made Meters, moving iron, flush mounting, accurate, 0-10, 0-15, 0-50 m.a., 0-100, 0-250 m.a., 0-1, 0-5 amps.; all at 6/-.

WESTERN Electric Condensers, 250v. working, 1 mf., 6d.; 2 mf., 1/-; 4 mf., 2/-; 400v. working, 1 mf., 1/-; 2 mf., 1/6.

WIRE-WOUND Potentiometers, 1,000, 2,500, 15,000, 20,000, 50,000, 90,000, 120,000, 200,000, 500,000, 2/- each; 1,000 ohm, semi variable, carry 150 m.a., 2/-.

PLESSEY Pick-up and Arm, 15/-; Cosmocord pick-up, with arm and volume control, 10/6.

RELIABLE Intervalve Transformers, 2/-; M.C. Multi-ratio output transformers, 2/6; 2-1, or 1-1 output transformers, 2/6; microphone transformers, 50 and 100-1, 2/6.

(This advertisement continued in third column.)

"I changed over to batteries

... that swarm of bees had gone"

—a short-wave listener writing in "WORLD RADIO"



This short-wave listener has quickly learnt one thing—that a smooth, steady supply of H.T. was, above all things, necessary. He changed to batteries and got it. If you, too, would have the thrill of receiving vast distances, try short-wave reception with Ever Ready Batteries. The unfluctuating flow of current from an Ever Ready Battery ensures for you the essentials for short-wave reception—a dead silent background and a smooth, accurate control of reaction.

THE EVER READY CO.
(Gt. Britain) LTD.

Hercules Place, Holloway,
London, N.7.



British Made

WIRELESS BATTERIES

Components, Etc., for Sale.—Contd.

(This advertisement continued from first column.)

A LARGE Selection of Pedestal, table and radiogram cabinets, by best manufacturers at a fraction of original cost, for callers.

THE Following Lines 6d. Each, or 5/- Per Dozen: Chassis valve holders, 5-, 6-, or 7-pin, screened screen-grid leads, any value 1-watt wire resistances, wire end condensers, 0.0001 to 0.1, 3 amp. main switches, Cydon capacitors, double trimmers.

SUPER Moving Coil Speakers, handle 10 watts, energised directly from A.C. mains, manufactured by world-famous radio and gramophone company; 40/-.

SCOTT Aerial and Anode Coils, dual range, complete with circuit; 2/6 per pair.

BLUE SPOT 29D.C. Moving Coil Speaker, with multi-ratio output transformer, 7in. cone, 2,500 ohms, 9/11; ditto 29P.M., permanent magnet, 18/9.

ELPHRO Volume Controls, 10,000, 12,000 or 15,000 ohms, complete with mains switch; 1/-.

T.C.C. Electrolytic Condensers, 8 mf., 440v. working 3/-; 4 mf., 440v. working, 3/-; 15 mf., 50v. working, 1/-; 50 mf., 12v. working, 1/-; 15 mf., 100 v. working, 1/3; 6 mf., 50v. working, 6d.; 2 mf., 100v. working, 6d.; 8+4 mf., 450v. working, 4/-.

DUBILLER Dry Electrolytic Condensers, 12 mf., 20v. working, 6d.; 50 mf., 50v. working, 1/9.

CONDENSER Blocks, H.M.V., 400v. working, 4+2+1+1+1+0.5, 3/9; 2+2+1+1+1+0.5, 3/-; Dubilier, 300v. working, 4+4+2+0.1, 3/-; Phillips 6+4+2+1+1, 4/6.

RADIOPHONE Logarithmic Wire Wound Potentiometer, 10,000 ohms, with mains switch, 2/-; S.W. H.F. chokes 10-200 metres, 9d.

CELESTION P.P.M.19 P.M. Moving Coil, with multi-ratio transformer; listed 48/-, at 25/-.

PREMIER SUPPLY STORES Announce the Purchase of the Complete Stock of a World-famous Continental Valve Manufacturer, all the following standard mains types, fully guaranteed, 4/6 each H.L., L., power, medium, high, low mag. and variable mu screen grids, 1-, 3- and 4-watt A.C. output, directly heated pentodes, 250v. 60 m.a., full wave rectifiers, D.C. types, 20v. 18 amp., filaments, screen grid V.M., H., H.L., power.

THE Following Types, 5/6 each; 350v., 120 m.a., full wave rectifier, 500v. 120 m.a., full wave rectifier, 2 1/2-watt indirectly heated pentode.

THE Following American Types, 4/6; 250, 112, 171, 210, 245, 226, 47, 46, 24, 35, 51, 77, 58, 55, 37, 80, 6A7, 2A7, 27.

THE Following Types, 6/6 each; 42, 77, 78, 2525, 36, 38, 83, 35, 44, 53, 6B7, 2A5, 2A6, 2B7, 5Z3, 6C6, 6A4, 6D6, 6F7, 43, 59. Send for catalogue of above types.

PREMIER SUPPLY STORES.

20-22, High St., Clapham, S.W.4. Phone: Macaulay 2188. Nearest Station: Clapham North (Underground). [7117]

MILDMAY RADIO EXCHANGE.

MILDMAY RADIO EXCHANGE Offers the Following, sound and perfect, cash with order or e.o.d.

SPECIAL Offer Regentone A.C. Mains Units, type W.S.A, brand new and in sealed boxes, output 150 volts 20 m.amps., having 4 tappings, 3 variable, also trickle charger for 2-, 4- or 6-volt accumulators; listed at £4/12/6, our net price 39/-.

SPECIAL Clearance Offer Telsen L.F. Chokes, 40 henry, brand new and in sealed boxes; 1/6 each; limited number only.

SPECIAL Clearance Offer Telsen Short Wave Coil Units, also brand new and in sealed boxes; 1/9 each.

FERRANTI A.F.4, 10/6; A.F.4, 7/6. A.F.5, 18/-; A.F.6, 18/-; A.F.7, 18/6; O.P.M.1, 10/-; O.P.1, 1-1 ratio, 7/6; O.P.2, 25-1 ratio, 7/6; O.P.3c, 1-1 ratio, push-pull, 8/6; O.P.M.2, 10/-; O.P.M.3, 12/-; O.P.M.4, 12/-; B.3 chokes, 5/- each; A.F.15c, 16/6; O.P.M.15c, 15/6.

BAKER'S Selhurst Senior D.C. Mains Moving Coil Speaker, 55/-, 2,500 ohms; Baker's Standard P.M. moving coil speaker, 45/-; Magnavox Magna 144, 2,500 ohms, 30/-; Magna 152, 2,500 ohms, 25/-.

COLLARO Type 32 Combined A.C. Mains Gramophone Motors, complete with pick-ups and volume controls, fitted with fully automatic stop and start plate, 12in. turntable; 50/-, listed at 24.

SPECIAL-Clearance Offer 3-valve Battery Operated Receivers, in solid oak cabinets, detector 2L.F.; offered at the very low price of 14/- each.

FERROCART E.10, F.14, pair 12/-, ganged; Wearite superhet. coils, 4/- each; Colvera K.21, K.22, K.23 coils, 12/6 set; Foster mains transformer, 700x0x700, 4v. 2a., 4v. 3a., 4v. 1a., 25/-; Ferranti S.V.8 mains transformer, 17/6.

FERROCART Colverdynes, 7/6 each; Westinghouse H.T.8, shrouded, 10/6; Rich and Bundy mains transformer, 300-0-300, with L.T. tappings, 16/6; Savage 400-0-400, with L.T. tappings, 16/6; Savage 400-0-400, with L.T. tappings, 15/6; pair Cydon 0.0005 condensers, 6/6.

EKCO Recorder, complete with discs, 22/6; Wright Da Coster A.C. mains moving coil speaker, heavy type, will handle 10 watts, £4; Burndept needle armature pick-up, 18/6; Marconi type K.17 pick-up, 25/-, 1934 model; Varley 100 m.a. chokes, 10/- each.

MARCONIPHONE 255 6-valve Superhet. Portable Receiver, complete with valves and in sound, perfect working order, fitted with Marconi valves; £6/15.

OSTAR GANZ 4-valve A.C.-D.C. Universal Mains Receiver, complete with valves and moving coil speaker, in solid walnut cabinet, using J.B. Linacore unit; £5.

ALL the Above Post or Carriage Paid.

WE Are Open All Day Thursday.

PHONE: Terminus 6751.

6, Pentonville Rd. (near The Angel), London, N.1 (2 minutes from Euston and King's Cross). Callers invited. [7110]

MINIATURE Radiophone 3-gang 0.0005 Superhet Condensers, 110 kc., split-end vane, top trimmers, dust cover (listed 22/6), 10/6.—Below.

RESISTANCES, colour coded, wired ends, 1-watt, new, assorted values 100 to 50,000 ohms; 3/- dozen.—Below.

ROTHERMEL P.M. Speakers, Universal transformers, 7in. cone, new, boxed (listed 39s. 6d.), 15/11.—Epton, 93, New Rd., Chingford, E.4. [7095]

Components, Etc., for Sale.—Contd.

SOUTHERN RADIO'S Wireless Bargains

RECEIVERS.—G.E.C. Osram 4-valve (actual) sets, complete with 4 Osram valves, permanent magnet moving coil speaker, magnificent pedestal cabinet, ready to use on all voltages A.C., all Osram proprietary components in original sealed cartons; £6/15 (list £15/15); an exceptional bargain.

CHROMWELL 3-valve Battery Sets, complete with three Cossor valves, permanent magnet moving coil speaker in magnificent walnut console cabinet, brand new, in original sealed cartons; £3/12/6 (list £4/8).

MIDGET A.C./D.C. 4-valve Receivers, with moving coil speakers, made by R.K., in original sealed cartons; £3/17/6 (list £10/10); magnificent appearance, ready to plug in.

COILS.—Igranic superhet, set of four (1 Osc., 2 L.F. with pigtails, 1 L.F. plain), 12/6 (list 50/-); Lissen superhet, 3-coil kit, screened, ganged on base with switch, type L.N.5131, 9/6; same description for band pass or any straight circuit; type L.N.5162, 7/-; Varley constant square peak coils, B.P.5, complete with all accessories in sealed cartons, 2/3; Lewcos BPF/R, B.F., O.S.C./126 (extensor) T.O.S./R, all at 3/6 each.

PICK-UPS.—Marconi model K.25 (1935 issue), 21/- (list 32/6).

CONDENSERS.—Lotus 3-gang, 12/6; 2-gang, 8/6; all 0.0005, fully screened with trimmers, complete with dials, knobs and escutcheons; special bargain line, Plessey 4-gang condensers, superhet. type, fully screened with trimmers (less dials) (standard dial will fit), 10/6 (list 45/-); Dubilier block condensers, 4 mfd. (2x1x1), 1,000v., 2/9; 4.5 mfd. (2.25x2.25), 3/-; T.C.C. (0.1x0.01), 1/3 each.

SPEAKERS.—Blue Spot 6R units, brand new and boxed, 10/6 (list 35/-); complete, mounted on Blue Spot chassis, 16/6 (list 45/-).

MISCELLANEOUS.—Set manufacturer's surplus skeleton type Westinghouse metal rectifiers, H.T.6, 7, 8, 9/3; Morse tapping keys, flash signal and buzzer, complete with battery and bulb, 2/-; Lissen general purpose output chokes, 20-28 henries, 18-60 m.a., L.N. 5501, 6/- each; Lewcos superhet. dual wave frame aerials, 9/-; utility midget condensers, 0.0005, complete with dial, knob escutcheon, 2/6; Bifio static cut-outs, definitely cuts out all electrical interference and all unwanted noises without decreasing volume, listed at 12/6, our price 2/3 each; brand new and boxed, with simple instruction leaflet; please state whether A.C., D.C., or battery set; note price, 2/3 (listed 12/6).

THOUSANDS of Bargains for Callers at our Various Shops. We have enlarged and reconstructed our 48, Lisle St., premises, and it is now the largest wireless depot in the West End, with a full range of 1935 receivers, components, etc., at keenest prices.

ALL Goods Guaranteed and Sent Post Paid.

BRANCHES at 46, Lisle St., W.C.2; 16, Leicester St., W.; 271-275, High Rd., Willesden Green, N.W.10; all mail orders to 323, Euston Rd., N.W.1.

SOUTHERN RADIO, 323, Euston Rd., London, N.W.1 (near Warren St. Tube). 'Phone: Museum 6324. [7096]

TELSEN Components; sensational offer by

OLYMPIA RADIO, Ltd.

TELSEN Matched Screened Coils, suitable for use as aerial or anode coils; can be embodied in any circuit; list price 7/-, our price 4/11.

TELSEN Band-Pass Coil Unit, comprising pair of accurately matched screened band-pass coils, complete with wave-change switch, escutcheon and knobs; list price 14/6, our price 8/11, per set.

SET of Telsen Band-Pass Screened Oscillator Coil Units, comprising band-pass coils and oscillator coil, complete with wave change switch, for single knob control; list price 21/6, our price 8/11, per set.

TELSEN Set of Triple Matched Screened Coils, suitable for aerial and 2 H.F. stages, or can be embodied in practically every modern circuit; list price 21/6, our price 12/11, per set.

TELSEN Radio-Grand Transformers, 3-1 ratio only; list price 7/6, our price 4/3.

TELSEN Ace Transformers, 3-1 and 5-1; list price 5/6 each, our price 3/9 each.

TELSEN D.C. H.T. Units, 200-250v. input, output 28 m.a. at 150 volts, 3 tappings; list price 25/6, our price 15/6.

MARCONI 2-valve Battery Receiver, complete with valves and all batteries, self contained cabinet; list price 4 guineas, our price £2/2/6.

LISSEN 2-valve A.C. Receiver, absolutely complete in handsome Bakelite cabinet; list price 8 guineas, our price £2/19/6.

ATLAS P.M. Speakers, one of the finest moving coils made, complete with transformer, suitable for pentode or power valve; list price 42/6, our price 14/11.

ATLAS T.12 Eliminators, output 120v. 12 m.a., complete with trickle charger; list price 77/6, our price 45/-.

TELSEN—More Components.

L.F. Coupling Units, 4/6; L.F. smoothing chokes, 3/11; tapped pentode output chokes, 3/6; Class "B" output transformers, 4/3; 313 disc drive, 2/3; air dielectric 0.0005 condensers, 1/11; Bakelite dielectric tuning condensers, 0.0005 only, 1/-; shortwave H.F. chokes, 1/9; binocular H.F. chokes, 3/6; etc., etc.

The Above Receivers are Mostly Brand New Decontrolled Models; we have large numbers as slightly shop soiled or second-hand models in addition; illustrated lists post free on application; also numerous other bargains in speakers, eliminators and components.

TERMS—Cash with Order or c.o.d.

ALL Goods Carriage Paid; everything guaranteed O.K., money refunded if not satisfactory; please mention this paper when replying.

RE Telsen—All goods carriage paid excepting transformers and chokes, for which please send 6d. extra owing to the heavy nature of the goods.

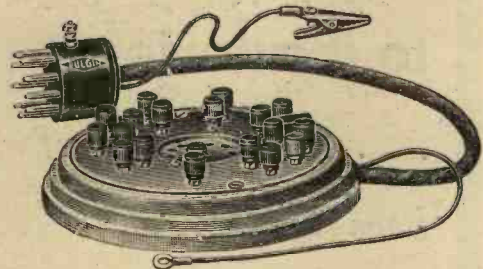
OLYMPIA RADIO, Ltd., Mail Order Dept., 49a, Shudehill, Manchester.

BRANCHES in All Principal Towns. [7053]

WHEATSTONE Bridges, 17 plugs, high class makers, new 20/-, second-hand 10/-; postage 1/-.—Beatons, Chalk Farm Rd., N.W.1. [7092]

VOMETER, 8gn. model, perfect, "Medisun" quartz ultra violet lamp, 10gn. model, 230v. D.C.; offers.—Tipper, Ostlers Lane, Cheddleton, Leek, Staffs. [7086]

BULGIN ALL VALVE TESTING ADAPTOR



Every type of British Made valve can be tested on this new ingenious unit if used with the appropriate adaptors. Comprises a 9-pin cable plug with cable and 9-pin holder on a moulded bakelite base with all points split and terminals provided.

Meters can be inserted into any circuit and voltmeters tapped to any points.

LIST No. V.T.14 .. Price 15/-

Plug Adaptors for the above.

List No.	Sockets.	Pins.	Price
A.27	9	to 7	2/9
A.28	9	to 4/5	

Socket Adaptors

A.25	7	to 9	each.
A.25	4/5	to 9	



A. F. BULGIN & CO. LTD.
Abbey Road, Barking, Essex.



There was a young fellow named Dick
At making Radio Sets he was slick
Every Set a success—
Nothing more—nothing less—
"Using FLUXITE"—he said—
"does the trick."

See that Fluxite is always by you—in the house—garage—workshop—anywhere where simple, speedy soldering is needed. Used for 30 years in Government works and by the leading engineers and manufacturers. **Of all Ironmongers—in Tins 4d., 8d., 1/4 and 2/8.**

Ask to see the Fluxite Small-space Soldering Set—compact but substantial—complete with full instructions—7/6. Ask also for Leaflet on Case Hardening Steel and Tempering Tools with Fluxite.

THE FLUXITE GUN

is a handy and economical tool that enables you to put the Fluxite where you want it on the soldering job, and is clean and simple to use. **Nothing to remove—no mess—no trouble. Always READY FOR USE.**

Also used to project grease into grease cups, bearings, etc.
Just fill the nozzle portion—half fill the cup—put together and press as required. **PRICE 1/6.**



ALL MECHANICS WILL HAVE
FLUXITE
IT SIMPLIFIES ALL SOLDERING

FLUXITE LTD. (Dept. W.W.), DRAGON WORKS,
BERNONSEY STREET, S.E.1.

Components, Etc., for Sale.—Contd.

WOBURN RADIO Offer Following Bankrupt Stock and Manufacturers Surplus:—

T.C.C. Condensers: Blocks, 20 mfd. (12 mfd. x 4 x 2 x 2 mfd.), 5/6, 14 mfd. (2 mfd. x 2 x 4 x 1 x 1), 5/-; 12.01 mfd. (4 x 4 x 2 x 1 x 0.01), 4/6; 6 mfd. (4 x 2), 2/6; 6.5 mfd. (2 mfd. x 9.5), 3/-; 11 mfd. (4 x 4 x 2 x 1), 3/6; 9 mfd. (4 x 4 x 1), 3/-; 5.55 mfd. (4 x 1 x 0.1 x 0.25), 2/6; 3.1 mfd. (1 x 1 x 0.1), 2/-; 1.2 mfd. (1 x 0.2), 1/-.

ELECTROLYTICS: 6 mfd. 50v. working, 15 mfd. 100v. working, 25 mfd. 25v. working, 50 mfd. 12v. working, 1/3 each.

T.C.C. Mic Tag Condensers, type "S" and "M." 4d. each; values, 001, 0015, 003, 006, 0001, 0002, 0003, 00025, 0003, 0004, 0005, 0007, 0008, 0009.

DUBILIER Dry Electrolytics, 4 mfd., 8 mfd., 500v. working, 3/-; 50 mfd. 50v. working, 3/-; Mershom wet electrolytics, 500v. 8 mfd., 2/9.

FORMO 1 mfd., 1,000v. test, Bakelite, 1/-; 2 mfd., 1,000v. test, 1/3; Wedg 4 mfd., 750v. test, 2/3; Tubulars: 0.1, 0.01, 0.02, 6d.; full range of T.C.C. tag condensers at 4d. each including unusual sizes, all types M.

BRITISH Radiophone Two Gang Condensers with Trimmers, 0005, 5/9; New Polar Midget 0005, 2-gang, 6/6; 3-gang, 9/9; Radiophone curved dials with escutcheon and dial lights, 3/9.

ESTON Iron Cored Canned Coils, with circuit, 2/6; Radiophone toggles, 6d.; binocular chokes, 1/2; H.F. chokes, 10d.; Columbia L.F. transformers, 3/1 and 5/1, 2/9; J.B. air spaced condensers, 0005 with escutcheon, dial light and drive, 3/3; Class B driver and choke, 8/6; with B.V.A. and 7-pin holder, 17/-; chassis mounting valve holder, 4-5 pin, 1/3 half dozen; 7-pin, 5d.; Edison condensers, 005 and 006, 4d.; Sistoflex, 7 yds. 6d.; screened sleeving, 3d. yd.

SONOCHORDE Speakers, D.C. energised, 2,000 ohms, new and boxed, 12/6 (carr. 1/-); Rothermel Midget P.M. speakers, power transformers, 12/-.

ROTHERMEL Piezo Electric Pick-ups, new model, boxed, listed 42/-, 30/-; Marconi K.25 pick-ups, boxed, 21/-.

WESTINGHOUSE Rectifiers, set manufacturers surplus skeleton type, H.T.8 and 9, 8/11; transformers for same with L.T. winding, 6/9; few only H.T.5 and 6 at 4/9.

G.P.O. Relays, magnificent instruments, few only, 10/- each.

W.R.C. Eliminators: 150v. 30m.a., A.C. model, 21/-; A.C. with trickle charger, 2v., 4v. or 6v., 1/2 amp., 32/6 (carriage 1/- extra on each).

TRADE List Ready, send heading and stamp.

TO Avoid Delay Send Orders Without Money, we pay c.o.d. charges on orders over 5/-.

WOBURN RADIO Co., 9, Sandland St., W.C.1. Holborn 7289. (Second floor, nearest stations, Holborn or Chancery Lane). [7046]

H. FRANKS has the following P.A. gear and components to offer at bargain prices.

CELESTION £6 P.P.M.79, P.M. speakers, 10 1/2 in. cone, handle 5 watts, with multi ratio transformer, in bak, mahogany, or walnut cabinets, original cartons; bargain, 45/- each.

CELESTION Energised M.C. Speakers, 2,500 ohms Universal tapped transformer; list 37/6, 13/6 each.

MANUFACTURER'S Surplus Stock of M.C. speakers, Magdynavox, Celestion and other well-known makes, 450, 2,000, 2,250 ohms, less output transformers; 8/6 each.

M.C. Units Racon, Truvox, American Amplion, 6v. field, £2 each; Johnson and Phillips 30hy. 250 m.a. chokes, £1 each.

CLAUDE LYONS 4-gang Condensers, 1/4 spindle, ball bearings, trimmers, etc.; 5/6 each.

G.E.C. 60-watt Converter Driven Amplifiers, in teak cases; breaking up price, £2 each.

MIRALY Pull Through, sound heads, complete with optical systems, £4 each; London Electric driven sound head, new condition, £5.

TALKIE Equipments.—Sound heads, meters, amplifiers, components, etc., at knock-out prices, callers invited; stamp for lists; terms, cash with order, c.o.d. carriage forward.—H. Franks, 23, Percy St., Tottenham Court Rd., W.1. Museum 8585. [7094]

TELE-RADIO Have Purchased Manufacturers' Surplus; same are being sold at ridiculous prices.

SET Manufacturers Surplus, skeleton type, Westinghouse rectifiers, H.T.7, H.T.8, 9/3; H.T.9, 9/6; H.T.10, 10/9; L.T.2, 9/3; L.T.4, 11/3; L.T.5, 11/9; transformers for same, from 7/11.

DUBILIER Resistances, 1 Watt wire ends, all sizes in stock, 100 ohms to 2 megs.; 7d.

A.C. Eliminators, input 200-250v. 150v. 25 m.a., finished in neat crystalline case, 3 positive tappings, Westinghouse rectified, fully guaranteed, 19/11, postage 1/-; D.C. 150v. 25 m.a., 10/11, postage 1/-.

WESTERN ELECTRIC Microphone, complete with stand; listed at £55, our price £17/10.

IGRANIC Transverse Current Microphone, complete with switchbox, transformer and meter, etc.; original price over £50, £7/19/6.

WE Have Large Stocks of Meters by Ferranti, Turner, Weston, also input and output transformers; our prices are right! Send for full lists.

ALL Goods Sent Carriage Paid (unless otherwise stated) c.o.d. or Cash with Order; real service; part exchanges arranged.

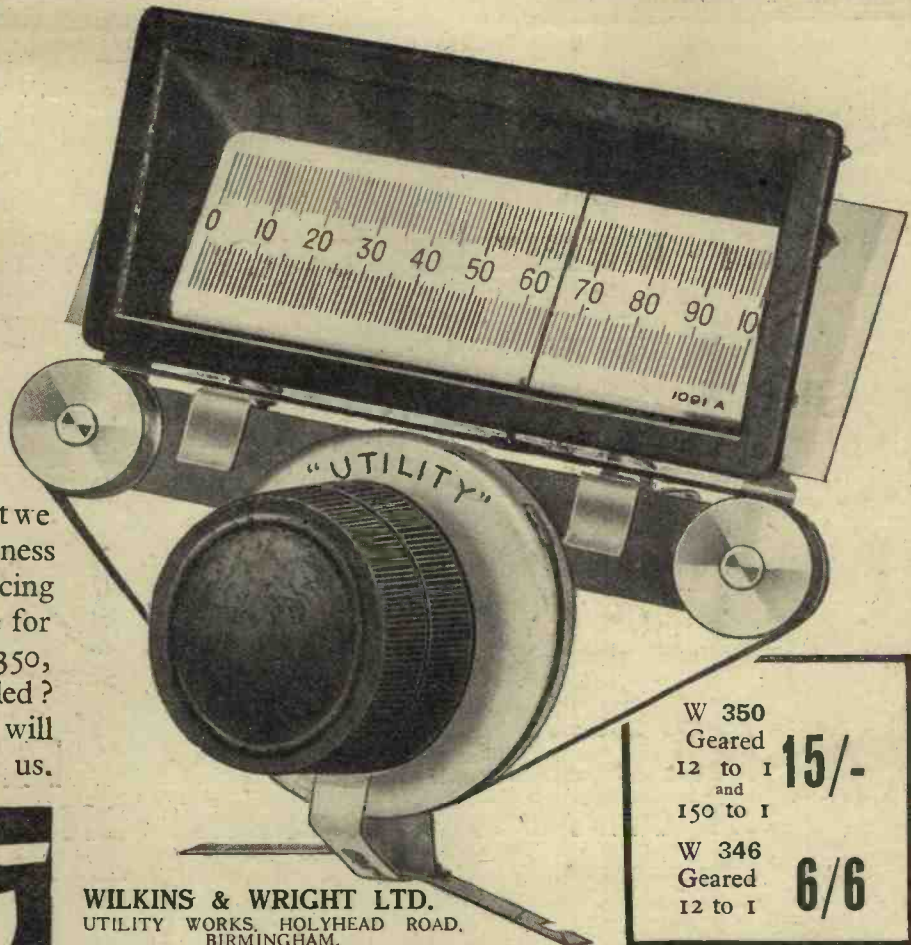
TELE-RADIO SUPPLIES, 305, King's Rd., S.W.3. [7082]

EXPERIMENTER has Large Quantity of Components and Materials for Disposal at Bargain Prices; write for long lists.—Heaton, 103a, Parchmore Rd., Thornton Heath, Surrey. [7015]

NEW, soiled, electro dynamic converter, 6v., 210v. 40 m.a., 50/-; Magna 6v. dual, pair, 40/-; Garrard spring motor, with plate, 35/-.—Beechote, Kingswoodway, Selsdon, Surrey. [7054]

WE WERE WRONG!

In our last advertisement we made a sad mistake, we spoke of "gilding the lily." Several of our readers have pointed out that this should have been "painting the lily." But we may perhaps be forgiven for our literary weakness as all our efforts are concentrated on producing the finest radio components available. Take for instance the dual-g geared dial illustrated, W350, is it not the best dial you have ever handled? If you have not yet handled one then it will be worth your while to get in touch with us.



W 350
Geared 15/-
12 to 1
and
150 to 1
W 346
Geared 6/6
12 to 1



WILKINS & WRIGHT LTD.
UTILITY WORKS, HOLYHEAD ROAD,
BIRMINGHAM.
London Agents: E. R. MORTON, LTD., 11, Newman St., Oxford St., W.1.

Belmont.

3 NEW FULLER BATTERIES

FOR USE AT HOME



NEW FULLER
HEAVY DUTY DRY BATTERY

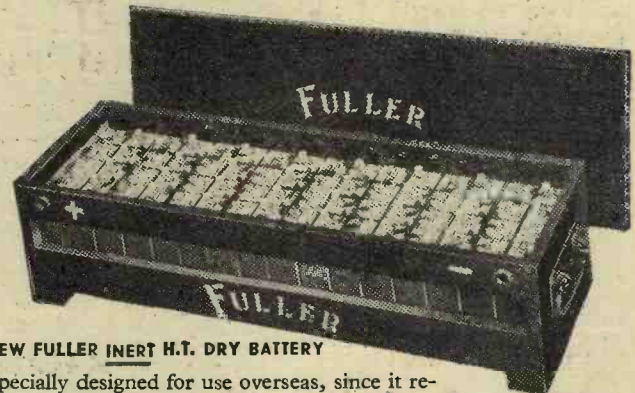
High capacity 45 volt units with 2-3 times the life of the ordinary H.T. Battery. For the largest multi-valve sets.



NEW FULLER
HIGH
CAPACITY 2 VOLT CELLS

Multiple thick plate type especially suitable for Multi-valve Radios and largest Radio-gramophones.

FOR USE ABROAD



NEW FULLER INERT H.T. DRY BATTERY

Specially designed for use overseas, since it remains inactive until water is added to the cells. No deterioration in course of transit. Very high capacity, Supplied in any voltage.

Service Agents throughout the country

Agents throughout the World

FULLER BATTERIES

for every Purpose — everywhere

Fuller Accumulator Co. (1926) Ltd., Chadwell Heath, Essex. Phone: Seven Kings 1200. Telegrams: "Fuller, Chadwell Heath."

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.

"LEADERSHIP" —

A QUALITY OFTEN CLAIMED
YET MERITED ONLY BY **ONE,**

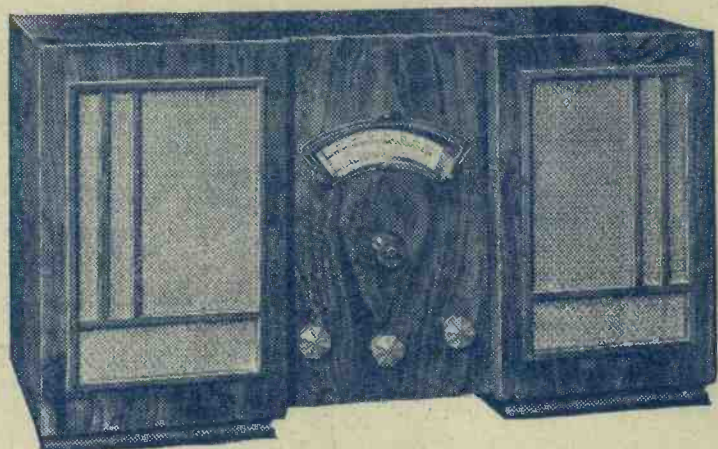
A QUALITY WHICH OTHERS *MUST* ASCRIBE (IF IT IS TO HAVE WORTH)
SUCH IS THE WORTH OF "AUSTIN" PRODUCTS.

The opinions of the Critics, the Trade and the Public alike have placed

"Austin"

RECEIVERS AND RADIOGRAMS IN THE PROUD POSITION OF LEADERSHIP

"AUSTIN" A.C. SUPER
Table Model Five-Valve (including Rectifier). Superhet for A.C. Mains, with Twin Matched Bin, Energised "Rola" Speaker, Provision for Pick-up, Extra Speaker, and Mains Aerial. The Input Circuit consists of a Band-pass Filter, with an inductively coupled link. The first Valve is one of the new Osram MX40 Heptode frequency changers, having the high conversion conductance of 570 micromhos. The I.F. Transformers, of 8 k/c. fixed peak separation have a dynamic resistance of approximately 200,000 ohms so that the stage gain of the frequency changer is about 46. The I.F. Valve is an Osram VMP4 Variable-mu H.F. Pentode coupled to a Double Diode-Triode, the Osram MHD4 one Diode of which is used for Delayed A.V.C. and the other for Signal Rectification. The output Valve is an Osram MPT4 Cathin Pentode, giving an output of 3 watt undistorted volume.
Controls:—(1) Tuning. (2) Wave-band and Gram. (3) Volume and On-off (4) Tone.
Price 18 Gns.
(or 12 monthly payments of 35s. 5d.)



SPECIAL PROVINCIAL DEMONSTRATIONS
in connection with our
£1,000 Competition
(for full particulars of this unique prize scheme see page 6).
During the next two or three weeks special demonstrations are being held in various parts of the country by our approved Dealer-Agents to give the opportunity to the Public of listening to a demonstration of the "Austin Receiver, and so to qualify for entry. Look for special announcements in your local papers.
During the week commencing December 3rd demonstrations are being given by
Messrs. Butcher Bros.,
96, Derby Road, Nottingham,
at premises which have been specially taken in the centre of the town at
South Parade, Nottingham,
and by
Messrs. Electrical Equipment Co.,
106, London Road, Leicester.

READ THESE RECENT EXPRESSIONS OF OPINION !

The Critics:—

"Here is perfection in Radio Engineering."
"Grid Leak" of the "Daily Sketch."
"The set that leaves me proud of British craft."
"Music Trades Review."
"They are the pioneers of something different one should not be frightened as to cost. The 'Austin' A.C. Super which they claim to be 'built like a watch' is certainly a fine piece of workmanship."
"Daily Mirror."

The Trade:—

"We would like to express our opinion on behalf of our customer and ourselves on this instrument. It was a pleasure to handle this set and also to sell it; it answered every requirement in tone, selectivity and sensitivity, AND WE COMPLIMENT YOU ON A MASTER PRODUCT."
Messrs. Sanigar's, 33, Park Street, Islington, N.1. Nov. 21st, 1934.
"I am giving daily demonstrations of the 'Austin' WHICH IS THE BEST JOB I HAVE YET HANDLED and have already sold four within the last few days in this rural area."
C. Seaman, Clementhorpe, Brough, East Yorks.

The Public:—

"I enclose card request for your guarantee, although from the fine workmanship of the chassis and the results I am obtaining, this would appear to be quite unnecessary."
B. C. H., Monkseaton, Northumberland.
"I am very pleased indeed with the set and it may interest you to know that so far I have heard 78 different stations at programme strength. This includes Moscow in broad daylight, which I consider a very good performance."
L. T., Matlock Cliff, Matlock.

The above expressions of opinion are only a few of the hundreds in similar vein which can be inspected at our offices at any time.

THE NEW & BETTER RADIO!

Advt. of The City Accumulator Co., Ltd., 18/20, Norman's Bldgs., Central Street, E.C.1. Phone: Clerkenwell 6206.