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EDITORIAL

To Our Readers
An Important Announcement

A new 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 matters, and this 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 range. 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 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. 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 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-
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 aerials 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 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 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 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.

Although those who ignore such precautions often escape the consequences, inconsistent and erratic behaviour of receivers has often been traced to metalwork 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.

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 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 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-µfd. 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 interstage 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.

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 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 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 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.
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 could 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 1,001,000 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 conveniently assumed to have been mislaid.

This important fact, indeed, is being utilized 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 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
Single-Sideband Working—

Europe are at least interested in their possibilities. It is quite impossible, at present, to foretell what future developments may occur. Certainly, a good deal of 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, a new 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 33 to 30 and 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 of 33 to 30 kc/s passed by the filter is then applied to modulate a second carrier of 51.5 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 latency of 15 to 20 cycles in the carrier replacement has...
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-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 superheterodines 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 if the 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, and, 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 experiments 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

**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 Douchurch 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 model of component used in the original model, suitable alternative products are given in some instances.

1 Variable condenser, 0.0005 mfd. Farnes $1.05
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3 Crystal detector, 0.0005 mfd. Ormond $1.05
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5 Microphone, 0.0005 mfd.; slow motion, Ormond $1.05
6 Tuning coil, two-stage Scientific Supply Stores, $1.50
7 Standard Tuning Store, Scientific Supply Stores, $1.50
8 Thomas transformer, with screened primary, 8:1,000 volts, 50 cycles; secondary, 200-4,000 volts, 30 ma.; 4 volts, 5.5 micro; centre-tapped; 1 volt, 5 micro, centre-tapped, $3.00
9 Transformer, 125/150/175/200, 125 volt, 2.5 ampere, National, $3.00
10 Microphone, 0.0005 mfd.; 700 volts, with holder, National $0.50

**Electrolytic condensers:**

- 5.0 mfd., high voltage type, Dubilier 0.0001 mfd.
- 4.0 mfd., high voltage type, Dubilier 0.0005 mfd.
- 4.0 mfd., Dubilier 0.0001 mfd.
- 1.0 mfd., Dubilier 0.0005 mfd.
- 0.5 mfd., 20 volts working, T.G.C. 0.0005 mfd.
- 0.5 mfd., 15 volts working, T.G.C. 0.0001 mfd.

**The generous output from the PXA valve is sufficient for most domestic needs.**
From TRIODE to DOUBLE-DIODE-PENTODE

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

The modern valve and its applications: this, the concluding installment, 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 30, October 12th issue)

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 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 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 produces 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 evolved 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. 17 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. 17. A simple generator of oscillations.](image1)

![Fig. 18. A two-valve frequency-changer, in which oscillator voltages are applied to the suppressor grid of a screened pentode detector.](image2)
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 oscillation 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 assume that the oscillation of the triode is such as to produce a total grid-swing of 26 volts, then, since the valve will bias itself back by grid current through R (Fig. 20) until only the extreme positive 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.

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 inately 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 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 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-mu valves used as high- and intermediate-frequency amplifiers, will reduce their amplification 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, 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 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 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 reaches the delay voltage V, after which D2 begins to rectify. The extra bias is usually provided by making the cathode of the diode positive by connecting it to

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 milli-amperes, it is possible to sacrifice a small portion of the cathode volts to and to use this for the diodes. This is done by using double-diode triodes, double-diode pentodes, and double-diode-pentodes, with their bewildering selection 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 it, further, a bias of 15 volts is required to reduce the gain of the variable-mu 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 DF/pen the pentode used as LF amplifier after the diodes has a variable-mu characteristic on the lines of those discussed in connection with screened valves for high-frequency amplification,

![Diagram of Delayed AVC Circuit](image)

Fig. 24.—Delayed AVC circuit. If the bias voltage of V2 is suitable, also an 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.
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-em 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.

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 formula, 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.

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 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 15d. (by post 15.7d.), is of just the right size for the pocket, and is obtainable from booksellers or direct from \[Avc\] Ltd., Dorset House, Stamford Street, London, S.E.I. Companion diaries are also issued by our sister journals, The Autocar and The Motor Cycle.

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.

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 1d. in each case.

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

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 have 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 wave-lengths of 220.0 metres (Cairo) and 209.0 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 half hour's music. The times of other test transmissions will be announced daily on the main service transmissions at Abu Zabal (343.9 metres) and Ras el Tin (474.4 metres) at 7 p.m.

A Notable Birthday
PROFESSOR EDOUARD BRANLEY, inventor of the coherer method of detecting wireless signals, has just celebrated his nineteenth birthday. The Professor is reported to be still busy in his radio laboratory.

Brighter "Blurs"
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 25,000 francs, take the form of cash, furniture, a trip in the Algeria-Sicily 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 prison for many months, include Dr. Algiers, 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 Hahn, former Director of the Cologne station.

Politics naturally play a large part in the affair, for without the change of regime 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, cafes, 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.

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 10.5 sq. 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.

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BROADCAST BREVITIES

Is it the Luxembourg Effect?

IS DROITWICH ELCING THE "LUXEMBOURG EFFECT" IN THIS COUNTRY? Dr. Van der Pol has already reported DROITWICH as an offenser 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 haddock listener is powerless when faced with interference of this kind, and the saddest part about it is that he seldom receives any compensation in the cause. As a consequence he tears his receiver to pieces in search of selectivity, and the only person who profits in the manufacture of selectivity gadgets.

A Perfect Transmission?

SET testers and others may be glad to know that to-night's orchestral concert from 9.45 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 "mics" are now the standard in the studio.

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 acoustic will be suitable?" I asked, and Mr. Cock laughed. "That speech 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 "tob the call" service after 7 p.m. would affect the wireless programmes!) The effect was first felt last week when the Belfast Wireless Orchestra, tabulated for a National broadcast, was replaced by gramophone records in the London studio.

£100,000

One wonders whether the Post Office will maintain its adamantine 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 "artists" 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 persuade the country by 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 well challenge those obtained with land lines. When the land lines were once more available the ultra short-wave transmitter 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 2XX 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 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 Frodsham find a very plausible and romantic reason in "Invitation to the Waltz," which is to be broadcast on November 24th (Regional) and 25th (National). Tessa Deane will play the heroine, and John Hobbs 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 in 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 Ha

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 Canardier, the Guardsman, 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 Canardier. 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 impromptu moment he is expected to drop in on his colleagues. Now his home has become a port of call for those permanently thirty people, the Iraun 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.

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**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 $1\mu V$ or so, it is not uncommon to find that the noise level equals the signal.

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 $\mu V$, 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 $\mu V$. 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 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.
New Apparatus Reviewed

Recent Products of the Manufacturers

"FYDELTONE MINOR" EXTENSION LOUD SPEAKER

ALTHOUGH of such compact size (the overall dimensions are only 6in. x 8in. x 4in.), 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 3½in. 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 expected to be expected to be obtained, but the lower cut-off does not commence before 150 cycles. The only noticeable resonance was in the vicinity of 300 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 loudspeaker.

The price with transformer is £35, 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, have sent in for test an AC mains-operated short-wave converter which is an attractively finished and well-made unit measuring 11½in. x 7½in. x 20½in. 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 gauged with the oscillator, waveband switching, giving a tuning range of from about 13.5 metres to 35 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 superhet receivers, and very good results obtained with both types. Although, when used with a superhet double frequency receiver, the latter is more involved, the two oscillators do not produce heterodyne whirls at any part of the waveband covered.

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-

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 conjunction 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 HBA, 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 10s.

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 plate, and while a single tuned circuit is used for all the radio frequencies required. This circuit covers a range of 300 kc/s to 280 kc/s, and for all higher frequencies up to 1,300 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 'squeegee.' 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 valve hand 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, 150 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 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 to 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, which is being incorrectly given. The address of the 362 Radio Valve Co., Ltd., is Stoneham Road Northwold Road, Upper Clapton, London, E.5.

The Avo oscillator, a radio signal generator which can be modulated at an audible frequency, was not at its best, so I went over to Radio-Paris for operatic selections, and heard an air from Bellini's 'I Puritani,' admirably sung by M. Faniardi, and the mad aria from Donizetti's 'Licia di Lammermoor,' by Mlle. Hedin. I must confess, however, that I do not greatly admire vocal pyrotechnics with this Hito obligato, and it was not long before I changed over to Kalundborg and Copenhagen for the concert of French music by the Radio Orchestre, reviving memories of bygone days while listening to that once-popular march, 'Le pire de la Victoire,' by Gaume.

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' 'Sylphide,' and the overture from Litolf's 'Maximilian Robespierre.' I thought the latter was a lot to Radio-Parse long 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 M. Poincard, and instead there was an excellent rendering of Mozart's Symphony in D Minor.

The Better Station

On Tuesday Cologne and Stuttgart broadcast a programme of 'Rigolotto' 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 Mählacker, for some reason, was not coming through as strongly as usual. After listening for a while I went over to Huizen for Dvorak'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 Potsdam I came in for another violin solo, this time by Henry Szeryng, who gave a very symphonic rendering of Vieuxtemps' 'Souvenir Espagnole,' supported by the excellent station orchestra under the baton of Theodore Mathieu.
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FEEDING

Last week, by a sporter's error, we said "our set and species are food enough to advertise themselves." Obviously we meant "good," but even this error means something. Our sets and species provide food for the thought. 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 homely and fantastic claims. We think that the "advertisements" sets led up too. Our ads are therefore, merely honest statements of what we think and do. Their natural corollary is the literature we offer you; 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 Wire World with more space to tell you what fine lines we are.

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An 0.5 mfd. plug-in Condenser unit can be supplied (Price 5/-) to enable the instrument to be used directly to measure output voltages.


 Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.
**EDITORIAL**

**Electric 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 p.r.n.r. 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 in its present form, the point of interest is to be noted that 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 impracticable, 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.
A Bird's-Eye View of Transmission and Reception: An

By A. L. M. Sowerby, M.Sc.

The shortest waves, a few wavelengths 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 recognizing 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" is exactly analogous to the sequence "mechanical
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 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...
Broadcasting in Outline—
each wave must be two feet long. If the string had executed 1,200 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

![Diagram](image)

Fig. 3.—Twenty successive waves from the string. If the string is vibrating 20 times per second, the 21st 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 1,100 feet in one second, AB = 1,100 feet, and the distance between one wave and the next (wavelength) is 1/20th of 1,100 feet.

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 it 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 86,600 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 seconds' worth of emitted waves will stretch remains the same. The waves, therefore, are longer. In symbols, the relationship is \( \lambda = \frac{300,000,000}{f} \), where \( \lambda \) = 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.

![Diagram](image)

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.

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.

![Diagram](image)

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.
Wireless World

DISTANT RECEPTION NOTES

Stations that Wander: Fewer X's

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

Europe's large family keep precisely to their wavelengths, so that it must be a matter of 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 which 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. Huisen, Radio-Paris, Zeesen, Warsaw and Luxembourg have all been good and Kaliningrad has only been interfered with on occasional evenings. The French Government is at last definitely closing down to the Eiffel Tower 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 (1) was accomplished by means of a variable condenser, usually with a capacity of 0.01 microfarad. A favourite form of tuner in those days was the loose-coupler. Its primary was a solenoid six inches square and the secondary could be moved inwards or outwards, travelling on two parallel round brass rods. The whole assembly 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, Athens, Frankfurt and Hilversum.

D. EXER.

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 in 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.

SEEN BUT NOT HEARD. As a broadcast 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., it is more than probable 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 255 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
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 par-
ticularly 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 trans-
mitters a receiver need have
quite a small degree of amplifi-
cation to provide adequate vol-
ume 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 de-
signed solely for local reception, such a
set will often give good results from a num-
ber of Continental transmissions, but if
then requires careful handling and is de-
pendent 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 con-
sequently 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 24 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 in-
ductance. 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 be-
comes poor owing to the increased effect
of secondary capacity. The maximum
ratio obtainable with a good frequency
response depends upon the general de-
sign 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 is 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 70,000 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 possible with the specified transformer, since it is designed for direct current through the primary. An HF choke C1 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 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 efficient 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 C4, and the 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.

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 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, returning, 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 2A., 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 of the detector. Grid bias for the output valve is obtained by means of the 700 ohms resistance R3 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-mfd electrolytic condenser C10 in order to avoid feed-back effects.

The usual 4-mfd. 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-mfd. electrolytic condenser C8. This simple arrangement provides more than enough smoothing for the output valve, but not sufficient for the
detector. 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-mfd.
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 \( \sqrt{3(500/2)} \).

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 2,000 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

1. Variable condenser, 0.0005 mfd., C1 Faraday RJS.
2. Dial for above.
Farmes Metric Drive.
3. Reaction condenser, 0.0015 mfd., C4 Ormond RJS.
4. Knob for above.
Ormond RJS.
5. Midget condenser, 0.0001 mfd. slow motion, C1
Ormond RJS.
6. Tuning coil, two-range, L1, L2
Scientific Supply Limited, Standard Two Type
7. Mains transformer, with screened primary, 240-250
volts, 10 cycles; secondary, 300-500 volts, 60
mfd.; 2,5 am., centre-tapped; 4,000, 2
amps., centre-tapped
(Australian Transformer, Basset, Highfield Partridge, Rich and Rounds, Round Bats, Vertolst, Wranleigh)
8. LF choke, 30 henry, 75 m. 4W.
The radio 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 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 0.6 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 should not be attributed to it, for practically all loudspeakers 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 sensitivity proved entirely ade-

The simplicity of the wiring is apparent in this photograph.

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Valve Voltages and Currents:

<table>
<thead>
<tr>
<th>Valve</th>
<th>Anode Voltage</th>
<th>Grid Bias</th>
<th>Anode Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dot. 4M1L</td>
<td>140</td>
<td>-2</td>
<td>5.3 mA</td>
</tr>
<tr>
<td>Output FXs</td>
<td>250</td>
<td>-31.5</td>
<td>44.0 mA</td>
</tr>
</tbody>
</table>


Regional, 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 fulfills 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.
On With the Dance

ANY 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.

I fancy there has been an attempt made to revive this idea 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-

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 border line beyond which Mrs. Grundy lives and has her being, "a red light shows in the c'apron' 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.C.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, a filter circuit in the form of a hireling valet whose duty it was to wait below at the street door and sling out all and sundry. Unfortunately, this human re-jector circuit proved most unsatisfactory, 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.

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
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 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 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 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 base 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 loud speakers are 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 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 oildskin, 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 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.
HINTS AND TIPS

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.

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 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 or main 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 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 depreciate attempts at improvement, a note of warning may be helpful.

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.

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**Fig. 1.**—Two extension speakers connected in parallel. By suitable adjustment of the tapped output transformer, 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-frequency 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 $L_2 C_2$ 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 $e_2 = g_r e_1$, in which $g_r$ 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 are 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 capacity 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.

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.; $g_c = 0.001$ 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 $g_c = 0.005$, the dynamic resistance must not exceed 7800 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 $g_c = 0.005$. At 110 kc/s, therefore, the dynamic resistance must be kept below 780,000 ohms, and it is very unlikely ever to exceed this figure in practice. At 1,000 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 feedback 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
Amplification with Modern Valves—

Generally, 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 g_m = 0.34, and even at 170 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 that the product g_C 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 r-2,

\[ g_R/n = gR/n. \]

and both tuned circuits have the same dynamic resistance R, then the value of dynamic resistance to be used in the curves of Fig. 3 is not R, but R/n. Thus if we have a value of g_C = 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 taps ratio a little less than 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', and the amplification is equal to g_R/n' = 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, \[ i_{2}/i_{1} = g_{RF} \]

can be found from the curve of Fig. 4 when H is known, and this symbol can be evaluated from the simple formula \[ H = pC/R \]

in which g=

mutual conductance in Amps/Volts, C grid-anode capacity in Farads, R = dynamic resistance in ohms.

Suppose we now use the single HF stage in Fig. 3 (a) to an amplifier circuit as in Fig. 4. For instance, to the receiver must be fed-back a value of g_C = 0.005. The highest frequency to which the receiver must tune is 5,000 kc/s, and Fig. 2 shows that the frequency is maintained, as far as feedback through the inter-electrode capacity is concerned, if the dynamic resistance is below 208,000 ohms. We are unlikely to obtain a resistance greater than 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 g_R = 300. The gain of the valve without feed-back is 300 times, and we must evaluate the increase due to the valve capacity. We have \[ H = pC/R = 10^{-10} \times 2.28 \times 10^9 \times 2.5 \times 10^{-10} = 5.7 \times 10^{-8} \cdot 1 \times 5 \times 10^9 = 0.708 \cdot f \text{ from Fig. 4.} \]

The stage gain decreases by 25 per cent. in the amplification in this case. It must, of course, be remembered that the calculation assumes perfect external screening, and that 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, with a valve selected with a value of g_C = 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-

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 Hogan 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 feedback. Thus the circuits are slightly mistuned to produce maximum amplification through the aid of the stray regeneration.

Detuning

The effect of feedback 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 asymmetrical. 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 Values—

able to maintain the correct shape of curve when several transformers are used. Invari-

ably, the response curve degenerates into one with a single peak with a small

bump in one side! By an HF amplifier, therefore, may exercise a profound effect upon its performance, even if they do not lead to actual ins-

stability. The effect of coupling external
to the valve is similar to that of the grid

B.C. and Electrical

Interference

The artillery battle between the Post Office and the Lon-
don and Home Counties Joint Electricity Authority over the matter of electrical interference

with broadcasting is being keenly watched at Portland Place, though B.B.C. is known to be

burning its fuses by taking part. Quite naturally, the Corporation is not going to interfere 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 truth-

fully 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 ac-

count.

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 bulbs 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 charac-

teristic of interval signals that they are exceedingly difficult to tune in with any degree of ac-

curacy. 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 Circuits-in-Chief, was in Hong

Kong and while Sir John Reith was

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 pre-

sented prizes at schools up and down the country.

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

Why Not the Air Force?

By the way, people are wonder-

ing when the Air Force will be represented in the high coun-

cils of British broadcasting. The Navy (Vice-Admiral Sir Charles

Stray couplings in an HF amplifier, therefore, may exercise a profound effect upon its performance, even if they do not lead to actual insta-

bility. The effect of coupling external
to the valve is similar to that of the grid

end-on capacitance, but the latter represents the minimum below which a reduction of feed-back is impossible unless neutralised
circuits are adopted.

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 shown, probably under the simple title: "B.B.C."

Artists in Person

PLACé no credence in stories that the B.B.C. is overcom-

ing 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 fit 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 Canley, Surrey.

A Palatial Station

King Prajadhipok is very proud of Siam's radio, for his country possesses probably the most palatial broad-

casting station in the world. While lunching with a Fleet Street globe-trotter the other day I learnt that this ex-

traordinary station is located in the palace of Phya Thai, Bangkok, where the stuff works in marble halls, or their Siamese equiva-

lent. His Majesty himself opened the station in 1931, and the pictureque silver gift micro-

phone bearing the Royal Arms is carefully preserved. It was used again by King Prajadhipok last December, when the open-

ing of the Siamese People's Assembly was relayed.

Old Etonian as "D.G."

The station operates on about 200 metres, although the short-

wave band is sometimes resorted to. The Director-General, Luang Che Kolsan, wears the old school tie (Etonian) and speaks English. During the war he served in the British Navy.

BROADCAST BREVITIES

By Our Special Correspondent

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 Studies for the North-East

A 350, a region which will

soon be a fully-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 opulent 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 produ-

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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. Those sharpened imaginations, with the 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.

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 to-morrow (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 Moyse (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 Compiegne on November 8th, when the Armistice terms were read to 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.

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

AND SO TO BED.

It is one of numerous bees in the honnet 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 hustle 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 violin 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
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" (Sapp pipes), "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 night (relayed from North Regional). It is described as "a malicious medley of the North," and as a Southerner I have a squirming feeling that people south of the Trent do not come out at all well in it.

THE AUDITOR.

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 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."

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 Verdi’s "Requiem," broadcast from the State Opera House in Vienna. On Friday next he conducts a gala concert at Radio Paris. All who enjoy orchestral music at its best should tune in.

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).
News of the Week

Current Events in Brief Review

King Alexander's Set

The King of Yugoslavia was a keen listener, spending many an hour tuning into foreign stations. According to a correspondent, the late King's receiver in the Royal Palace is now wielded by his a pious hand."

An Early Start

British broadcasting starts daily at 11.15 a.m., but the Egyptian State broadcasting system, only recently formed, is able to broadcast 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 What It Is

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

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 National Braille Press has published by Mr. Charles Wheeler, which is described in The Wireless World of February 3rd, 1933, consists of 400 pages complete with more than a hundred diagrams.

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.

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.

St. John's Wireless Relay Services, Ltd., have opened at Westwood-in-Thames what is described as the largest building solely devoted to wireless relay work in the country. The new building is housed in five separate receivers with eight amplifying units giving a total output of 50,000 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 been printed. Even heavier than its predecessors, the Call Book lists the names and addresses of amateur radio operators 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 print. The remainder of the world's "hams and hams" can be accommodated in 54 pages.

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

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

Distance Leads Enchantment?

Wireless license 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 100 miles of the station, £1 s. from 100 to 250 miles, and £1 1s. beyond that radius. Hotels, boarding houses and cafes pay on a similarly graduated scale, ranging from five guineas down to £1 15s.

The Deutschlander

The new 150-kilowatt German National station, the Deutschlander, 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, 23, Lisburn Road, Hampstead, London, N.W.3. Early application is advised.

Leeds Triumph

A mong 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 acommon 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 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 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—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 that the radio path 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 intervalue 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 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 secondary 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 was adopted as suitable for short-wave superheterodyne reception. Naturally this frequency will bring about second-channel interference unless a high degree of preselection is utilized. 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 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 0.0005 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 connected 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 nmdf. 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 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. Conditions 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 aerials. Provision is made for the addition of an outside aerial if desired.

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 m.mfd., the anode-cathode 0.6 m.mfd., and the grid-anode capacity only 1.4 m.mfd. 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 1 in. The diameter of the bulb is about 1 in.

The valve is being developed in the Radiotron Laboratories, and it is understood that successful operation has been secured at such high a frequency as 600 mc/6.05 metres). Previously operation at such frequencies has only been possible with the Barkhausen oscillator, and the ability to employ ordinary circuit technique represents a big step forward in this important branch of radio development.

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 PX.5?

Answers to all such questions are in the 1935 edition of The Wireless World Diary, obtainable from booksellers or direct from Eliffe and Sons Ltd., Desert House, Stamford St., London, S.E. 1 Price 1s. 6d. (by post, 1s. 7d.)
**Halcyon Model 4501**

A Universal Superheterodyne with Many Interesting Features


**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 wave-range switch, and show the appropriate settings by illuminated and lettering on a translucent panel to the right of the tuning scale.

The controls comprise the main tuning, volume control and mains switch, wave-range switch and a three-position tone control. The latter is useful in cutting down background noise 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 prevailing 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 contributes 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 400 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 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 trans-
missons 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 res-}

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

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.

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 a concert by the Haar-
lem Orchestra. It began with Beethoven's Symphony No. 1 in C, which, apart from its own peculiar charm, is doubly interest-
ing as showing the lingering influence of Mozart on Beethoven's earlier work. This was followed by Mendelssohn's Violin Con-
certo in E Minor, in which the solo instru-
ment was admirably played by Leyendörff. 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 Mendels-
sohn 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 even-
ing had been well spent. Huizen was coming through with almost its old clearness, though at times a slight background was evident—presumably from Brascov.

The following evening I listened for a time to the French National Symphony Orches-
tra 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 Muhl-
lacker, where the Stuttgart station orchestra was giving a concert of operatic music in which I enjoyed the bass solo by Hermann Rieh from Rossini's "Barber of Seville."

Italian Memories

On Sunday morning I made an infelic-
tual 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 Tos-
canini, 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, 440 metres is almost exactly opposite the 1,500 mark on the long waveband. This time I came in for the end of Braga's "Serenade," 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 Denda's "Funiculi Funicula," evidently coming through from Trieste. I hurried there to hear several Italian folk songs, which re-
vived happy memories of a holiday spent in Northern Italy.

Tuesday evening offered a varied selec-
tion of interesting programmes, beginning with Leipzig, where the Dresden Philhar-
monic Orchestra was giving a popular clasi-
cical concert, of which I heard a selection from Beethoven's "Pastorale," comprising two of the dances and the Rákoczy march, followed by Tchaikovsky's Andante Cantabile. Then on to Cologne for the beginning of Richard Strauss' "Sinfonia Domestica," but, feel-
ing rather tired and more inclined for lighter music, I soon went over to Radio-
Paris for a little of Debies' opera "Lakmé." CALIBAN.
New Apparatus Reviewed

Recent Products of the Manufacturers

The specimen tested falls within the first-mentioned category, being a 60-volt unit measuring 9jn x 3jn x 2jn. 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.

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 81.5, and 1.98 amp-hours per cell. Continued to the 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 45. 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. 1169 will be found very useful, as, although similar to the first-mentioned, it is fitted with an insulated terminal, and the price is 3d.

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 adapter for those having screw terminals.

As there are now some valves fitted with a toplug terminal, one of the top plugs for the grid connection Belling-Lee has included in this series of connectors an adapter 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-graphophone, to be known as Model "J54A," 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 graphophone switch, also a potentiometer for use as a tone volume control, are included, and the price is 5s. 6d.

The Switchtel 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'Ombrain, B.Sc., late of the Electrical Research Association, has joined Kingsway Radio, of 1-9, Daje 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 A.V.C. 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 A.V.C. declines to a minimum. On going slightly off tune the sensitivity rises again, but as soon as another station is approached the A.V.C. 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 A.V.C., but this is rarely to be found in receivers to-day. By amplified A.V.C. 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 H.F. valves. "Pull" and even amplified A.V.C. 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 A.V.C. 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 A.V.C. is substantiated mainly by the provision of a circuit detail rather than by the achievement of a well-marked effect.

Amplified A.V.C. has been a feature of Haynes receivers for well over a year. In the Haynes two H.F. 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 A.V.C., 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.

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EDITORIAL

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 cooperate 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 unheard.

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 incommoded 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 make reception to a degree often unbelievable until interference-free reception has been experienced.

Variations in Reception
Should the B.B.C. Warn Listeners?

A CASE 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, and the effect of this on the listener was startling. The explanation then was that the station had been moving around the antenna system.

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 which they are in no way responsible.

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Radio Interference: Post

The Methods Employed and Equipment Used

By A. Morris, A.R.C.S.E., M.I.E.E.

Many 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 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...
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 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 preas-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, 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 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 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 by 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.
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 shooting 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 unscrupulous inventors one meets in Carey Street, whether 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 worldly 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 not 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 lac-tician 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.

IN 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 amphere 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 ordinary 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 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 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-
A New Source of Filament Current—

Wireless World

The un assembled parts of an air depol ariser 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 900-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 is 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 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 as long as the present day, and merely requires cleaning.

Fig. 4.—Discharge curve of 10-lb. air depolarised cell run for three hours under load of 0.7 ampere.

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 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.

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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 Tou house at 8.15, but came on later in the evening owing to M. Dounemigue's broadcast speech. While waiting for the recital I went over to Brussels No. 1 for a Mendelssohn concert and heard part of the "Rey Blas" overture.

On Sunday, after ineffectual attempts to return Stockholm and Paris P.T.T.'s, I settled down for a time with Copenhagen, where the Radio Orchestra played 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 "Rusalka" and secondly, "Mentre ti faccio," both by Mozart. I then went over to Copenhagen for the "House of the Dead," and the Ballet music from Vesti's "Aida," finishing up the evening with a harpsichord recital from Radio Paris.
Making the Most of a Dual Loud Speaker

Experiments in Stereoscopic Sound Effects

By "CATHODE RAY"

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 directions, 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 performance. 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 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.

The idea of using two, or even more, different sorts of loud speaker, each handling part of the musical scale, has been well noticed 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 every thing 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 pizlo-electric (made by R. A. Rothermel, Ltd.), and others which are merely ordinary loud speakers reduced 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 possible in this way is so 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.

Some of you who have heard a demonstration of the "Multitone" 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 "whoopiness" 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 satisfactorily from them. The magnetic
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-centimeter radio service between Lynnsea and St. Inglevert. The development of efficient and stable oscillators for 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 84 per cent. of the volume of double cotton-covered wire. The layer of cellophane protects the enamel insulation against heat and varnish solvents. Wireless World, New York, October, 1934.

A Self-tuning Receiver
THE new Atwater-Kent II-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 electronic 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-valve receivers produced by the America Company, and by the R.C.A. Victor company, cover wavelengths between 81 meter 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 Pittsburgh interferes with GSB on 37.55 metres. Similarly, GSD on 35.55 meters is interfered with by the German station DJD, and by C JR, Winnipeg. —Radio News, New York, October, 1934.

BOOK REVIEW

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 that the course of several years' work it is only natural that a great deal of published data would find its way into the author's files.

The information, culled from observations and tests conducted during the years, includes 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.

Cables are dealt with very fully, in Chapter III some fifteen different styles are illustrated and winding details provided, while in the latter 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 superhetorodyne, 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 valuable, as it gives the functions of all the American valve types, as they are described here, for throughout the book the 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.
Developing Single-Span Tuning

An Improved Aerial Filter

By W. T. COCKING

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 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 range of the set, it may occur from stations operating on frequencies of 3,350-4,700 kc/s (89.5-158.8 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 4,000 μH and condensers of only 10 mmfd. 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 mmfd. The coils moreover would be another source of difficulty, for their self-capacity would be such that they would cease to act as impedances 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 100 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 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 voltage damping resistances with a consequent gain in uniformity of response. On the long waveband, the coils L1 and L2 and the resistances R3 and R2 can be ignored, so that in effect the filter becomes a simple parallel tuned circuit with C1 and C2 in parallel with the aerial capacity and tuning L3 to about the middle of the long waveband. The resistance R3 is inserted in order to prevent an excessive response.
Developing Single-Span Tuning—being obtained, and the measured resolution of 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 150-380 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 superhetodynes 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 wavelength 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 both bands fall off 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.

Short-wave Broadcasting

Listen for South America : Short Waves in Europe

U p 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 America, 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 HLB (40.17 metres), HIZ (47.5), HIA (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 extra-ordinarily good days have been followed by "dead" periods, although on no day has it been impossible to receive the writer's usual "test" station—WxXAL 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.

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 Bandong on 15.93 metres.

Of the European transmissions there is no need to say much. The various wavelengths used by Zeeses 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 90, and Moncv and Rome, whatever wave they use, seem to be received at that strength.

THE RADIO INDUSTRY

I t 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.

British Batteries, Ltd., of Union Street, Redditch, Worcestershire, have now produced additional Pertrix replacement batteries for a number of receivers, including Portadine, Phillips, Marconiphone, etc.

A broadsheet issued by Belling and Lee, Ltd., Cambridge Arterial Road, Enfield, Middlesex, shows pictorially the connection of Belling-Leee interference-suppressing devices to various electrical appliances, and also to the listener's home-wiring systems. Catalogues are available for our readers.

All Concor receivers and kits are attractively illustrated and described in a new catalogue.

PROGRAMMES FROM BRAZIL. Special programmes, with news in English, are broadcast daily, except Sundays, from PRF, Rio de Janeiro, on 41.5 (9,592 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 60 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 VKgLR have been received on one or two mornings round about 7.30 a.m. This station seems to be even more consistent than Sydney, VKoME, 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.

New Catalogues Received

Electro Dynamic Construction Co., Ltd., Devonshire Grove, London, S.15—Power for Public Address: Leaflet describing various portable generators, 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).

(Continued on page 308)
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 lacklustre listener made another attempt to pick up the station.

They Write to Us

I have definite indications that the listener no longer write to the B.B.C. when in trouble. They now turn to the Fema. 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 the necessary transmission equipment, 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 listeners' 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 Bezeris. Representations are being made to the French authorities, who may be persuaded to keep their station closer to their allotted frequency.

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 "Obsolescent" Stories

Even so, stories have gone the rounds that these changes will render certain receivers obsolescent. 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-marking 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-General at Broadcasting House after his long trip. There are no flowers, no banners, no addresses of welcome.

It is expected that Sir John Reith will arrive one morning at 9.29, and 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, but, for understandable reasons, very few of the staff are consenting to be photographed in their offices.

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 Mullenis (Aust.), Ltd., 231, Strand? To my mind, this Aus-

Broadcasting a Stag Hunt

A Deutschlandsender radio squad at a meet in the former Imperial hunting ground, "Schorfheide," near Berlin. The commented-on short-wave transmitter and the rear is the control engineer.

General at Broadcasting House after his long trip. There are no flowers, no banners, no addresses of welcome. It is expected that Sir John Reith will arrive one morning at 9.29, and a 'good morning' to the liftman, and at 9.31 be once more deep in his work.

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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 silly 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 plausible 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 programmers, including, as it does, such artistes as Stanley Holloway, Leslie Sarony, Leslie Holmes, Tessa Deane, Val Broiding, Wilson, Keppell and Betty, the Three Radio Rogers, and the Tiller Dancing Girls. It is a very haphazard division, and also quite a misleading one.

Dave Apollon and Carroll Gibbons

Two important 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 shrewd snoop 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 smashing her."

By Our Special Correspondent
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 tendered 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, and directed towards 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 seems every reason to make the way as plain as possible for those who desire to render new apparatus ineffective. In the preparation of the specification the Committee have had the cooperation 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.

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 cooperation 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 suprise 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 for the assessment of appraisement of radio interference are practical and could be effectively included in any form of official regulations. Although certain counts of interference 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


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 agencies, 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 Coulom- bend and Deible.

This book presents the fundamental principles of wireless in an entirely novel and refreshing manner, and gives a real insight into the subject. Pp. 128 with sixteen illustrations. Published by George Newnes, Ltd., Southampton Street, Strand, London, W.C. Price 2s. 6d. net.
New Apparatus Reviewed

Recent Products of the Manufacturers

**DUBILIER CONDENSERS**

**NEW** additions to the Dubilier range of condensers comprise an extension of the 620 series to include some new models for 2,000 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 2½in. x 1½in. x ½in. 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 8d. to 3s. 6d., 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 2½in. x 2½in. high over the terminals x ½in. wide. In the 1,000-volt test serves the sizes range from 0.01 mfd.

**LISEN QPP TRANSFORMER**

This transformer is for use with a QPP output stage, and as it has a step-up ratio of 3 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-
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 heterodyne 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 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 obtaining 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 variable between 48 and 52 kc/s and in practice is tuned to approx. 51 kc/s, C2 being set so that

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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 New Oxford Street, London, W.1. 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 4in. 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 L12 type valves are used in parallel, with resistance-capacity coupling from the input stage to the plate of the H.T. stage.

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 from the curves supplied by the makers and reproduced by courtesy of the G.E.C., in whose laboratories the measurements were made.

In addition a 4-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.

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 1,500-22,000 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 waveband 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., may be in continuous use for twenty-four hours per day are dis-
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 tedious 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 8.30 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 Berounmuser 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.

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 8.50 (Regional) on Tuesday, immediately after John Watts'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.

"SOFT LIGHTS AND SWEET MUSIC," devised by Austin Croom-Johnson, will be heard in the National programme at 9.15 on Tuesday. Solists are John Burnby, Albert Harris and Elizabeth Welch. In the photograph, taken during the first presentation of this popular feature, Mr. Croom-Johnson can be seen at the right-hand pianoforte.
for the Week

casts at Home and Abroad

PLUS FOURS?
IIt would be a pity to miss the first concert to-night (London, Midland and West Re-

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 Pètes at 8.30 on Monday. The Strasbourg Cathedral Choir will take part with the Municipal Orchestra in Saint-Saens' "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 fiction 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 I of "Die Fledermaus" by Johann Strauss, while on Wednesday next, November 21st, Rimsky-Korsakov's "The Snow Maiden" will be heard at 7.30 in the National programme.

A MUSICAL PANORAMA.
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 (7.30 to 9 p.m.) in 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.

HIGHLIGHTS OF THE WEEK

FRIDAY, NOV. 16th
Nat. 8.30, The Kentucky Minstrels.
10, Rt. Hn. Winston Churchill; "Causes of War."
London Reg., 8, Henry Hall and the B.B.C. Dance Orchestra.
Abroad.
Bernim, 7, "Unsinge"—Opera in 4 Acts (Lortzing).

SATURDAY, NOV. 17th
London Reg., 8, "Moonstruck"—Push the Old Tin-Box Industry in Speech and Sound.
Abroad.
Frankfurt, 7.15, Paul Lincke Concert from the Hippodrome.

SUNDAY, NOV. 18th
Nat. 1.30, Maurice Cole, Piano Recital.
9, Bournemouth Municipal Orchestra, Soloist—Gains Hall (soprano).
6.30, Billy Mays and Wynne Apple in popular concert.
Abroad.
Kalsundberg, 9.10, Light Russian Music in the Balshah Quintet.
Radio Paris, 8, Opera, "Otello" (Verdi).

MONDAY, NOV. 19th
Nat. 8.40, "Chimera," a play by Roland Creasy.
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 Brussels, 8.30 to 9.15.

TUESDAY, NOV. 20th
London Reg., 7, Songs from the Radio Shows.
Abroad.
Kalsundberg, 9.35, Swedish Dance from the Station Orchestra.

WEDNESDAY, NOV. 21st
Nat. 7.40, "The Snow Maiden" (Rimsky-Korsakov), relayed from Sadler's Wells.
London Reg., 9, "Chasing Cross Road"—a show with music by Glynn and Clay Keys.

THURSDAY, NOV. 22nd
Nat. 8, "Chasing 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. 2), 8.30, Peter Benoit Concert by the Augmented Station Orchestra.

THURSDAY, NOV. 22nd
Nat. 8, "Chasing 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 Grandes.
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 open for manufacturers to publish specific data as to the performance of their products. My observations lead me to believe that the knowledge is higher than ever before, in fact, that probably due more to your various publications than any other cause, as providing as it does to all and sundry an opportunity of keeping abreast with the various improvements. Although the introduction of too advanced terminology is therefore to be deplored that the manufacturers still from time to time advertise their products and literature to appeal to the non-technical alone. Surely, it would be to their advantage to write explicit what the benefit of those who require such information; at the moment, the few who do peruse them who infer which must appear to the unbiased reader to represent in themselves the makers who have most confidence in their wares.

L. J. Lowen.

Twickenham.

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 Noelites are concerned, I do not think so! There have been many complaints in the local papers about the disappointing reception experienced in some parts of Droitwich: Although the quality is better than that given by Daventry, and the strength is increased a little, it fades away and even at the most sensitive positions being accompanied by very bad distortion. Daventry never faded in this manner, and I don't think there is any other reason why one should do so, so I 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 service like Droitwich should be kept clear of such interference.

Harbury-on-Tone.

J. D. B.

Service and Commercial Operating

A letter complaining of bad quality in commercial and service transmission has only elicited two replies, and those 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, but 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 gentleman 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 new ideas were as bad as that, even when due allowance had 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 in the absence of training as is intensive as I presume it to be.

I can quite sympathise with your correspondent in his Sidelot suit with the thermometer below freezing; it is certainly unfair to expect him to give of his best with apparatus that has faded away.

What this gentleman can possibly mean by calling my corresfres the "tongue tied hams," I cannot imagine. As I am one of these "lacking" members, 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 Wireless World, and in particular I referred to 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 it is possible, the people who are concerned with its development.

24, Stonewall 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 (having 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 some one 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 picture. Or, in their millions beating, night after night, to watch a little stylus laboriously trace out a pen-and-ink sketched of something which, when finished, turned out to be of nothing very exciting. 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 naked eye, all these weeks, was very different. I had pictured myself listening to my audio receiver and watching, a few feet away, the illuminated screen of my viso 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 12/20 instead of 25, we divide the necessary width of wave-band by 300 at one stroke. We do not need such an enormous reduction factor, so we can use, if we wish to, to give us our colours, leaving still a factor of 100. With this factor at our disposal, an excellent picture quality is possible. There, are, of course, a lot of points that require working out. Presumably the "scene" would be shot on amateur film or equipment of special design. The audio transmission would, of course, have to be retarded "so as to synchronise with the video 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 video transmission in the receiver, ready for illumination at the end of the 20 seconds, is more difficult, involving as it does a new retentive screen or some magnetic, photographic or other "storage" process; but here, again, I cannot believe that there is any insuperable problem. I set as I pointed out in a letter in your issue for 29th September, it takes some time in the months and minds of the technicians to-day, so perhaps the time lag in this case will be very much less.

Dorsay Bell.

London.

27th 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 back 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 their transformers? I am sorry that this practice has lapsed since it was last stimulated in your columns a few years ago. My very best wishes for your continued success.

Current Topics

Events of the Week in Brief Review

A 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 début on the ether.

The Wrong Word?

THE discovery that "Radio-gram" is the wrong word to use in respect of a radio-gramophone, having been employed in a radio traffic parlance for many years, has led to the usual crop of alternative suggestions. They include "Radio-graph," "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 Mr. Davis, of Wolverhampton, and is a crystal set built on a piece of ordnance smaller than a threepenny 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 more 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 Bar. 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, Coimbre and Baraga.

French Mysteries Solved

UNTIL recently the number of French licences has been a mystery. The first census, taken in May last, revealed 1,544,295 registered receivers, of which 702,426 were located in Paris. The latest census 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 Denlart, 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.

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. Kirby, of the B.B.C.; Mr. G. F. Brown, Department of Scientific and Industrial Research; Mr. A. J. Gill, G.P.O. Engineering Dept., and Dr. Bannett, head of German P.O. television laboratory.

Police have been seeking a reason for the rapid communications effected between the Viennese Nazis and their brethren outside the city. It is significant that 130 small radio transmitters have now been confiscated in the city.

Ship-Shore Radio


The lecture will be illustrated by lantern slides and followed by a discussion.

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 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 130 to 193 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, Lacene, 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 first trial 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 1933 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 Marconiophone 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 St. Paul's was catered for by Marconi, as well as the service at Westminster War Memorial and the Finsbury War Memorial. Marconi public address equipment was also in use at the British Legion Festival of Remembrance at the Royal Albert Hall.
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.

A

Norwegian physicist, was made up of a central nucleus surrounded at a considerable distance by a cloud of electrons. The nature and function of these electrons need not concern us very deeply, but it is important to note that these exist as, 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 transfer from it to 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 bring 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 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 more than the superposition upon this vast random movement of a trifling drift in one direction; the emerging electrons may only have moved a tiny distance.

If the atoms of a substance have their electrons so firmly fixed that this exchange is not possible, the material will not conduct. All metals are conductors; the class of insulators being 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 drawn 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 (6,000,000,000,000,000,000,000,000) 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—
cumber some 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. It is evident that a current of one ampere is flowing means that one coulomb of electricity, or about $6 \times 10^{19}$ electrons, flows past any point in the path of the current in each second.

![Diagram of electrical circuits](image)

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:

Current in amperes $= EMF$ in volts

Resistance in ohms or, using the usual single-letter abbreviations for the three quantities, as $I = E/R$. It will 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 $2/10$ths 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 the 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. Writing 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 across 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 milliamper is thus seen to be a thousandth part of an ampere. Several other such convenient prefixes are in common use; the most frequent are:

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>milli-</td>
<td>One thousandth</td>
<td>$m$</td>
</tr>
<tr>
<td>micro-</td>
<td>One millionth</td>
<td>$\mu$</td>
</tr>
<tr>
<td>kilo-</td>
<td>One thousand</td>
<td>k</td>
</tr>
<tr>
<td>mega-</td>
<td>One million</td>
<td>M</td>
</tr>
</tbody>
</table>

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" is quicker to write than 500,000$\Omega$.

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 ($\Omega$), 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.

**Ekko 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 superhetodyne 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 maintain local interference.

The battery set (Model BT95) has a triode-pentode frequency changer and a QIP output stage. While in the universal set (Model ADT95) the frequency changer is an octode and the output valve a power


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 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


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 broadcast 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 W 504 pentode "Wector" 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 trioke 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

![Diagram of the receiver](image-url)
"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 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.

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 baffe area. The wood used in its construction is perhaps a little thin having regard to

General view of the underside of the chassis showing short-wave aerial and oscillator coils.
An Unmatched Condenser?

A correspondent, who fears that the varying 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 winding and a variable condenser, preferably shunted by a "test pointer" 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 "walk" 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.

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 use 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 IF 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 injecting 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 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"

A 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 milliamperes each, but operating at 15 milliamperes each, will afford vastly more amplification than a single valve of the same type taking the full rated current of 3 milliamperes. Of the various methods available for limiting consumption, it may be said that 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.

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, providing 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, Stanford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal information not given by the technical staff, nor can technical enquiries be dealt with by telephone.

ACCESSIBILITY: The Wireless World has urged that many sets are operated in a state of chronic misalignment solely because the interiors are inaccessible. It is gratifying to record that, in the Ketterer-Braden KB381 receiver, flats (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 ADVERTISMENTS

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is 1s. or 1s. 3d. for every additional word.

Each paragraph is charged separately and name and address must be inserted.

SPECIAL DISCOUNTS are allowed to Trade Advertisers who order for consecutive insertion, provided a contract is placed in advance, and that the terms of payment are settled in advance.

Advertisements for these columns are accepted up to FIRST MONDAY IN EVERY MONTH, and must be in the hands of the Head Office of "The Wireless World," 15 Portland Place, London, W.1.

Advertisements sent in after this time will, if accepted, be inserted in the following month unless otherwise arranged by instructions.

Advertisements that arrive too late for a particular number will not be inserted in the following issue unless otherwise arranged by instructions.

Advertisements must be typed or written clearly.

The proprietors retain the right to refuse or withdraw advertisements.

Postal Orders and Cheques must be made payable to "The Wireless World, Ltd.," and must be in the hands of the Head Office at least seven days before the date of issue.

Receivers and Amplifiers, etc.

RECEIVERS AND AMPLIFIERS, ETC.

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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 journalism." It is considered proper to claim far more for an advertised article than it is capable of giving. On the assumption of the (logical) 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 curiosity. That is what we 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 "Real Bass Ruffle?" 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 baffie will cure that, and at a very low price. In fact, "anti-colouration" complete baffles can be supplied in almost any size and shape. Prices from 2d. to 5s.

Complete baffies in any size and finish from £2.

Illustrated Literature free on request.

The eager awaiting second volume of "New Notes in Radio" is taking a little longer to complete than we anticipated, but is expected to appear in this space.

HARTLEY TURNER RADIO LTD.,
Thornbury Road, Isleworth, Middx.

Please note our new telephone number: HE/Window 4560.
The Cry of the "Bitten"

This is not a story of Bulldogs and puns, but of the many conditioned Amplifier builders who pleed with us to take their "not to specification" amplifiers in part exchange for a Sound Product.

We HATE to be dishonest, but what can we do with them? The designer chose certain components to give him the results aimed at and in consistency achieved. The "Widow World Amplifier" is a quality job on which the most expensive components were chosen. Those unfortunate people who departed from the specification are now realising their error. House.

A COMPREHENSIVE exchange offer is now being prepared and will be announced in the near future. If you are embarking building the amplifier and still want we will accept any other catalogue of transformers and coils.

SOUND SALES LTD., Contractors to the G.P.O., etc.

ASTOUNDING RADIO OFFER / 17 ONLY OF THE FAMOUS PYE P/A SUPERPORTABLE RADIO demonstration models, as new and fully guaranteed by Ben Marche of Brixton.

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Only with a steady source of H.T. can you hope successfully to receive the minute and critical short wave signals. Ever Ready Batteries will assure you for it. The freedom from hum and crackle and the smooth control of reaction that is so essential in short wave reception can be yours by relying on these world-tried batteries.

The EVER READY CO. (Q. Bolsoz) LTD.
Mercedes Place, Holloway, London, N.7.

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SOME Remarks.—C.W.—The B.F.C. 630, 45, 60, 150, 150-c.w. valves, 4 N.R.I. Type A-10s, give trouble-free performance with tubes and Mlocos, on 200 to 250 volts, and 500 to 600 watts, at a cost of least of everything; ret. £320 and in perfect order, can be used as a self-completing station. A.C. 600, 900, 1200, etc., can be used as a complete station.

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NEW FIAT BRAND Telephones, etc., etc., 600 to 6000 watts, £12/6. In distant orders allow 1/3, 20/-.

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ULTRA—Furtsh"—a modern cabinet, with contrasting squared valiant panel, 20x17x11, 13/6, powerful type, 22/6 to 30s, needful, photo on request.

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RADIOGRAM Cabinets; 5/10 upwards.

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SEND particulars of your requirements giving size at least and also what you expect to spend on your set of over 100 different types; from 3/- to £4/10/6.

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U.S.A. Bals Type F.A., 3,500 or 6,000-ohm field, power transformer, £15. (With type F.P. loud-speaker, £5, £10.5, £15.

MAGNETIC D.C.125 (Pie, acon, 250 volts, £12.10/6, £25, £35.

MAGNETIC, 125; all with handwound coils, power or potential transformers, 2,500, 6,000 £15.50. Magnetics M.P.S.M. £25.

TRIANGULAR, with cobalt 24 hours, service paid; cash or order on c.o.d.


HIBERT, New Coventry St., W.—Read below: If you are requiring magnetic reproducing at reasonably low cost, read one of the following high-grade speakers; result, orders are coming in daily.

10/6 Only!—Brand new, triaxial reproduction speakers manufactured by the best known British makers, ceramic, 2,500 or 6,000 ohm, 100 watts power or potential transformer, 10/6 each.

12/6 Only!—As above but with 100 times, a very powerful speaker capable of handling all musical output.

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17/6 Only!—As above but with 100 times, ideal for use with quite powerful systems.

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VUAHALL—Magnetica medium magnet, universal, 500 watts, £25. £35. £50. £100. £150.

VUAXHALL—American Made, type K—2,500 or 6,000 ohm.


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MOUTHCOIL. Speakers for experimenters wanting to go further, hear the drama and other without achievement all needed systems, brand new, fresh, handled with care and skill, £15, £20, £25, £30, £35, £40, etc., backed with blanking clips; state power or potential transformer.

VUAHALL—American Made, type K—2,500 or 6,000 ohm.


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VUAHALL—American Made, type K—2,500 or 6,000 ohm.
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LESS THAN HALF PRICE

HAVING PURCHASED the entire stock from the manufacturers of the 8-vale Cromwell Superhet we are offering complete kits for home construction. This comprise all components by first-class manufacturers — genuine B.V.A. valves, metal chassis, Heavy Duty energised moving-coil speaker, inlaid walnut cabinet — everything necessary to construct this up-to-the-minute receiver. Read the specification.

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EDITORIAL

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 22s. 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 filament 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 it 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 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 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 line as the rungs of a ladder each step upwards marks a tenfold increase in intensity, but a much 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 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 average 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 at that frequency.

These peak values are shown in Fig. 2 (b). In comparing (a) with (b) we must...
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).

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 remarkable; even above 12,000 cycles some power is emitted. Evidently a faithful reproduction of "a" 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 1,025 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 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 peculiarly 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 it is observed that 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 focus 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 vibration of the vocal cords, and this tone is modulated by the resonant cavities of the throat and mouth just as a carried 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 instead 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 above the middle G.

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 56 per cent. which is obtained when listening to the direct voice.
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," must, if he savoured fully the curious tone, have been receiving frequencies up to 15,000 cycles, except in the cases of the 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; ghastly 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 splutter. 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 prejudices 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.

Distant Reception Notes

Despite the announcement that it was to be closed down forthwith, the Eiffel Tower still works spannationally. 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 Vitis, 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 1,646 metres on which this station 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 Transmoyes transmitter, but the Lyons transmissions on 653 metres were 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 be, has been somewhat disappoured.

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 jamming phenomenon, 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 Schweizersicher Landesender, 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 Zesen wants to be the Deutschlandsender. The DX enthusiast does not 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 most of the time. The average number received 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 Kajns and Lahlí on the long waves, and Brno, Rennes, Hörby and Germany on the medium band.

So numerous are the bad transmissions that it is rather difficult to select the best dozen. However, for complete reliability I would give my vote to Radio Bremen, 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: Brusels, North, and South Ridderburg, Berlin, Milan, the Poste Parisien, Hillversum, Bordeaux, Frankfurt, Trieste, and Königsberg.

D. EXER.

Fig. 7.—The spectrum of the castanets.

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 £50. 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.

WIRELESS WORLD

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NOVEMBER 23rd, 1934.
Radio Interference Detector

The Post Office Portable Equipment

By A. MORRIS, A.R.C.Sc., M.I.E.E.

In 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 electrical 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 is generally unduly susceptible to interference. The mode of propagation and type of interference are subsequently determined and the source located. The

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 the first few hours of operation, nine Boston-area amateurs (100 miles away) were contacted, R8 to Rq 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

- **Frequency (MHz)**: 56, 5.357, 5.263, 5.172, 5.085, 5.0
- **Wavelength (Metres)**: 8 ft, 4 in, 8 ft, 25 in, 8 ft, 0 in, 8 ft, 10 in, 7 ft, 9 in
- **Aerial Length (LA)**: 8 ft, 7 in, 8 ft, 9 ins, 8 ft, 7 ins, 8 ft, 9 ins, 8 ft, 7 ins
- **Reflector Length (LR)**: 4 ft, 6 ft, 4 in, 4 ft, 6 in, 4 ft, 6 in, 4 ft, 6 in
- **Aerial to Spacing (S1)**: 4 in, 5 in, 4 ft, 2 in, 4 in, 5 in, 4 in, 2 in
- **Aerial to Reflector S2**: variation

**Dimensions**

- **Reflector-type aerial array for the five-metre wave-band.** Dimensions are given in the table.
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 superseded 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 sees its birth—and yet there is no poet to write an ode in praise of a rhythm approaching 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 teletypewriter systems of modern line telegraph practice. But these are 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 San 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 15ft., 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 difference 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.

Folly 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 arrangements 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-mu 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 interstage coils had to be centretapped 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, rewound them, for 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
tuning condenser. By cutting off the ends of the terminal screws of Colvem 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 was "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 unnecessary, as the response curve is straight down to 32 cycles, and increasing the value to 0.1 mfd. causes a peculiar type 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 ironed choke coils with 0.0005 mfd. connected permanently across the bias resistance.

The curves taken show that the critical optimum value for the bias at 125 volts on the aux. grid is 1.8 volts, as 2.0 volts produces a curve similar to the 1.6 volts line.

The power unit is conventional, and contains the biasing resistances and by-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 overbiased 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

![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.](image1)

![Fig. 3. The overall fidelity curve of the receiver shows a loss of only 1.5 db. at 10,000 cycles.](image2)
My Home Set—III—

The final problem was to combine the set with a speaker which could do justice to the reproduction of music. I employed a Hartley Turner speaker mounted on a 4½ ft. baffle of oak one inch thick. This latter is further deadened by unsymmetrical felt baffles 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 6 in. dia-

A close-up of the tuning coils with two of the screening covers removed to show the trimmers employed for adjusting the wavelengths.

phragm 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 4½ ft 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 reproduction from the set is particularly free from these, except for a frequent 9,000-cycle whistle, and only occasionally on London National are "chirrups" 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 in the progress of progress has been ordered, 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 uncalculated-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. Soverby 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 Control 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, W. Nestel, in the Elektrotechnische Zeit-

schrift 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 anem valves, a low-frequency amplifier can be made which will magnify the smallest amplitudes by 2:1 and simultaneously diminish the largest ones according to a ratio of 0.81, 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 power of 8 kilowatts was increased to 285 kilo-

watts! 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, and discs have been recorded by the intervention of a "compressor" and reproduced with the intervention of a corre-

sponding "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 interesting new technique seems to present very important possibilities. And who shall say that these two new developments, the "Luxembourg Effect" and the "Expanding the Music," have no other connection than the coincidence of their coming into promi-

ence almost at the same moment?
Current Topics

Events of the Week in Brief Review

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 have hitherto been devoted to child welfare, but for the next meeting on November 27th Mr. A. F. Mariner, of the Mallord 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, Clarence Road to hear this address.

Fraud!
SOVIET Government audit officers, going through the account-books of station Dniepropetrovsk, found that royalty payments had been made to gentlemen of the name of Beet-hoven, 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 Göteborg 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. Mandel, the present 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.

Radio Toulouse en Fête
ON Sunday next, November 23rd, 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 accuse 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 15th, 1929. "The wireless set," 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 some four years old it registered 45 volts, and last week it still registered 30 volts.

 Danish Television
THE first Scandinavian television company has been founded in Copenhagen. Known as the Danish Radio-Filmrey, 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 5,725,904. 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 2,500, an order for 100,000 sets. This, it is urged, would help to reduce unemployment and give a badly needed fillip to the French wireless 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."
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 "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.

F 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 needed 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 300 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 1d. for heating. Quite a large set, therefore, can be worked for about 4d. an hour, or 0.1d. 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 of the LF 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. Two alternative types of valve vie for place in the output stage, Class "B" and QPP. Although with the available valve 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 an intermediate 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 frequencies depends on the efficiency of the loud speaker, but is unlikely to be less than 3 watts. Where this 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 predetector 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 latter 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 grid and plate to use 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 selectivity 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 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 singlespan 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, of 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?

Radio Nomenclature Criticised

By "CATHODE RAY"

The introduction of the "mechanical horse" did not bring the term "horse-experimentator" into the vocabulary of the transport worker.

"And you call it wireless!" How nauseatingly familiar is this rebuke to every wireless 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 54 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 medieval 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 littered 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 500-3,000 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—"micro", 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 moribund 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 farr.

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 that all 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 blacklined paper before knothole study.

Thirteen years ago Dame Melba sang into a funnel at Chelmsford and was heard hundreds of miles away. Everybody and his brother (or cousin, 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." A remembered 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," "Capacitance," 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-role is one that does not greatly appeal to me.
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.

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, 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 morale 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. 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 its approach the end of its useful life.
**Listeners' Guide**

Outstanding Broadcasts at

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**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.**

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**THE ROYAL WEDDING.**

Not so very long ago the broadcasting of a Royal Wedding between 11 a.m. and 12 noon would have meant 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.

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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.

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**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.

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**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 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.

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**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.

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**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 pianos, will give "A Concert of Waltzes," directed by Dr. Ehrenschutz.

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**FUN IN MUSIC.**

Some of the most tantalisingly attractive items occur in the afternoons when many people are unable to listen. 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.

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**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 7.30 o'clock on Monday next.

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**BRIGHTER SUNDAYS.**

What would our grand-parents have said if they could have seen the light and varied nature of next Sunday's broadcasting 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 into shorter periods, the aim being to secure brightness by way of variety.
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 Beromünster tomorrow evening between 7 and 9 o'clock. The conductor is Weingarten.

Then, on Sunday evening, from 7 to 8.30, the Deutschlandsender offers a Brahms concert by the Station Orchestra and Choir, the German Oratorio 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 OPHICLIDE 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 about thirty years; a steel smelter; a trap-maker, and a woman who comes from Cornwall 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 WEEK

Home and Abroad

the National wavelengths at 8 o'clock on Monday and the second on the Regional wavelengths at 8 o'clock on Tuesday.

Emily Bronte'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 exclusively on the National wavelength, and will be unable to follow Part 2.

The novel has been adapted by Barbara Cooper 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 7.30, begins a special feature programme entitled "Around the Shores" presented by Mr. T. Madden and Company, with orchestra?

HIGHLIGHTS OF THE WEEK.

FRIDAY, NOV. 23rd.


Saturday, NOV. 24th.

London Reg., 7.15, Symphony Concert by the Philharmonic Orchestra, relayed from the Conservatoire.

SUNDAY, NOV. 25th.

Nat., 11.30, Two hours of music with the Welsh National Symphony Orchestra, conducted by Mynach Ieuan. London Reg., 7.15, Symphony Concert by the Philharmonic Orchestra, relayed from the Conservatoire.

BUDAPEST, 8.30, Hungarian Music by the Ferenc Liszt Academy and the Royal Hungarian Orchestra.

London Reg., 7.15, Humorous Musical Programme by the Station Orchestra and soloists.

TUESDAY, NOV. 26th.


London Reg., "Wuthering Heights," Part II.

ALBANY, 8.30, "Franklin Delsantone," 9, Round the World Concert.

WEDNESDAY, NOV. 27th.


London Reg., 8.30, The Kentucky Minstrels.

THURSDAY, NOV. 28th.


KALISZBURG, 7.45, Concert by the Radio Symphony Orchestra: Schmitz: "Adolf Busch (violin)."
New Apparatus Reviewed

GOLTONE METOCEL 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.

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 41-volt flash lamp battery. When connected to the pick-up terminals of an ordinary broadcast set it provides the means for making amusing announcements.

LISSEN CONDENSERS

Lis sen condensers are made in two styles; one is a series with mica dielectric, for use in H.F. circuits, and a range of Mansbridge-type paper dielectric condensers mainly for L.F. and smoothing circuits, but suitable, also, as H.F. by-pass condensers.

The mica series are available in capacities of from 0.0005 mfd. (50 micro-mfd.) to 0.02 mfd., the prices ranging from 6d. to 2s. 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.

The Mansbridge type are available in sizes ranging from 0.01 mfd. to 2 mfd., the maximum working voltage being 250 V. A generous margin of safety is allowed, as the several specimens sent to us have been tested at 750 volts DC, and all successfully withstand 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, Ixworth, Middlesex.

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 1/2 in. diameter glass tube measuring 1/2 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 it remains at a reasonable temperature under full load a large area is necessary for rapid heat dissipation. The tube on which it is wound is 1 in. long and 3/4 in. in diameter. This style is described as the "Hi-load" resistor, and they can be obtained with intermediate tappings.

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 discolour. When 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. 2d. to 1s. 3d., with prices increasing as the wattage goes up.

MAXWELL 4-watt and 20-watt resistors.

The "Hi-load" series cost 2s., 2d., 2s. 9d. and 3s. for ro-, 20-, 30- and 50-watt types; intermediate tapping adds 4d. to the price, while several are required special rates will apply.

The makers are R. Roberts (L.F.), Ltd., 5-6, Aston Road, Birmingham, 6.

FLUXITE GUN

A HANDY receptacle for Fluxite soldering paste has been introduced by the manufacturers, 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 side is 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, and 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 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. 173, 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.

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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)

I

t 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: \( P = IR \) 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. These lines mark 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:

\[
P = IR = 10 \times 20 = 200 \text{ watts.}
\]

\[
E^2/R = 200^2/20 = 2000 \text{ watts.}
\]

The power is limited, 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 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 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.

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Foundations of Wireless

the curves of Fig. 6. In these, time is plotted from left to right and current upward; the dotted curves refer to a circuit containing only an ordinary resistance, 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. The 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 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 that force is removed, the spring will return sharply to its original length when released. Similarly, the movement of electrons in D is greater for greater applied voltages, the insulation breaks 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 only physical object designed 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 having 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 microfarads (symbols μF and μF) 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 Victor Patents, Ltd., at 3 p.m. on November 27th. Readers are invited to attend. Address: The Courts, Silverdale, London, S.E.26.

Partners, Wilson and Co., Ltd., of Havensett Works, Evington Valley Road, Leicester, are to be congratulated on their new range of 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 Worple 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: 110 volts 6d. 6d. 100 volts 5d. 6d., 60 volts 3s. 6d. Corresponding "Leader" accumulators are priced at 3s. 6d. and 4s. 6d. for the 20 and 40 A.H capacities respectively.

We have had a request from Associated Radio Laboratories, 29y, 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.

**BROADCAST BREVITIES**

**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 our 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 ardour 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_ has, 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 301.1 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.

**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 1776.

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 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 plans for North Scottish Regional, which is to be erected beside Burghead golf course on the outskirts of the town.

**Over 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.

**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.

**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 14th 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.

**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 Niel 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.
McMichael Twin Speaker Superhet

An AC Mains Receiver with Inter-station Noise Suppression


The makers of this receiver were among the first to adopt the principle of twin loudspeaker 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 wave range 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 Drottwich 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 420 kc/s.
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-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 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 cowling 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 receiver chassis is mounted on a sheet-metal framework carrying the twin loud speakers. The top chassis is readily removable for inspection.

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 Tinibucto 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 bold performance of Gison’s Overture to “Richard III” and Haydn’s ‘cello concerto in E. Thence to Radio-Paris for the National Orchestra and soloists in Faure’s opera “Penelope,” but, not knowing the plot, I was unable to follow it with much interest, I heard a beautiful symphony by Bruckner, 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 Heavyside 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 Pianoconcerto 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 Lafaye, I heard an unusual quartet for four bagpipes—of the Continental type—played by the Hazard 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 Dittersdorf’s Sonat in E flat for viola and pianoforte, played by August Erbert 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 B minor for flute and harpsichord”. CALIBAN.

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 allow 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 STATION STATIONS OF THE WORLD

(N.B.—Times of Transmission given in parentheses are approximate only and represent G.M.T.)

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## CLUB NEWS

### Home-made Transformers

The design of transformers and low-frequency coils was dealt with in a recent lecture by Mr. J. C. Emerson, B.Sc., before the Golders Green and Hendon Radio Society. After discussing fundamental features, the lecturer gave a simple formula enabling the size of transformer windings for a given output to be immediately determined. The construction work was carefully described. Hon. Secretary: Mr. F. P. Hillier, 8, Devonshire 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. C. Chambers, 14, Camden Road, South Croydon.

### Mixing Tea by Photo-cell

The method used to which the photoelectric cell is put was interestingly dealt with by Mr. W. G. Stockton, of the General Electric Co., at a recent meeting of the Slade Radio (Birmingham). The lecture described, with the aid of eastern slides, how the cell is used for timing horse races, counting papers, tubes and steel tubes, in the control of town lighting, the operation of burglar alarms, and even in the mixing of tea. Sec. Secretary: Mr. H. B. Smith, 110, Hillaries Road, Gravelly Hill, Birmingham.

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**Sound Waves Varieties**

Sound waves and their behaviour formed the subject of a demonstration by Mr. W. S. 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 the movement of air columns as in organ pipes.—Hon. Secretary: Mr. J. C. Emerson, B.Sc., Chancery Lane, W.C.2.
IT is a gratifying fact that the only correspond-
ence commenting on our advertising which we
have had so far has been from W.B.
"Stentorian" users who accuse us of unduly dis-
tracting 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 our-
selves with reiterating our claims and inviting
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and better bass response. It has enabled us to place the
bass response lower in the scale and obtain a more
crisp mid-range at the same time. This results in
superior reproduction.

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muffling and also enabling the "Stentorian" to be used
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desired brings better "balance" of reproduction. (See
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2. The public are invited to visit their local Dealer for a demonstration of either of the two “AUSTIN” models, the “A.C. Super” or the “Hargreaves 100”, and at the same time to obtain free a free Competition entry form. This entry form is to be completed correctly, stating clearly the model and serial number of the whole receiver, and the date of purchase.

3. The competitors are advised to write two answers, each not exceeding 24 words.

4. AIR APPRECIATION OR CRITICISM of the performance of the model is a worth while feature of this competition.

5. An entry 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. Competition entries must be sent to the Dealers, the name and address of whose Dealer appears on the entry form.

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   Mr. W. J. G. Page, Managing Director of “AUSTIN” Receivers.

9. No correspondence will be entered into regarding results, correspondence must be sent to the Dealers for acknowledgment.

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 advertisements in “The Wireless World” and several weeks before the end of January, 1935.

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EDITORIAL

Valves

How to Cultivate a More Liberal Use

I t 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 “valve-shy” 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 radiophones.

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 reject 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 in 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 2½ 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 tubes 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 replaced...
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 disappointments 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:

<table>
<thead>
<tr>
<th>Type</th>
<th>Filament</th>
<th>Emission Efficiency</th>
<th>Mutual Conductance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bright</td>
<td>Rünter</td>
<td>4.0 0.75 5 0.2</td>
<td></td>
</tr>
<tr>
<td>Throriated</td>
<td>Bulb Rünter</td>
<td>2.0 0.4 30 0.28</td>
<td></td>
</tr>
<tr>
<td>Double</td>
<td>Throriated</td>
<td>2.0 0.1 300 1.8</td>
<td></td>
</tr>
</tbody>
</table>

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 standardized and no economy is worth considering in this direction.

**Wireless World**

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 burn.

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 a capacity factor will have its effect on the reaction circuit—usually an important section of older type sets, and if ganged circuits are used some retiming 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 'poppy.'

**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 revamping a multi-stage HF amplifier.

(to be continued.)
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

TRIODES

DIODE TYPES

Battery or BH Mains Triode. IH Triode (5-pin type). Battery Bi-grid. IH Bi-grid.


SCREEN-GUID AND VARIABLE-MU

- Top Cap = Anode
- Battery SG Valve.
- IH SG Valve or HF Pentode (5-pin type).
- IH HF Pentode (7-pin type).

OUTPUT PENTODES

- Top Cap = Anode
- Battery or DH Output Pentode.
- IH Output Pentode (5-pin type).
- IH Output Pentode (7-pin type).

QUIESCENT OUTPUT VALVES

- Top Cap = Anode
- Battery Class "B" Valve.
- Battery QPP Valve (7-pin type).
- Battery QPP Valve (9-pin type).

RECTIFIERS

- Full-wave HT Rectifier.
- IH Rectifier (5-pin type).
- IH Rectifier (7-pin type).
- Barretter.
- Thermal Delay Switch.

MISCELLANEOUS

MULLARD SIDE CONTACT TYPES (UNIVERSAL)

- Top Cap = Control Grid
- IH Octode.
- IH HF Pentode.
- IH Duo-diode.
- IH Triode.

- Top Cap = Control Grid
- IH Output Pentode.
- IH Half-wave Rectifier.
- IH Full-wave Rectifier.
- IH Voltage-doubler.
A SCOTTISH WEEK.

Not 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 will undulate with "News out of Scotland"—a dramatic contras-
ing 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 Orches-
tral Union of Glasgow (Scottish Region, 9 p.m.).

A SCOTTISH SABBATH.

Sunday is a Scottish Sabbath for Londoners. At 3 p.m. comes the Scottish Festival Service in St. Columbia’s, Pont Street, relayed by London Re-
gional, which also radiates a Scottish religious service at 7.15 p.m. from Mayfield North Church, Edinburgh.

The Caledonian strain re-
sounds again on Tuesday with a feature programme over the London and Scottish Regions—"The Tail o' the Herrin'," 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 Eng-
lish 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, Decem-
ber 3rd, at 8 p.m. offers a concert of "Winter Storms" which should bring many arm-
chair people to the fireside and benefit the coal trade.

VICTORIAN BALLADS.

Although the Victorian drawing-room ballad has been a good stand-by of the comic-
dian in recent years, it is still taken seriously by many peo-
ple. On Wednesday evening at 7.45 Phyllis Scott, soprano, and John Rowe, baritone, are to give some "Victorian Re-
miniscences," including many old favourites which have no-
thing to fear from modern styles. Phyllis Scott will be at the piano. This recital will be broadcast by London Regional.

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.

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, Ver-
di's tuneful opera "Rigo-
letto" 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 Macken-
zie’s well-known romance has been musicalised by Harold Scott and dramatised by Denis Freeman for broadcast-
ing on Wednesday next, De-
cember 5th (London Regional, 8.30). 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, Gar-
denia Terrace, Lambeth. One can almost smell the gas lamps!

ERNIE BERGER, German celebrity singer, who takes the part of Gabriel in Haydn’s ‘Creation’ to be broadcast from Copenhagen-Kalundborg on Thursday next.

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 Eberschutz, the Generalmusikdirektor, or Adrian Boult, of the Fatherland.

“G.B.S.” PLAY.

Bernard Shaw’s little play ‘Village Wooing’ should make excellent material for broadcast-
ing, there being only two characters. It is to be re-
layed from the Malvern Festi-
val Theatre on Monday next, December 3rd, at 8.45 (Na-
tional), 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 novel-

ist and a strong-minded young woman and has two scenes—the desk of a lawyer and a village shop.

Very few plays are suitable for broadcasting from the boards of the theatre, but Shawian drama, which depends as much upon the words as upon the action, usually "gets over" the microphone very successfully.
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.

"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 Juhi-Thomsen's Whispering Band plays. From midnight to one o'clock, Jens Warny's band will be heard from the "Ninths" 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 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 Danielli, Guest 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 ask one of those who believe that a sense of fun can be communicated without the aid 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 artists.

SIR WALTER ALCOCK, atcon-

sole) 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, piano forte 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,
Natl., 7.30, Kentucky Minstrels.
8.30, "News of Sunday.
Abroad. Königsberg, 8, Opera: "Il Tabarro" (Puccini)
SATURDAY, DEC. 1st,
London Reg., 8, Rachmaninoff Piano Recital by Frank Latta.
Abroad.
Brussels, 8.30, Programme by the Leyte Concert Society.
SUNDAY, DEC. 2nd
Natl., 1.30, Medevilov's Balalaika Orchestra. 3.45, Piano Recital by Josef Holender. 7, Leslie Jeffries and Orchestra at the Grand Hotel, Enthousa. 10, Alfredo Campoli and his Band. London Reg., 9, Sunday Orchestral Concert, B.B.C. Orchestra with Lionel Tertis (violin).
Abroad.
Vienna, 7.30, Music from Viennese operettas.
MONDAY, DEC. 3rd
Abroad.
Hamburg, 8, Schubert Songs, Dances and Marches.
TUESDAY, DEC. 4th
Abroad.
Brisbane No. 1, 8, Gala Concert from Théâtre Royal du Louvre, in memory of King Leopold III.
Warsaw, 7.15, Opera: "The Devil and Catherine," by Dvorak.
WEDNESDAY, DEC. 5th
Abroad.
Warsaw, 8, Chopin Recital.
THURSDAY, DEC. 6th.
Natl., 8, Harold Ramsey and his Rhythm Symphony Orchestra. 8.30, Hepworth, Green and Davis.
Abroad.
Kabulnberg, 7.30, Oratorio: "The Creation" (Haydn).
Warsaw, 8, Concert of Finnish Music.
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, 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 footproofness and reliability of modern wireless sets. It 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 flown.

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 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 instinctive "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 "super" 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 soft voicing 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-sensitivity 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 A 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 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 Escharotic 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 unsensitive 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-Kopenhagen. 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.R.C. in the Corporation's Charter.

Lord Selonon and Television

THE British Television Commission to America was fitted by private and Government radio officials in New York and Washington. Lord Selonon, 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 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 cooperation 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 9s. 6d. post free and not as stated.

Money from South Africa

THE sum of £5 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 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.

Medical Talks at Mealtime

CONTINUING its campaign against the broadcasting of unsavoury talks during meal-times, our Paris contemporary, Hsnt 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 Dealers' 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.

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 falling 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 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 is 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 Cosson valve will often give warning of its approaching demise 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 Mareoni 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 loudspeaker.

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 contact, 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-mu valves after AVC, an electrically operated 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 symp-
toms 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 de-
scribed 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 resist-
ance 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
QP 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,
to test the anode currents of such valves separately. The diode sec-
tions of duo-diode-triods 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

R ECENT articles in The Wireless
World have dealt with the latest de-
velopments 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 detec-
tor 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 gauging.

The sensitivity and selectivity are ade-
quate for general distant reception and the
quality of reproduction is unusually good,
the output being adequate for most pur-
poses and the frequency response is almost
constant over a wide range. A volume control is
fitted which operates on both radio and
phonograph. Economy in current consu-
mption has been carefully considered,
and the receiver draws only 10mA from the
HT battery.

LIST OF PARTS

1 Aerial filter

2 Parallel tanks, 11u. dia. x 11u. long

3 Resistances, 50 ohms, 1 watt

4 Resistances, 500 ohms, 1 watt

5 Condenser, 0.0015 mfd. 1000 volt class

6 Condenser, 250 volt class

Quantities No. 38 disc and 12 35 DBC wire

1 Miscellaneous board, brackets, etc.

1 Miscellaneous wire, 250 ft. 30 DBC and 16 35 DBC wire

1 Qualifier cond. assembly

1 Parallel tube, 11u. dia. x 11u. long

Quantities No. 38 disc and 12 35 DBC wire

1 Tuning dial

Edystane 573

1 Variable condenser, 0.0005 mfd.

Polar Type "C"

1 Condenser, 0.001 mfd.

Coburn

2 Variable condensers, 0.001 mfd.

Edystane 300

2 Knobs

Edystane 16

2 Screening cans, 11u. dia. x 11u. height

(Man's Radio) Cottons R3 221

1 Screening can, 11u. dia. x 4ft. height

(Coburn) Cottons R3 207

1 Variable resistances, 100 ohms

(Bugle, Coburn, Watson)

1 Variable resistances, wire-wound. 50 ohms, with knob

Kahn - F. W. Lofthouse & Co., Ltd.

1 Finger plate

1 Tapered variable control potentiometer, 300,000 ohms

(Claude Lyons, Macag, Rochester)

Resistances,

1, 35,000 ohms, 1 watt

1, 25,000 ohms, 1 watt

1, 15,000 ohms, 1 watt

1, 10,000 ohms, 1 watt

1, 150,000 ohms, 1 watt

1, 100,000 ohms, 1 watt

(Bray, Dubber, Ferranti, Graham Farish, Claude
Lyons, Polar-3MV, Watmers)

Fixed condensers,

1, 25 mfd. tubular

TMC Hydro 521

1, 85 μfd. tubular

TMC Hydro 717

2, 000 μfd. tubular

TMC Hydro 715

3, 400 μfd. tubular

TMC Hydro 723

1, 1 μfd.

TMC Hydro 742

2 μfd.

TMC Hydro 15

(Dubber, Graham Farish, Henson, Polar-3MV, T.C.C.)

2 Valves holders, 1-pin

Ciba Econost Mounting Type 26

2 Valve holders, 1-pin

Ciba Econost Mounting Type 26

1 Screened HF choke

(Radio-1)

1 OPP transformer, 600 cts.

Linden 1N 1200

(Graham Farish, Montill)

1 QMS tube switch, DPST

Bolton 680

1 QMS single switch, 3 point

Bolton 587

1 Speaker plug and socket, 5-way

Bellinger 1111

4 Electrically operated terminals, A. E. - Polar-3MV

Bellinger - "B"

1 Connector, 3-way

Bolton 1111

1 Battery clip, 6-way, with terminals and inside end

Cottons 313 677

5 Wander plugs, 3 GB. 1GB. - 1GB. 1 - GB. 2

Ciba "A"

1 GB battery, 4 volts

1 GB battery, 9 volts

1 GB battery clip

1 PT battery, 150 volts

1 LT accumulator, 2 volts

1 Adjustable screened screen

Cottons Inc. No. 22 tinned copper wire, 4 lengths Sidecot, wood, etc.

Wood panel, 16x. x 16x.

Plumber's board, 9 x 14 x 1 Fin.

Plymo-Scott

Series, 90 μv. No. 2 R. Ω.; 90 μv. No. 4 R. Ω.; 90 μv. No. 8 R. Ω.; 90 μv. No. 16 R. Ω.; 1 Fin. No. 400 Ω. with red

valves:

1 Ferranti V33E, 1 Osram or Marconi VM3, 1 Osram or Marconi VM2, 1 Osram or Marconi MV3, 1 Osram or Marconi UVS

1 Loud-speaker universal or QMH or QMF

W.B. Fosse Stentor

Cabinet

E.A. Escomb, 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 the set is electrically isolated from
electric charges on the set, and that the aerial
leak is due to non-insulation of the set by the
earth leads. The aerial potential is not an
island, but only part of a large earth-leakage
system which includes the whole set.

Consequence, those who wish to retain
their aerials 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 aerial.

Class "B," QPF, and other "quiescent" systems
require a more perfectly regulated source of
anode current supply. The plan of the
design, recommended, is to follow the
design as far as the output valve, and at
that point to substitute either a pentode
or tetrode with the 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, in-
stability should seldom give trouble, and we
suggest to a constructor of the Olympic S-S
that the uncontrolled 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-braded sleeving.

If this proves to be ineffective, he should
be assured himself that the by-pass condensers
are in order, and that all earthing con-
nexions to the chassis are making good
contact. As a last resort, it would be per-
missible to remove between 10 and 20 turns
from the primary of the transformer L4.

Circuits for Selectivity

The user of a high-quality local-station
receiver (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

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 Readers' Problems (continued)

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

There exists a possibility, however, that the
performance and general handiness of the
receiver could be improved appreciably by
modernising the tuning 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
case of hum is in an AC mains receiver in
interaction 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 the method of
testing that will settle the matter

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
appears on short-circuiting the transformer
secondary, it may be assumed quite
definitely that interaction is responsible for
it. The procedure is illustrated diagrammat-
ically 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
can 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 tuned superheterodyne for A.C. mains.

Although this receiver properly belongs to the four-valve class of small superhetes, 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 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 loudspeaker 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.

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.
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 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 £5s. it should bring high 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 Value Number, Part III of the series under the above title has unavoidably been held over.
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 aesthetic 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 plants 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.
The Technique of Radio Interference —

principles of measurement, and numerical value of the interfering effect of noise upon a broadcast programme. The standard method of stating the magnitude 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 regarded as the Signal/Noise power ratio, the reciprocal of which represents the audio power aspect of the interference with program 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 Decrees of April and May 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 characteristic of this network is identical with that 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.

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.I.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 the "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 voltage (M.S.C.) and modulation ratio M, in the presence of a disturbance. If those component disturbing E.M.F.'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 quadrature detector of constant S, the approximate numerical value of the audio-frequency power of the noise has been experimentally 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 M² (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 E.M.F.'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 E.M.F. 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 E.M.F.

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-

A works testing set for estimating the strength of interference.

Chassis of the works testing set.
The Technique of Radio Interference — at its output terminals. The remainder of the equipment consists of a rejector and potentiometer circuit, a heterodyne receiver, a detector, a transformer, an LF filter, and an LF amplifier. In order to provide for an undistorted carrier, in the presence of which the HF disturbance can be measured as noise at the output of the detector, the equivalent embodiments 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 method described, the carrier output of the receiver 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) the carrier frequency, as such as for example, the output from a multivibrator of low fundamental frequency, as in the method employed by the National League of Broadcasting 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 carrier-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 being along 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 disturbance in the output of a receiver subjected to radio disturbance will depend upon the simultaneous absence or presence of a carrier. On this account, therefore, an undistorted 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 copy on attention on Thursday, November 15th, that I found myself wishing that the various programmes directed at the public each day may take 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 even from the Academic Church, in Osterbro, than in the capital. The Overture, from Mozart's "Serenade" 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 Luxembourg, to enjoy the first movement of Debussy's suite, "En bateau," in which the clear, round tone of the brass was very noticeable. This is the most 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 "Echele du soleil," which I do not recall having previously heard, and Brahms' 6th 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 Langenbeck 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 Glazunov'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 Schuman's "Manfred" overture followed by three of Schubert's songs well worth hearing by Herrn 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 Balakirev'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' 6th Symphony in E Minor, which I had heard a few days before from Radio-Paris.

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 heterodyne, this receiver has just that extra selectivity which is required in view of the increase in power output of many of 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 paralleled 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 3½ inch "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 loud speaking systems, the preceding whether imported complete or in parts

Locomotives, locomotive pick-ups, locomotive valves, 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, resistors, transformer, transformer 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.
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 newly-constructed radio-equipped house. My omission to accept his invitation in the past few months has been accidental. Now it will be in vain. But even should 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, as my friend Captain Robinson has said he requires a day of real good work to justify its existence? Perhaps, though, he is like another good friend of mine and what happens to be a mathematician engaged in tracking $\sqrt{-1}$ to its ultimate home in the 4th 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 perform 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.

But, whereas either of speech or music, is a thing which can only be properly appreciated when the whole mind is given to it, listening to an orchestra, though 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 lost, as will all the advantages of the 4th dimension. The 4th dimension of course, is relegated to the scrap heap and the fraydied nerves of the inhabitants will lead them ultimately to the police court, the asylum, or both.

Very solemnly I warn Richard Arbib and all others who would be brought, by the proper use, the horn of a great blessing. As, a very great number of people now tend to suppose 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 concerts, 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 a shave in the 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 getting 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 boooor wireless can be to the sack, 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 your reply 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 programmes are of more entertainment value than the recorded ones. For instance, announcements made with regard to a recorded talk is to follow is 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 eloquent 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 lab. has 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 B.B.C. version of the film transmissions recently radiated by the B.B.C. and made notes of each film in turn. Some had not half a dozen harmonics, 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 are now taking steps to deal with these 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 a great deal of.

Putney.

LESLIE J. DAVIS.

[* This is being done at an early date. - Ed.]
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 "G.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 a general 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: "Daventry 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 pull 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 "G.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 get the clue is here:

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 that 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 debut 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.

Piano, four violins, 'cello, double bass, flute (doubling bassoon 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 unconfirmed 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 assistants 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 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 was 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 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 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.

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 the array is arranged above or below the radiating system, the vertical distribution of energy will be entirely due to the net effect of the various radiation reactions between the radiating and 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$^3\theta$, where the
SHORT WAVES AND THE AMATEUR

SHORL waves and the Amateur
angle is measured with the vertical, and a distribution shaped like a "square law" condenser valve is obtained. This aerial has very small radiation at high angles, 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 attraction.

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-wavelengths along the cones become narrow and radiation is more in the direction of the length of the 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 bisector of the angle. Fig. 3 gives 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 properties, the 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 a.m. and 5 p.m. It is estimated that at about 14.00 p.m. (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 RT-8 with high speed fading not excessive. Our American friends appear to be closing down until next summer on the 20 m. band, reports received indicating negative results.

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 chrominplated fittings.

High-grade gramophone components are employed, and a combined tone control and scratch filter is provided.

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.

W3XL on 16.97 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 W8XXK on 19.72 metres are radiating the same programme, and these occasions are quite valuable when a really fair check on comparative strength and reliability is desired.

The general run of things recently has tended to make the 19-metre station the more reliable of the two.

Perhaps someone will be able to explain, before short waves develop into the 20 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 W4QGO, 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 broadcastings must surely be held by the owner of "little station Tl-4NRH, in Heredia, Costa Rica." How many amateurs have heard this announcement, on either the 31- or 19-metre bands? Tl-4NRH used to be listed as using 74 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 (HCARL), 45 metres; Barranquilla, Colombia (HJ3AGH), on 42 metres; Bogota, Colombia (HKE), on 41.55; Bogota (HJ3ABD), on 40.57; Geneva (HHP), on 38.5; Tokyo (JHAA), on 38.12; Rabat (CNR), on 37.3; Havana (COH), on 37.8.

Then comes the 31-metre band, below which we have Madrid (EAQ) on 30.4; Brussels (ORK) on 30.1; and then the 25-metre band. Between 25 and 19 metres are the following:

Moscow (RNE) on 24.9; Lisbon (CTCCT) on 24.33; Rabat (CNR) on 23.3; Little America (Byrd's station KFZ) on 22.68; and last but not least, Cartago, Costa Rica (TJR), on 20.69. MEGACYCLE.
## 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)

<table>
<thead>
<tr>
<th>Station</th>
<th>Frequency (MHz)</th>
<th>Power (kW)</th>
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<tbody>
<tr>
<td>Krakow (Poland)</td>
<td>125</td>
<td>1935</td>
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<tr>
<td>Brussels (Belgium)</td>
<td>166</td>
<td>1807</td>
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<tr>
<td>Havana (Havana)</td>
<td>239</td>
<td>230</td>
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<tr>
<td>Vienna (Austria)</td>
<td>239</td>
<td>230</td>
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<tr>
<td>Stockholm (Sweden)</td>
<td>316</td>
<td>233</td>
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<tr>
<td>Moscow, No. 1, RW1 (Komsinter) (U.S.S.R.)</td>
<td>174</td>
<td>1724</td>
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<tr>
<td>Paris (Radio France)</td>
<td>182</td>
<td>1697</td>
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<tr>
<td>Istanbul (Turkey)</td>
<td>191</td>
<td>1971</td>
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<td>Berlin (Deutschlandsender Zonen) (Germany)</td>
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<td>London (UK)</td>
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<td>Milan (Italy)</td>
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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 bassChange to sheet will be imparted to the loud speaker, a condition which may be quite effectively offset 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 in 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. The magnet 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 pressed orforged, 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-free 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 little of the story.

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