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The Wireless World

31st Year of Publication

Covering Every Wireless Interest

MAY, 1941

EDITORIAL
NEW U.S.W. FREQUENCY CHANGER.
By J. A. Sargrove, F.T.S., M.Brit.I.R.E., N.C.M.E.

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

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<table>
<thead>
<tr>
<th>TYPE</th>
<th>OPERATING VOLTS</th>
<th>CONSTRUCTION</th>
<th>OUTPUT VOLTS</th>
<th>D.O. UNSMOOTHED</th>
<th>OUTPUT M.A.</th>
<th>TYPE OF RECTIFIER</th>
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<td>7</td>
<td>300</td>
<td>100</td>
<td>Sync. Vibrator</td>
<td></td>
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<tr>
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<td>3.5</td>
<td>300</td>
<td>100</td>
<td>Sync. Vibrator</td>
<td></td>
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<tr>
<td>VP506</td>
<td>6</td>
<td>6/7</td>
<td>200-275-250-225</td>
<td>100</td>
<td>OZ 4 Valve</td>
<td></td>
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<td>6</td>
<td>6/7</td>
<td>200-275-250-225</td>
<td>100</td>
<td>OZ 4 Valve</td>
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<td>200-275-250-225</td>
<td>100</td>
<td>OZ 4 Valve</td>
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<td>6</td>
<td>4.5</td>
<td>200-175-150-125</td>
<td>100</td>
<td>OZ 4 Valve</td>
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Makeshifts and Improvisations

Maintaining the Broadcast Service

UNLESS there is a generous increase in the number of components—and especially valves—released for use as replacements in domestic broadcast receivers, servicemen and servicing departments will soon be hard put to it to ensure that the bulk of the public can receive the B.B.C. transmissions. Very rightly, the needs of the Forces come first, and at the best, a shortage of supplies for some time to come seems practically inevitable.

This being so, we must cultivate a new outlook on what is permissible in the maintenance of broadcast receivers. Instead of trying to restore the performance of a defective set to as nearly as possible its original state, it will sometimes be necessary to rest content with something that will do no more than receive the B.B.C. Home Service programme with fair intelligibility. For example, it may, through shortage of replacement valves or components, be necessary to cut out the RF stage of a superheterodyne, or, in extreme cases, perhaps even to eliminate the frequency-changing and IF stages of a set of this type, converting it into a simple detector-AF combination for local-station work.

Much ingenuity will be needed if the best use is to be made of the comparatively few replacement parts that are available, and this journal proposes to print articles giving advice and suggestions for wartime makeshift methods of maintaining receivers—not at the standard we should like, but up to a standard that is sufficient for minimum requirements. Readers who have ideas on the subject or who have devised unconventional methods of overcoming difficulties due to shortage of replacement parts are invited to contribute their suggestions for the benefit of others.

While on this question of minimum requirements, we submit that the authorities and the industry would be well advised to concentrate such resources as are available on the production of those components and accessories for which, in spite of the greatest ingenuity, substitutes cannot be found. Output valves and power rectifiers are in this category.

Training: Theoretical and Practical

The position would be easier if an ample supply of well-trained and competent servicemen were available to carry out repair and maintenance work. Clearly, it requires much more fundamental knowledge of receiver technique to improvise a repair than merely to replace every component that is faulty—or suspected of being faulty. This matter should be borne in mind by all who are responsible for the training of those who are to replace the servicemen who have joined the Forces. At times like these there is a tendency, with which everyone will sympathise, to plan intensive courses of training on severely practical lines. But some knowledge of the fundamentals of receiver design will be essential for those who are to maintain the listeners' end of the broadcasting service in the face of a severe shortage of replacement parts. At the same time, it would be worth while giving specific instruction in means of improvising repairs in cases where parts for complete reconditioning are lacking.

It is a minor annoyance, but one we are all ready to face, that these restrictions are beginning to make themselves felt at a time when long-distance broadcasting is becoming more valuable than ever before as a source of news. Those who have high-performance receivers would be well advised to look after them carefully.
THE use of two valves for the purpose of frequency changing has often been adopted in order to obtain improved frequency stability in ultra-short-wave receivers. In such cases, however, one of the two valves usually performed the mixer function, and the other the oscillator; thus, although segregating the two functions of the frequency changer, no particular improvements in the frequency stability of the oscillator per se was obtained, though the effects upon the oscillator frequency stability of the varying conditions prevailing in the mixer valve, due to the varying supply voltages, automatic gain control and varying signal strength were eliminated.

To achieve this purpose it is better to use, instead of two dissimilar type valves, two identical triode-hexodes of the type in which the grid G1 of the hexode is common to the triode grid. The best-known example of this kind of combined valve is the American type 6K8G, which, like the Type "A" valve, suggested to the Standardisation Committee of the Brit. I.R.E. 1 will perform in the circuit of Fig. 2 in a most satisfactory manner.

One of the improvements to this type, suggested with a view to enabling it to fulfil radio frequency amplifier applications more satisfactorily, is the inclusion of top and bottom screening elements, such as are normally employed in the structure of RF pentodes. Whilst useful in the following circuit, they are not in this case absolutely essential, due to the totally dissimilar input and output frequencies employed, and also to the automatic neutralisation of space charge fluctuation that occurs in the circuit consequent on arranging the oscillator and output circuits as push-pull systems, and the input circuit as a parallel system.

To comprehend more fully the arguments that follow, let us recall a few points about the behaviour of the anode of the hexode is also at a relatively large distance from the second accelerator electrode G4; this gives ample room for secondary electrons originating in the anode to form a space charge between the anode and the second accelerator barring the way of the secondaries, which would otherwise reach the accelerator electrode when the anode potential is lower than the secondary-accelerator potential.
New U.S.W Frequency Changer—this type of multiplicative frequency changer valve in which the oscillator frequency voltage appears on the first control grid, whilst the signal frequency voltages are applied to the second control grid, G3. Due to the decelerating action of the negative potential of G3 on the electrons emerging at high speed through the interstices of the G2, an increased electron density occurs between these electrodes. Under certain conditions the decelerating action is sufficient to bring the electrons to rest in this space, from where they can flow either forward to the more remote parts of the hexode or fall backwards into the first accelerator electrode. This accumulation of temporarily stationary electrons is termed a space charge, or virtual cathode.

Once the existence of this space charge is understood, it will be obvious that the exact position of the "centre of gravity" of the space charge will depend on the mean kinetic energy of the electrons feeding it, which, in turn, is a function of the first control grid potential, the centre of gravity being nearer to the second control grid (G3) if the first control grid has a potential near to that of the cathode (points B' and B", Figs. 3 and 4), and farther away from the second control grid if this potential has a more negative value (points A, Figs. 3 and 4). When the first control grid potential is equal to the so-called cut-off value of the static grid-volts anode-current curve, this space charge will cease to exist (points C' and C", Figs. 3 and 4). By approaching and receding from the second control grid, the space charge acts as a pulsating variable condenser between G1 and G3. It can be shown that this virtual condenser has a negative capacitance value of between 1-10 μF, depending on the mean oscillator grid potential built up by the grid-leak condenser system. Plainly, this varying capacitance will induce into the second control grid circuit an oscillating voltage which, in turn, will cause an oscillating current to flow through the input circuit. The frequency of oscillation will be determined by the resonant circuit of the tube circuit and the input current. The amplitude of the oscillating voltage and current will be controlled by the grid-leak condenser and the grid bias.

Space Charge Movement.

It is perhaps best to illustrate these phenomena, as in Fig. 3, according to the convention which I have previously proposed and used, showing the horizontal of the electron path is an index of the instantaneous velocity of the electrons, the horizontal axis being transit-time. From the distance-time diagram it will be manifest that a horizontal part of the electron progression curve indicates electrons momentarily at rest. For instance, points P and Q on the curve represent such states. It will be seen also that at these points some electrons are still moving forward, whereas others are already returning, this being due to the Maxwell distribution of velocities of the original electron emission from the cathode, as well as to the variation in electron speeds occurring due to the non-uniformity of the potential gradients in the interstices of the grids affecting the electron trajectories within the limits of the electrode potentials, and the initial velocity, in accordance with the laws of probability. The space charge at point Q is also termed the virtual cathode of the hexode.

**Fig. 3.** Time-distance diagrams illustrating electron velocities during one period of oscillation in the pair of 6K8G triode-hexodes used in the circuit. The operating points are explained by Fig. 4.

**Fig. 4.** Phase relationship of the first control grid voltages of the pair of triode-hexodes used in the circuit during one period of oscillation. Points A, B', B", C' and C" are also referred to in Fig. 3.

---

New U-S-W Frequency Changer—

Frequency of this induced voltage is identical with the first control grid (oscillator) frequency, but its phase relation thereto depends on the reactive character of the input circuit. This induced voltage is in quadrature to the inducing current, only when the input circuit is purely resistive, i.e., its resonant frequency is exactly the same as the actual oscillator frequency. On all other frequencies the phase relationship leads or lags behind the quadrature condition, depending on whether the input circuit is inductive or capacitive to the oscillator frequency.

Transit Time Effects.

On short waves, due to transit-time effects, space charge coupling can be detrimental, as, even if the input circuit is resonant to the oscillator frequency, a lag in the induced voltage will occur. The lagging second control grid voltage will cause a decrease in the mean anode current, and a leading induced voltage an increase. The decreasing anode current will at the same time produce a decreasing conversion conductance, which, in turn, depends on cathode space charge variations. This trouble is particularly marked on very short wavelengths as the channel width of an individual station is such a very small percentage of the actual station frequency that a very small percentage oscillator frequency drift will completely lose the desired station and bring in other unwanted channels in turn. (See Fig. 5.)

The double-triode Franklin oscillator embodied in this new circuit removes all these troubles, as its stability is of the same order as a crystal controlled master oscillator. This exceptional stability is due to the minute coupling capacitors required between the basic tuned circuit and the valves which makes any variation in valve capacitance negligible. This fact is generally known, but what is not usually realised is that due to the fact that two point coupling to the tuned circuit is employed instead of three required in the Hartley or Colpitts arrangements, the Franklin circuit oscillates theoretically at a frequency much closer to the resonant frequency of the tuned circuit. The Hartley circuit works at a lower frequency due to its inductive coupling, whilst the Colpitts oscillator, due to capacitive coupling, works at a higher frequency than the resonant frequency.

Oscillator Frequency.

A slight delay is caused in the Franklin regenerative coupling by the electron transit time in the two triodes. On extremely short waves this will make itself felt, and hence the circuit will oscillate at a lower frequency than resonance. Whilst having a failing similar to the Hartley, it must be stressed that the order of magnitude of the trouble is smaller, due to the aforementioned very small coupling condensers. On short waves in a Hartley circuit the frequency drift is due not only to the lagging regenerative coupling but also due to the close coupling shunting the circuit by the varying valve impedance. This latter factor is clearly not of any importance in the Franklin oscillator due to the extremely loose coupling employed. Thus we have a net advantage and are left with the main residual cause of frequency drift which is variation in the value of inductance and capacitance of the basic oscillatory circuit, due to temperature change, etc., which can be minimised by well-tried methods. In no case would coil or condenser effects be comparable with those caused by valve characteristic variations in the single-valve oscillator.

In addition to having a high order of frequency stability the use of a twin triode Franklin oscillator in this new frequency changer has these

Fig. 5. Diagram showing channel width as a percentage of carrier frequency and maximum tolerable oscillator drift based on the assumption that loss of intelligibility is appreciable at 10 per cent. of channel width.

Wireless World

(1) The theory and Design of Valve Oscillators," by Dr. H. A. Thomas (Chapman and Hall).
From this it will be seen that opposite conditions prevail in the two valves at each portion of the oscillator cycle. Clearly this measure completely obviates the locking effect without having to resort to neutralising circuits or other artificial means.

Output Filtering.
The input system is in parallel, whilst the oscillator system, though actually in cascade, can be considered in push-pull from the point of view of the mixer system, the grids being in opposite phase. Consequently the AC anode currents of the two hexodes will flow in opposite phase to each other. This is a very agreeable incidental feature. It enables the valve circuits to obtain an easily a cancellation or elimination of the input frequency, as well as the oscillator frequency in the first IF transformer, by the simple expedient of connecting a relatively small condenser from anode to anode of the two hexodes. The most convenient arrangement is that shown in Fig. 2, where a central tapped anode coil is used. The IF tuning condenser is split into two condensers in series, the centre tap being earthed, thus producing a simple filter circuit. This filter removes practically all traces of the higher frequency components of the anode currents.

In constructing this novel U-S-W frequency changer, the usual short wiring is essential as well as very careful and intelligent layout. If the remainder of the circuit is well designed, the normal commercial 6K6G valve can be used up to frequencies of the order of a hundred megacycles. At first sight this may seem a surprising result as the valve in question has a normal bakelite base, and thus is subject to the usual leakage troubles. However, in the ordinary type of simple mixer circuits, leakage was usually blamed for much graver troubles which occurred in the long electrode leads between the valve proper and the valve pins. Due to the automatic neutralisation described above, many of these detrimental couplings are rendered innocuous, and hence the satisfactory results are more or less automatically achieved.

RIPPLE CONTROL TRANSMITTER
This apparatus has been developed by the G.E.C. for switching on and off electrical apparatus by means of LF impulses superimposed on AC power mains. A valve oscillator provides the necessary power of 150 watts, six control frequencies between 380 and 550 c/s being generated. The receiver consists of a series of reeds tuned to the various frequencies, these reeds operating mercury switches through gear mechanism. The system is mainly intended for use in factories and other places where three phase supply is available, and is, at present, largely used for distributing air raid warnings.

From the World's Technical Press
At such a time as this the wireless engineer might well feel cut off from the world, so far as a knowledge of the advances in wireless technique are concerned, were it not for such a service as that rendered by the Wireless Engineer. In the April issue were 100 articles recently published in the world's Technical Press are abstracted or referred to in this monthly feature of our sister journal. Whilst important articles in English, in a journal likely to be readily accessible, may be dealt with by a parenthetic addition to the title, a page or more is frequently devoted to an article of similar importance appearing in a German or Italian journal.

In addition to this section and a summary of recently accepted patent specifications, the April issue contains articles on receiver aerial coupling circuits, the ganging of superheterodyne receivers and feedback amplifier circuits. Published on the first of the month, The Wireless Engineer is obtainable to order through newsagents, or direct from our publishers at Donset House, Stamford Street, London, S.E.1, at 2s. 6d., including postage.
Auxiliary DC Source

And Some of Its Applications

The need for an auxiliary source of DC potential often arises in experiments with receivers, but the cost of a supply unit of conventional design is not always justified. This article describes how the necessary potential can be obtained inexpensively, and also shows many ways in which it can be used.

It will be assumed—as indeed should be fairly obvious—that only a small current will be drawn from the auxiliary supply circuit to be described in this article. Fig. 1 shows how an ordinary rectifier unit, conventional except that in this case choke input smoothing is employed, may be modified to provide an auxiliary supply, negative with respect to earth. Any spare battery valve will suffice for this auxiliary rectifier. The output voltage can be adjusted from about 150 volts to 350 volts by selection of the capacity C; the higher the capacity the higher the resultant voltage. In the interests of valve life it is advisable to use the smallest capacity and hence lowest voltage sufficient for the designer's needs. If no spare filament winding is available on the transformer, it is possible in some cases to wind a small quantity of thin wire on top of the existing windings, sometimes without even dismantling the core. Alternatively, a "bell-type" transformer, which can be obtained for a few shillings, can be used.

If the current drain on the auxiliary supply is very small, the smoothing choke L may be replaced by a resistance.

Turning to the uses to which an auxiliary source of DC supply may be put, we will first suppose that means are required for balancing the anode currents in a push-pull output stage. One way of doing this, shown in Fig. 2, does not call for any auxiliary supply. The currents may be equalised by adjusting the slider of R1, and when bias is reduced on one valve it is increased on the other. If the variation of bias required be plus or minus 1 volt, and the HT 250 volts, then suitable values for the resistances are R1 = 10,000 ohms, and R2 and R3 = 1.25 megohms (say 1 megohm to use the nearest commercial value). Other values in the same proportion may be used. Greater variations than plus or minus 1 volt are often required, in which case either R1 should be proportionately increased or R2 and R3 proportionately decreased.

One disadvantage of this circuit is that as the grids are biased positively with respect to earth, the cathodes must be given an extra positive bias by the same amount. Unfortunately, this is effectively subtracted from the HT volts available for the valve. This disadvantage may be overcome by using an

Fig. 1.—Connections of an auxiliary supply circuit (in dotted lines) added to a choke-input rectifying system.

Fig. 2.—Balancing a push-pull output stage by a method which does not call for an auxiliary source of grid voltage.

Fig. 3.—Method of balancing the output stage by means of an auxiliary source of bias.

MAY, 1941.
Auxiliary DC Source—auxiliary supply, negative with respect to earth. Fig. 3 shows the circuit of Fig. 2 adapted so that the main bias is taken from the HT supply, while the variable portion is taken from the auxiliary supply. Notice that the cathodes require less positive bias to earth than is necessary in the simple auto-biased circuit.

Supposing that there are no spare volts available from the HT system for biasing purposes. Then all bias may be obtained from the auxiliary supply, as shown in Fig. 4. Here R4 is the main bias resistance and with the values previously suggested 10 volts main bias will be obtained if R4 = 25,000 ohms. At this point it should be emphasised that the bias produced by R1 is additional bias at both ends, so that when the slider is in the centre point both valves will receive 11 volts bias, but either may be biased to 12 volts whilst the other be biased to 10 volts by moving the slider to either end.

If a change-over from auto-bias to independent bias be made, however, one should not forget that the total permissible external grid-to-cathode resistance is reduced to about 50,000 ohms per valve. When using the circuit of Fig. 4 the grid leak resistance plus the value of R1 plus twice the value of R4 should therefore be not greater than 50,000 ohms. The value of R4 should be doubled because it is in the grid circuit of both valves. It sometimes happens that the auxiliary supply is used for several purposes, when it may be desirable to decouple the grids from the auxiliary supply. One may achieve this by connecting high-capacity low-voltage electrolytic condensers from each end of R4 to earth, or by the more conventional circuit of Fig. 4 (a).

A second use for the auxiliary supply is in connection with single-valve phase-splitters. Two common difficulties in the design of these are to avoid overloading, and to avoid a large difference of potential between the heater and the cathode of the phase-splitter valve. Both difficulties may be overcome by the use of an auxiliary supply, as shown in Fig. 5. Here the valve is utilising the full voltage between HT positive and auxiliary negative, thereby reducing considerably the dangers of overloading. In order to lighten the load on the auxiliary supply, all resistances should be made as high as is consistent with other considerations. By suitably proportioning the anode and cathode coupling and decoupling resistances, the cathode potential may be brought just sufficiently above earth to provide the bias for the valve.

A third use for an auxiliary supply is in connection with the AVC amplifier used with the negative feedback detector previously described in The Wireless World. It may be remembered that this detector imposes very little load on the tuned circuit and the AVC voltage developed is almost independent of the degree of modulation. Fig. 6 shows the circuit, complete with decoupling. The decoupling resistance values should be small compared with the coupling resistance values in order that the ratio between the AC and the DC loads be made close to unity, and distortion be avoided at high modulation. Many other uses for the auxiliary supply will doubtless occur to the experimenter, such as paralysing the AF amplifier in QAVC circuits. In happier days it may prove useful in connection with DC-coupled vision-frequency amplifiers.

Fig. 4.—With this biasing system the full HT voltage is available for the anode circuits of the output valves. The inset diagram (a) shows the addition of a decoupling resistance and condenser.

Fig. 5.—Auxiliary voltage supply to a phase-splitting valve.

Fig. 6.—Method of feeding an AVC amplifying valve.

MAY, 1941.
Binaural Transmission

Combining Frequency and Amplitude Modulation with a Single Carrier

The quest for perfection in quality of reproduction has travelled far along the track of single-channel transmission. Consistently good results are obtained from modern quality loudspeakers in conjunction with amplifiers of wide-frequency response and low harmonic distortion, but occasionally the quality enthusiast is treated to a programme of outstanding excellence having that touch of realism and perspective which is normally lacking in everyday programmes.

When this happens it will usually be found that there is a long reverberation time in the hall or studio where the original performance is taking place. Sounds are arriving at the microphone more than once and in different phases, and we are, in fact, being given a foretaste of the type of quality that true binaural transmission might provide.

The practical difficulties of transmitting two or more separate channels in the correct phase for producing "stereophonic" sound effects have long since been solved satisfactorily, and readers will no doubt remember the classical demonstration in 1933 arranged by Dr. Harvey Fletcher in collaboration with the Bell Telephone Laboratories and the Philadelphia Orchestra under Leopold Stokowski. The obstacle to the realisation of a binaural broadcasting service has been the difficulty of finding space in a frequency spectrum already overcrowded by single-channel "monaural" transmissions.

A system for transmitting two audio channels on the same carrier would solve the problem, and an ingenious method has been put forward recently by A. V. Eastman and J. R. Woodyard.

The basic principle is explained in simple terms by the diagrams of Fig. 1. A normal amplitude-modulated signal may be represented as in Fig. 1 (a) by a carrier vector and two sideband vectors 2 and 3. If the carrier vector, which revolves counter-clockwise at constant velocity were stopped at every revolution in the position shown, the vector 2 representing the upper sideband would have gained on the carrier, thus increasing the angle, and 3, representing the lower sideband, would have lagged by a similar angle. These two sideband vectors can, therefore, be visualised as revolving symmetrically in opposite directions about the main vector. When applied to a normal detector preceded by a symmetrically tuned circuit the two audio components resulting from the interaction of sidebands 2 and 3 with the carrier are additive and will provide one channel of the binaural system.

The other channel is associated with sidebands 5 and 6: Fig. 1 (b), which are developed in the transmitter about a carrier 4 which is superposed in a balanced modulator, but whose phase would be always 90 degrees in advance of the main carrier 1. The vector relationship of the components of the complete signal are depicted in Fig. 1 (c).

Due to the phase shift of 90 degrees from the carrier 1, the interaction of sidebands 5 and 6 produces audio components which are in opposite phase and will cancel in the normal detector circuit. They can, however, be made to produce their original audio frequencies by the artificial introduction of a carrier in the proper phase, and this is accomplished by advancing the phase of the received carrier by 90 degrees in a special receiver which then automatically becomes deaf to the modulation in the channel represented by sidebands 2 and 3.

Before conversion, the relationship between the carrier 1 and the sidebands 5 and 6 is closely analogous to a frequency modulated wave in which the frequency swing is small compared with the applied audio frequency. In fact, the method of reception used for this channel is one which has been employed for frequency modulation, and the fundamental circuit is given in Fig. 2.

The local oscillator is tuned to the same frequency as the incoming carrier and the coupling to the aerial circuit is adjusted until the oscillator locks with the carrier at a phase angle of more than 90 degrees. The

1 Electronics, February, 1941.
exact phase angle required is determined by the relative amplitudes of the oscillator and the incoming carrier at the rectifier and is adjusted until the resultant phase angle is 90 degrees from the incoming carrier.

The sidebands 5 and 6 are now in the same relationship to the carrier as 2 and 3 were in the normal receiver. Hence their interaction will produce an audio output and the product of 2 and 3 will be rejected.

A practical circuit with values suitable for RF amplification on the medium-wave band is shown in Fig. 3. The grid detector is a pentode with triode connections and the oscillator is a general-purpose triode. Coils are wound on formers of the same diameter and are mounted coaxially with adjustable couplings.

In setting up the circuit the distance $d_1$ between the aerial and oscillator coupling coils is first adjusted so that the oscillator locks-in over the desired frequency range. The oscillator grid leak also has some influence on this adjustment. Next, $d_2$ is varied until, with no incoming signal the RF voltage on the detector grid reaches the value indicated by the vector relationship of Fig. 2. In practice a value from 3 to 10 times the strongest signal received will be required. If the $Q$ of the detector input circuit is high a damping resistance may be required to ensure that the detector does not respond directly to frequency modulation which would result in the introduction of some second harmonic distortion. A further adjustment of carrier phase is available in the coupling $d_3$ which controls the magnitude of the direct RF input to the detector.

The provision of an oscillator switch $S$ enables the set to be changed from frequency-modulated to normal amplitude-modulated reception as a check, but a separate receiver would, of course, perform the latter function in binaural reception.

At the transmitter the modifications necessary for the addition of the sidebands associated with the second audio channel are not unduly complicated. A schematic diagram is given in Fig. 4 and it will be seen that the output from the second microphone is applied to a balanced modulator which suppresses the carrier and leaves the sidebands, which subsequently pass through one of two alternative types of phase-shifting network before mixing with the output from the existing amplitude modulator. The band width of the combined transmitter is no greater than that required for single channel operation.

A demonstration of the system has been given at the University of Washington in collaboration with Mr. E. D. Scott, and the results obtained showed that the scheme is quite practicable. The tests were made as part of a series of investigations into the problems of frequency modulation and the modulation system differed slightly from the method originally proposed. Nevertheless, good separation between the channels was obtained, the background of one system being about 30 db. down on the other. Working along these lines we see no technical reason why an experimental binaural broadcasting service should not be established.

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Fig. 3. Practical circuit for receiving the frequency-modulated half of the binaural channel. The values are suitable for the medium-wave range.

Fig. 4. Schematic circuit diagram of modulator stages in the binaural single RF channel transmitter.
Broadcasting in India

A Survey of its Development

The history of broadcast development in India is a story of steady progress in spite of what at first appears to be insurmountable difficulties. These difficulties, which are peculiar to the Indian Empire, include the extremely high atmospheric disturbance level; the vast, widely scattered population; the multiplicity of languages spoken, and the illiteracy of its people.

Prior to relinquishing his post as the first Controller of Broadcasting in India, Mr. Lionel Fielden, who was recently made a Companion of the Order of the Indian Empire, issued the first annual report on the activities of All India Radio, and, since no separate report on Indian broadcasting had previously been issued, he included an historical survey of its development. We therefore take the opportunity of recording its growth as given in the report, which is published by the Manager of Publications, Government of India, Delhi, at Rs.3 (5s.), and occupies some 250 pages, plus numerous maps, graphs and circuits.

Although there had been a broadcasting service in the Madras Presidency since 1924, the history of organised broadcasting in India begins in July, 1927, when Lord Irwin (now Lord Halifax), then Viceroy, inaugurated the first transmitter of the Indian Broadcasting Company. This medium-wave 1.5-kW station was situated in Bombay. In just over a month the second 1.5-kW transmitter was opened in Calcutta. The effective service range of each of these stations was about 30 miles, which fact accounts for the number of licences in force at the end of 1927 being little over than 3,500.

Within a year the number of licences had risen to over 6,000, but the increase thereafter was very slow, and by the end of 1932 the number of licence holders was only 8,500. There were still only two stations operating. In 1932-33, however, there was a sudden increase, the total at the end of 1933 being nearly 11,000 and a year later 16,000. The sudden increase is attributed in the report to the opening of the B.B.C. Empire Service in December, 1932, and the consequent purchase of sets by a large number of Europeans in India.

Symbolic of the modern design of Indian medium-wave stations is this view of the transmitting building and 180 ft. self-radiating mast of the Trichinopoly station. The mast is surmounted by a “capacity top” to increase its effective height.

Apparent Failure

It was in 1930 that the original Indian Broadcasting Company went into liquidation, and it seemed, therefore, that broadcasting in India had failed. It is suggested in the report that the failure may, perhaps, be ascribed to four reasons which, in part, still hold good to-day. First, the lack of funds, secondly the very high price of receivers (about Rs.500 (£37 10s.) for a four-valve set), thirdly that Indian conditions were by no means as favourable to the rapid growth of broadcasting as those of the West and, lastly, there was difficulty in collecting the Rs.10 annual licence fee (of which the company took 60 per cent., in addition to a 10 per cent “tribute” on the value of all imported receivers).

Broadcasting was taken over by the Government of India in 1930, and the two existing stations were operated as the Indian State Broadcasting Service. After many vicissitudes, during which independent States had started schemes for the establishment of their own broadcasting services, the Government put the broadcasting...
Broadcasting in India—

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service on its feet in 1935 and appointed Mr. Lionel Fielden as the first Controller of Broadcasting. The following year saw the opening of a 20-kW medium-wave station at Delhi, and the arrival of Mr. H. L. Kirke, of the B.B.C. Research Department, to study the situation with the Controller, and to report on a scheme for the expansion of the service.

Toward the end of 1936 a member of the B.B.C. engineering staff, Mr. C. W. Goyder, who was a well-known amateur transmitter in the early days of wireless, was, in accordance with Mr. Kirke’s recommendation, appointed chief engineer of All India Radio, as the broadcasting service was then called.

Mr. Goyder still holds that position.

So far as readers of The Wireless World are concerned, the most interesting facts about the development of broadcasting in India are to be culled from Chapter V of the report which deals with the engineering and technical aspects.

Short-wave Network

The report makes it clear that the area covered by a direct-ray service from the medium-wave stations at present planned will only represent a small fraction of the total area of India. The limitation to the indirect-ray service area of the medium-wave stations is atmospheric disturbance. These considerations, together with the fact that the indirect-ray service area of a short-wave transmitter is much greater, and it can also provide an indirect-ray long-distance service during daylight as well as after dark, led to the establishment of four 10-kW short-wave stations so disposed that the whole of the country is given a second-grade broadcasting service under normal conditions. These stations are situated at Delhi, Bombay, Madras and Calcutta, and each has a normal effective range of 500 miles.

The provision of these stations is but the initial step in the development scheme for covering the country. As short-wave transmissions are unreliable owing to fading, it is hoped eventually to build additional medium-wave stations to give a direct-ray service throughout the country. This, however, would incur a capital expenditure of approximately 10 crores of rupees (£7,500,000).

Due to the general purpose of a short-wave service, the Indian stations are intended to serve the country in which they are located, and not overseas. To provide a service from a short-wave station in the area in which it is located, it is necessary to employ a wavelength which does not produce a ‘‘skip-distance’’ zone around the station. Field-strength measurements made prior to the inauguration of the Delhi short-wave station showed that the best night-time wavelength was around 90 metres. Later measurements indicated that a wavelength of the order of 60 metres was more satisfactory for the early summer months. For daylight transmissions 31 metres is used.

In order to minimise skip-distance troubles over relatively short distances, special attention had to be given to the angular radiation character of the aerial system which has a normal effective range of 500 miles. Later measurements indicated that a wavelength of 90 metres was more satisfactory for the early summer months. For daylight transmissions 31 metres is used.

In the development scheme it was agreed to erect a number of receiving centres. The first of these to be put into service is located at Todaipur, on the outskirts of New Delhi, and the others to be erected at each of the transmitting stations will be on similar lines. These diversity receiving centres are intended not only for relaying transmissions from overseas, but also from A.I.R. stations, as existing telephone circuits are unsuitable for linking the transmitters.

For these receiving centres the

All India Radio development scheme showing the disposition of the 14 stations at present in use and the areas they serve.

MAY, 1941.
Broadcasting in India—Bruce horizontal rhombic aerial has been adopted as a standard. Two rhombic aerials are normally used in conjunction with a third which, depending on prevailing conditions, may be a horizontal doublet, an inverted “V,” or a vertical aerial.

The receiving equipment comprises four rack-mounted sets, three of which are normally used for a relay, whilst the fourth is kept as a standby tuned to another transmitter radiating the same programme. To avoid mutual interference between the beat oscillators of each receiver when more than one is tuned to the same frequency, the IF stages of the four receivers are adjusted to have mid-band frequencies of 430, 445, 460 and 475 kc/s respectively (in later receivers the separation has been increased to 20 kc/s).

The experiments made up to the last week of February show that the development of broadcasting in India is subject to many difficulties, not the least of which is a lack of funds to provide an adequate service. It is noteworthy that the Rs. 40 lakhs (£300,000) originally allocated for the development of broadcasting over an area thirty times that of the British Isles with a population of more than 350,000,000 is less than the amount available for providing a television service for the London area.

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AF amplification; a driver; and, lastly, a double-triode output valve working in Class B. The IF transformers are of the iron cored type in which adjustments are made by sliding the core. Experience showed that in conjunction with fixed condensers for tuning these provide better stability than is obtainable with variable trimming condensers.

Power is derived from a 6-volt car type battery and vibrator. In the interests of frequency stability, directly heated valves are used in the mixer and IF stages; elsewhere indirectly heated types are employed, as they give greater freedom from hum due to the HT generator.

The receiver is designed for a maximum output of 3 watts to the loud-speaker, which, incidentally, has itself been a source of trouble. The choice of loudspeaker is practically restricted to the permanent magnet type, and during the S.W. Monsoon speech coils and cones tend to become distorted unless special precautions are taken.

A time switch is fitted to the receiver, which is enclosed in a metal box. The time switch was found to be necessary because in some villages the receivers were used for longer periods than intended with the result that the battery had run down long before battery replacement was due, whilst in other villages programmes were missed because the receiver was not switched on in time.

By far the most serious limitation to short-wave reception in India is the interference resulting from the use of DC for the operation of ceiling fans, which, during the summer months, are in use for the greater part of the day and night. Proposals for the compulsory use of suppressors are being considered.

It will be seen from the foregoing that the development of broadcasting in India is subject to many difficulties, not the least of which is a lack of funds to provide an adequate service. It is noteworthy that the Rs. 40 lakhs (£300,000) originally allocated for the development of broadcasting over an area thirty times that of the British Isles with a population of more than 350,000,000 is less than the amount available for providing a television service for the London area.

Short-wave Receiving Conditions

PROSPECTS FOR MAY

(SUBMITTED BY THE ENGINEERING DEPARTMENT OF CABLE AND WIRELESS, LTD.)

SHORT-WAVE receiving conditions were erratic throughout the greater part of March as a result of numerous ionosphere storms, the dates of occurrence of which were as follows:—March 1st to 8th inclusive; 13th to 23rd inclusive (but excluding 17th and 18th); and 28th to 31st inclusive. Those at the beginning of the month were of unexpected severity.

Sudden ionosphere disturbances of the “Dellinger” type occurred as under, these and other times given in this report being GMT on the 24-hour clock notation.—(A) March 1st at 1310; (B) March 3rd at 0825. The effects of (A) were widespread, but lasted for only about 20 minutes, whilst those of (B) were confined mainly to easterly and southerly routes, but continued for about one hour.

The increased intensity and frequency of ionosphere storms exhibited during March and, in particular, their occurrence at the middle of the month, with subsequent moderation during its fourth week (i.e., from 24th to 27th inclusive), were substantially in accordance with the prospects for March which were given in the issue of the Journal published on February 20th.

As is well known, North Atlantic routes are very susceptible to the effects of such storms, and some idea of the extent to which reception may be impaired thereby is afforded by comparing the “disturbance factor” for August, 1940 (a month of few disturbances), with that for March, 1941. This is shown graphically by the accompanying curves (a) and (b) respectively.

MAY, 1941.
Short-wave Receiving Conditions—

It will be observed that even during the most favourable period of the day in March disturbance was greater than that which obtained during all but one hour of the day in August last. Inci-

dently, in regard to curve (b), leaders of these reports may recollect that relatively poor conditions were predicted for the period around 0900 and conversely good reception for the period 1300 to 1900. The adverse conditions which prevailed on the North Atlantic route during the month under review proved to be more extensive than any experienced during the last eight years.

Fortunately, when signals along the direct route are rendered uncommercial, it is usually found practicable automatically to relay messages by way of an additional station, so situated that the signals to and from it traverse less-disturbed regions of the ionosphere.

Particulars of the broadcast bands which, it is considered, should prove most reliable during May under normal conditions of propagation at the times stated for five selected routes are given below; these may serve as a guide when considering the possibilities of reception from places not too remote from those specified.

Attention is drawn to the fact that a number of factors, for example, (a) transmitter power, (b) efficiency of aerials at both the transmitting and receiving end, and (c) ionosphere abnormals, may often result in better reception being obtained on wavebands other than those quoted. Moreover, transmission on each of the stated bands may not be available.

**Capetown**: Midt, 31 m; 0300, 31, 41 or 49 m; 0600, 19 or 25 m; 0900 and 1400, 16 m; 1800, 19 or 25 m; 2100, 25 or 31 m.

**Bombay**: Midt, 31 m; 0500, 16 or 19 m; 0800, 1200 and 1500, 16 m; 1800, 16 or 19 m; 2100, 19, 25 or 31 m.

**Mails** may be weak between 0900 and 1300.

**Cairo**: Midt, 31 or 41 m; 0400, 25 or 31 m; 0700, 25 or 31 m; 1100, 19 or 25 m; 1700, 25 m; 2100, 25 or 31 m.

**Signals** may be subject to weakness between 0900 and 1300.

**Buenos Aires** may be weak during the period from 1000 to 1300.

**Morse Gramophone Records**

The speed of transmission in the final records is approximately eighteen words per minute with a moderate background of jamming. The major part of the text consists of code and figure groups which cannot easily be memorised, and this, of course, is a great advantage. The complete set of four double-sided records with key costs $12.8 (tax 2s. 8d. extra) and is produced by The Columbia Graphophone Co., Hayes, Middlesex.

**Wireless World**

In view of the great stimulus which the war has given to the learning of the Morse Code, considerable interest will be aroused by a series of four gramophone records recently produced for the benefit of those studying without skilled assistance. They have been prepared with the co-operation of R.A.F. signalers, and, as might be expected, keying is beyond reproach. It is interesting to note that even in the earlier records which are at beginners' speed, the principle is adopted of not dragging out each letter so slowly that the whole of its rhythmic characteristic is lost. As explained in the text accompanying the records, the method of presenting the code and the order in which the various portions are taken for instructional purposes is based on the latest practice adopted by the three Services, while the procedure and special signs given are taken from the unified procedure of the Services.

In the textual key accompanying the records there is one small point of criticism which might with advantage be attended to in a later reprint. This is the printing of such symbols as **—** (end of message) as AR without any indication that they are invariably sent as one sign and not as separate letters; and this in spite of the care taken in the first record to explain this very fact.

**Wireless Industry**

The S.S. White Co. of Great Britain Ltd., St. Pancras Way, London, N.W.1., have issued two supplements to, the treatise on flexible remote controls mentioned in our March issue. They deal with applications to car radio and allied problems. Holman Batteries Ltd., announce that their head office has been transferred to 137, Victoria Street, London, S.W.1. The telephone number remains as before, Victoria 1437/4.

We have received from British Insulated Cables Ltd., a copy of Leaflet NSG6, dealing with 'Pernax,' a plastic tape for insulation and joint sealing, which is designed for use out of doors in wet and corrosive atmospheres.

The head offices of Sloan Electrical Co., Ltd., have moved from Fetter Lane to 41, Kingsway London, W.C.2. New East London depot has also been opened at 6, Albany Road, E.10.
THE WORLD OF WIRELESS

REVISION OF RESERVED OCCUPATIONS
Its Effect Upon the Wireless Industry

In following the general principle of imposing a much stricter application of the test as to whether or not work is essential to the war effort, the wireless industry will suffer to a certain extent with the introduction of the recently revised schedule of reserved occupations. It introduces a change of principle in reservation, namely, that account is taken not only of the occupation but of the actual work upon which a man is engaged.

In accordance with this plan, wireless engineers, fault finders, wireless repairers, mechanics and servicemen between the ages of 25 and 35 years will be reserved if they are engaged on work which is "prolonged" because of its importance to the war effort. Men in these occupations over the age of 35 are reserved whether engaged on protected work or not. As in the past, men in these occupations will not be called on for service other than in a trade capacity.

There is virtually no change in the reservation ages of seagoing wireless operators, civil aviation operators, valve makers and those engaged on the maintenance of wireless transmitting and receiving equipment (including radio interference detection apparatus) in electrical communication and signalling systems.

Whereas loudspeaker cone makers were reserved from 30 there will in future be no reservation of men of military age in this occupation.

VALVE SUPPLIES

The valve situation is causing considerable concern among retailers. Whilst fully appreciating the needs of the Services, the National Council of the Wireless Retailers' Association recently voiced its feeling that more valves should be available to the public. It was pointed out that it is palpably necessary for the population to have receivers in working order not merely for the purpose of entertainment but to ensure that official news is widely heard.

At a recent meeting of the Council of the National Association of Radio Retailers it was decided to make representations in the appropriate quarters for valves to be released for replacement purposes.

BST

In view of the Home Office decision to continue to use the designation British Summer Time for the period from May 4th to August 10th, when an additional hour will be added to the existing Summer Time, the use of the abbreviation BST in The Wireless World may cause some confusion.

As the May issue is current when both the old and the new summer time are in force, it should be noted that BST in this issue denotes time one hour only ahead of GMT.

A change to Daylight Saving Time on April 27th. This will mean that transmissions from America will be received an hour earlier than scheduled during the period from that date until we change to the new Summer Time.

B.B.C. BOARD

It will be remembered that soon after the outbreak of war the B.B.C. Board of Governors was reduced from its peacetime number of seven to two; namely, Sir Alan Powell, who was appointed chairman in succession to Mr. R. C. Norman in March, 1939, and Mr. C. H. G. Mills, vice-chairman since 1937.

The Board has now been increased to six. The two serving members are continuing in office with the following new members: Sir Iain Fraser and Mr. J. J. Mallon, who were on the Board prior to its reduction. Mr. Arthur Mann, and Lady Violet Bonham Carter.

FM SATURATION?

EDITORIAL comment in a recent issue of Broadcasting stated that saturation in FM is already evident in New York. The Federal Communications Commission, which has so far granted FM channels to the applicants in rotation, now finds that seven of the eleven channels available for the nation's radio hub have already been allocated, and that there are now many more applications than there are channels available.

Eleven frequency-modulated transmitters is the maximum permitted by the F.C.C. for metropolitan areas. It may, states the writer, be found technically possible to separate FM stations by only 100 kc/s instead of the present 200 kc/s. Some feel, however, that even this would be only a temporary measure.

POSTAL SERVICING COURSE

Further details are now available of the postal course in radio servicing, sponsored by the National Association of Radio Retailers, to which reference was made in last month's issue.

The first part of the course is devoted to an explanation, in a progressive manner, of the way in which each part of a receiving system operates. Throughout this part, which comprises ten lessons, it is shown how and where to look for trouble.

The second part, the lessons deal with the various sections of a modern broadcast receiver. The function of each is explained, together with the correct method of servicing and checking for correct operation. The twentieth and concluding lesson deals with mechanical repair and assembly.

The course, which is available at an inclusive fee of 3 gns. to anyone in the wireless industry, is illustrated by diagrams and charts, and each lesson is accompanied by a series of questions to which answers are made available to the student.

MAY, 1941.
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BRITISH STANDARDS IN WARTIME

Two New Publications

THE British Standards Institution, which is helping Government departments in the preparation of War Emergency Specifications, as well as performing many other special tasks, still continues its normal work, and has recently issued two Specifications of general wireless interest.

Some time ago friction arose between water supply undertakings and electrical interests over the practice of earthing to water pipes. Conflicting views were apparently largely reconciled in 1938, when agreed regulations for earthing were issued. A British Standard Specification (BS.951-1941) covering these regulations has now been produced. It is based on performance rather than on mechanical design of earthing clamps, etc., but certain mechanical features of construction are laid down. For instance, the earthing lead must not be connected to a screw used for tightening the clamp on the pipe.

The second Specification, BS.415-1941, deals with safety requirements for "mains-operated apparatus for radio, acoustic and visual reproduction," and is a revision of an earlier specification already reviewed in our pages. A new section, dealing with the installation of apparatus, has been added.

The Specifications are obtainable from the British Standards Institution, 28, Victoria Street, London, S.W.1, at 2s. 3d. each, including postage.

RECORDING TECHNIQUE

Instead of the usual method of removing the swarf or thread from a wax recording during cutting by means of a rubber tube near the stylus, which is connected to a vacuum pump and sucks away all the shavings, a recording company in the U.S.A. has developed a blower system which directs a tiny blast of air across the surface of the disc just behind the cutting-head and so impels the thread of coating material to the centre of the disc.

This method is claimed to be an improvement on the vacuum system as the air-stream is removed from the proximity of the cutting stylus where it cannot produce air noise in high-quality recordings.

With direct-recording discs, the surface of which is less delicate than a wax, such devices as automatic brushes or thin rubber wiper-blades (known in America as "chip-chasers") are employed.

MAY, 1941.

DEFENCE OF LONDON

Wireless Men Wanted

THE Commanding Officer of London District Signals (Royal Corps of Signals) asks us to draw attention to the fact that his unit needs wireless men—not necessarily fully trained—for operating and maintenance work. The age limits for enlistment (18 to 59 years) are exceptionally wide, and the conditions of service are such as to appeal especially to those living in London. One of the most important tasks of the unit is to maintain a wireless service between all military strategical points in its area as a safeguard against landline breakdowns through enemy action; the work is interesting and opportunities for promotion are good. Application should be made to St John's Wood Barracks, St John's Wood Road, London, N.W.8.

R.C.A. REPORT

THE twenty-first annual report of the Radio Corporation of America shows a net profit of $9,173,156, which is an increase of 13 per cent. In the review of the Corporation's activities for 1940 some interesting details are given. It is announced that a simplified model of the electron microscope is being built for use in educational, medical and industrial research laboratories. It is less than one-half the size of the original model, costs less than half as much and is plugged into an ordinary lighting socket.

THE L.A.R.U.

IN announcing the affiliation of the Brazilian amateur radio society, Liga de Amadores Brasileiros de Radio Emissao, to the International Amateur Radio Union, Mr. K. B. Warner, the secretary of the Union, states that 37 countries are now members.

In Brazil there are about 1,000 amateur operators, all of whom belong to the L.A.B.R.E. Due to present international conditions amateurs in that country are not allowed to contact stations in foreign countries actively at war, so the emphasis is on domestic communication. Numerous groups of amateurs form weather-reporting nets and emergency communications reserves. The Brazilian amateurs' official organ is called QTC—"I have a message for you."

FROM ALL QUARTERS

B.B.C. News on Short Waves

The transmission of news in English in the B.B.C.'s European and World Services takes place at the following times (BST), and, at the time of going to press, on the following short wavelengths. Those marked with an asterisk are used in the European Service.

0630 49.50* 0655 51.50 0720 51.50 0745 51.50 0810 51.50 0850 54.20 0910 54.20 0930 54.20 0950 54.20 1010 54.20 1055 54.20 1130 54.20 1210 54.20 1250 54.20 1330 54.20 1410 54.20 1450 54.20 1530 54.20 1610 54.20 1650 54.20 1730 54.20 1810 54.20 1850 54.20 1930 54.20 2010 54.20 2050 54.20 2130 54.20 2210 54.20 2250 54.20

M. Braillard

M. RAYMOND BRAILLARD, director of the Brussels wavelength checking station of the Union Internationale de Radiodiffusion, which was removed to Geneva in 1939 when the Nazis invaded Belgium, has now given up this position which he has held for many years. Since January 1st he has been director of the technical services of the National Broadcasting Service in unoccupied France. It is rumoured that the U.I.R. checking station is to be reinstalled in Brussels.

Yugoslav Listeners

According to the latest available figures there are 185,000 licensed listeners in Yugoslavia, which is approximately 1.9 per cent. of the population. A receiving licence costs 300 dinar (approximately 30s.).

Brit. I.R.E. Incorporated with I.W.T.

At an extraordinary meeting of the Institute of Wireless Technology on March 22nd, the members unanimously
The World of Wireless—

greed to the fusion of the I.W.T. with the British Institution of Radio Engineers. The combined bodies will be known as the British Institution of Radio Engineers Incorporated with the Institute of Wireless Technology, and will have its headquarters at Duke Street House, Duke Street, Grosvenor Square, London, W.1. Sir William Noble has been invited to be president of the joint body, the first meeting of which will be held on April 26th. Examinations have been arranged to take place on May 16th and 17th.

Echoes

In the eleventh annual report of the Australian Radio Research Board some details are given of the observations on the ionosphere in the investigation of which an automatic effective height-recorder covering the range of frequencies from 2 to 13 Mc/s in 23 minutes was used. The Board’s investigation of the ionosphere and atmosphere revealed the presence of reflected waves.

Brazilian Short Waves

What appears to be one of the largest short-wave stations in the Western Hemisphere is being erected by the R.C.A. Manufacturing Company for the Brazilian Government at Rio de Janeiro. The new 50-kW transmitter will be linked with five directional and three non-directional aerials. Two of the directional arrays will be beamed on Europe, two on the U.S. and one on Asia. The station is scheduled to be ready for operation by next January according to present arrangements.

Training Operators

In order to train men for the Services and the Mercantile Marine the North British Wireless College at 21, West Maitland Street, Edinburgh, has equipped three main telegraph rooms with 71 key points. Each point is fitted for duplex working. Versimilitude to working conditions is given by introducing interference.

B.B.C. Publicity

The B.B.C. recently introduced an innovation by transmitting for the benefit of the European Continental Press a summary of the programmes of the Home, World and European Services for the following twenty-four or forty-eight hours. It is radiated at 14.45 BST on 373 1. 4749, 25, 38 and 25, 29 metres.

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**NEWS IN ENGLISH FROM ABROAD**

**REGULAR SHORT-WAVE TRANSMISSIONS**

<table>
<thead>
<tr>
<th>Country : Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>America</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WXH (Bound Brook)</td>
<td>17.78</td>
<td>16.67</td>
<td>4:01, 6:00</td>
</tr>
<tr>
<td>WQRS (Milfia)</td>
<td>9.670</td>
<td>7.32</td>
<td>11:45, 12:15</td>
</tr>
<tr>
<td>WCRB (Philadelphia)</td>
<td>15.270</td>
<td>13:05</td>
<td>12:30 a.m., 14:45</td>
</tr>
<tr>
<td>WUBX (Wayne)</td>
<td>9.650</td>
<td>7.30</td>
<td>8:30, 11:45</td>
</tr>
<tr>
<td>WCX</td>
<td>11.830</td>
<td>25.30</td>
<td>7:30</td>
</tr>
<tr>
<td>WCBX</td>
<td>17.830</td>
<td>18.63</td>
<td>2:01, 3:00, 4:01, 4:15, 5:01, 5:30</td>
</tr>
<tr>
<td>WGEDO (Schenectady)</td>
<td>9.330</td>
<td>31.48</td>
<td>8:30, 1:45</td>
</tr>
<tr>
<td>WGEA (Schenectady)</td>
<td>15.330</td>
<td>10.27</td>
<td>1:00, 2:00, 6:00, 7:45</td>
</tr>
<tr>
<td>WPIT (Pittsburgh)</td>
<td>16.210</td>
<td>19.72</td>
<td>6:00</td>
</tr>
<tr>
<td>WRUL (Boston)</td>
<td>11.790</td>
<td>25.45</td>
<td>8:15, 9:30, 9:30 护</td>
</tr>
<tr>
<td>WRUL</td>
<td>15.330</td>
<td>19.55</td>
<td>8:15, 9:30, 9:30 护</td>
</tr>
<tr>
<td><strong>Australia</strong></td>
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<td></td>
<td></td>
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<tr>
<td>VLO (Sydney)</td>
<td>9.615</td>
<td>31.20</td>
<td>8:0 a.m., 8:00</td>
</tr>
<tr>
<td>VLG5</td>
<td>9.680</td>
<td>30.99</td>
<td>1:30, 4:30, 8:15, 10:30</td>
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<tr>
<td>VLG8</td>
<td>11.870</td>
<td>25.57</td>
<td>8:0 a.m., 2:40, 6:50</td>
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<tr>
<td>VLG7</td>
<td>11.880</td>
<td>25.55</td>
<td>2:15, 8:0, 11:00</td>
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<tr>
<td>VLG8</td>
<td>17.800</td>
<td>10.95</td>
<td>7:0 a.m.</td>
</tr>
<tr>
<td><strong>China</strong></td>
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<td></td>
<td></td>
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<tr>
<td>XBC3 (Changking)</td>
<td>7.908</td>
<td>30.86</td>
<td>11:30 a.m., 12:10, 9:30, 10:30</td>
</tr>
<tr>
<td><strong>Egypt</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SUX (Cairo)</td>
<td>7.690</td>
<td>38.14</td>
<td>6:00, 10:10</td>
</tr>
<tr>
<td><strong>Finland</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>OFD (Lahti)</td>
<td>9.390</td>
<td>31.58</td>
<td>12:15 a.m., 7:15, 10:15</td>
</tr>
<tr>
<td>OFE</td>
<td>11.780</td>
<td>25.47</td>
<td>12:15 a.m., 8:40 a.m., 7:15, 10:15</td>
</tr>
<tr>
<td>OIR</td>
<td>18.190</td>
<td>19.75</td>
<td>12:15 a.m., 7:15, 10:15</td>
</tr>
<tr>
<td><strong>French Equatorial Africa</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazzaville</td>
<td>11.970</td>
<td>25.06</td>
<td>8:45</td>
</tr>
<tr>
<td><strong>Greece</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athens</td>
<td>7.675</td>
<td>42.40</td>
<td>8:45</td>
</tr>
<tr>
<td>Athens</td>
<td>9.050</td>
<td>30.95</td>
<td>8:45</td>
</tr>
<tr>
<td><strong>India</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VUD3 (Delhi)</td>
<td>9.260</td>
<td>31.28</td>
<td>1:30, 4:50</td>
</tr>
<tr>
<td>VUD4</td>
<td>11.630</td>
<td>25.30</td>
<td>9:0 a.m., 1:30, 4:50, 9:15</td>
</tr>
<tr>
<td>VUD5</td>
<td>10.290</td>
<td>19.02</td>
<td>9:0 a.m.</td>
</tr>
<tr>
<td><strong>Iran</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQS (Tehran)</td>
<td>6.155</td>
<td>48.74</td>
<td>7:30</td>
</tr>
<tr>
<td><strong>Japan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JLG3 (Tokio)</td>
<td>9.235</td>
<td>31.57</td>
<td>10:30</td>
</tr>
<tr>
<td>JZI</td>
<td>9.535</td>
<td>31.40</td>
<td>6:00</td>
</tr>
<tr>
<td>JZI</td>
<td>11.800</td>
<td>25.42</td>
<td>6:00</td>
</tr>
</tbody>
</table>

It should be noted that the times are one hour only ahead of GMT, and are a.m. unless otherwise stated. The times of the transmission of news in English in the B.B.C. Short-wave Service are given on the preceding pages.

* Saturdays only.  † Saturdays excepted.  ‡ Sundays only.  § Sundays excepted.

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**MAY, 1941.**
Economy in Receiver Maintenance

By "SERVICE"

IT is in the power of most service engineers to carry out quite a number of legitimate modifications to sets they are repairing which will help the National economy effort considerably. Some of them will be enforced by circumstances beyond our control, but wherever possible the aim should be to conserve material and to prevent the return of faulty material to the manufacturer whenever it is possible for the components to be repaired locally. Manufacturers are having a hard time in maintaining their service of spare parts and technical information due, not only to lack of parts, shortage of valves, etc., but also to severe depletion of staff.

Government work is making a greater and greater demand upon the manufacturing facilities of radio factories, and it will be left to service engineers who are outside the field of military activities because of medical or age considerations to carry on maintenance work to the best of their ability.

In normal circumstances it would generally be cheaper to replace a faulty coil than to repair the winding, but under present wartime conditions the fitting of a replacement coil, even if one were obtainable, is not always justified.

Transformers are another type of component which it is now desirable to have rewound, rather than that they should be scrapped and replaced.

There are many firms which are open to take on this specialised work, and faulty transformers of all types should be sent away for rewinding; in any case it is quite likely that the manufacturers will be able to fulfil orders for transformers for replacement.

Multiple condenser blocks must not be returned just because one of the sections becomes faulty. The defective section should be isolated, and a new component of suitable value and type wired into the circuit in its place. Several manufacturers are advocating this policy themselves, and provide suitable clamps which enable single tubular condensers of the centre-hole fixing type to be fixed to the inside of the cabinet. With such a modification it must not be forgotten that a connection must be made not only from the positive terminal of the condenser to the HT positive point in the circuit, but there must also be provided a connection between the case of the condenser and the chassis, or negative part of the circuit.

Lowered Standards

The effect which may be noticeable with this modification brings us to another important question concerning the standard demanded from a receiver under present difficult conditions. Fixing an external smoothing condenser with its long leads may slightly increase hum, but if there is no simple way of overcoming this trouble the conditions must be accepted by the owner of the receiver.

A similar position will undoubtedly be necessary concerning valves. Supplies of these important accessories are bound to become very scarce and owners of receivers will have to tolerate loss of sensitivity by using valves far past the point in their lives at which they would normally be replaced. If RF or IF valves lose their emission to an extent which prevents full amplification on distant stations but enables the B.B.C. transmissions to be obtained well, the owner of the receiver must put up with this state of affairs and continue to use the valves until the very last amount of service has been obtained from them.

Quality of reproduction is a little more difficult to deal with and low-emission AF or output valves can destroy the enjoyment of listening to a good symphony concert, but where only slight loss of quality is noticed this should be tolerated, especially, as is so often the case, the transmissions themselves are hardly up to pre-war standard.

In many instances certain types of valves, especially the older ones, will be unobtainable but the service engineer who has retained his Wireless World valve data issue will be able to select suitable modern equivalents to use in place of them, even if it means changing the older type 5-pin valve.

MAY, 1941.
Economy in Receiver Maintenance—saving for victory and working for victory. The service engineer will be playing his part by economising for victory.

Short-wave Conditions

With reference to the article under the heading of "Short-wave Receiving Conditions" in the January issue of The Wireless World just to hand, we can confirm the Dellinginer fade-out for November 15 of last year. At the time we were taking the B.B.C. News Service via GSI/V at 0830, and our log shows that the fade-out occurred precisely at 0835 GMT on all Northern signals. The signal which at 0830 gave us a noise level of -25 db. disappeared altogether in five minutes, but there was a slight reappearance of the GSV signal at 0835, and signals were normal on all bands before 0930.

R. MORRIS,
Engineer-in-Charge, Panorama Receiving Station, South African Broadcasting Corporation.

The Future of Amateur Radio

I have read the recent articles and correspondence in your journal on the subject of the future of amateur radio and have also looked up the article in the T. & R. Bulletin of the R.S.G.B. referred to in your April editorial, and would like, if I may, to add some comments of my own, as one whose interest in amateur transmission—despite a G3 licence—extends back over fifteen years or so.

The main point at issue seems to be the question of the organisation of amateur transmission after this war, and in particular of how contact with the G.P.O. on the subject of amateur licences shall be established. In this connection your contributor "Navigator" suggests that "a committee, including some pre-war amateurs, be set up and should be given full powers to advise the G.P.O."!

Now let us look at the facts. The R.S.G.B. at the outbreak of war included in its membership well over 80 per cent. of the fully licensed amateur transmitters in this country, and as such could justly claim to represent their interests. This fact, war and still is, fully recognised by the G.P.O., and is no doubt the reason why, on every matter affecting amateur licences, the R.S.G.B. has been, and is being, consulted by the Post Office. As your editorial points out, there will almost certainly be a big increase of interest in amateur radio transmission after the war, and, consequently, the need of a body to represent amateur transmitters as a whole will be greater than ever.

In the light of the facts mentioned above, what better organisation could there be for this purpose, than the R.S.G.B., with its record of hard work...
Wireless World

Letters to the Editor—
on behalf of amateur interests—and hard work it has been, particularly at
the recent Radiotelephone Conferences, where every effort has been
made in the past by commercial
interests and others to cripple or very
gravely restrict amateur transmission.
The fact that the war has not inter-
f ered with the steady growth in mem-
bership of the Society, particularly
amongst members of the Forces, is ob-
viously an added point in its favour.
This being so, it is difficult to see
what could be gained from " Navi-
gator's " rather airy suggestions of " a
committee with full powers to ad-
vise," when such a body already exists
and is functioning very efficiently. As
" Navigator " is a member of the
R.S.G.B. he must be aware of this,
and one is led to the conclusion that
the omission from his article of all
reference to that body is merely an ex-
pression of some personal grievance.
That you, Sir, were in honour bound to support your contributor I
have no doubt, but the suggestion in
your April editorial of the R.S.G.B.
losing the confidence of its members
and the reference to " a sole exclusive
heaven " must appear to most mem-
bers of the Society as so much plain
nonsense, and are particularly regret-
table in a journal of the standing of
The Wireless World, which rendered
yeoman service to the R.S.G.B. and
the amateur transmitting movement
fifteen or twenty years ago. No one
would wish to discredit the ideas of any
contributor to your journal merely be-
cause they did not coincide with one's
own or with R.S.G.B. views, but when a
contributor makes a suggestion which, if carried out, would override
completely the one organisation which
has done so much for the amateur
transmitter in this country, and which
to my own knowledge has the support
of its members as never before, despite
the cessation of all amateur transmis-
sion, then it is time to point out to
him the error of his ways.
E. H. Jones (G5CJ).

Bolton, Lancs.

I SHOULD like to offer my con-
gratulations on the Editorial in the
April issue of The Wireless World.
The remarks made cover quite ade-
quately the very silly opinions ex-
pressed in the T. & R. Bulletins, and I
hope that the R.S.G.B. will see the un-
representative nature of the matter
they saw fit to print.
Another point the R.S.G.B. seem,
rather foolishly, to try continually to
make, concerns new transmitters.
There has been for some years a con-
tinual moan from the pages of the
T. & R. Bulletin of the inadequacy of
the amateur bands and the increasing
difficulties in operation. Yet, in spite
of those objections, their policy seems
to be to go out of their way to per-
suade anyone to become an R.S.G.B.
member and get a transmitting licence.
By all means encourage people who
have a mild interest, but why try to
make one's own and one's friends' ex-
periments more difficult and less suc-
cessful than they need be?
In conclusion I will wish The Wire-
less World continued success and the
maintenance of a very sound judgment that has always correctly interpreted
the feelings of the radio public.
W. Crossland
(G5CI; Mem. R.S.G.B.).

Whitstable, Kent.

Book Review
The Meter at Work. By John F.
Rider. Pp. 152; 138 diagrams and
illustrations. John F. Rider Pub-
lisher, Inc., 404, Fourth Avenue,
New York City, U.S.A. Price (in
U.S.A.) $1.25.

This is a frankly elementary book
evidently intended to meet that
curiosity about measuring instruments
that shows itself early and keenly in
the careers of all normal students of
radio. It provides a general survey
of the principles of basic meters, and
may well form a preliminary to their
more detailed and mathematical
study. Moving-coil, moving-iron,
electrostatic, dynamometer, and other
types are dealt with : composite mea-
suring devices, such as valve-volt-
meters, etc., incorporating basic
meters, are rightly considered outside
the scope of the book. What each
basic type measures and how it does
so is clearly explained ; the differences
between meters and their suitability
for special sorts of measurements are
discussed so that the reader should
have no difficulty in choosing the
correct circuits for particular sorts
of work ; their mechanical construction
is well described ; illustrations greatly
assist the text in all cases. Sufficient
mathematical considerations are con-
venient for enabling the student to un-
stand and design voltage multipliers
and current shunts and to comprehend
the action of rectifier instruments.
The construction of the book itself is
interesting in that it is transversely
divided into entirely separate upper
and lower portions : the upper part
contains all the illustrations, which
may thus be found and studied with-
out turning pages back and forth in
the text to do so.—W. H. C.

The "Fluxite Quins" at work

See that FLUXITE is always by you—
in the house—garage—workshop—
whenever speedy soldering is needed.
Used for 30 years in Government
works and by leading engineers and
manufacturers. Of Ironmongers—in
tins. 4d., 8d., 1/4 and 2/6.

Ask to see the FLUXITE SMALL-
SPACE SOLDERING SET—compact
but substantial—complete with full
instructions, 7/6.

Write for Free Book on the art of
"soft "soldering and ask for Leaflet
on CASE-HARDENING STEEL and
TEMPERING TOOLS with FLUXITE.

TO CYCLISTS! Your wheels will
NOT keep round and true unless the
spokes are tied with fluxite wire at the
crossings AND SOLDERED. This makes
a much stronger wheel. It's simple—with
FLUXITE—but IMPORTANT.

THE FLUXITE GUN
is always ready to put Fluxite on the
soldering job instantly. A little
pressure places the right quantity on
the right spot and one charging lasts
for ages. Price 1/6, or filled 2/6.

FLUXITE LTD.
(Dept. W.W.),
BERMONDSEY
STREET, S.E.I.

ALL MECHANICS WILL HAVE

FLUXITE
IT SIMPLIFIES ALL SOLDERING

MAY, 1941.
The Earliest Amateur

By FREE GRID

A similar manner from one of the young Ruhmkorfs, and I managed to send messages successfully from one dormitory to another until I was discovered by a prowling master, and the apparatus confiscated. Barring Hertz himself, I think, therefore, that I may fairly claim to have been the earliest transmitter, and since he was obviously a professional, it leaves me without dispute as the earliest amateur.

A Legal Loophole

It has been said by somebody that no Act of Parliament has ever been drafted so skillfully that it was not possible to drive a coach and four through its provisions. Although I am no believer in wisecracks and smart sayings of this or any other kind, I must confess that I have never had any fault to find with this particular one, as it always seemed to me to be so manifestly true. For the most part, indeed, Acts of Parliament seem to be drafted by a congenital idiot, as the majority of them are so painfully easy to evade that there is little or no call for the exercise of ingenuity in so doing.

I must admit, however, that I thought I had found a great exception in the case of the Regulations forbidding car radio, which, as you know, prohibits the transport of a wireless set of any type in any sort of road vehicle. There seemed to be no loophole in the Regulations whatever, as even perambulators and wheelbarrows were, I found, on consulting the proper authorities, road vehicles within the meaning of the Act.

It is true that there appears to be nothing to stop the transport of wireless by a water vehicle, but discovery of this fact will be of precious little use to me until I take up my residence in Venice as part of the army of occupation after the war, and can persuade the local Romes and Juliets to bring themselves up to date, and at the same time to save themselves embarrassment by jettisoning the traditional singing gondolier in favour of a wireless set churning out appropriate hot music.

I was about to give up in despair and confess myself beaten by the law for the first time in my life when suddenly a solution of the problem came to me. Actually the idea came to me through my being called into consultation by the committee of a well-known hunt who are proposing to bring themselves up to date by going in for wholesale mechanisation, the old-fashioned horses being substituted by a fleet of light tanks.

As a result of this mechanism project the horses were being disposed of for a mere song, and I was able to equip each member of my family with a thoroughlyrated at a knock-out price, thus solving the petrol rationing problem. It was, however, not until I had got the horses actually on the road that I realised that these animals were not vehicles within the meaning of the Act, and I kicked myself for not having thought of it before, or, to be more precise, one of my purchases did the kicking for me when I rather carelessly strayed into its zone of fire.

Since the horse is shod with metal there is no difficulty about an earth connection, as at least one leg of a horse is always in contact with the ground, except, as I subsequently found, when galloping, this little discovery incidentally solving an old controversy which raged in racing circles a few years ago. My greatest discovery in the case of horse radio was, however, the fact that by simply connecting the aerial lead to the bit the whole of the horse could be used as a capacity aerial, since excellent contact is made via the bit to its salivary glands and so to its whole body.

F.G.T.

The decision to continue to refer to BST when double summer time comes into force on May 4th is in the best traditions of official muddledom. Surely it would avoid all confusion, as well as being a fitting tribute to myself, the original suggester of it, if it were called F.G.T.
Wide-Range Tuning Indicator

Improving the “Magic Eye”

Tunin9 indicators of the cathode-ray type are generally more sensitive to voltages well within the operating range than to extreme voltages. Thus, if such a device is adjusted to indicate resonance accurately on a carrier of average strength, it will not do so when the received carrier is abnormally strong or weak. A circuit arrangement for an indicator free from this defect, and possessing the same high sensitivity for both average and abnormal signals, has recently been devised by the R.C.A.

Fig. 1—How the intensity range of a cathode-ray tuning indicator may be widened by introducing a time-delay circuit.

laboratories, and is shown in very simple form in Fig. 1. The principle of operation, referring to this figure, is as follows:—

The voltage to be indicated is impressed upon the grid of the valve shown, and also, through a suitable time-delay network, upon its cathode. If the impressed voltage swings to an abnormal value, say, highly negative, the grid potential may swing outside the straight portion of the characteristic, and the valve may become effectively inoperative. However, after a certain time interval determined by the values of resistor R and condenser C, this abnormal potential difference between grid and cathode disappears. Thus, the valve comes under effective control again.

Fig. 2 illustrates the application of the principle to a radio receiver, in which a diode rectifier develops a signal across resistor R1. The time constant of the resistance-capacity circuit R2, C1 feeding the cathode is appreciably greater than that of the circuit R3, C2 feeding the grid, thus providing the necessary delay. The indicator valve may be a 6E5, which has a rod control electrode A between the cathode K and luminescent target T, this rod being supported by the anode and electrically connected to it, the tuning being indicated in the well-known way by contraction of the shadow thrown by the rod on the target.

When a signal of abnormal strength is received the target shadow closes up and becomes unresponsive to adjustment of the tuning condenser; however, after the delay interval determined by the resistance and capacity values in the circuits R2, Cr and R3, C2 respectively, the valve returns to normal operating conditions and tuning can once more be performed by the visual indication of the shadow.

As usually connected, the 6E5 is unresponsive to signals more negative than —9 volts on the grid; with the circuit of Fig. 2 it can be arranged to respond to swings as great as —220 volts.

Another possible arrangement comprises separate rectifiers for grid and cathode circuits. The same principle of differential delay is utilised, but preferably the long time-constant circuit connected with the cathode operates with a delay bias so that for signals of less than a certain amplitude only one rectifier is operative.

The voltage to be indicated is impressed upon the grid of the valve shown, and also, through a suitable time-delay network, upon its cathode.

If the impressed voltage swings to an abnormal value, say, highly negative, the grid potential may swing outside the straight portion of the characteristic, and the valve may become effectively inoperative. However, after a certain time interval determined by the values of resistor R and condenser C, this abnormal potential difference between grid and cathode disappears. Thus, the valve comes under effective control again.

The application of the arrangement described is not confined to the tuning indicator of a broadcast receiver. The “magic eye” is coming into increasing use as an inexpensive and robust indicator for measuring devices of various kinds, and in many of these a widening of the useful range would be a distinct advantage.

MAY, 1941.
RANDOM RADIATIONS

Standard Sets?

Under the Government’s latest scheme for ensuring that every man, woman or factory is playing his, her or its full part in the national effort, it doesn’t seem unlikely that there may have to be some closing of the ranks in the wireless industry. It’s far more economical to keep the whole of one factory working whole-time than to produce the same output from a few shops of three or four factories, some of them, maybe, working only part-time. The wireless industry has been having, and is still having, a difficult time. Men have been called-up, girls have gone to the “Wafas,” the “Wrens” or the “Ats,” or into munition works. In some cases it has been necessary to call on wireless factories to concentrate their energies on making apparatus urgently required by the Fighting Forces rather than on receivers for the home. It would probably be an advantage to all concerned if a little carefully planned sorting out were done, some factories being earmarked entirely for Government work and others entirely for the supply of what Mr. and Mrs. Everybody need. If this is done we shall almost certainly see some sets marketed “for the duration” as the joint product of two or three—even more—well-known firms. We may even see the standard set.

No Bad Idea

Whatever we may think of the standard set as a peacetime product (and there’s a good deal to be said for it as such) we can’t be in two minds about its utility and general desirability in wartime. After all, we can put up with the lack of frills in our wartime receivers. What is chiefly needed is something robust and reliable that will bring in entertainment and news from the home stations with reasonable volume and tolerable quality. What kind of set? Well, probably a 4-valve AC/DC superhet. (battery model as well, naturally) with an output of 2-3 watts. If this is done we shall certainly see some sets marketed “for the duration” as the joint product of two or three—or even more—well-known firms. We may even see the standard set.

By “DIALLIST”

Valve Replacements

How many different types of even British valves there are to-day I don’t know. In pre-war years I used to tot them up—and was generally pretty staggered by the increase over the total twelve months previously. Since the war began I’ve been too busily occupied to have much time for such things, but the number of present valve types, if not legion, is getting on that way. Certainly there are far more than are genuinely necessary. The authorities have had to do something to curtail the waste of effort called for by the production of such a galaxy, with the result that some kinds are now very difficult to obtain. The adoption of a standard receiver equipped with four standard valves would obviously do much to ease the position. Were they free to turn their energies, so far as these are concerned with civilian needs, mainly on to the production of four widely used types, valve-makers could supply all our requirements and still have ample workers and machinery to deal with the demands of the fighting and other Services.

Makshifts

You may, by the way, find (or have found already, to your sorrow) that when certain valves in your receiver go the way that all valves eventually go, replacements are all but—if not entirely—unobtainable. When this occurs there are two alternatives. The first (which won’t commend itself to you) is to raise despairing hands and to lament that the set will be of no further use till peace returns; the second (which will) is to discover which available valve can be pressed into service as a substitute for the late lamented. A careful study of The Wireless World valve list will often reveal that there is something else of another make whose characteristics are not so very different from those that you want. If they are so near as makes no matter the same, but belong to a valve with a different kind of base, the old socket can be removed and a new one to suit the substitute valve installed in its place. Should there be some important difference in one or other of the characteristics, certain alterations—probably of the minor kind—in the circuit may be needed in order to fit in with them. There are two points. The worn-out and irreplaceable valve must be of a very special kind used in a very special circuit if you can’t find something.
that will carry on with the job when comparatively trifling modifications have been made.

Worth Noting

Sometimes if the valve for which no spare can be obtained is of the "compound" type the circuit arrangement may be modified to enable the work to be done by two valves of simpler kinds. A complicated multi-electrode frequency-changer may be replaced, after the exercise of some ingenuity, by two separate valves acting as oscillator and first detector respectively. Similar expedients may enable single "portmanteau" valves to be replaced by pairs of similar type in other parts of the set. Again, one "stage" of a receiver—an RF stage, for instance—may be cut out altogether, should stern necessity dictate, and still leave the set perfectly capable of bringing in the Home or Forces programmes satisfactorily. There are heaps of ways in which the apparently insurmountable difficulty presented by the impossibility of obtaining valves of particular kinds may be surmounted. Keen wireless men will probably welcome opportunities of pitting their brains against such difficulties.

A Big Change

As I write the U.S.A. medium-wave stations have just completed their sweeping wavelength change. As announced in last month's Wireless World, no fewer than 795 of them out of 883 were due to do so. The change is the result of a big "clearing up of the ether" on the other side of the Atlantic, where reception conditions had become in many places even worse than they were over here before the U.I.R. brought out its succession of wavelength plans. The problem in North America is a knotty one. Both the United States and Canada are huge countries with great sparsely populated tracts between big towns. High power and a large number of stations are needed if any but the most local of services is to be provided. And high-powered stations can often make themselves heard in no uncertain way at great distances. The South American countries, Mexico in particular, added to the difficulties of the problem. It is hoped, however, that the new scheme, with its provision for the use of directional aerials where necessary and for the limitation of the output power of certain stations between certain hours, will do a great deal towards improving reception.

MAY, 1941.
RECENT INVENTIONS
A Monthly Selection of the More Interesting Radio Developments

WIRELESS NAVIGATION

The figure shows a DF receiver particularly designed for "homing" on to a short-wave transmitter. The signals are received on two mutually perpendicular aerials A, A1 and B, B1 (which may be replaced by a pair of Adcock dipoles) with an additional "vertical" aerial V for sense-determination. The pick-up from the aerial B, B1 is fed to the receiver R after being modulated at M with a low-frequency note which serves to distinguish say the fore-and-aft line from a short-wave transmitter. The pick-up from the aerial A, A1 is periodically reversed before reaching the receiver by a switch S, which is worked synchronously with a switch S1 between the receiver and an indicator J to show when the pilot is on or off his course. If the switches S and S1 are operated in pairs, it is found that, particularly when automatic volume control is used, the receiver tends to respond more strongly to the dots than to the dashes, and thus gives an off-course indication which is more pronounced to one side than the other. The reason for this unbalanced response is due in part to the different lengths, i.e., time-duration, of the two signals, and in part to the curvature of the valve characteristic.

To offset it, the receiver is provided with a shunt circuit, including a crystal or similar device, which is arranged so as to attenuate the positive pulses (derived from the dot signals) without affecting the negative pulses produced by the dash signals. This arrangement is thus balanced so as to give equal deflections for equal deviations off-course either to port or starboard.


SHOR-T-WAVE AERIALS

The top of the supporting mast of a television or other short-wave aerial is fitted with a metal cap which is bored so that it can be readily dismantled for packing and transport. The usual dipole is mounted at one end of the cross-bar and a reflector at the other.


CATHODE-RAY TUBES

The electrostatic deflecting plates of a cathode-ray tube are usually arranged in two pairs, which are set at right-angles to each other, and one behind the other, along the length of the electron stream. This makes the length of the tube greater than it otherwise need be, and also presents certain other disadvantages.

Accordingly it is now proposed to combine the four plates into a single unit in the shape of an open-ended box B, which occupies less space longitudinally, and also ensures that both pairs of plates act at the same point along the length of the stream. This, in turn, helps to reduce the width of the stream, and serves to maintain equal deflection sensitivity.

C.-R. tube with combined deflecting plates.

The sides of the box are made of a semi-conducting material, such as a ceramic base impregnated with graphite. A conducting strip is inset along each corner of the box, to which the deflecting voltages are applied at A and A1. The arrangement is stated to prevent "fringing," or defocusing of the electron stream.


MAY, 1941.
### Wireless World

#### ELECTRADIX RADIOS

**L.T. Battery-operated Home-made VIBRATOR KITS**

To obtain H.T. successfully. Supersede H.T. Batteries. The Vibrator converts D.C. to A.C. by vibrating uniformly. Any voltage up to 100 watts obtained by transformers and rectified for radio H.T.

American Vibrators totally enclosed, slightly dented covers. 4-pin non-sync. Low price.

**Price** Post free 12/-

**CHARGE METERS.** Weston Model 354. Central zero to 15 amps, pol. mag. dead beat. Flush panel, 2pin. dial.

**Price** 9/6

**AUTOMATIC CIRCUIT BREAKERS**

**SINGLE POLE, HEAVY IRON CASE 250/400 Volts**

Illustration shows S.P. with cover-removed

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**TRIPLE POLE, 3 TRIPS Light Iron Case 300/500 Volt**

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**TRIPLE POLE, 3 TRIPS Heavy Iron Case 300/500 Volt**

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**2-AMP. THERMO TIME-LAG CIRCUIT BREAKERS**

**A SPECIAL DESIGN IN AUTO-SWITCHES**

with time-lag, tripping on 2 to 3 amps. Safety thermo switch with long-break auto overload trip. For back of panel with front indicating knob, compact, 4in. x 2in. x 3in. deep. Any voltage up to 1,000 v. (as illus.)

**Worth a Guinea.**

**Only 5/6**

**THE ROLLS-ROYCE OF BUZZERS**


**Price** 10/-

**INDEPENDENT POWER**

300 watt Petrol Electric Set, 100 volts, 50/60 cycles, 3 amps. and 30 volts 10 amps. D.C. Portable, lightweight, with switchboard.

**Price** £32

**PETROL ELECTRIC GENERATING SETS**

For Lighting and Charging


**Price** £17 10s.

**ANOTHER RELAY FOR RADIO WORK**

A 2 m.a. Table Relay. Compact vertical type, enclosed. Screened 500 or 2,000 ohm coils. Platinum contacts. Single pole change over on 2 m.a. ½ amp. contacts. Wood base. Metal Case. Size 2½in. diam. 3½in. high. Price only 10/-

**REDUCTION GEARED A.C. MICRO MOTORS**

Final shaft speed 60 r.p.m. Reversible, with 2-pole make switch. Squirrel cage rotor self-starting with dog clutch. For L.T. 12 to 25 volts or on mains with lamp res. Made for radio tuning drive, useful for models, record chart drums, time switching and many other purposes. High torque. Synchronisation and precision made, 25½. Precision made and new, 7½.

**SPEAKER BARGAINS**

**MOVING COIL SPEAKERS.** Mains energised, 6in. to 9in. All good makers, 6in. cone, 7½. Few with damaged cones, 5½. **B.T.H. & Celestion O.K.** 12½. Few damaged cones 7½.

**A.C. MAINS SPEAKERS.** Jensen with rectifier for 230 volts, 7½in. cone and transformer. 25½.

**PERMANENT MAGNET SPEAKERS**


**BATTERY ENERGISED M.C. SPEAKERS**

Kolster-Brandes 4 to 6 volts, 8in. cone - 8½. A few Reed Cone Speakers - 7½.

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**"NITNDAY" Metal Rectifiers—Steel Chassis**

Model N/A 2½, Radio Home Charger. To charge 2 volts ½ amp.

Model N/A 6½, Trickle Charger. To charge 6 volts ½ amp. Model N/B 6½/1, Car Charger. To charge 6 volts 1 amp.

Model N/B 8½/1, Car Charger. To charge 8 volts 1½ amps.

Model N/C 6½, Car Charger. To charge 6 volts 2 amps.

Model N/D 12½/1, H.M. Car Charger. To charge 12 volts 1 amp.

Model N/D 12½/2, N.K. Car Charger. To charge 12 volts 2 amps.

Model N/E 2, Doubling Car Charger. To charge 6 volts and 12 volts 2 amps.

ALL MODELS FOR A.C. 200/250 VOLTS INPUT.

5½ EMERGENCY PARCELS, useful stand-by electrical and radio repair material and apparatus, 10 lbs. for 7½, or 7 lbs. 5½.

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Magnet model; exceptional bargain; limited number. with beautifully finished cabinet in polished walnut.


Loudspeakers.


WANTED.


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A. Bakers Selhurst Radio, 75, Sussex Rd., South Croydon. [9519]

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Magnet model; exceptional bargain; limited number. with beautifully finished cabinet in polished walnut.


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EX R.A.F. GLASS ACCUMULATOR TANKS, new and used, 4/6 each.

EX R.A.F. Switch Panel, with case (new), fitted 8 small knurled switches, leads, cords and clips, complete in wood cabinet, 2/6 each post 6d. per panel.

HIGH-VOLTAGE TRANSFORMERS, useful for test work or for 2000 volt 250 amp. and 7000 volt 7 amp.; 1st class 20/-.

VOLTAGE TRANSFORMERS (Auto Wound), 100/101 to 200/101 v. or vice versa, fully guaranteed 20/-.

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DENG-OUT LAMPS, Ex R.A.F. high tension lamps, complete with 15 volt bulb (any bulb can be fitted), new, 1st class 2/6.

DENG-OUT LAMPS, Ex R.A.F. portable type, or can be bracket fitted, glue down, three colour fittings, white, red and blue. New, 2/6 each.

MINIATURE TRANSFORMERS, complete with 250 volt 50 m/a. D.C., output 700 volts at 5 m/a. D.C. complete (in new condition).

ROTARY CONVERTOR, 250 volt input, 12 volt output 350 volts, 50 m/a. D.C. 250 volt input, 12 volt output, 3500 volts at 5 m/a. D.C., input 220 volts A.C., output 12 volts 10 m/a. D.C.

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PLESSEY 4-watt Valve Coils, with switch, unboxed, guaranteed pre-war made, 2/- each, 5000 coils; 2/6, 21/6 and 72/6 each. 50000 coils; 7/6, 16/6 and 35/- each. 100000 coil sets; 10/6, 20/- and 25/6 each.

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TENTS, Camping, etc.

Low Prices, 50/-, 75/-, 100/-, 200/- each. Prices subject to change without notice.

CHASSIS Mounting Valve Holders, American Types.

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CELESTION Valve Holders, 5 and 7pin chassis types.

CENTRAL LABOUR CONTROL, Midlands type, 2,000 and 5,000 volt 10 m/a. D.C.

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No overheating with Solon Electric Soldering

Overheated iron need filing and re-touching; a laborious and troublesome job—cut it out by using a SOLON. With Solon Electric Soldering, in 4 minutes, the bit gets to the correct heat and stays there!—but as long as you need it; 15 hrs’ work takes only 1 min. No flame—no dirt. The constant heat, at the point, makes the solder run swiftly; sweat it right into the joint; gives you a strong new job.

Made far following standard voltages: 200-250 volts, 500-700 volts, 1,000-1,500 volts, 2,000-2,500 volts. Brand new for chassis, etc: £3/5.

WARRANTY—All parts are guaranteed under manufacturer’s guarantee for one year from date of purchase.

We also manufacture DC dc rotary transformers, small alternators, small DC motors, etc. Mains transformers up to 10 kva. Petrol electric generator sets up to 50 kva. Battery chargers for private and industrial use, and are fully equipped for general small engineering work.
WIRELESS Technical Instructors Required in Army Units.

EQUIPMENTS,—Day 8/9 per day (7 days a week): fully furnished and equipped accommodation, or if this cannot be provided allowances at authorized rates; if married and otherwise eligible, will allow pay in respect of wife and children, subject to allotment from pay.

CANDIDATES Should Preferably be under 35 and over 24, and

(A) Hold one of the following qualifications:—
Graduate of the Institution of Electrical Engineers.
Final (Grade III) Certificate of City and Guilds of London Institute in Radio Communication.
Higher National Certificate in Electrical Engineering.

B) Be able to pass an examination on the following syllabus:

- Elementary knowledge of valves; simple theory of series and parallel circuit of L and C
- Mutual and self induction and inductance; effect of inductance on growth and delay of current.
- Capacitance; charging and discharging of condensers; through resistance and inductance.
- Alternating currents; vector diagrams; effect of resistance variation; effects of L and G in A.C. circuit, phase difference of current and voltage; resonance in a circuit.
- Principles of radio practice.
- Simple theory of amplification, oscillators, detectors; general principles of radio practice.

SUITABLE Candidates will be interviewed at Local Offices, and, if successful, will be enrolled and appointed Acting Sergeant Tradesman. For those who are on the Reserve of decorated Occupations special arrangements will be made to enable them to be enlisted. In the event of any applicant found to be resident under Settelies of Reserved Occupations a preliminary application will be made for relaxation of the condition. Full particulars can be obtained in this case on payment of 6/6.

APPLICATION Forms may be Obtained by Postcard from the Secretary, Army Service Corps. The War Office (A.G.5), Whitehall, S.W.1.

RADAR ENGINEER, capable taking charge service department, must be exempt (Warrington); 25 per week—Box 2571, c/o The Wireless World.

CAPABLE Radio Engineer, must be exempt; good salary and prospects; state experience, age, qualifications—Davson's Ltd., 59, Bankey St., Warrington. (5/7)

RADAR Service Engineer, exempt military service, required by West End firm; it is necessary tuition given in fault finding on latest sets. Permanent job, good wages—William, 54, Gloucester Rd., S.W.7. (5/03)

The British Broadcasting Corporation.—APPLICATIONS are invited for a limited number of APPOINTMENTS to the UNEMPLOYED STAFF for the duration of the war, in the OVERSEAS AND ENGINEERING INFORMATION DEPARTMENT. COMMENCING Salary will be Dependent on Qualifications and Experience, with annual increments to scale subject to satisfactory service, to a maximum of £400 per annum.

CANDIDATES must be British nationality and, in addition, should have a keen interest in short-wave communication, a knowledge of short-wave transmission and reception, preferably within the British power range, and sufficient theoretical qualifications in radio communication and be capable of dealing with technical correspondents. Successful candidates will be appointed to London in the first instance, but must be prepared to proceed elsewhere if needed. Future permanent employment will be determined by merit and the existence of vacancies. Further details of the conditions of employment in this service will be given to candidates selected for interview.

APPLICATIONS, giving full details of education, qualifications, and experience, should be forwarded to the Engineer, Engineering Information Office, Broadcasting House, London, W.1. Envelopes should be marked O.E.I.D. Applications and testimonials of previous occupants, and from persons who wish to locate their applications acknowledged and to be informed if their applications are successful should enclose two stamped addressed envelopes.

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