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Telephone Vision

Opportunity for Post Office Enterprise

THE Post Office is proverbially progressive and enterprising; there have even been occasions when we have questioned whether their enterprise has not exceeded the bounds permissible to a Government office enjoying monopolistic privileges. No one would, however, dispute the rights of the Post Office to develop and improve the telephone service, and it is in this direction that we suggest that there may be opportunity offered.

In Germany, for some considerable time, an experimental television service combined with the telephone has been successfully operated, and has preceded any attempt at a national television broadcasting service. In cities as far distant as 400 miles telephone booths have been established where, by appointment, friends can converse with one another and see each other at the same time. The cost has been kept at a very reasonable figure, which has encouraged patronage of the service.

To inaugurate similar services between London and large centres such as Manchester and Birmingham, where suitable cables may already be installed, would be an interesting new line of development for the Post Office promising a commercial return for the expenditure involved. It would not, perhaps, be essential in such cases where the subject televised would be large for the highest definition system to be adopted, and this would facilitate the extension of the service over less efficient lines. We imagine that such a service might prove extremely popular here, and it is certain that the publicity which such a step by the Post Office would give to television would encourage the public to take a keener interest in the service of television broadcasting.

B.B.C.

The New Appointment

SIR JOHN REITH'S successor has been appointed and so at last speculation on who would occupy his chair has come to an end. Broadcasting has had little contact with the new Chief, but his mental equipment and experience promise competence in his new sphere.

There are many who think that a Chief should have been found within the B.B.C. organisation and, therefore, more intimately acquainted with the machine which he has to control, but broad experience is no doubt of greater value than detailed knowledge of the broadcasting organisation now that the system is so firmly established. In any case, as we have pointed out previously on this page, the delay in settling the succession almost precluded the possibility of the appointment falling upon an individual within the existing organisation because the delay must inevitably have meant that candidates within the B.B.C. were in competition, each with his own following within Broadcasting House. It must be a great relief to the staff to know that the appointment has been made and that the new Chief has neither friends nor enemies in broadcasting, if only by virtue of having had no broadcasting contacts prior to his appointment.

The new Chief has our sincerest good wishes for success in his new duties, which will exact from him a continuation of that devotion to public service which has already marked his career to its present stage.

Reflection of Wireless Waves

By J. H. PIDDINGTON, M.Sc., B.E.

IT is believed that reflections of waves from levels a few miles above the earth's surface and within the boundaries of its atmosphere are due to irregularly distributed "clouds" or patches, rather than to the presence of a layer. Investigations into this matter are described, and the author concludes that low-level reflection is unimportant in explaining transmission phenomena, though the structure of the higher true ionospheric regions was found to be such that television signals might at times be reflected from them.

A LITTLE more than a year ago Mr. R. A. Watson Watt[1] described in these columns the discovery of ionised layers at heights above the earth from about five to nine miles, which strongly reflected wireless waves. It was suggested that these layers had a reflection coefficient of about 0.7 and that they would be effective in causing fading and unexpectedly long transmission paths of ultra-short-wave signals, as well as multiple images in television pictures within the service area of the television transmitter. (By the "reflection coefficient" of a layer or patch is meant the ratio of the strengths of the signals returned from the layer or patch to its strength if returned from a perfectly reflecting infinite plane surface at the same distance from the transmitter.)

LOW-LEVEL "CLOUDS" AND THEIR EFFECTS

The E and F Layers

It was at once realised by ionospheric physicists that if these highly reflecting strata really did exist, then most of our ideas concerning the propagation of wireless waves to great distances would need radical revision, for since 1926 it has been customary to regard such communication as generally being effected either by way of Region E in the case of long waves, or by way of Region F in the case of the shorter waves. However, an examination of the original communication of Watson Watt and his co-workers[2] in which they present the arguments leading to the conclusions outlined above made two points clear. First, the results themselves shown in the form of photographs of the cathode-ray oscillograph screen were undoubtedly reliable, and of the greatest scientific importance; for, although earlier investigators claimed to have noticed reflections from this low-lying region, the evidence produced did not appear conclusive. Secondly, the interpretation of the results appeared open to considerable doubt, and in the light of further investigations that have been made it is felt that this interpretation must be radically altered.

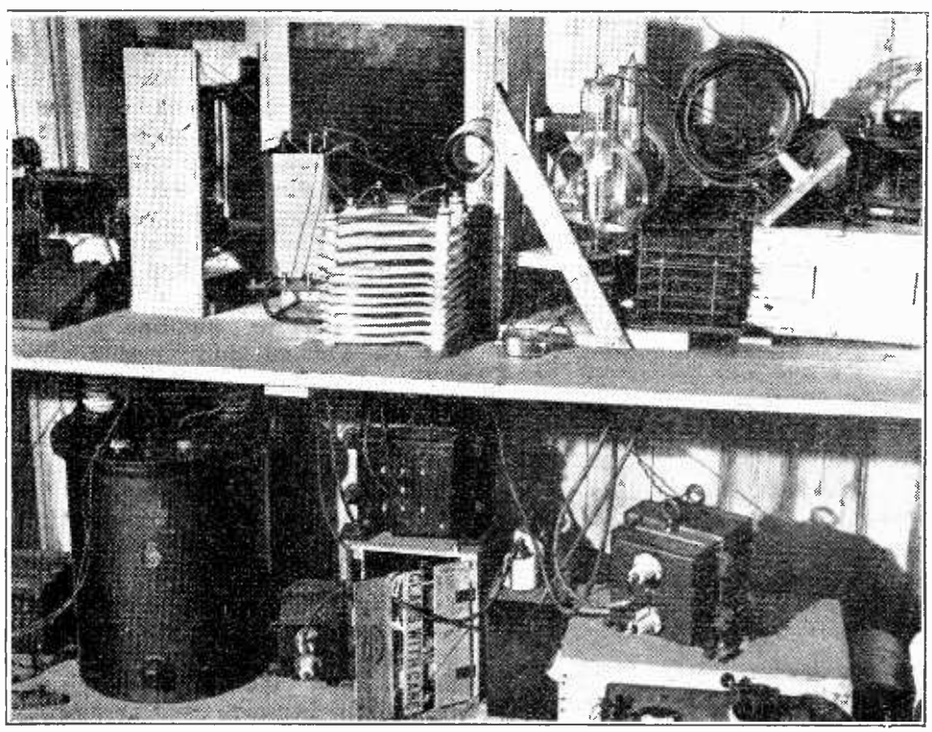
In a recent paper,[3] Professor Appleton and the writer describe the results of an investigation on reflection coefficients of ionospheric regions, during which they paid special attention to these "low-level" reflections. Before discussing the results, however, it might be of some interest to mention the type of apparatus necessary to undertake such an investigation.

The well-known "pulse" method of investigation was used in which very short duration signals are sent out at regular intervals. The wave travels the short distance from the transmitter to the receiver, and is registered by the fast-moving spot of a cathode-ray oscillograph. A little later the wave reflected from the ionosphere arrives and this "echo" also makes its mark. The height of the layer from which reflection takes place is obtained by multiplying half the time delay of the echo by the velocity of the wave. In the case of reflection from a level of five miles, the time delay involved is only about fifty microseconds, and therein lie the experimental difficulties. Since the echo cannot be detected while the powerful direct ray continues to arrive at the receiver, the latter must be completed within fifty microseconds of its starting.

A portion of the transmitter is shown in the accompanying photograph. Below are the power supplies, the high-tension unit giving up to 15,000 volts. On the left is the modulating equipment which supplies a grid bias to the main oscillating valves of −2,000 volts, this high value being required to stop them oscillating quickly at the completion of a pulse.

Generating the Pulses

Methods used for generating the modulating pulses are rather interesting. Electrical methods are the most successful, although some workers have successfully used semi-mechanical methods, one being the use of a switch in the form of a small steel ball swinging between two plates. In the transmitter here described gas-filled triodes were used to generate the pulses. The fast upstroke of the pulse occurs when this type of valve strikes, and the duration of the pulse is determined by the time-



The powerful transmitter used in making radio "soundings" of the atmosphere.

[1] R. A. Watson Watt, *Wireless World*, March 5th, 1937.

[2] R. A. Watson Watt, A. F. Wilkins and E. G. Bowen, *Proc. Roy. Soc.* A. 161, p. 181 (1937).

[3] E. V. Appleton and J. H. Piddington, *Proc. Roy. Soc.* A. 164, p. 467 (1938).

Reflection of Wireless Waves—

constant of a resistance-capacity circuit. When the pulse is due to finish a second valve strikes and forms a short-circuit across the impedance in which the pulse voltage has been developed. The method has been developed by several workers[4] to its present form.

The pulse, which is almost perfectly square-topped, is then amplified suitably and fed to the grid of a 250-watt modulating valve. While the grid of this valve is at the same potential as its cathode it passes a current of $\frac{1}{4}$ amp. which flows through a resistor of about 8,000 ohms and causes a grid bias of $-2{,}000$ volts to be impressed on the main transmitting valves. During the pulse the grid of the modulating valve is at -200 volts, and the valve is non-conducting. There is, therefore, no bias on the oscillators and the transmitter operates.

The oscillators with their associated tuned circuit are to be seen on the right of the photograph. The oscillatory circuit is heavily damped and feeds a half-wave horizontal dipole by means of a matched feeder. The power supplied to the oscillators during the pulse was 8 kilowatts, although they were actually rated at 250 watts; the power delivered to the aerial was about $2\frac{1}{2}$ kilowatts and the pulse lasted 20 microseconds.

It is inevitable that a pulse in passing through a receiver must have its duration increased, but this effect is decreased if the band-pass characteristic of the receiver is made wider. The receiver used had an overall band width of 66 kilocycles per second, and even this resulted in a lengthening of the pulses from 20 to 50 microseconds, which was, however, tolerable.

Distinguishing Weak Echoes

The above apparatus was calibrated to determine the weakest reflections it would be capable of "seeing." This calibration depends on the power of the transmitter, and sensitivity and noise level of the receiver. Obviously if a given receiver is used with two transmitters the combination which can "see" the weakest reflecting layers is that where the more powerful transmitter is employed. The calibration is simply done by observing the first and second reflections from the F region and noting the weakest echo which is distinguishable above the noise level. This gave sufficient data to show that a layer at a height of six miles, with a reflection coefficient of 0.0001, would give an echo capable of detection. No such echoes were observed in a period of three months, from which it was concluded that the reflections, if any, from this region correspond to reflection coefficients of less than one in ten thousand.

Since the experimental results obtained by Watson Watt and his co-workers appeared to indicate conclusively the presence of some reflecting agency at distances of the order of six miles from the transmitter, further efforts were made to obtain reflections. By the courtesy of Mr. Watson Watt the receiver mentioned above was used in conjunction with the very powerful transmitter used in the original investigations and reflections were obtained. The coefficient of reflection was found under normal conditions to be between 0.00002 and 0.00007, and it is believed that the reflecting agency is not in the form of a layer at all, but occurs rather as irregularly distributed patches or blobs. Signals returned from these low levels are designated as "B region" echoes, this nomenclature being adopted in order that the reflections (also very weak) which Watson Watt, Wilkins and Bowen, as well as other workers, have obtained from heights of about 30 miles may be classed as C region echoes. The D region may then be thought of as between about 37 miles and 56 miles, although its properties and composition have yet to be determined. A further upward trend leads us to the E, or Kennely-Heaviside, region, which is too well-known to need further reference at present, although its "fine structure" will be discussed later.

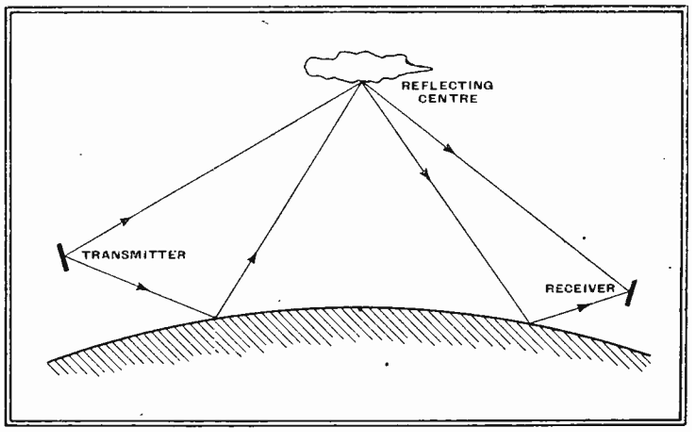


Fig. 1. Showing the four ways in which a signal may pass from transmitter dipole to receiver dipole via the reflecting centre. The wave which passes directly over the ground is not shown.

Further tests were carried out in connection with the B region reflections at television wavelengths. Using the Alexandra Palace transmissions, ghost images were occasionally seen when the receiver was 43 miles from the sender. Most, and perhaps all, of these were found to be due to aeroplanes. A typical ghost image occurred one inch away from the main picture, which was ten inches wide. This meant that the echo arrived about 9 microseconds after the ground signal, so that the path difference for the two rays was 1.7 miles.

The influence of B region on television signals may be easily calculated if we assume the reflection coefficient found for 6 mc/sec. waves to hold for 45 mc/sec. waves. It is at least very unlikely that the reflection coefficient will be greater than 0.00005, so we will adopt this figure for our calculations.

It is at considerable distances from the transmitter that such reflections would most easily be seen, and an example has been worked out in which the distance from the transmitter to the receiver is 43 miles, and the B region reflecting centre is half-way between the two. Now, as shown in Fig. 1, there are four separate ray paths along which signals may travel via the reflecting patch to the receiver. It is easy to show that if the height of the patch is about three miles or more, then the path difference of the rays which travel direct to the patch and those which travel to the patch after being reflected at the ground is quite large compared to a wavelength. It is, therefore, possible to so adjust the position of the reflecting centre that both rays arriving at the patch are in phase, and that both rays which leave the patch arrive at the receiver in phase, the field strength thereby being increased by a factor of 4.

The field strength, E, in volts per metre at the receiver is given by the following formula:

$$E = \frac{0.79\sqrt{P} \times r}{d}$$

where P is the power transmitted in kilowatts

r is the reflection coefficient of the B region patch,

and d is the total path travelled in miles.

This formula refers only to the waves which are reflected in B region. It includes the factor of 4 due to phase addition of the various waves, and includes an allowance of four decibels due to the directive characteristics of the Alexandra Palace aerial. If we put $P = 3$ kilowatts, which is the mean power transmitted on the vision channel from Alexandra Palace, and $d = 43$ miles, we find the field strength to be 1.5 microvolts per metre.

The Ground Wave

The wave which travels directly over the ground may be estimated from the theoretical curves published by T. L. Eckersley,[5] and when allowance is made for bending due to the atmosphere the field strength is found to be about 80 microvolts per metre. We should hardly expect, therefore, even under the most ideal conditions, to be able to see B region echoes at this distance, and at shorter distances the strength of the wave which travels along the ground will be even stronger compared to that which is reflected from B region. This is in accord

[4] S. H. Falloon and G. Millington, *Marconi Rev.*, Nov. 1935.

[5] T. L. Eckersley, *Journ. I.E.E.*, 80, p. 286, (1937).

Reflection of Wireless Waves—

with practical observations, as the propagation of ultra short waves to well beyond the line of sight is, in general, adequately accounted for by diffraction or the curving of the waves around the earth, and by refraction or the bending of the waves in the atmosphere near the earth's surface.

The propagation of waves of length less than 10 metres over distances of thousands of miles must be due to reflection at F region, and their reception within the "skip-distance" of this layer is probably due to reflection by the small densely ionised clouds occurring inside the normal E region, which will now be described.

The powerful pulse transmitter which was described above has been used by Prof. Appleton and the writer in a detailed investigation of the properties of these E region scattering centres. They find that the reflection coefficients, while much larger than that corresponding to B region, are still small, seldom rising above 0.05 and generally being less than 0.005. There appear to be two types observable at frequencies as low as 9 megacycles per second, but at television frequencies we might expect to find only one type, and these appear to indicate the entry into the atmosphere both by day and night of cosmic particles which produce bursts of ionisation of very great intensity. The second type of scattering centre found in E region probably has a solar origin and does not produce patches of such dense ionisation.

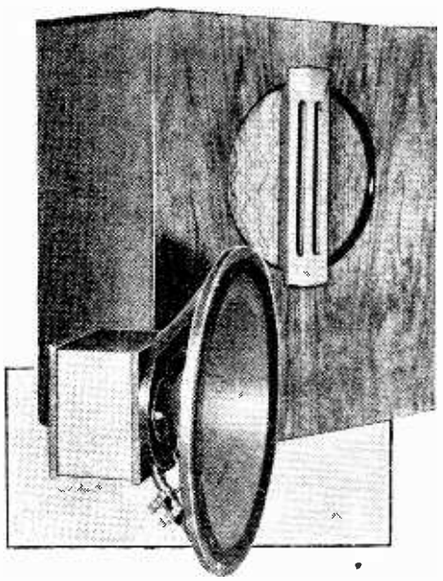
The importance of these E region scattering centres, as far as the establishment in England of several television stations operating on the same wavelength is concerned, might be considerable. A calculation along similar lines to that which was made above in reference to Fig. 1 suggests that field strengths of the order of 50 to 100 microvolts per metre might be obtained at a very considerable distance from the transmitter. This is, however, completely neglecting the radiation diagram or directivity of the television aerial, and careful design in this respect would, at least to a great extent, overcome the difficulty.

The way in which the patches of ionisation are distributed throughout the E region is rather interesting. They are found as low as 50 miles, and above this level they occur more and more frequently until a height of about 70 miles is reached. At still greater heights the frequency of occurrence decreases steadily until very few only are noticeable at heights of 120 miles. This distribution is curiously similar to that found for the intensity of aurorae, which are also caused by the entry into the earth's atmosphere of particles which are able to cause ionisation.

New Wharfedale Loud Speakers

TWO new models have recently been added to the range of Wharfedale loud speakers. Both are PM types with massive square section "Alnico" magnets rated to give a flux density of 14,000 lines per square centimetre.

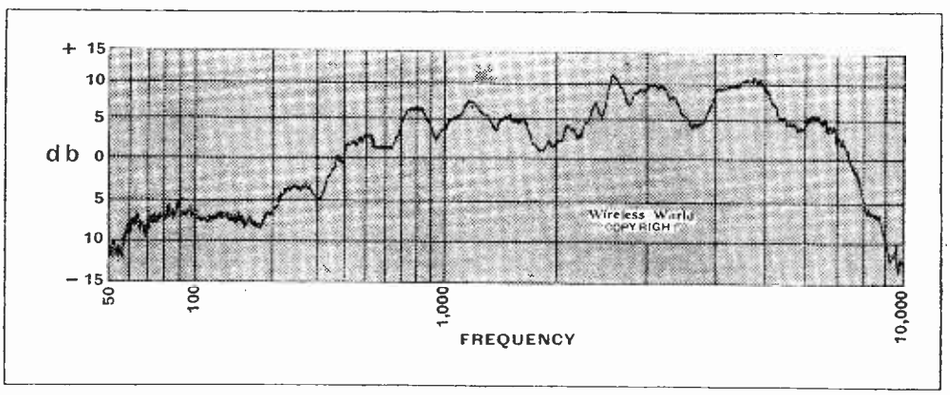
The "Portland" auditorium chassis is fitted with a 9in. diaphragm of the concentrically corrugated type which has been so successfully applied in previous products of this firm. It will be seen that the frequency characteristic is remarkably level up to 7,000 cycles and that there is no serious diminution of output up to 10,000 cycles. The powerful magnet gives excellent damping, and the reproduction has that firmness of tone and clear separation of component parts in music which is the mark of a well-designed instrument. There is no obvious fundamental resonance in the bass, and the powerful magnet gives a high electro-acoustic efficiency in addition to the more important advantages of critical damping. The price is £4 10s. or £5 5s. with transformer.



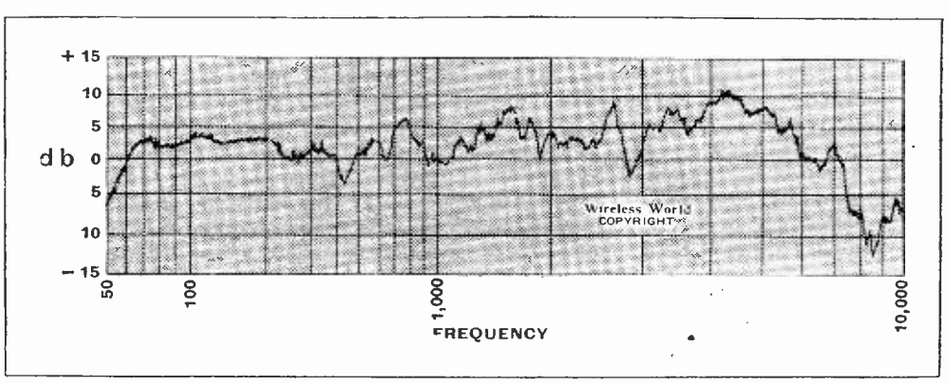
Wharfedale "Portland" chassis and "Langham" cabinet loud speaker.

The "Langham" cabinet model is an interesting design, for it has a unit with a "free-edged" cone and a totally enclosed back. Sound-absorbing material is disposed inside the cabinet to suppress internal reflections at high frequencies, and the characteristic has been given a general rise from 50 to 4,000 cycles to allow for the change of reverberation with frequency in the average living room. Under normal conditions of use there certainly seems to be far more bass in the general balance than the out-of-doors curve would suggest. Over most of the frequency range the forward response is at the same level as the "Portland" chassis with a similar magnet, but on account of the suppression of the radiation from the back the general efficiency of the "Langham" appears to be somewhat lower. The difference is not serious, however, and the loud speaker is one which will make an excellent adjunct to the better class of receiving sets. The chassis alone with free-edged cone costs £5 10s., and the complete "Langham" cabinet baffle with the same unit, £8 10s. An output transformer can be supplied in either case for 15s. extra.

The makers are Wharfedale Wireless Works, Hutchinson Lane, Brighouse, Yorks.



(Above) Axial response curve of Wharfedale "Langham" cabinet loud speaker. Microphone distance 4 ft., input 1 watt.



(Left) Axial response curve of Wharfedale "Portland" chassis. Microphone distance 4 ft., input 1 watt.

Band-Spread Tuning

By H. B. DENT

SIMPLIFYING THE CONTROL OF SHORT-WAVE RECEIVERS

OF the many problems that arise in the designing of a short-wave receiver, few present so much difficulty as the tuning arrangements. It is not the mechanical side of the business that troubles one so much as the electrical, for as the frequencies are so much higher than we have to contend with on the medium broadcast waveband, quite a small variation in the capacity of the tuning condenser results in a comparatively large change in frequency.

WHY tuning is inherently so much more difficult on short than on medium or long waves is clearly explained in this article. Mechanical and electrical means of overcoming the trouble are described.

For example, a 0.0005 mfd. (500 m-mfds.) condenser tuning a medium-wave size coil may cover a band of 1,500 to 550 kc/s, 200 to 550 metres, or a change of 950 kc/s. In this ether space can be accommodated about 100 broadcast stations, and if the dial is engraved 0-100 we get approximately one station, or station channel, per division. With a dial of about four inches in diameter the actual movement of the condenser spindle for a dial-change of one division is extremely small, and quite a good slow-motion drive is needed to make the tuning-in of stations reasonably easy.

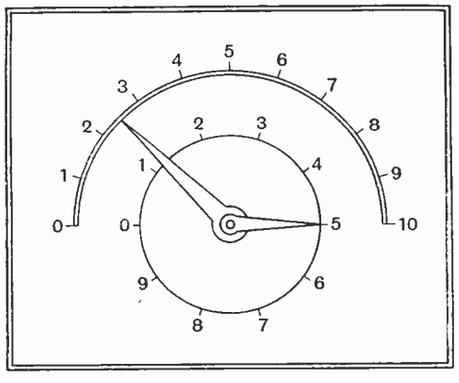


Fig. 1.—Mechanical band-spread: in conjunction with a suitably geared drive, the use of main and subsidiary scales permits the accurate recording of tuning settings.

Let us now examine the conditions obtaining on, say, 20 metres. If we use the same size condenser and merely change the coil it would be possible to cover a band of frequencies of from, say, 15,000 kc/s to 5,500 kc/s. Note that the ratio of the lower to the higher frequency is the same as on the broadcast band previously mentioned, but this now represents a frequency coverage of 9,500 kc/s, giving room for 950 stations, and with our 0-100 division dial nearly ten stations will be crowded into each division. Obviously, the tuning will be very critical.

Needless to say, the usual practice is to reduce the size of the tuning condenser, and one of about 160 m-mfds. or smaller is generally employed. Even with a condenser of this size we can get a frequency coverage of, for example, from 15,000 kc/s to 7,250 kc/s—20 to 41.5 metres. In the process we will have somewhat improved the true tuning range as the stray capacities will almost certainly be smaller and the effective capacity change will consequently be relatively larger.

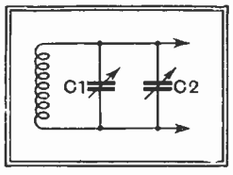


Fig. 2.—Electrical band-spread by means of a parallel-connected condenser.

Even this very drastic reduction in the size of the condenser has only lowered the actual band of frequencies coveraged to 7,750 kc/s, still giving about seven stations, or station channels, of 10 kc/s in each division on the dial. The tuning must inevitably be just seven times more critical than on the medium waveband. In order to achieve the same conditions the frequency band will have to be limited to 950 or, say, 1,000 kc/s, but then the waveband covered by a full rotation of the condenser will be only from 20 to 21.4 metres. Obviously, this is quite impracticable, as, to cover a range of 12.5 to 80 metres only, dozens of coils will have to be used.

On the short wave, therefore, a compromise is necessary. One way out of the difficulty is to reduce the size of the variable condenser to 100 m-mfds., fit a really good slow-motion drive and take more care in the tuning.

If one examines the short-wave region it will be seen that there are many areas having no real interest to the average listener, and only quite small bands are occupied by broadcast and amateur stations, the remainder being used by commercial services of one kind or another.

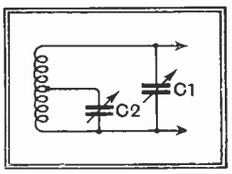


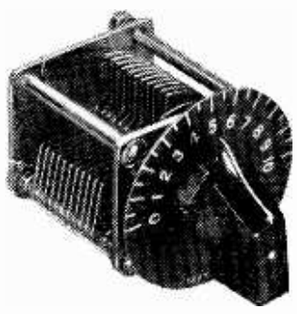
Fig. 3.—In this arrangement the band-spread condenser C2 is connected across a part of the tuning coil.

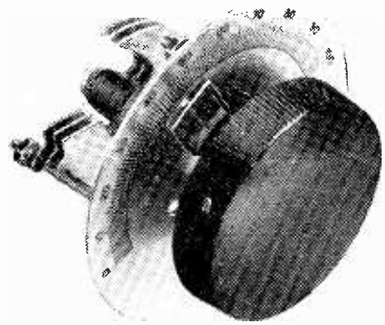
Broadcasting is confined mainly to six well-defined areas, commonly referred to as the 21, 17, 15, 11, 9 and 6 Mc/s bands, while amateurs have use of frequencies in the region of 28, 14, 7 and 3.5 Mc/s, in addition to some frequencies just below the medium broadcast band and comprising 1,715 to 1,925 Mc/s, which in the true sense is hardly a short-wave band.

Alternative Systems

The question that now arises is how can one cover this enormous band of frequencies with a reasonable number of coils, or ranges, and at the same time make it possible to tune over the useful portions of the band in such a way that stations can be logged on the dial with a reasonable certainty of repetition?

There are two schemes in general use; one is described as mechanical and the other as electrical band-spread. In mechanical band-spread advantage is taken of the slow-motion driving mechanism to provide a vernier or subsidiary pointer having its own scale. If the gear-down ratio is 20 to 1 the driving knob makes ten complete revolutions for one half-revolution of the condenser spindle. Now by having a main pointer travelling over a scale engraved 0-10, as shown in Fig. 1, and arranging for the second pointer to traverse another scale, similarly engraved, the smaller will make one complete revolution for a travel of the larger of from, say, 0 to 1 on the outer scale.

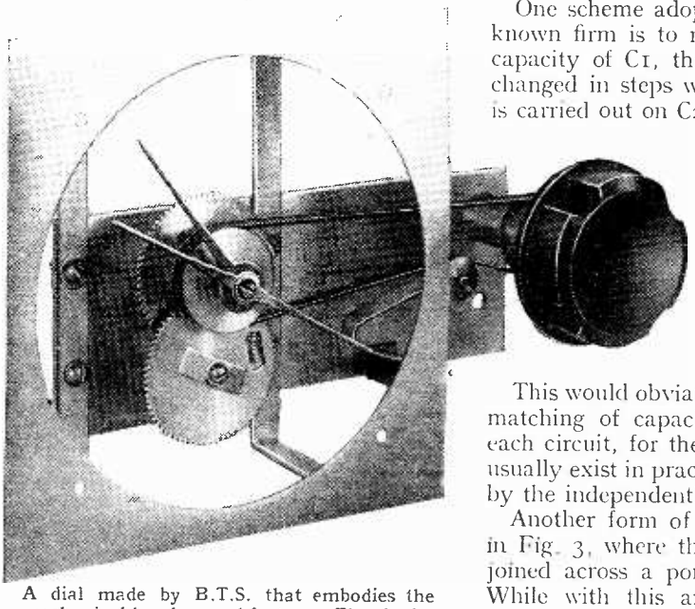




Component parts of an electrical band-spread system. The condenser on the left is variable in steps and the intervals are covered by the vernier unit on the right. It is made by Eddystone.

Band-Spread Tuning—

If the vernier scale was made the same diameter as the outer, the result produced would be equivalent to fitting a scale having twenty times the length of the 0-10 scale. Thus, if this is 6 inches long we obtain an effective length with the vernier of 10 feet. By choosing different ratios from those taken for this example even longer effective scales can be produced.



A dial made by B.T.S. that embodies the mechanical band-spread feature. The single-ended pointer makes eight complete revolutions for one half-revolution of the double-ended one. This actually follows the movement of the condenser shaft.

Though there are many variations of it, this is the basic idea of mechanical band-spread. It demands a very good slow-motion mechanism, which must be entirely free from slip or backlash.

Electrical band-spread is quite different, and for this is employed another tuning condenser which is usually of much smaller capacity than the main one. In its simplest form the small vernier, C2, is joined in parallel with the larger, C1, as shown in Fig. 2, being provided with a separate scale and driving mechanism.

One scheme adopted by a certain well-known firm is to make C2 one-tenth the capacity of C1, the capacity of which is changed in steps while the tuning proper is carried out on C2.

In an amateur short-wave set one could fit independently controlled C1 condensers in each of the tuned circuits, and employ a ganged assembly of small band-spread condensers.

This would obviate the need for accurate matching of capacity and inductance in each circuit, for the small differences that usually exist in practice would be corrected by the independently tuned units.

Another form of band-spread is shown in Fig. 3, where the vernier condenser is joined across a portion only of the coil. While with this arrangement both condensers could be of the same capacity, the band-spread unit C2 is best made only just large enough to cover the required waveband.

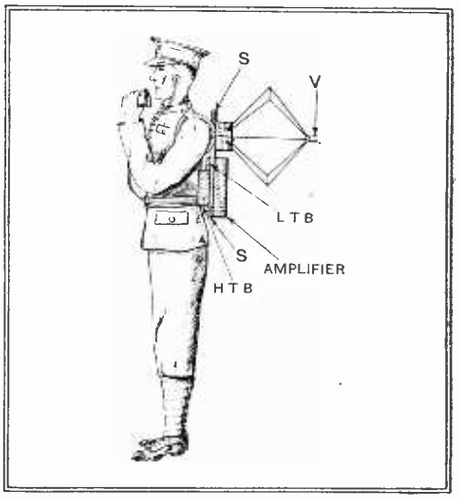
One advantage of this system is that the actual frequency coverage obtained with C2 can be made large or small merely by moving the tapping point on the coil. It is thus possible to fix the tapping on different range coils so that the portions of the range it is required to expand can just be covered by the band-spread condenser. This enables the greatest benefit to be derived from the system.

USW in the Field

AN interesting feature of a transmitter-receiver designed for military use and shown in the accompanying sketch (Patent 462529) is the use of a "split" frame aerial, the sides of which have a large surface area per unit length. This ensures maximum efficiency both as a radiator or receiver, particularly when the size of the loop is small relatively to the wavelength handled.

The harness of the set is equally convenient whether the soldier is standing upright, or crawling forward under fire, or lying prone. In fact, the only position the wearer cannot adopt is that of lying on his back. Also the front view of a man so equipped is not noticeably different from that of his fellows, so that he runs no special risk of being sniped by the enemy.

The amplifier stage and the filament and high-tension batteries are mounted on opposite sides of the lower end of a vertical panel S. The aerial is secured to the top of the panel, a cross-bar underneath being held by the shoulder straps. The valve V shown at the apex of the aerial is, in practice, enclosed in a protective casing. It is back-coupled through the inductances formed by the two sides of the split aerial, and is modulated for transmission, and "quenched" for super-regenerative reception. Stethoscopes are used in place of the usual headphones. The overall weight of the outfit is less than 20lb.



Transmitter-receiver operating with a split loop aerial. The valve at the apex of the loop functions as an oscillator for transmission and as a super-regenerative detector for reception.

Engineering Electronics. By Donald G. Fink. Pp. 358 with 217 Figs. McGraw Hill, Aldwych House, Aldwych, London, W.C.2, 1928. Price 21s.

THE "hard" valve (in American, "high-vacuum tube") is by far the most widespread and well-known electronic device; in fact, the author of this book estimates, from the number of valves in the average American receiver, and the number of sets in use, that there are more valves than inhabitants in the United States. But in the last ten or fifteen years other electronic devices which have been discovered are rapidly acquiring practical importance, not only for strictly "wireless" purposes, but in other applications, such as the familiar neon sign, and for industrial processes such as colour matching by photoelectric cells.

In "Engineering Electronics" the author begins by describing the fundamental properties of the electron, and its behaviour in electrostatic and magnetic fields, both in vacuo and in the presence of gas (e.g. Neon) or of vapour (e.g. Mercury, Sodium). As far as possible, this explanation is physical rather than mathematical, and is plentifully illustrated with curves showing the results graphically, so that it is fairly intelligible even if the "maths" is "skipped," although such "skipping" is scarcely necessary, since only school algebra and trigonometry are involved.

Commercially produced electron devices are then described; there are chapters on high-vacuum valves, gas-filled valves and Thyratrons, photoelectric cells, neon and other gas-filled electronic light sources, and a chapter on miscellaneous specialised devices such as cathode ray oscillograph tubes and television transmitting tubes (the "Iconoscope" and the Farnsworth "Image dissector").

The book concludes with four chapters on applications; to "power" purposes (mercury-arc rectifiers, grid-controlled and otherwise), to wireless and telephony, and to industrial control. These chapters are illustrated with outline diagrams of connections which enable the principles to be followed much more easily than if full details of components, etc., were given, of the "home constructor's set" variety. The author, in his preface, says that he has tried "to steer a course between simple descriptions of equipment on the one hand and elaborate technicalities on the other"; we think he has succeeded in this aim. C. R. C.

The Wireless Industry

McMichael, Ltd., have introduced an AC/DC version of their Model 380, illustrated in our issue of June 2nd.

The uses of "Silentbloc" vibration-absorbing mountings for protecting radio apparatus in aircraft, etc., are described in a well-prepared illustrated booklet issued by Silentbloc, Ltd., Victoria Gardens, Ladbroke Road, Notting Hill Gate, London, W.11.

The Sinclair Speaker works are closing down for the annual holiday from August 1st to August 7th, both days inclusive.

Home Recording

By HUMFREY ANDREWES, B.Sc., A.M.I.E.E.

PART III.—THE DISC AND THE STYLUS

IN the first two articles of this series the general principles of lateral disc recording and the mechanical details of the machines used for direct recording have been discussed. We now turn to a consideration of the general requirements of the blanks on which the records are to be cut. It may be mentioned in passing that in strict gramophone parlance the record is the recording on one side of a disc, and when we refer to a disc we strictly are speaking of both sides in the case of a double-sided commercial pressing. This may perhaps sound pedantic, but the distinction can be important in purchasing pressings.

As has been previously explained, in the manufacture of the commercial gramophone record the recording is made on a wax blank. When such a wax is played back immediately, as a test for the artists and recording engineers to hear before the final wax is made, it is, of course, being used exactly like a direct record. Such a playing renders it useless for the manufacture of a matrix, and, for this reason, it is common practice in commercial recording studios to record two waxes simultaneously so that one may be played back and the other used for the matrix if the recording is passed. Except for experimental work, where a record is only played once or twice at the most, material as soft as wax is obviously quite unsuitable for making true direct gramophone records unless some hardening process can be evolved so that the wax can be played a number of times without damage.

Disc Material

We therefore arrive at the requirements for a suitable material for the direct recording blank. It must be initially soft enough so that a clean groove of the correct depth may be cut and at the same time must be hard enough, or must be capable of being hardened quickly, so that it may be played back a large number of times without the walls or bottom of the groove being damaged by the replay needle. Such requirements were not easy to obtain in the early stages of the development of direct recording, but in the past few years a number of blanks have come on the market, and it is now possible to cut a record which has a lower surface noise level than any shellac pressing, and which can, under favourable conditions, give a very high degree of fidelity, and yet can be reproduced using a straight steel needle well over one hundred times. A few years ago this would have been regarded as impossible, but intensive research has been carried out on the preparation of the recording disc.

In considering the subject of direct recording, and recording blanks in particular, it is interesting to note that the original records made by Edison were, of course, direct recordings, as they were made on a cylinder covered with thick tinfoil, and the hill and dale system was used. The recorder was, of course, used to reproduce the recording, and some of the early home recorders were worked on a similar principle, except that an aluminium disc was used instead of a tinfoil cylinder and the lateral system employed. It might not be out of place, in view of this, to give here some further details with regard to Edison's original phonograph. A patent was taken out for it in December, 1877, and the cylinder carrying the tinfoil was mounted on the lead screw, while the recording diaphragm was kept fixed. The lead screw was driven by hand, and a flywheel was mounted on it to keep the speed steady. We see, therefore, that the principles on which the modern gramophone recording machine works were to be found in Edison's original talking machine invented sixty years ago, and that this machine was probably the first direct-recording apparatus.

Probably the simplest and cheapest recording blank available to the experimenter is the plain aluminium disc. Aluminium is normally used as it is fairly soft, but a groove cannot be cut in it in the strict sense as in the case of the wax blank, and hence a conical cutter is often used which pushes rather than cuts a groove, which is normally about one- or two-thousandths of an inch deep. Such a groove has a very poor shape, and the record is played back with thorn or fibre needles, and the surface noise is rather high. Such records have a fairly short playing life, but if cost and simplicity are the most important factors, and a long life is not required, as in the case of experimental recordings, there is no doubt that the plain aluminium disc has its uses. Copper blanks have also been tried, and in the case of both metals the cutting is materially assisted by lubricating the disc with oil or grease before the recording is made, and by leaving some oil or grease on the disc the surface noise may be reduced and the playing life increased.

At an early stage in the development of direct recording it was realised that the plain aluminium disc had serious drawbacks, and considerable research work has been done in this country, on the Continent, and in the United States to develop a disc which would not only have a longer life, but which could be cut in a similar manner to the commercial wax recording blank, and a large number of different types are now available to the experimenter.

HAVING described the general principles of direct home recording and the machines in general use, the author now turns to a discussion of the all-important matter of the discs or recording blanks. The various different types available to the amateur are described and the different treatments they require are explained in this article.

Types of Disc

These discs fall into three main classes. First, those which have as their base an aluminium or zinc disc coated with a suitable compound on which the actual recording is made, the metal base only being used to support the compound. Secondly, discs having a base consisting of a thin sheet of glass, suitably coated; and thirdly, those which are homogeneous and usually flexible and consist entirely of the material on which the recording is cut. There is also a fourth class, which was at one time available in the United States, but not, it is believed, in this country, which was pre-grooved—that is to say, a plain spiral was already cut in the disc, which was of a semi-soft material, and hence no tracking mechanism was necessary in recording on such blanks. This latter type was, however, as might be expected, not very satisfactory, and such discs are not now available.

Taking now the first class of disc, these are usually coated with a cellulose compound, and there are a number of different makes on the market. There is also a type which is coated with a plastic material, and these have to be subjected to a heat treatment after recording, when they become extremely hard. All the types of disc having a metal base have the great advantage that they are unbreakable, but can, of course, be bent, and all discs should always be carefully examined for flatness before being used, as otherwise a light and heavy track will be produced if there is a serious bump at any point.

In examining the disc it should be borne in mind that a sudden rise and fall of the cutter head and stylus is far more serious than a gradual one, and may even cause the point of the stylus to leave the disc altogether and leave a gap in the track. A method often adopted for checking the flatness of the disc is to place it on the recording table, and, while it is rotating,

Home Recording—

observe the reflection of some stationary object, such as the tracking arm or the slide of the tracking mechanism and see how much the reflection moves. If the movement is slight and gradual the disc is satisfactory, but if the movement is sudden, even though it is not great, the recording on such a disc may be unsatisfactory, particularly if the movement observed is at the edge of a twelve-inch disc. Naturally, imperfections in flatness are most noticeable in large-diameter discs, and, as a rule, there is very little trouble with discs of ten inches and less in diameter. As explained in the section dealing with recording machines, some manufacturers dish the turntable, so that when the centre clamp is pressed down on a disc having an aluminium base, any small unevenness is taken up. A suitable washer must be fitted when other types of disc are used. The writer has found that, as a general rule, discs having a base material other than aluminium cannot be dished in this way, particularly those with a zinc base.

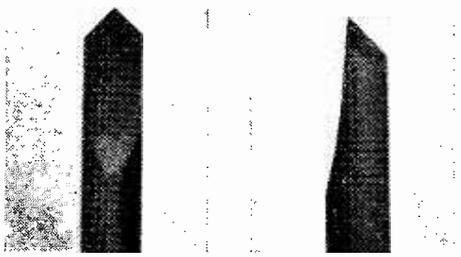


Fig. 1.—Two enlarged views of a steel cutting stylus.

In all types of metal-base discs the cellulose or other coating should be fairly thin, so that the walls of the groove cut in the disc are well supported by the metal base. Although this type is usually subjected to a hardening process, the coating is still resilient to a certain extent, and, therefore, if the coating is not fairly thin the walls of the groove tend to give under the pressure of the replay needle on large amplitudes, and also where the velocity is high, with subsequent losses. All discs of this type also show a loss in the reproduction of the higher parts of the frequency spectrum compared with the shellac pressing, and this "disc loss" must be allowed for in considering the characteristic of the recording head and amplifier. The cellulose type of disc may be cut with either a steel or sapphire recording stylus, and the swarf is often white or pale blue in colour. Some makes of disc, however, have a dark brown or black swarf.

Hardening Processes

A special hardening fluid is often recommended by makers, and the experimenter should follow the instructions given for different types of disc. A light lubricating oil is included in most hardening fluids for this type of disc, with the result that the finished disc is greasy to the touch. If left for a considerable time the disc may become dry, and it should then be rubbed over with hardening fluid to relubricate the grooves.

Turning now to the second type of disc, in this case the coating is of a gelatinous nature, and a hardening process is essential if a number of playings are required, although it may be played immediately in experimental work if the disc is not required to be kept. The hardening process takes slightly longer than in the case of the cellulose type, but this is not normally important. The finished disc is slightly harder than those of the previous type, with the result that, under favourable conditions, it is possible to obtain a slightly louder record and some improvement in the higher frequency response. As a glass base is used for this type of disc, it is claimed that a more uniformly flat disc is produced, but there is, of course, the disadvantage that the disc is breakable, although no more so than the familiar shellac pressing. A sapphire stylus must always be used for cutting this type of disc.

Finally, we come to the homogeneous type of disc. These are cut in a similar manner to the cellulose kind, but they are usually flexible, and it is therefore sometimes more difficult to get them to lie flatly on the recording table, with the result that a light and heavy cut is obtained on the edge of the disc. These discs are, it is believed, widely used on the Continent and do not require any hardening process, although a little lubrication is again an advantage. These discs may also be cut with a steel or sapphire stylus.

As mentioned in the first article in this series, a number of these discs may be used as master recordings from which matrices may be made, from which shellac pressings can be taken, and it may be stated here that the cellulose type is most suitable for the purpose. Up to the present time the second type has not been found satisfactory for this purpose. Where it is desired to use the disc for the manufacture of a matrix, it is usually better not to use any hardening process, and although the master may, of course, be played, great care should be exercised in this operation.

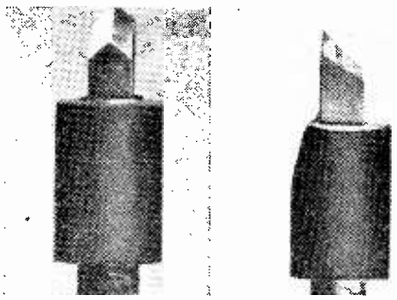


Fig. 2.— Two views of a typical sapphire stylus; note the angles of the different faces.

Before leaving the subject of the disc itself it might be mentioned that as there are now a variety of different makes of disc available, all of which have their advantages and disadvantages, and as the final word has not been said by a long way, it must be left to the experimenter to try the various different discs and choose the one which best suits his particular purpose.

We now come to the question of the actual stylus with which the groove in the disc is to be cut. In the first article in this series it was explained that, owing to the nature of the material to be cut, the shape of the groove in a directly recorded disc differs from that of the commercial pressing, and photomicrographs of the two types of groove were shown. It is obvious, therefore, that we shall find that the shape of the point of the cutting stylus is different for the two types of recording. Figs. 1 and 2 show typical shapes of steel and sapphire direct-recording cutters. In the majority of cases the direct-recording stylus has sides at 90 degrees, and the stylus ends in a very sharp point, whereas the wax sapphire is rounded. The set-off angle, as it is called, is usually 45 degrees, so we see that the point is triangular in shape. This can be clearly seen in the photographs.

Stylus Life

A number of different steel and sapphire styluses are available to the experimenter, and the success obtainable with different makes of cutter depends largely on the accurate formation of the actual point. As a general rule, the cutting life of a steel stylus is comparatively short, and with some makes averages about three to six twelve-inch sides. This type of stylus has, however, the advantage that it is comparatively cheap, varying between threepence to ninepence per stylus. For the experimenter this is perhaps an important point, as so often the stylus is damaged accidentally, due to errors in the operation of the tracking mechanism, that the cost of the cutting stylus can be a serious financial item.

The sapphire stylus, on the other hand, normally has a much longer life, and thirty or forty twelve-inch sides can often be cut with one stylus, but as they are more expensive and vary in price from three to fifteen shillings, accidental damage must be avoided. It may also be stated that the second class of disc mentioned above can only be cut with a sapphire stylus, and hence greater care must be taken when using this type of disc. It is always desirable to test the stylus before any important recording is undertaken, particularly in the case of the steel type.

A method often adopted, if a high-power microscope is not available to check a batch of styluses, is as follows: Using a carefully selected disc, an unmodulated cut about one-eighth to a quarter of an inch wide is made with each stylus, and then these cuts are played back under standardised conditions. Such conditions depend naturally on the equipment used. The author has found that in any serious work it is very desirable to determine definite playback conditions so

Home Recording—

that at any time the level and degree of surface noise between different recordings can be compared. If the apparatus is adjusted so that a fair amount of surface noise can be heard when a new high-quality shellac pressing is played, and the level always adjusted to give a predetermined reading on the volume level indicator using a constant frequency disc, then the quality of a given cutting stylus can be readily determined, provided, of course, that it is first known that the test disc which is being used is itself satisfactory. Conditions may, of course, be such that for normal playback the surface noise is excessive, as it is only possible by exaggerating such faults that the best possible results, using any given type of disc and cutting stylus, can be obtained.

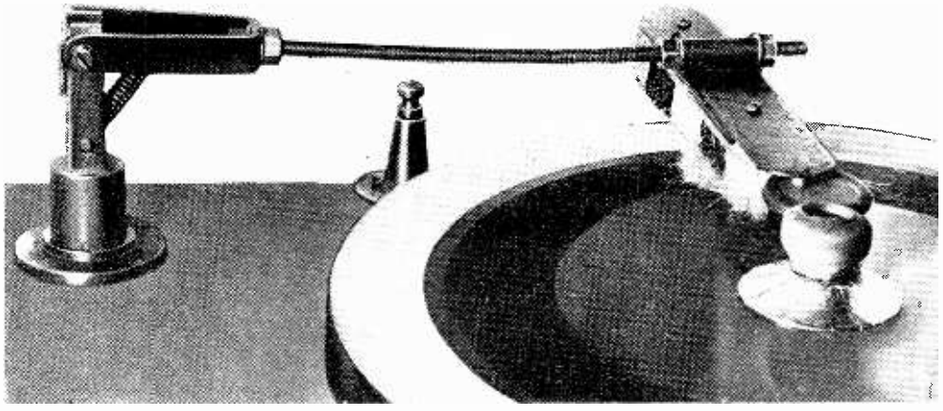


Fig. 3.—Swarf brush; note the eccentric wheel at the end of the brush-holder driven from the centre clamp.

Surface Noise

The author has found it convenient to divide surface noise due to the cutting stylus into three grades—A, B, C—with the use of a plus and minus sign for intermediate grades. Thus, for given playback conditions, an A surface is good, a B surface is moderate (about equal to the average commercial pressing), and a C surface is definitely poor. An A plus surface is occasionally met where, even under the most exacting conditions, scarcely any surface noise can be heard. Such discs should always be kept for demonstration to one's friends. It need hardly be added that the playback needle must be above suspicion for such tests.

When all types of direct recording disc are cut correctly a thin thread of the disc coating comes off from the cutting stylus and is known as swarf. If this swarf is allowed to collect behind the stylus or in a circle on the disc without attention it is very liable to cause cutting faults, and may even lift the stylus from the disc and give complete breaks in the track. This trouble is particularly serious with gelatinous type of coating, as in this case the swarf is considerably stronger than the cellulose type, and may cause damage to the point of the sapphire stylus. Some method of dealing with this swarf must, therefore, be evolved, and it will not be out of place to outline here some of the methods usually adopted.

Taking first the cellulose type of disc, the thread of swarf as it comes away from the stylus is often electrostatically charged, and, therefore, tends to cling closely to the surface of the disc and often follows the line of the previous groove cut. The simplest way of dealing with this swarf is to brush it with a soft brush, about an inch wide, and cause it to collect round the centre clamp. A little practice is required to acquire the requisite skill, but, although simple, it is perhaps rather a tedious process and makes the recording of a programme or item requiring monitoring rather difficult if one is single-handed. A simple automatic brush has therefore been evolved by one manufacturer, and is shown in Fig. 3. In order to keep the brush moving over the surface of the disc it is mounted on a pivoted arm in a similar manner to a pick-up and an eccentric wheel driven from the centre clamp causes the brush to oscillate to and fro. The swarf collects under the brush and then collects round the centre clamp.

Unfortunately, owing to the electrostatic charge on the swarf in the case of the cellulose type of disc, it cannot be removed by suction as is done in the case of the thread of wax from the commercial wax recording machine. The suction method can, however, be adopted in the case of the gelatinous coating. Suction plant is a somewhat expensive item, and some brushing method will therefore appeal more, perhaps, to the experimenter. A brush similar to that already described is, however, not satisfactory, as this type of disc is softer and can readily be marked, and must not even be touched by the hand before it has been hardened. A pad of soft material such as flannel or cotton-wool makes a good substitute, although even this produces a mark on the disc. Marks produced in this way on the disc do not, however, affect the surface noise appreciably, but tend to spoil the appearance slightly. If suction is not used, therefore, with this type of disc, brushing with a soft brush by hand must be resorted to, and as the swarf forms a good ring round the disc when the cut is correct, with a little practice this can be done satisfactorily. Most manufacturers recommend that the stylus should be set at a slight angle to the radial line of a disc so that the swarf tends to be thrown towards the centre of the disc, but this angle must not, of course, be too great or the groove cut in the disc will be distorted.

News from the Clubs

Dollis Hill Radio Communication Society

Headquarters: Brainteroft Schools Warren Road, London, N.W.2.
Meetings: Alternate Tuesdays at 8.15 p.m.
Hon. Sec.: Mr. E. Eldridge, 79, Oxgate Gardens, London, N.W.2.

On July 12th members discussed the accurate measuring of transmitter efficiency, and this was followed by a discussion on receivers and transmitters installed and used in mobile W/T stations.

Romford and District Amateur Radio Society

Headquarters: Y.M.C.A. Red Triangle Club, North Street, Romford.
Meetings: Tuesdays at 8.30 p.m.
Hon. Sec.: Mr. R. C. E. Beardow, 3 Geneva Gardens, Chadwell Heath.

Among members there are now nine with full transmitting licences and thirteen with artificial aerial licences. Several further applications are pending.

Bootle and District Amateur Transmitting Society

Headquarters: 368, Stanley Road, Bootle, Liverpool, 20.
Meetings: Tuesday evenings.
Hon. Sec.: Mr. C. E. Cunliffe, 368, Stanley Road, Bootle, Liverpool, 20.

Meetings are at present being held in the temporary headquarters, the address of which is mentioned above. Persons in the district are invited to write to the hon. secretary for a membership application form.

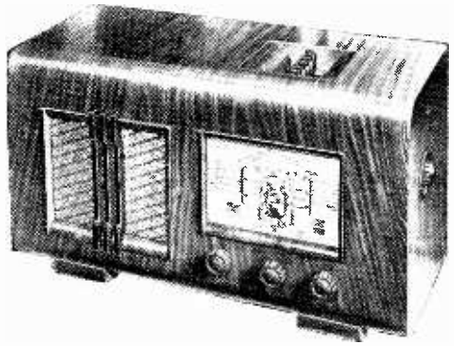
North Manchester Radio Society

Headquarters: 14, Fairfax Road, Prestwich, near Manchester.
Meetings: Alternate Sundays at 3.30 p.m.
Hon. Sec.: Mr. R. Lawton, 10, Dalton Avenue, Thatch Leach Lane, Whitefield, near Manchester.

Regular meetings of the above society are now being held on alternate Sundays, commencing at 3.30 p.m., the rooms being available for use of members from 3 p.m. The membership fee is 5s. a year, payable in two half-yearly instalments of 2s. 6d. A charge of 3d. is also made at each meeting. The meetings so far fixed are as follows:

August 14th and 28th, September 11th and 25th, October 9th and 23rd, November 6th and 20th, December 4th and 18th. More dates may be added later, and arrangements will be made for members to visit various places of interest.

TWO NEW BURNDEPT RECEIVERS



In their latest Models 298 and 299 Burndept, Ltd., provide press-button mechanical tuning in addition to continuous tuning over a range of 13.5 to 580 metres and 750 to 2,000 metres in four bands. A five-valve superheterodyne circuit is used in each case, the battery Model 298 having a separate oscillator instead of a power rectifier to make up this number. A permanent magnet loud speaker is fitted in both models and the price for AC or battery operation is 10½ guineas.

NEWS OF

THE NEW D.G.

Professor Frederick Wolff Ogilvie

ONE of the London newspapers on the day of the appointment of Dr. Frederick Wolff Ogilvie as Director-General of the B.B.C., had, as a poster topic, "Why Ogilvie?" We would ask, "Why not?" Surely it cannot be expected that the appointment of a successor to Sir John Reith would at once meet with general approval. It certainly came as a surprise, for, although his name was one of the first to be mentioned for the post, he was little known to the man-in-the-street.

Dr. Ogilvie, who is at present President and Vice-Chancellor of Queen's University, Belfast, has had a distinguished academic career, both at Edinburgh University, where he was from 1926 to 1934 Professor of Political Economy, and, latterly, at Belfast. He will not take up his new duties until October 1st, so that the B.B.C. will have been without a D.G. for three months.

There has been much speculation on the question of the salary of the new Chief, but the amount, variously stated at from £6,000 to £10,000 per annum, is fixed by the Board of Governors, who made the appointment.

TAIL BIGGER THAN DOG

Work Beginning on Broadcasting House Extension

A START is about to be made at clearing the site now occupied by Nos. 10-22 inclusive, Portland Place, London, W.1, for the erection of the extension to Broadcasting House. The demolition of the existing buildings, and clearing the site, will occupy several months, during which time detailed planning will be completed. It is hoped to have the building ready for occupation towards the end of 1940

The extension as planned has a volume slightly in excess of the existing building. The architectural treatment, which has been approved by the Royal Fine Art Commission, will continue and amplify that of the existing façade to Portland Place. The extension is planned as an office building above ground-floor level, with a control suite on the seventh floor, and a restaurant on the eighth floor. A light court will occupy the centre of the structure. Below ground level will be accommodated a general purposes studio 80ft. by 54ft. by 30ft. high, three dramatic studios, an effects studio and a number of rehearsal rooms. It has already been announced that the architects are Messrs. Val Myer and Watson-Hart, F.F.R.I.B.A., and Messrs. Wimperis, Simpson & Guthrie, F.F.R.I.B.A., in association with Mr. M. T. Tudsbery, M.Inst.C.E., the Civil Engineer to the Corporation.

FILM RECORDING

Increasing Use in Broadcasting

THE B.B.C. recording staff are showing an increasing tendency to resort to the use of the film track for recorded programmes. The principal reason is that cuts can be made more easily with this method than with any other. Freedom from hiss, provided the film is kept spotlessly clean, is another important advantage.

It is probable that film tracks may be used for the repetition of the Empire programmes in the near future.

Film Tracking the Loch Ness Monster

On Monday last, July 25th, a venturesome little party, headed by John Pudney, the B.B.C. producer, sallied into the open at Fort Augustus with a mobile recording van to capture something of the aura of mystery which has hung over Loch Ness since 1933, when the Monster splashed into the headlines for the first time.

Wax recordings of interviews with "eye witnesses" are to be blended in a feature programme which will be re-recorded on a film track for broadcasting to Regional listeners on August 21st.

NEW AMERICAN NETWORK

Scheme for Linking Up Individual Stations

TO supply the thirty-two million American set-owners with broadcast material, there are 728 transmitting stations, almost half of them being linked up with either the N.B.C., the C.B.S., or the Mutual networks. Of the remaining stations, 387 in number, the majority are strung across the country supplying independent broadcasts over local areas.

The problem of welding these stations into a profitable independent system has twice been handled unsuccessfully, three years ago by the Trans-continental Broadcasting System and, more recently, by Airways, Inc.

Now a new effort is being promoted by the Western Radio Union, a subsidiary of the well-established Western Newspaper Union, which serves 10,000 newspapers with syndicated material. The new system would embody a coast-to-coast network, primary coverage being rural areas. Much of the material broadcast would be in the form of electrical transcriptions, which offer a flexibility essential to isolated stations.

It is expected that the system, which is to be designated by the letters W.R.U., will be operating in the autumn, and eventually it may have the largest membership of any of the existing systems.

RESULTS OF RECENT A.A.A. Championship races at the White City were for the first time relayed to the scoreboard by means of this portable 3-metre transmitter.

BERLIN EXHIBITION PRE-VIEW

Televisors for the German Public

FOR the first time in Germany television receivers will, at the annual Radio Exhibition, be available to the public. They will cost about Rm.600 (approx. £50) for television reception only, or about Rm.850 for a combined television and all-wave receiver. It is also expected that large-screen reception on a 50 cm. sq. screen will be attempted.

Other items of interest which will be seen at the Show, which will remain open longer than usual (August 5th to 21st) include a new mains receiver at about half the price of the old Volksempfanger, and a new edition of the original "People's Set," incorporating a moving-coil loud speaker.

A giant theatre, seating some 4,000, for the performance of a Radio Revue, will be a feature of the Show.

FRENCH NEWS SUPPRESSED

Unpopular Muzzling of the Broadcast Word

AS was recently reported in these pages, the time allocated to broadcast news bulletins from French State and private stations has been reduced from one-and-a-half hours to twenty-one minutes. This drastic treatment is the result of applications made to the Government by the National Federation of Newspapers, and it has aroused serious protests from general public, various wireless associations and even from a certain section of the Press.

The Federation has published an official statement repudiating any responsibility for the suppression, pointing out that the object of its demands was to revise the hours of broadcast news bulletins so as to prevent them from coinciding with the release of newspapers. It is expected that the subject will be brought before the Government for further consideration.

SHORT WAVES AT PORTSMOUTH

SHORT-WAVE transmitters on a modern cruiser and a destroyer will be used on Saturday (July 29th) for commentaries on the naval activities which begin Portsmouth's Navy Week. A receiving station on shore will relay signals to the B.B.C.'s mobile broadcasting van, whence they will be

THE WEEK

"piped" to Broadcasting House.

The principal commentary falls to Thomas Woodrooffe, who will describe from Nelson's *Victory* typical scenes in the dockyard around. Assisting him will be two staff commentators, one on the cruiser and the other on the destroyer.

STANDARDISED CONCERT PITCH

DURING the recent summer meetings of the International Broadcasting Union a technical committee reported on its studies into the acoustic qualities of the note "A" which is used internationally as the tuning note for orchestras. Conditions of temperature in different parts of the world affect the pitch of identical tuning forks, and the problem of standardisation will probably resolve itself into frequency measurement. The committee proposed that the matter should be treated in conjunction with the International Acoustic Committee at the earliest opportunity.

FROM ALL QUARTERS

Malayan Short-wave Station

SIR SHENTON THOMAS, Governor of the Straits Settlements, last week opened the new short-wave transmitter of the British Malaya Broadcasting Corporation, which will operate on 30.96 metres.

Cable for Radiolympia Television

INTERFERENCE during the televising of Bertram Mills's circus from Olympia last January has led to the decision to use a cable link for the Radiolympia transmissions, which begin on August 24th.

Popularity of Radio in India

THE increasing popularity of wireless in Baroda, India, where the Government of the State has recently sanctioned the sum of Rs. 150,000 for the construction of a broadcasting station for the State, is evidenced by the increase in receiving licences which recently numbered 419 as compared with 247 a year ago.

New York Television Exhibition

IN Radio City, New York, the National Broadcasting Company has installed a permanent television exhibition. This includes, in addition to apparatus and exhibits, a large, glass-walled studio from which performances being televised can be seen by visitors.

Radio Exhibitions

IT might be of interest to readers to have for reference purposes the following list of radio exhibitions arranged in date order:

German.—Berlin, August 5th to 21st.
British.—Radio Manufacturers' Association, Olympia, August 24th to September 3rd.
Polish.—Warsaw, August 27th to September 11th.
French.—Grande Palais, Paris, September 1st to 11th.
Belgian.—10th Salon de la T.S.F., Brussels, September 3rd to 13th.
Swiss.—National Swiss Fair, Lausanne, September 10th to 25th.

Portable Police Communication Set

THE South African Police has sponsored the construction, by an amateur, of a portable two-way transmitter receiver. It uses a wavelength of 4.5 metres, weighs 10lb., and has an effective range of up to 15 miles.

Paris Traffic Controlled by Wireless

DURING the visit of Their Majesties to France the gendarmerie of Paris made use of a low cruising dirigible for the control of traffic, it being in wireless communication with a mobile ground station.

Brussels Broadcasting House

ALTHOUGH the new building has been completed it is not expected to be completely equipped for three months. The inauguration will probably take place next November.

That East Anglian Relay

THE decision to erect a 5-kW relay station in the Norwich district, or a little farther inland, is still trembling in the balance, but B.B.C. engineers have recently completed a survey with mobile receiving equipment to gauge the field strength of all the home broadcasting stations in Norfolk, Suffolk and parts of Nottinghamshire and Lincolnshire.

French Television Takes a Rest

TELEVISION transmissions from the Eiffel Tower closed down on July 15th for a month in order to make certain technical readjustments. This is a striking emulation of the fine B.B.C. example set last year when the London television station closed down for three weeks.

Pianoforte Electro-Acoustics

AT a recent meeting of the Institute of Wireless Technology the President, Mr. Sydney A. Hurren, gave an interesting lecture on Pianoforte Electro-Acoustics. He described the principles of the "Pianotron," in which each note has its own pick-up by which effective and permanent "voicing" can be secured over the whole range; a demonstration on the instrument followed.

New York Likes 16 Metres

AMERICAN theatre-goers are adjured by the *New York Times* to make a practice of tuning-in Daventry on 16 metres for recordings of programmes which they have missed during the evening.

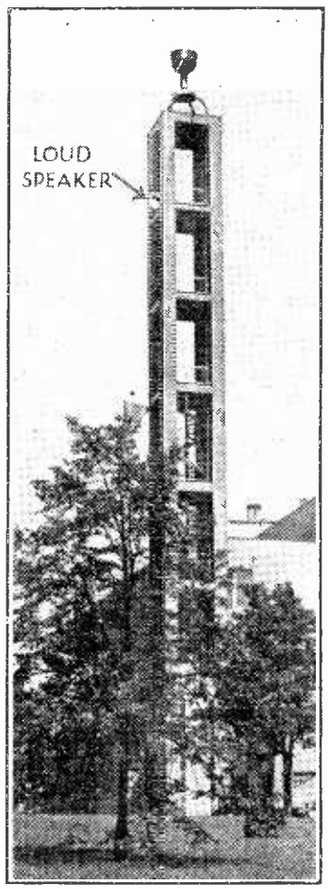
According to New York opinion, London leads the way in 16-metre broadcasting from Europe to America. During the early evening both GSG and GSP are reported to be giving clear, interference-free reception.

Dubilier Sports

THE fifteenth annual sports meeting of the Dubilier Athletic Sports Association was held on Saturday, July 16th.

Miscellaneous Advertisements for August 4th Issue

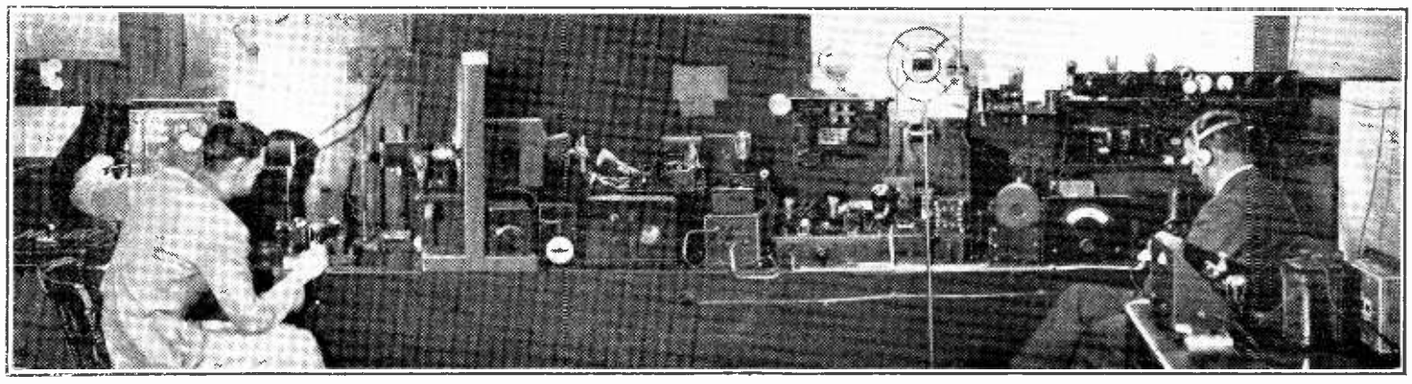
WITH the approach of the August Bank Holiday slight alterations are necessary in our printing arrangements. Miscellaneous advertisements intended for the issue of August 4th must be received not later than first post tomorrow, Friday, July 29th.



SPIRE OF A MODERN CHURCH in Prague, Czechoslovakia, which is probably the only one of its kind in the world to have been expressly designed for the accommodation of an electrical sound reproduction system; a loud speaker near the top of the spire diffuses peals of bells "rung" from a recording.

R.S.G.B Convention

AN enterprising programme has been arranged for the 13th Convention of the Radio Society of Great Britain which will be held from September 1st to 3rd. The programme, besides including those hardy annuals the Saturday Night Dinner and I.E.E. Meetings, also embraces visits to Alexandra Palace, Greenwich Observatory, Broadcasting House and the G.E.C. Research Laboratories at Wembley.



EXPERIMENTAL TELEVISION transmissions radiated from station G6PU at Portsmouth Municipal College have been successfully conducted for some time. Mr. A. Parsons, Senior Lecturer in Telecommunications is seen (right) at the end of the lab. bench where photo-electric cell sub-amplifier, modulator and 25-watt 10-metre vision transmitter are located. On the left a student is operating the arc and low-definition scanning arrangements.

Developing a High-Quality Communication Receiver

How a Receiver is Designed—XX

THE TUNING SYSTEM

IN a receiver covering a wide range of wavelengths the tuning system is of great importance and the general alternatives are discussed in detail in this article. It is shown that the use of two variable condensers—one of large and the other of small capacity—is desirable.

BEFORE proceeding to discuss the details of the RF stage and frequency-changer, it is necessary to consider the tuning system which we shall adopt. As pointed out in an earlier article our aim is to provide a tuning range of from, approximately 5 metres to 2,000 metres, the only gap in this band being around 645 metres which corresponds to the intermediate frequency of 465 kc/s. The obvious thing to do is to use a single variable condenser and a wavechange switch, as shown in Fig. 21, which enables a series of different coils to be used, thus dividing the enormous range into a number each of which is of more reasonable magnitude.

This, in fact, is the way in which most receivers cover the short, medium and long wavebands. Most receivers, however, do not tune below about 13 metres, and some do not even go to as low a waveband as this. It is then possible to use only one or two short wavebands in addition to the medium and long wavebands with small gaps in unimportant parts of the whole range. This course, however, is likely to involve us in difficulties if we try to extend the tuning range down to 5 metres and for two reasons. The first is that the total minimum capacity in the tuned circuit is likely to be so high that the coil inductance required for tuning to 5 metres will be of the same order as the inductance of the wiring. The other is that at the maximum capacity of a variable condenser of large enough capacity to give an adequate tuning range, the L/C ratio will be so low that a very poor performance will be secured. Experience shows that for ultra-short-wave reception the tuning condenser should not have a larger capacity than about 60 $\mu\mu$F. On the medium and long wavebands, however, the capacity should not be less than 350 $\mu\mu$F, if the whole of the medium-wave band is to be covered, and it is actually easier if a higher capacity is used.

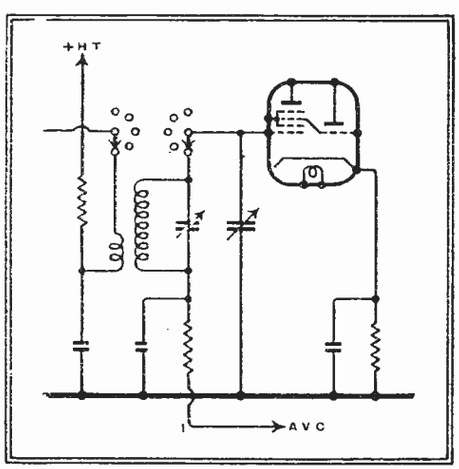


Fig. 21.—The conventional switching system with a single variable condenser is shown here.

It would seem, therefore, that the right course to adopt is to use two variable condensers, one of small capacity suitable for ultra-short wavelengths, and the other of large capacity suitable for the broadcast bands. Only in this way can we avoid an unsatisfactory compromise. It is obviously impossible to use only a small-capacity condenser, because the tuning range obtainable would be so small that we should probably need fifteen bands or more to cover the whole range of wavelengths. A single large condenser, however, while satisfactory from the point of view of giving a small number of bands, makes it extremely difficult to secure a satisfactory performance at ultra-short waves.

The first thing to do is obviously to assess the values of the stray circuit capacities, for these govern the tuning range obtainable with a given variable condenser. We can estimate these capacities as follows:— The self-capacity of the coil is likely to be about 5 $\mu\mu$F, and we can allow 3 $\mu\mu$F for the switch and 7 $\mu\mu$F for the input capacity of the valve. Wiring will add a further 3 $\mu\mu$F, and the output capacity of the preceding valve can be taken roughly as 5 $\mu\mu$F, since we are likely to be using a step-up ratio in an inter-valve transformer. This gives a total of 25 $\mu\mu$F, to which we must add about 5.5 $\mu\mu$F for the extra capacity of the trimmer.

On the ultra-short-wave side, therefore, the minimum capacities are unlikely to be less than 30.5 $\mu\mu$F apart from the minimum capacity of the variable condenser itself. In the choice of the condenser we are limited by the components available, but it so happens that an eminently suitable model is now obtainable. It has widely spaced plates and ceramic insulation with a minimum capacity of 8 $\mu\mu$F and a maximum of 60 $\mu\mu$F. With a circuit minimum of 30.5 $\mu\mu$F this makes the total capacity variable between the limits of 38.5 $\mu\mu$F and 90.5 $\mu\mu$F giving a capacity ratio of 2.35 : 1 and a frequency or wavelength ratio of 1.535 : 1.

Choosing the inductance values so that the bands overlap slightly we can cover 5 – 16.65 metres in three bands of 5 – 7.7 metres (60 – 39 Mc/s), 7.5 – 11.5 metres (40 – 26.1 Mc/s) and 10.87 – 16.65 metres (27.5 – 18 Mc/s). The inductance values for these bands come out respectively as 0.1835 μH, 0.412 μH and 0.87 μH. When using two variable condensers in this way the most convenient switching system is that shown in Fig. 22. Here L1 C1 represent the ultra-short-wave coils and condenser controlled by the switch S1. In one position of the switch the ultra-short-wave coils are all disconnected and contact is made with the arm of the second switch S2, to which is connected the variable condenser C2 of large capacity. This switch selects the higher inductance coils for the longer wavelengths. On ultra-short-waves only the small condenser, C1, is in circuit, but on the other bands the small condenser is in parallel with the main one.

The Lower Frequency Ranges

For the present we shall assume that this will be set at medium when the larger condenser is being used and we shall now proceed to estimate the stray capacities of the circuits tuned by the larger capacity. This will be the same as before except that we have to add a further 3 $\mu\mu$F for the switch, another 5 $\mu\mu$F for wiring, and 8 $\mu\mu$F for the minimum capacity of the small variable condenser. In addition, we shall add a further 9 $\mu\mu$F to take care of the probably higher self-capacities of some of the longer wavelength coils and the possibly higher transferred valve capacities, since we may not want to use such a big step-down ratio in transformers. We shall, therefore, take the total minimum as 55 $\mu\mu$F for all ranges tuned by C2. A standard variable condenser of similar general construction to the small capacity one has a minimum capacity of 13.5 $\mu\mu$F and a maximum of 525 $\mu\mu$F, giving a capacity change of 68.5 $\mu\mu$F to 580 $\mu\mu$F.

High-Quality Communication Receiver—

This is a ratio of 8.46 – 1, giving a frequency or wavelength ratio of 2.91 to 1. On the long waveband we have to tune to 150 kc/s or 2,000 metres. To allow a little overlap, we shall make the lowest frequency 140 kc/s, and we can then cover 0.406 – 0.14 Mc/s (740 – 2,145 metres) for the long-wave band. For the medium-wave band we shall probably be wise if we set the lowest frequency as 0.5 Mc/s or 600 metres, even if we cannot quite reach 200 metres on this band. Taking this figure our lowest wavelength is 207.5 metres (1.455 Mc/s).

The next band will obviously overlap with this and must also obviously be tuned by the large condenser. We can, therefore, arbitrarily fix the lowest frequency as 1.2 Mc. and then the highest works out as 3.5 Mc/s (85.7 – 250 metres). We have now a gap of 18 – 3.5 Mc/s, and we have to decide whether we shall use the large condenser or the small for this gap or whether we shall adopt a compromise by using both, each for a portion of the range. Here practical considerations are likely to decide us because the usual switch plates have a maximum of 5 contacts. For the switch S1 we require one contact for the change-over to S2 which leaves four possible bands for this condenser. For the other we can have a maximum of five bands.

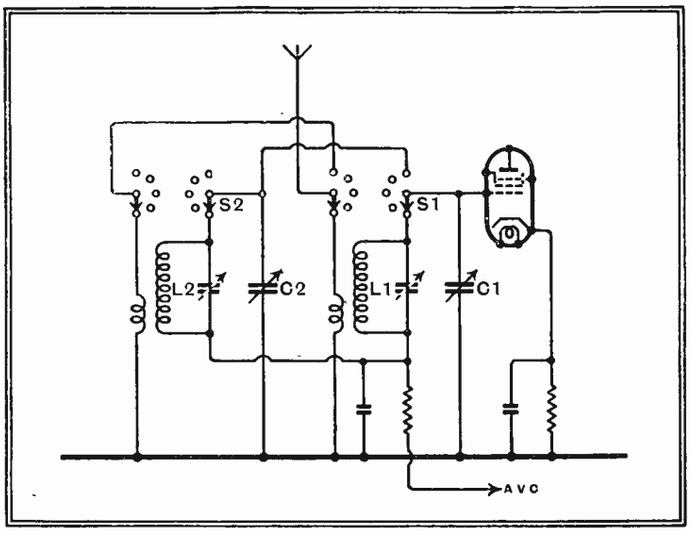


Fig. 22.—By adopting two waveband switches two variable condensers can be used without unduly complicating the wiring.

Now with two further bands using the large condenser we can fill in the gap completely allowing reasonable overlap. Using the small condenser only we should require four bands to fill in the gap which would make a total of seven bands for the small condenser, and we should need eight contacts on the switch. Apart from the difficulty of accommodating the extra coils and trimmers we should have to use a non-standard switch. We could, by using two extra ranges on the small condenser just overlap with one extra range on the large condenser making five small condenser ranges and four large. We should now require a six-contact switch for S1, however, and the overlap between ranges would be quite small and would allow little latitude for variations in circuit constants.

It will, therefore, probably be best to content ourselves with the three bands only for the small condenser and to fill in the gap by two bands on the large condenser. These work out at 2.75 – 8 Mc/s (109 – 37.5 metres) and 6.87 – 20 Mc/s (43.6 – 15 metres). With eight bands arranged in this way we can obtain a continuous tuning range from 60 – 0.14 Mc/s (5 – 2,145 metres), except for the gap of 0.5 – 0.406 Mc/s or 600 – 740 metres, which gap is necessary for the intermediate frequency. The inductance values for the five bands controlled by the large-capacity condenser work out at 0.927 μH, 5.8 μH, 30.25 μH, 175 μH and 2,250 μH respectively, taking the ranges in ascending order of wavelength.

These values of inductance are suitable for the signal-frequency tuned circuits. The primary for the RF transformer and for the aerial coupling must be determined largely experimentally, and in the design of the coils themselves a compromise must be made between the conflicting requirements of efficiency and the available space. Actually, it will not be possible to use coils with a larger diameter than some 0.5in., because they will take up an unreasonable amount of space. Moreover, even if one could tolerate the space needed for large coils, when so many have to be accommodated the leads will become so long that on ultra-short waves the lead inductance would probably be as great as, if not greater than, the total inductance required by the tuned circuit.

In the oscillator circuit the coil inductances must be of lower value and a condenser must be inserted in series with the coil in order that the oscillator may function at a frequency higher than that of the signal by the intermediate frequency. When the signal-frequency circuit constants are known, formulæ exist for calculating the optimum values for the oscillator circuit inductance, parallel capacity and padding capacity. The parallel capacity must, of course, be adjustable, and on most bands the padding capacity must be adjustable also. On band 1 the padding capacity becomes infinite. Actually, of course, a finite value is required, but is so large that it can be ignored for practical purposes. On band 4 a definite value of capacity is required, but this is large and it is unnecessary to provide an adjustable trimmer. On all other bands, however, a portion of the capacity must be made adjustable to permit the exact value being chosen. This is all the more necessary since the capacity is used in practice to correct for very small variations in inductance which are inevitably present to some degree. The matching of the coils is naturally important, but this is beyond the ability of most constructors, since they have not suitable apparatus available. The main inductance matching, therefore, must be left to the coil manufacturer.

By adopting the arrangement shown with a small capacity condenser for the three ultra-short-wave ranges, we obtain good operating conditions, and, moreover, make tuning easier through keeping the frequency ratio at a reasonably low figure. On the other bands, a more normal frequency ratio is obtained, but this is not important because the small capacity condenser is then available to give band-spread.

TELEVISION PROGRAMMES

An hour's special film transmission intended for the industry only will be given from 11 a.m. to 12 noon each weekday.

THURSDAY, JULY 28th.

3, Jack Jackson and his Band. **3.35,** Gaumont-British News. **3.45,** Craftsmen at Work—Saddlery.

9, "Re-View," songs and scenes from bygone shows. **9.30,** British Movietonews. **9.40,** As at 3.45. **9.55,** Cartoon Film. **10,** Eric Wild and his Band. **10.20,** News Bulletin.

FRIDAY, JULY 29th.

3, Jane Carr. **3.10,** Film. **3.25-4,** "Nocturne in Palermo," by Clifford Bax, with music by A. Davies-Adams.

9, Starlight. **9.10,** Cartoon Film. **9.15,** Ballroom Dancing. **9.30,** Gaumont-British News. **9.40,** "Charivari"—variety. **10.10,** News Bulletin.

SATURDAY, JULY 30th.

3, In Our Garden, by Reginald Perry. **3.15,** Cartoon Film. **3.20,** "Re-View" (as on Thursday at 9 p.m.). **3.50,** Gaumont-British News.

9, "Order to View," a revue by Michael Trafford with music by Billy Milton. **9.30,** Film. **9.45,** "In the Dentist's Chair," the thriller by Anthony Armstrong. **10.5,** British Movietonews. **10.15,** News Bulletin.

SUNDAY, JULY 31st.

8.50, News Bulletin. **9.5-10.5,** "Bird in Hand," a play in three acts by John Drinkwater.

MONDAY, AUGUST 1st.

3, Cartoon Film. **3.5,** O.B. from the Crystal Palace of Bank Holiday Celebrations—"All the Fun of the Fair." **3.25,** Gaumont-British News. **3.35,** Crystal Palace O.B. continued. **3.50,** Film—Madrid in 1935.

9, Cabaret. **9.30,** British Movietonews. **9.40,** Cartoon Film. **9.50,** Catch-as-catch-can wrestling. **10.10,** News Bulletin.

TUESDAY, AUGUST 2nd.

3, Cabaret. **3.30,** British Movietonews. **3.40-4.10,** A panorama of Exhibitions, from Paris, 1797, to Glasgow, 1938.

9, Starlight—Jane Carr. **9.10,** Cartoon Film. **9.15,** "Ann and Harold," serial by Louis Goodrich, Episode 4—Their Wedding. **9.30,** Gaumont-British News. **9.40,** Pas Seul. **10,** News Bulletin.

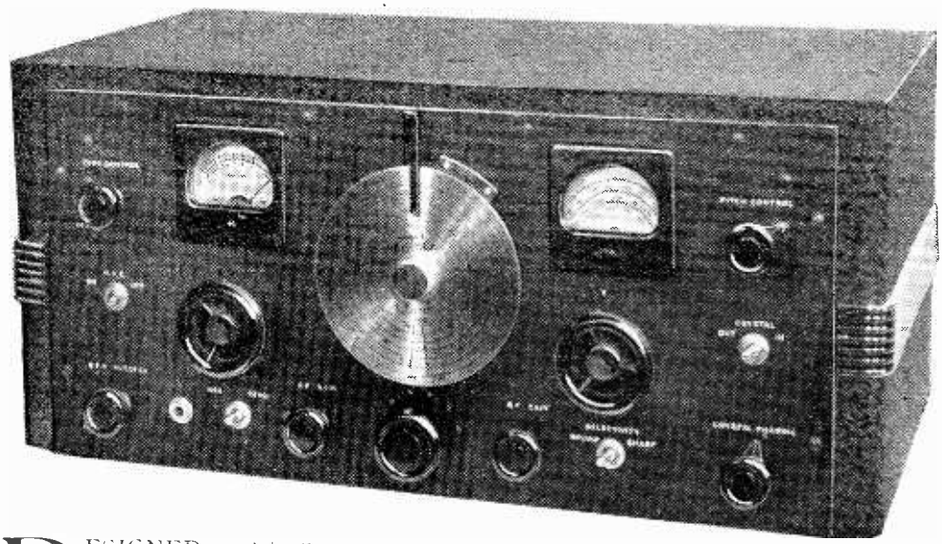
WEDNESDAY, AUGUST 3rd.

3-4, "Bird in Hand" (as on Sunday at 9.5 p.m.).

9, Starlight. **9.10,** Cartoon Film. **9.15,** Tennis Demonstration. **9.30,** British Movietonews. **9.40,** "Contrasts." **10.10,** News Bulletin.

A Set Built on Professional Lines for Use by Amateurs

Hallicrafters SUPER



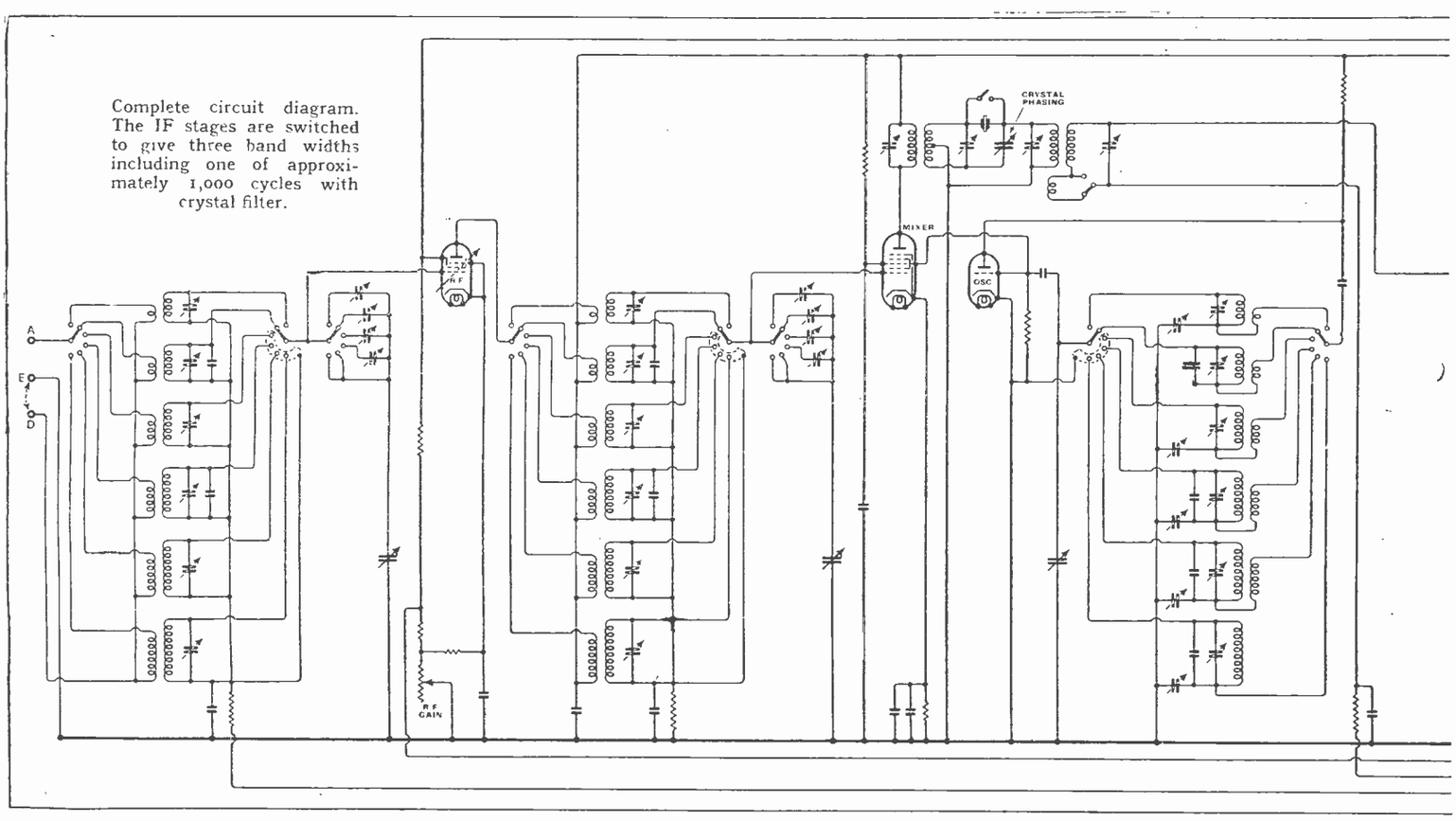
FEATURES. ***Waverange.***—*4.85 to 550 metres in six bands:—(1) 545-1555 kc/s. (2) 1545-4300 kc/s. (3) 4.2-10.2 Mc/s. (4) 9.8-20.5 Mc/s. (5) 19-36 Mc/s. (6) 35-62 Mc/s.* ***Circuit.***—*RF ampl.—mixer—separate osc.—1st IF ampl. and crystal filter—2nd IF ampl.—2nd det. AVC and 1st AF ampl.—push-pull output tetrodes. Beat freq. osc.—signal indicator ampl.—full-wave rectifier.* ***Controls.***—*(1) Main tuning. (2) Band spread tuning. (3) Waverange. (4) AF gain. (5) RF gain and signal meter switch. (6) BFO injector and on-off switch. (7) BFO pitch control. (8) Selectivity switch. (9) Crystal filter switch. (10) Crystal phasing. (11) AVC on-off switch. (12) Send-receive switch. (13) Tone control and on-off switch. (14) Meter amplifier zero adjustment.* ***Agents and Distributors.***—*Webb's Radio, 14, Soho Street, London, W.1.*

DESIGNED primarily to meet the requirements of the American radio relay organisation the thoroughbred "communication" short-wave receiver has been developed to a high degree of electrical and mechanical perfection. The receiver under review is an excellent example of a type which is finding favour not only with the transmitting fraternity in this country but also with those who take an interest in long-distance short-wave reception, whether from the amateur or the professional point of view.

There are eleven valves, including rectifier, and six stages are in the direct line of amplification between aerial and loud speaker. Two of these are devoted to IF amplification, and there is an RF amplifier which functions on all six wavebands. The high overall magnification which this arrangement promises is fully realised, and even at the highest frequencies the settings of the AF and RF volume controls indicate that there is an ample reserve of power on any signal.

By judicious allocation of the total amplification between these two controls an outstandingly good signal-to-noise ratio was obtained. Two American broadcast transmissions which were completely engulfed by background noise in a good "all-wave" set came through quite clearly on the Hallicrafters receiver.

The set is also much more stable than most from the point of view of micro-

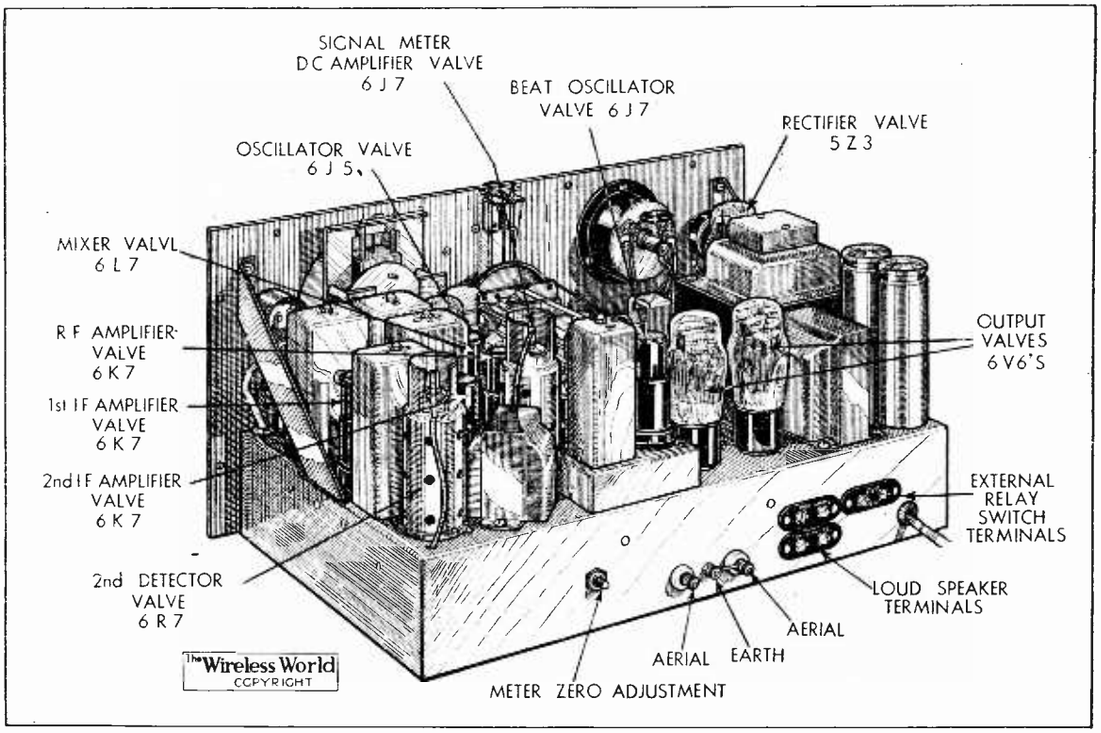


Complete circuit diagram. The IF stages are switched to give three band widths including one of approximately 1,000 cycles with crystal filter.

SKYRIDER

TYPE SX-16

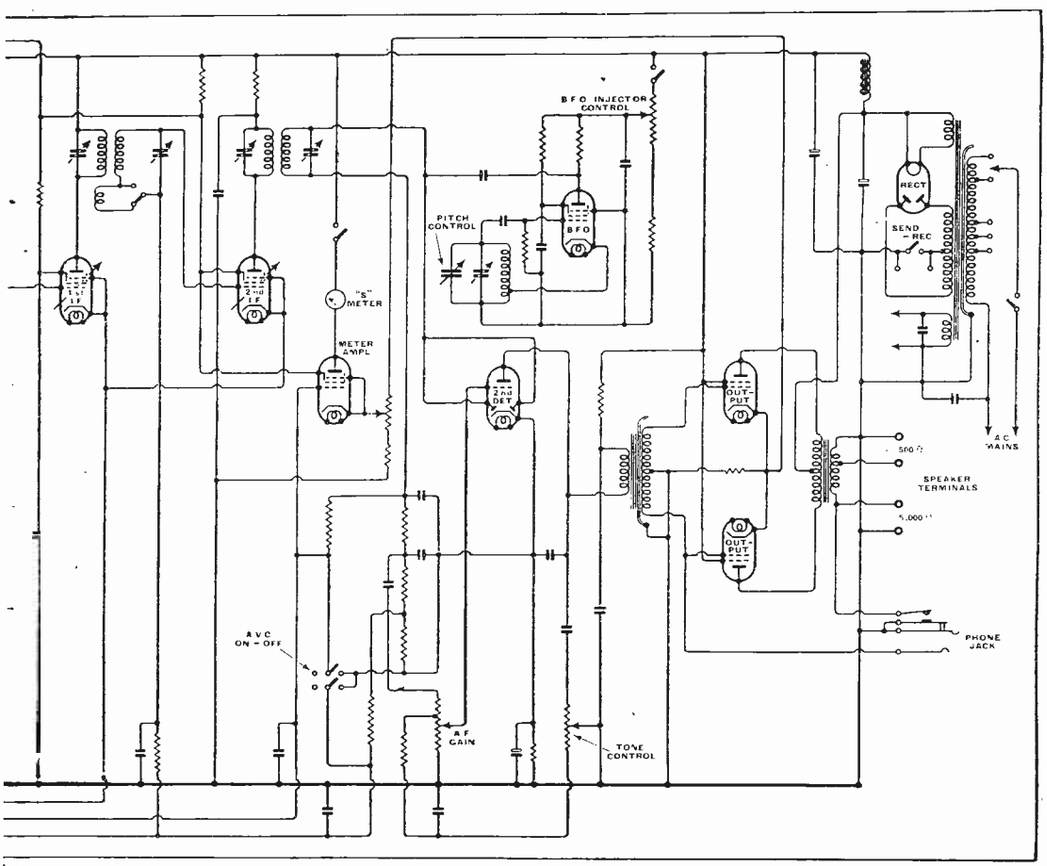
phony. Even on the television band with a carrier showing +9 (i.e., the maximum) on the signal strength meter far more watts than could be usefully employed were given by the output stage before the point of acoustic instability was reached. This is clearly marked, and there is no suggestion of feed-back building up gradually at any level below the threshold.



In mechanical construction the chassis shows the same refinement in detail as is found in the circuit design. Ceramic insulation is widely used and will be seen in the aerial terminal supports.

Frequency stability is of a high order, and the television sound carrier is as accurately tuned at the end as at the beginning of the hour's transmission. The frequency shift due to warming up is also much smaller than usual and well within the normal IF band width.

It is in the selectivity that this receiver shows its greatest superiority over broadcast sets. The normal operating band width of 7.5 kc/s for a 100: 1 reduction of signal strength can be narrowed to less than 1 kc by the crystal filter or expanded to 25.5 kc/s by switching in a third winding on the iron-cored IF transformers. With the broadened band width, quality of reproduction is first rate, and any lack of extreme top which a "high-fidelity" reproducer might reveal is more than compensated for by the clean handling of the middle and upper-middle registers by the push-pull output stage.



When the crystal is switched in and properly balanced it is possible to explore the modulation fringe of a broadcast transmission and get a very good estimate of the distribution of energy in different parts of the sound spectrum. When receiving CW signals with the beat oscillator in operation only one side of the zero beat comes through, so that selectivity may be visualised literally in terms of audio frequency. Incidentally, the strength of the local oscillation injected into the main circuit is under perfectly graduated control, and the pitch control is equally smooth in operation.

Every detail of the performance is neatly executed and well rounded off. Self-generated whistles are conspicuous by their absence, and only on the 32-62 Mc's band is second channel breakthrough of any consequence. No set with one or even two RF stages could do better than this.

Smooth Controls

A good deal of attention has been given to what may be termed the amenities of working the set. To the seasoned experimenter this is important, for he may spend hours at the controls working to a prearranged schedule, and anything which will relieve the tension of constant application will be appreciated.

The main tuning condenser is of composite construction. Three of the stator vanes near the middle of each section are specially shaped to act also as stators for the small-capacity band-spread gang condenser with its own separate spindle and

Hallicrafters Super Skyrider—

rotors mounted at one side of the main condenser frame. By this arrangement, only one set of insulation for the combined stators is required and parallel losses are thus eliminated. Both the main and the band-spread tuning spindles are driven through reduction gearing incorporating lead flywheels to facilitate rapid movement from one part of the scale to another. The control knobs are of large diameter, and are moulded in bakelite with a smooth periphery. All these features combine to give just the right balance between the various demands of coarse and fine tuning.

The main tuning scale with its 338 degree scales is sufficiently accurate to locate a station within the range of the band-spread condenser. Each wave range is directly calibrated, and a pointer coupled with the wave-range switch automatically directs the eye to the appropriate scale. For accurate logging of stations, a vernier degree scale is provided on the outside edge of the metal dial.

The band-spread scale is engraved in the form of a spiral on a translucent scale with a shadow tuning device which leaves no ambiguity as to the portion of the scale to be read. There are no fewer than 1,000 degrees marked on this scale, and on the 20-metre band each degree is equivalent to a change of frequency of 5 kc/s. One complete turn of the band-spread control knob moves the scale five divisions.

The "S" meter is also provided with an internally illuminated scale. It is calibrated from zero to 9 plus, and is fed through a valve biased so that with no signal the maximum current is flowing in the meter. Any strong signal or atmospheric will result only in a reduction of current, and in order that the scale may be read in the conventional manner the meter has been given a right-hand zero. A potentiometer control for zero adjustment is fitted at the back of the chassis. Here will be found the terminals with ceramic insulation for doublet or single-wire aerials, and output terminals for loud speakers with 500 or 5,000 ohms impedance. The latter will be best suited to the majority of British speakers with transformers suitable for, say, a low-impedance triode valve.

Near the loud-speaker terminals is another terminal panel to which a remote control relay may be connected for breaking the HT supply when the transmitter is brought into operation. Actually these terminals are in parallel with the manually operated send-receive switch on the front panel. The headphone jack is connected to the triode portion of the second detector through half of the push-pull intervalve transformer. With this arrangement crystal headphones can be used without any special precautions.

This is a receiver which is exceptionally well turned out in every particular. It has the range and selectivity to satisfy the keenest long-distance enthusiast. It gives out signals cleanly without background noise, self-generated whistles or overload distortion, and it is rock stable in operation.

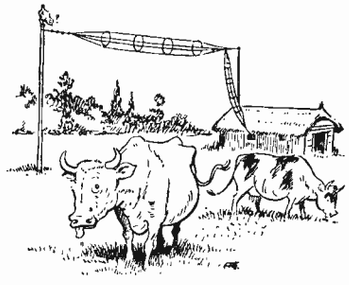
Unbiased

By FREE GRID

Relays and Autotuning

I SEEM to have raised a hornet's nest about my ears by the opinion I put forward in these columns recently that the motor-driven type of press-button receiver was the only one suitable for providing with a remote tuning control unit. You may recollect that my idea was to dodge the interference radiated by the house mains by placing a press-button receiver at the end of the garden out of harm's way and working it by means of a remote push-button unit.

Several readers have written to tell me that actually the type of push-button receiver in which each button puts a small pre-set fixed-variable condenser across each of the tuned circuits is equally applicable to remote control as is the motor-driven type; in fact, they tell me that it is actually simpler to arrange as all that has to be done is to use a simple solenoid to operate the push-buttons. If this be the case—and personally I cannot see any snags in it—I should think that an even simpler arrangement would be one of the so-called mechanical push-button sets where the button merely works a lever which shoves the tuning condenser round to a predetermined point. Surely a solenoid should be equally applicable to this also.



A receiver-house in the country.

At any rate, whether this is so or not, I can well see that the development of push-button sets has definitely solved the old controversy of relays versus individual wireless sets. All that need be done nowadays is for some enterprising company to build a gigantic receiver-house somewhere out in the country far from electrical interference and to invite everybody to house their receiver therein for a small weekly fee, tuning being done by remote push-button control.

Justice for Jazz-Lovers

I WAS very interested to read in a daily newspaper an article in which it was suggested that broadcasting wavelengths should be grouped together according to the type of entertainment that was to be sent out on them, one wavelength being reserved exclusively for high-brow stuff, another for talks and a third for jazz and broadcasts from the Zoological Gardens. The article containing the suggestions was written by one, Ivor Novello, who, judging from the exaggerated respect with which Mrs. Free Grid treated his name when I read it out from the newspaper at

"Exaggerated respect with which Mrs. Free Grid treated his name."

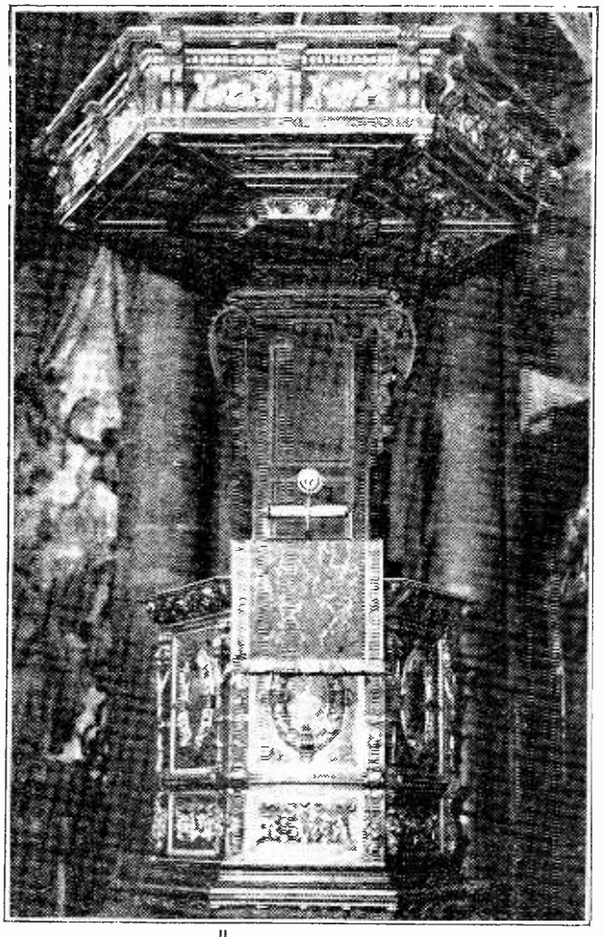
breakfast time, must, I think, be a film star or something like that. I am interested in the suggestion mainly because it has appeared so often in *The Wireless World*, both in my own weekly notes and in other less-widely-read parts of the journal.

Frankly, I cannot see that there would be the slightest difficulty in putting the idea into practice. Some people seem to anticipate that there would be a grave quarrel among the various groups as to which should have the best wavelengths. It is well known, of course, that down at the very bottom of the medium band there is less carrying power than higher up, and it might be thought that it would be very unfair to allot this particular part of the band to any type of programme, even chamber music, for instance.

I quite fail to agree with this as I see not the slightest reason why the promoters of low-brow jazz concerts should not be content to occupy this part of the wavelength spectrum. Although carrying power is admittedly restricted, this is more than compensated for by the fact that electrical interference, heterodyne whistles and sideband splutter are more prevalent. The presence of these extraneous noises cannot possibly be detected by the jazz-lover, since they merely sound like part of the programme; in fact, if anything, they improve it. There could then be no possible cause for complaint. In certain areas where interference is exceptionally bad it wouldn't much matter whether the ordinary jazz programme were heard or not as listeners wouldn't be able to detect its absence, as its similarity to man-made static is really extraordinary.

Sound Reinforcement in Westminster Abbey

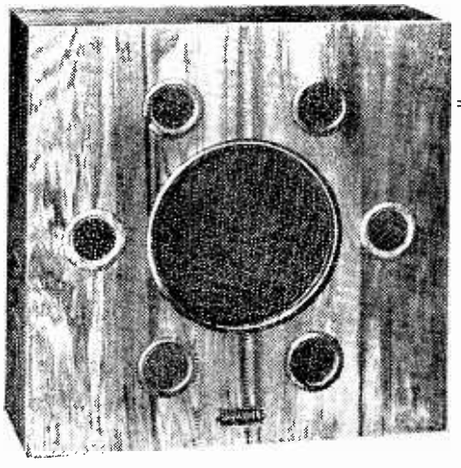
AN INSTALLATION PRESENTING UNUSUAL PROBLEMS



Mounting of the moving-coil microphone on the pulpit.

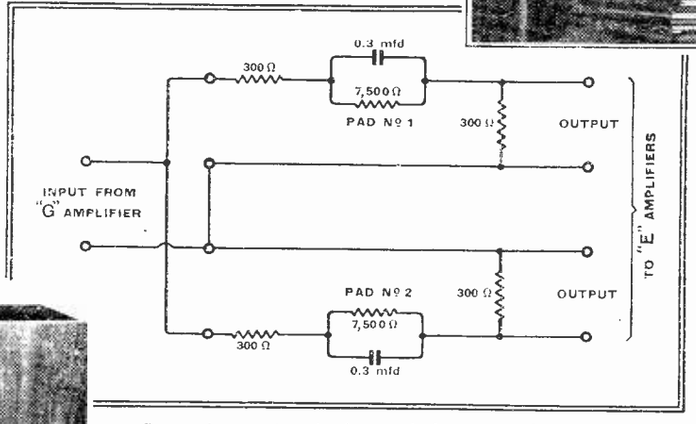
As may well be imagined, the installation of a permanent public address system in Westminster Abbey involved the solution of many problems arising from the acoustics and construction of the building. The extremely hard nature of the walls and floor spaces, together with the extreme height, made it necessary that a large number of loud speakers should be used but that all of them should be operated at a very low volume. The development of the "Brimavox" loud speaker by Standard Telephones and Cables, the firm responsible for the installation, greatly facilitated progress, and it is this instrument that serves throughout the Abbey. This loud speaker is of the permanent-magnet type, with dual diaphragms and a power rating of 2 watts. The speech coil impedance is 2.5 ohms, but a transformer is mounted on the chassis giving a standard impedance of 5,000 or 2,500 ohms. The former value was adopted throughout the installation.

In order to determine the most suitable volume at which the loud speakers should be operated and the area that could be satisfactorily covered by each, very many experiments were necessary. The final layout decided upon called for the installation of thirty-three loud speakers in all.



The Brimavox speaker; radiation of low frequencies from the front of the diaphragm is reinforced in correct phase by radiation from the back through a series of tubes, the openings of which can be seen in this photograph.

It was found convenient to dispense with the cabinets and mount the units on 6in. shaped baffle-boards in the Choir and High Altar positions. These baffles were then mounted inside the decorative canopies surmounting the choir stalls and sides of the Sanctuary, thereby screening them from view. It was not possible to hide the remaining cabinets, but they were subsequently painted to match their respective backgrounds. The average height of mounting the speakers throughout the whole installation was about 12ft.



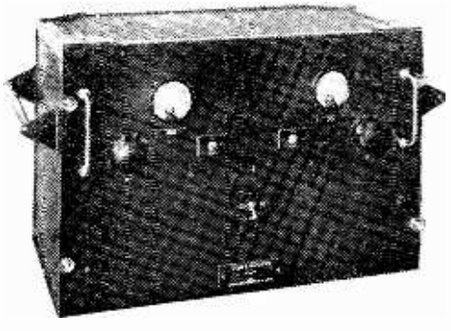
Correction network inserted between the input and output amplifiers.

To meet the requirements of the Abbey authorities, moving-coil microphones were installed, one being placed in the pulpit, lectern, precentor's desk and Sanctuary, and two at the High Altar, making a total of six in all. Three additional microphone points were wired but not equipped, one in the lantern and two in the nave.

Individual consideration was given to the method of mounting each microphone, and special fixings were made for each instrument with the exception of the microphone in the Sanctuary, which was mounted on a floorstand. This stand, in conjunction with an 80ft. screened cord and the additional microphone points already mentioned, afforded a considerable degree of flexibility for special services.

A single "G" amplifying unit was used to drive two "E" amplifiers, each delivering 30 watts. The nave circuit of fourteen speakers, considered to be approximately half the total load, was connected to one "E" amplifier. The second was used for the remaining circuits, which, excluding the monitor, totalled eighteen speakers. Each circuit was terminated on a control panel and matched by means of constant-impedance fader potentiometers to the 500-ohms output of the amplifier.

A separate on-off switch was included in each fader circuit, also a monitoring jack, thus enabling a flexible lead from the monitor speaker to be plugged into any desired output circuit. The micro-



One of the two Standard Telephones "E" amplifiers used to feed the loud speakers in the Abbey installation.

Sound Reinforcement in Westminster Abbey—phone keys are also incorporated in the control panel, and thus all microphones and speakers are controlled from the one panel.

In order to sharpen the speech and as an added precaution against any tendency to resonate, external pads, arranged as in the accompanying diagram, were connected between the output of the "G" and the inputs of the two "Es."

With regard to the operation of the equipment, it is essential that the controls should be continuously supervised during the entire service, thus ensuring that the speakers are worked at a suitable volume level and that appropriate microphones are selected. Certain Abbey vergers have been instructed in the operation of the equipment, and one of them is detailed for duty at the control panel during each service.

In America To-day

By Our Special Correspondent

SINGLE-ENDED TELEVISION PENTODES

IN several issues of *The Wireless World* there has been mentioned the possibility of shortening the wiring in a high-frequency amplifier by using alternate top-grid and top-plate pentodes. Another attack on this same problem is represented by the latest American television pentodes, which are known as types RCA-1852 and RCA-1853. These both have metal shells, eight-pin "octal" bases, and heaters drawing 450 milliamperes at 6.3 volts. They differ only in that the 1852 has a steeper slope and sharper cut-off. All leads come through the base, the argument being that it is more important to shorten the wiring than to keep grid and plate on opposite faces of the metal baseplate of the amplifier. There is room for opinion on that point, but it is quite true that the pin arrangement has been chosen to shorten the wiring while permitting the shield-can of the coupling device to serve the customary auxiliary purpose of screening each tube from its neighbour. The diagrams attempt to illustrate this and other points.

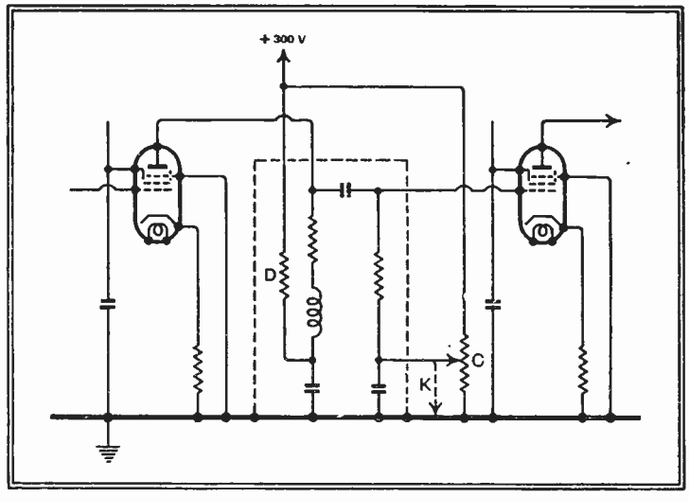


Fig. 1.—Resistance-coupled amplifier with sharp-cut-off tube type 1852.

In a resistance-coupled VF amplifier the sharp-cut-off 1852 is suitable, used somewhat as in Fig. 1. Two circuit conditions are here suggested. In the first the grid resistor has a value not greater than 250,000 ohms and is returned to chassis as indicated by the arrow K, the corresponding cathode resistor having a value of 160 ohms. The second condition applies to cases where it is necessary to employ a grid resistance as high as 1 megohm, with the consequent possibility of positive grid "locking." In this case the grid is first given a positive bias by returning the grid resistor as suggested by arrow C to a point about 9,000 ohms from the chassis end of a 259,000-ohm voltage divider whose "high" end is 300 volts (+) above chassis potential. This positive bias is then overbalanced by increasing the cathode resistor to 1,000 ohms. If for any reason the tube draws more than normal current, the overbalance increases and limits the rise. The screen supply (not shown) is through 60,000 ohms from a "plus 300" source. The heater has also been omitted for simplicity, two pins thus appearing blank. The plate circuit has been shown with the usual decoupler resistor D and a load composed of both inductance and resistance—say, 2,500 ohms of the latter—merely as an illustrative example. Cathode by-passing, if used, has the usual effect of increasing gain and distortion.

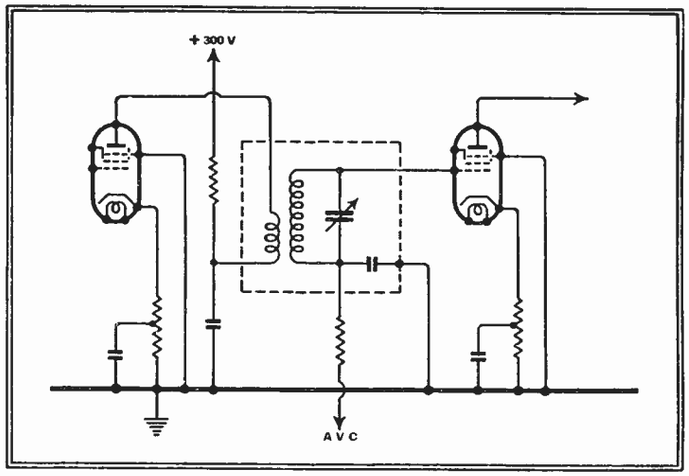


Fig. 2.—This diagram shows the arrangement for transformer coupling with either the sharp cut-off or remote cut-off tube.

Short wiring is also possible in a transformer-coupled stage, as shown by Fig. 2. In this case it is advisable to limit degeneration by partial by-passing of the cathode resistor. For the sharp-cut-off tube this resistor has a value of 160 ohms tapped for by-passing at 35 ohms from the cathode end, while for the remote-cut-off tube the values are 190 and 70 ohms respectively. The screen series resistor must be decreased from 60,000 to perhaps 30,000 ohms if the remote-cut-off tube is used.

The foregoing operating suggestions are in part, and the following constants altogether, supplied by the manufacturer, the Radio Corporation of America.

	1852	1853
Input capacitance (micro-micro-farads)	5	8
Output capacitance...	11	5
Feedback capacitance	.015	.015
Supply voltage ...	300	300
Screen series resistor	60,000	30,000
Cathode resistor ...	160 tapped or 160 or 1,000 plain (see text)	190 tapped (see text)
Amplification factor	6750	3500
Transconductance (mA/V) ...	9	5
Plate current (mA.)	10	12.5
Screen current (mA.)	2.5	3.2
Bias	*	— 3
Cut-off bias (approx.)	—12	—23

* Normally about —3, but actually adjusted to give normal plate current.

STANDARD-WAVE ANTENNA OF STATION KDKA

THE antenna used for medium-wave broadcasting from station KDKA, near Pittsburgh, Pennsylvania, U.S.A., is perhaps of only academic interest to a transatlantic reader, since it is designed for the particular purpose of preventing sky-wave transmission. The intent was, of course, not to prevent reception in Europe but to prevent the dreadful garbling of

In America To-day—

KDKA's signal in its normal service area —an effect only too well known in the Eastern United States.

The main antenna at KDKA is a vertical radiator with the customary buried radial net beneath it. Such an antenna provides a problem for the designer; by making it taller than is necessary for the best low-angle transmission into the normal service area he can at considerable cost secure a partial erasure of the high-angle or sky-wave transmission which causes garbling. Unfortunately, the erasure is not complete by any means. At KDKA the main antenna has therefore been made of a height to provide the best service-area signal and the sky-wave suppressed by a circle of auxiliary antennas. These auxiliaries are also vertical but of considerably lesser height. They are, in fact, somewhat less than ¼-wave high, but loaded to near-resonance. Exact resonance is avoided, since weather changes make it difficult to maintain resonance, as is all too well known to anyone who has ever worked with antenna arrays.

The main antenna has an adjustable top section and is set at something near ½-wave height (electrical height, that is). Power is fed to the main antenna only, the suppressor-antennas being parasitic. This arrangement not only provides a very simple feed-system but also makes possible the facile adjustment of phasing at the auxiliary antennas, by adjustment of the loading devices. Improvement of the signal at some points has certainly been very marked. It remains to be seen whether this improvement is sufficiently widespread to encourage the installation of similar systems at other stations. New England should be a notable proving ground for antenna systems, since the clear-signal service areas of some of our north-eastern stations resemble a slice of Swiss cheese. It is even reported that the very excellently operated 50 kilowatt station WTIC at Hartford, Connecticut, is very poorly heard at some points within 20 miles. The former 5 kilowatt WBZ, then located at Springfield, Massachusetts, and using an antenna power between 5 and 10 kilowatts, was very "fuzzy" at several points within plain eyesight of Springfield. Of course, KDKA is not in New England, but one automatically thinks of New England whenever there is talk of transmission improvement.

Change and Decay [*or Sour Grapes*]

1938 MODELS ARE NEARLY OUT OF DATE

ONE learns a lot from advertisements. On the principle of the survival of the fittest, those that fail to appeal presumably drop out, so what remains may be assumed to reflect human nature candidly—much more candidly than human nature itself would care to admit. Few people describe themselves as snobbish; yet the advertisements show that snob-appeal is a winning card.

Another winning card is novelty. Splashed across some advertisements one sees the single word "NEW"; few lack this word, which is nearly always underlined or printed in red. Or else we are told that the article offered is "Just Out!" Other announcements, while obviously reluctant to admit that last year's models left much to be desired, are full of the information that this year's are Improved, Much Improved, or even Enormously Improved. Offering the same model for a second year is equivalent to confessing failure. It doesn't matter how marvellous and perfect and in advance of its time it was the year before; in some mysterious way its virtue has departed from it merely with the passage of time.

Of course, the commercial motive is too obvious to need pointing out. But commerce would be unable to "cash in" on the novelty theme unless it were one of the fundamental human desires. In some fields it is not so. A person who tried to divert attention from Canterbury Cathedral by advertising a new and greatly improved cathedral in the same district would find little response. Connoisseurs of wine, too, are not impressed by the "Just Out!" type of publicity. But the radio-buying public are.

It is only to be expected, of course; because radio is a fast-developing affair.

By "CATHODE RAY"

If a set were to be brought out now of exactly the same type as those sold fifteen years ago, no amount of front-page shouting about its up-to-dateness would convince people that it really was an advance on last year's models.

Yet even a fifteen-year-old set might compare favourably in a few details with what is turned out now. I remember the loving care with which massive brass terminals were hand-lacquered and panel mounting screws were all turned with their slots exactly parallel to the edges. We should not let the advertisers bludgeon us into supposing that Change *always* means the same thing as Progress.

Quite a lot depends on the accident of which came first. If wireless had come first, then line telegraphy and telephony would have been hailed as a great advance, economising in power, simplifying processes, and ensuring secrecy of communication. If in some way, difficult to imagine, the triode had been invented after the pentode, might it not have displaced the pentode by reason of its obvious advantages—simplicity, cheapness, absence of screen current, purer amplification, freedom from risk of damage due to excessive load impedance, much greater latitude of load impedance? Change has unquestionably been a strong point in the valve industry during the last year or so; four of the best-known makers have now adopted different and non-interchangeable systems of bases. But if this is progress, show me the reversing lever.

Old, But Good

The earlier types of output transformer were terribly bulky and expensive. But at least their efficiency was over 50 per cent. and they did not saturate when the rated power was handled at low frequencies. If it only had the merit of being new, don't you think some firm would be glad to announce, as a great improvement, the idea of having the loud speaker separate from the receiver instead of being boxed up with it? And somebody would be floating a company to commercialise the clever new invention of miniature "loud" speakers (or *headphones*) to attach to individuals' ears so that they can listen without disturbing others. A counter-attraction might be an amazing new wireless wonder, a real sensation, a receiver needing *no* batteries, *no* mains, *no* power supply at all; *no* maintenance costs whatever! All this rendered possible by a marvellous crystal, more mysterious than any fortune-teller's! Can you imagine the demand? By the way, and getting back to reality, I believe crystal sets are still sold in small numbers, though nobody dares advertise them.

Perhaps, even, if all receivers hitherto had been of the push-button tuned type, somebody would be busy now laying out a national advertising campaign to herald the introduction at Radiolympia of a revolutionary new improvement in radio, something definitely years ahead—only a single knob for tuning to *all* stations! No unsightly rows of buttons; no retrimming; no motors; no ATC; no nothing, except pure undiluted enjoyment, with *one* key in your hand to *every* station!

When radio becomes old enough for the pioneers to become extinct, so that nobody remembers what the beginning was like, no doubt many things will come full circle. Already there have been examples. QPP was invented during the War, to make the best of valves then available. About seventeen years later the steady march of progress arrived at it again. It is like Einstein's theory that you have only to travel eastwards in space for long enough and you will arrive at the same place from the west.

The point of all this? Before we are very much older Radiolympia will be opening its doors (it is going to be a radio show this year, I hear) and 1938 models will be "out of date." Have you your money ready in your hand to exchange for all the NEW features of 1939? No? Well, perhaps I have been some consolation to you.

Random Radiations

By "DIALLIST"

The Spark Nuisance

SOME time ago I wrote optimistically that we should not have to endure spark interference on the medium-wave band much longer, as the days of the spark transmitter were numbered. A ship's radio operator is kind enough to send me "horse's mouth" information on the subject, which is not quite so cheering. It appears that under Article 7 of the Madrid Convention it is only the higher-powered spark transmitters that are to be banned the year after next. According to the Article mentioned, "No new installation for the emission of Type B waves may be fitted in ships or in aircraft, except when the transmitters, working on full power, take less than 300 watts at audible frequency measured at the input of the supply transformer." Actually, new ships are still being fitted with low-powered spark transmitters as their only means of radio communication, and unless some new agreement is concluded the spark nuisance may be with us indefinitely, though the intensity of the interference and the range at which it occurs may be considerably reduced. My correspondent, who should know what he is talking about, adds that the use of "spark" should be absolutely prohibited except for distress or similar signalling. I quite agree

Midget Televisors

I HEAR rumours that some of the television receivers using miniature cathode-ray tubes which will be on view at the Exhibition are to be marketed at prices which should bring them within range of a large number of possible viewers. It seems to be on the cards that the simplest and cheapest of these tiny television receivers may be for vision only. At first sight a receiver that doesn't deal with the accompanying sound might seem not very useful; but I am not so sure about that. Almost any small superhet without a high-frequency stage will receive the television sound within the area where the field strength is good, provided that it will tune down to a little above 14 metres, say between 21 and 22 megacycles. Reception takes place by means of the second harmonic of the oscillator—usually pretty strong—which beats with the sound fundamental frequency of 41.5 megacycles to produce the intermediate frequency of the receiver. I don't think I am giving away any trade secrets when I say that this oscillator second harmonic method of reception is actually made use of in some of the smaller sets which have a television sound range.

The Interference Height Limit

A WEEK or two ago I wrote in these notes that it was generally believed that, though the horizontal field of interference from car ignition systems could be extensive, it did not rise vertically much more than 30ft. above the source. A Lancashire reader, whom I have often heard at work on the amateur wavebands, writes to tell me about some experiences of his. His aerial, he tells me, is situated in a field bordering a main road which carries a good deal of traffic. Making a generous allowance for sag in the middle, the effective height of the aerial is at least 40ft. above the ignition system of any passing car. He has tried aerials of several different kinds, but his reception is so badly interfered with that a passing car will cause even a R9 signal to be swamped for a moment.

A Queer Effect

My correspondent does not mention whether or not the down-lead is screened. As the aerial is presumably quite near the road I should imagine that screening would be almost essential to prevent pick-up by the down-lead. Curiously enough, though, he has noticed that interference is at its worst not when a car is opposite the down-lead, but when it is on a level with the middle of the roof part of the aerial. And there's another interesting fact that has been observed. The road rises rather sharply as it passes the house. It is found that a car going uphill causes much more interference than one coming down, though the former is on the far side of the road. My correspondent suggests that this may be due to the fact that cars climbing the hill do so with a fully opened throttle, which means that a large volume of gas is drawn into the cylinders and that compression is high. He asks whether, in such circumstances, the magneto would not give a stronger spark. I should think it quite possible, for there is more resistance to be overcome.

Facts Wanted

I have read reports on a good many investigations into the extent of the interference field produced by car ignition systems, and to the best of my recollection all have been agreed that from 25 to 30ft. above the source is the limit of the height to which it extends. This Lancashire reader is inclined to class such estimates as bunkum and to believe that interference extends to at least 60ft., and probably higher than that, above the source. It would be interesting to know whether the experiences of other readers con-

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, JULY 28th.

Nat., 11.40 a.m., Launch of the new *Mauretania*. 6.40, Billy Cotton and his Band. 8, "Round the Fol-de-Rols," from the Isle of Wight, Llandudno and Hastings. 9, Louis Kentner, pianoforte.

Reg., 7, Suggestions for Week-End Walks in London. 8.40, "Dead Metaphors," talk by Lord Dunsany. 9, "Dear Love," a musical comedy.

Abroad.

Brussels II, 9, The I.N.R. Symphony Orchestra, conducted by Dejoncker, with Huybrechts, pianoforte.

FRIDAY, JULY 29th.

Nat., 7.40, "Paradise Isle"—variety. 8.15, Louis Levy Presents "You Shall Have Music." 9, "The Mighty Adam," musical play. 9.45, "Up Against It."

Reg., 8, "The Two *Mauretanias*," a sound picture of the two ships. 8.30, American Music relayed from Zurich. 9, Northern Music Hall. 10.25, "Ashore To-night": Dance Bands from the *Queen Mary* and the *Empress of Britain*.

Abroad.

Munich, 8.10, Bruckner's Seventh Symphony.

Paris, PTT, 8.30, Vichy Concert—The Municipal Symphony Orchestra, conducted by Fourestier, with Reynal, violin.

SATURDAY, JULY 30th.

Nat., 4.40 and 6.45, Navy Week at Portsmouth—commentaries from Portsmouth Dockyard. 7.30, Brian Lawrance and his Orchestra. 8, "The Case of the Frightened Lady" by Edgar Wallace. 10.25, Massed Bands of the Southern Command, from the Tidworth Tattoo.

Reg., 7.5, Amateur Photography—I, Talk by F. J. Mortimer, Editor of *Amateur Photographer*. 8.30, Sing-Song—a Saturday night entertainment.

Abroad.

Radio-Paris, 7, Salzburg Festival—"Fidelio," opera (Beethoven) from the Festival Theatre.

SUNDAY, JULY 31st.

Nat., 1.45, Troise and his Mandoliers. 6.30, Menges String Quartet. 9.5, Leslie Jeffries and his Orchestra.

Reg., 5, Medvedeff's Balalaika Orchestra. 9.5, "London on the Spree," Seven Centuries of Cockney Diversion. 9.45, Fred Hartley and his Sextet.

Abroad.

Radio-Paris, 8.15, Vichy Concert—"Rigoletto," opera (Verdi).

MONDAY, AUGUST 1st.

Nat., 7, "The Bungalow Club." 9, Victor Silvester and his Ballroom Orchestra. 9.45, "The Past Week," talk by the Hon. Harold Nicolson.

Reg., 8, Recital by Mark Hambourg. 8.20, Bank Holiday at Weston-super-Mare. 9, "To-day of All Days," comedy.

Abroad.

Frankfurt, 7 "Figaro," opera (Mozart).

Strasbourg, 8.30, "The Taming of the Shrew," comedy after Shakespeare.

TUESDAY, AUGUST 2nd.

Nat., 7.20, B.B.C. Theatre Organ and Three Grand Pianos. 8, Canadian Fantasy—from Toronto. 8.30, Seaside Nights: Southend.

Reg., 8, The Royal National Eisteddfod of Wales. Mass in B. Minor (Bach). 9.5, "The Absentee"—story by L. A. G. Strong. 9.30, "A Ship in the Bay," musical comedy.

Abroad.

Stuttgart, 8.15, Musical Conglomeration: Village Band, bass, guitar, piano, etc.

WEDNESDAY, AUGUST 3rd.

Nat., 6.25, Organ Recital by Maurice Vinden from the B.B.C. Concert Hall. 8, "A Ship in the Bay." 9, "The Mystery of the *Marie Celeste*."

Reg., 6, Irish Dance Music. 7, Variety. 8, Your Visit to Scotland. 9, Dave Frost and his Band.

Abroad.

Deutschlandsender, 7, "Don Giovanni," opera (Mozart).

Frankfurt, 8.15, "Song of the Danube," programme of folk music.

firm this view or not. Perhaps, too, some of the firms which specialise in the erection of anti-interference receiving aerials would tell us what height they find to be effective in getting rid of car ignition interference.

News from Schenectady

A VERY interesting letter about W2XAD and W2XAF, the Schenectady twins, comes from Mr. E. S. Darlington, who is in charge of short-wave broadcasting at the stations. He began his letter to me in momentary expectation of the arrival of a lorry to remove him, or rather his belongings, to the old WGY studios, which are being rebuilt for the short-wave stations' use. The lorry did actually arrive just as he was getting to the end of page 2, so he had to finish in haste and go. He tells me that the new 100-kilowatt plant, which will work on 9,550 kc/s (31.41 metres), is expected to be ready for its tests by September, if all goes well. I didn't know before that all of the transmitting gear made by the American G.E.C. is developed and tested at South Schenectady before being erected on its proper site. The 500-kilowatt WLW plant was made and tried out there before going to Cincinnati. The new 100-kilowatt short-wave plant will actually be allotted to W2XAD, for that station has now been assigned the additional frequency of 9,550 kilocycles. If it is found to work satisfactorily it may be the forerunner of other 100-kilowatt short-wave outfits in different parts of the United States.

Four Wavelengths Now

In the last paragraph I mentioned that an additional frequency had been assigned to W2XAD. This station is now using three frequencies. Here they are, with their times: 1 p.m. to 5 p.m. B.S.T., 21,500 kc/s (13.95 metres); South American beam transmission centred on Rio de Janeiro. 5.15 p.m. to 11 p.m., 15,300 kc/s (19.56 metres); beam transmission to Europe, centred on London. 12.15 a.m. to 4 a.m., 9.550 kc/s (31.41 metres); beam transmission for South America, centred on Rio. The sister station, W2XAF, works only on 9,530 kc/s (31.48 metres). From 9 p.m. to 11 p.m. B.S.T. it is using a horizontal dipole aerial, which is essentially non-directional. From 11 p.m. to 5 a.m. a South American beam transmission takes place, the beam being centred on Buenos Aires. The carrier power output of both stations is from 20 to 25 kilowatts, according to the frequency in use. On the beam transmissions the effective carrier power is reckoned as equivalent to between 200 and 250 kilowatts.

On the Short Waves

IN the first place, I must apologise to one or two readers for letters still unanswered. Unfortunately, through circumstances quite beyond my control, I have not been able to deal with any correspondence for some time now, but hope to be able to do so again shortly. Will those readers concerned please accept my apologies?

For the first time for many years my short-wave activities have been rather curtailed, so that these notes will necessarily be brief and deal mainly with the work of others.

My friend G5MA has again been active with his 5-metre portable station, and on July 10th visited his favourite site near Alton.

The following stations were contacted on two-way 'phone: G2GG Newbury—who, I believe, has been considerably heartened by these contacts after ploughing a rather lonely 5-metre furrow in that part of the world—G5CM Alsold, near Guildford, G8IX Woking, G3MR Berrylands, G8NV Golders Green (R7), G8MG Reading, G6XM Farnborough (on C.W.), G8LY, who represents the fairer sex at Winchester, and G5RD Abbots Langley and G5RD(P) at Coles Hill, near Amersham.

The last contact produced some interesting results, since G5RD's portable's signal rose from R4 on the "wrong side" of the hill to G5MA(P) to R9 when the transmitter was moved over to the "right side" of the hill.

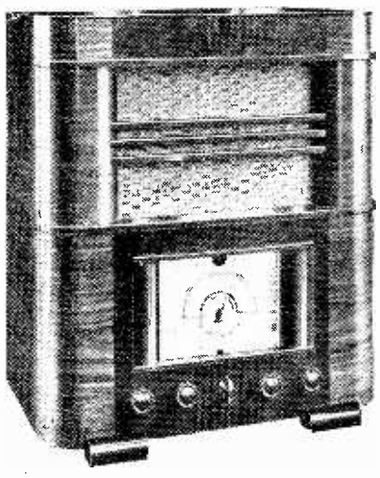
The power supply for G5MA's transmitter, that is the 300-volt HT supply, is derived from a car engine via a belt-driven generator, but how G5MA managed to get all the "works" under the bonnet we may never know; all I can say is it looks beautiful—an opinion, I believe, which G2OGD and others can confirm. ETHACOMBER.

"C. AND R. BRIDGE"

SOME readers have expressed doubt about using the bridge described in the issue of June 16th ("Home Laboratory" series) for measurement of electrolytic condensers, although these are specifically mentioned in the article. Their difficulty is the absence of provision for polarising voltage.

To relieve any uncertainty it can be stated that the bridge is quite suitable for measuring electrolytics as it stands, and no external polarising voltage is needed. Numerous tests have confirmed that such measurements agree satisfactorily with those obtained in more orthodox ways. The explanation appears to be that the condenser acts as a rectifier, and provided that (as in this case) there is no conducting path for the charge to leak off, it supplies its own polarising voltage.

VIDOR MODEL 300



This four-waveband AC superheterodyne just released by Vidor Ltd. covers 13.5 to 2,000 metres and has a nine-valve circuit, including rectifier. The output stage makes use of two beam tetrodes and is rated at 18 watts. A separate control is provided to increase the bass response and the moving-coil loud speaker has a 10-inch diaphragm. The price is 13 guineas.

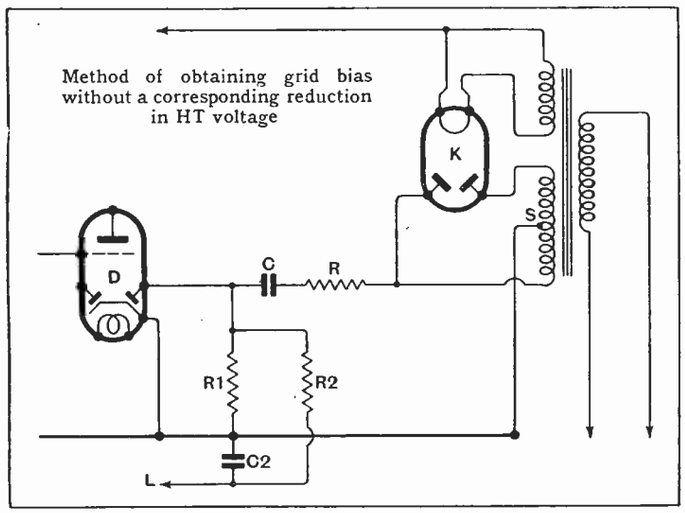
Recent Inventions

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

"FREE" BIAS

IN a mains-driven receiver it is the practice to provide for grid-biasing voltages which are negative with respect to what may be called the "zero" or negative pole of the high-tension supply. Usually, however, this results in some reduction of the full voltage which would otherwise be available for the power stage of the set.

According to the invention, this limitation is avoided by inserting



a separate rectifier in parallel with the AC supply, for developing a "free" voltage which is more negative than the normal zero. As shown in the figure, the additional rectifier consists of a diode D forming part of the electrode system of one of the valve amplifiers. The diode is connected through a blocking condenser C and limiting resistance R to one terminal of the secondary winding S of the usual mains-supply unit K, whilst the cathode is connected to a mid-point tapping on the same secondary winding. During each half-cycle of the supply, a negative voltage is built up across the load resistance R1, and is fed through a smoothing circuit R2, C2 to the grid-bias line L.

J. E. Rhys-Jones, J. O. G. Barrett, and The Plessey Co., Ltd. Application date December 3rd, 1936. No. 484013.

o o o o

SHORT-WAVE VALVES

IN a valve of the Barkhausen-Kurz type, for handling very short waves, the anode is made of a series of wires which act as so many dipole aerials, and either radiate energy directly from the valve, or receive it. The dipoles are spaced apart by a fraction of the wave-length so as to have a directional effect. Preferably they are arranged in the form of a miniature aerial array of the so-called "fir-tree" type, which gives a pronounced beam effect.

The cathode of the valve is made of comparatively large area, though only the outer edges are coated with emissive material. One or more secondary-emission electrodes may be used to increase the supply of electrons.

Telefunken Ges fur drahtlose Telegraphie m.b.h. Convention date (Germany), May 6th, 1936. No. 483888.

A.V.C. IN TELEVISION

IN transmitting television signals it is necessary to vary the "mean" value of the carrier wave so that it shall keep step with slow changes in the "average" background illumination of the picture. This renders it difficult to apply the same methods of automatic volume control that are commonly used in broadcasting, where the carrier wave is "anchored" to a datum line, and where fading makes itself felt as a falling-off in the amplitude of the carrier about that line.

The invention is concerned with means for applying automatic volume control to television signals of the kind in which the carrier wave is varied from time to time as the average background illumination of the picture alters. The method consists in "displacing" the synchronising signals so that the minimum amplitude of the received signals corresponds with minimum picture modulation, and using this value as the basis from which AVC voltages are developed to offset the effect of fading.

H. E. Kallmann and R. E. Spencer. Application date, September 30th, 1936. No. 484202.

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CONTROLLING THE ELECTRON STREAM

IT is usual, both in receiving and transmitting valves, as well as in cathode-ray tubes, to place the main control grid, or control field, at a point where the velocity of the electron stream is comparatively low, so that the electrons remain under control for some appreciable time. In some cases, in fact, it is usual to insert retarding electrodes so as to reduce the electron velocity almost to zero at the point of control. This, of course, allows a comparatively low control voltage to be used.

But, on the other hand, if the time taken for the electrons to pass through the control field is comparable with the frequency of the applied signals, then the electron stream will absorb energy from the tuned input circuit, and will reduce the selectivity of the latter by damping.

According to the invention the electrons leaving the cathode are either sharply focused (or are otherwise forced by the shape of the electrodes) to travel in an oblique path, and the point of control is located at the far end of this path where the electron velocity is high.

Telefunken Ges fur drahtlose Telegraphie m.b.h. Convention date (Germany), October 8th, 1935. No. 483050.

o o o o

IN the so-called "beam" type of valve, the electrons emitted from the cathode are focused into a jet by a control grid and apertured anode, in much the same way as the "gun" forms the stream in a cathode-ray tube. The output electrode is spaced well away from the cathode, and the operation of the valve depends upon varying the number or intensity of the electrons, which are allowed to pass through. Usually the formation of the jet is effected by one set of electrodes, namely a control-grid, an apertured accelerator anode, and an apertured suppressor electrode, which is arranged close to and parallel with the anode.

It is found that with this arrangement the jet tends to spread too much laterally. The invention accordingly consists of inserting a second set of electrodes, similar to the first accelerator and suppressor discs, between the latter and the output or collecting plate. This allows a smaller control voltage to be used, and so increases the efficiency or mutual conductance of the valve.

Marconi's Wireless Telegraph Co., Ltd., and G. F. Brett. Application date October 26th, 1936. No. 483827.

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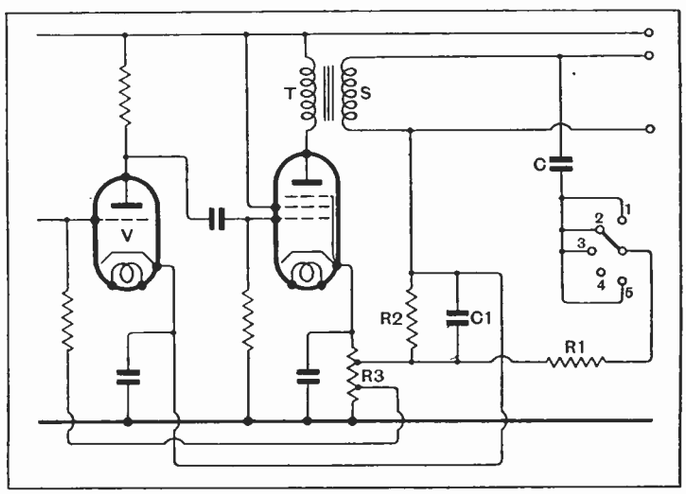
ALL-WAVE RECEIVERS

IT is known that better quality can be obtained by applying negative feed-back to the AF stage, particularly on a "universal" mains-driven set where there is a minimum HT supply. At the same time, the use of negative feed-back reduces the overall amplification of the set, and this is not always desirable, particularly on the short waves where sensitivity is important.

The object of the invention is to take advantage of both conditions by using negative feed-back on the long and middle waves, where quality is an important factor, and cutting it out for short-wave reception where the question of sensitivity or range comes first.

The drawing shows the AF stage of an all-wave set. The output transformer T is coupled to a special secondary winding S, which feeds two series resistances R1, R2 through a condenser C. The resistance R2 is included in the cathode lead of the valve V, and tapped to the biasing resistance R3. This applies negative feed-back, which is automatically "toned down" for the higher frequencies by the condenser C1.

A switch with five points 1 - - - 5



Negative feed-back circuit for all-wave set arranged to be inoperative on the short waves.

which is ganged with the wave-change switch, open-circuits the "feed-back" connection on the short-wave setting 4, leaving it operative for the first three wave-settings, as well as for gramophone reproduction on the last contact —point 5.

G. Priechenfried. Application date January 25th, 1937. No. 483869.

MISCELLANEOUS ADVERTISEMENTS

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12 words or less, 3 - and 3d. for every additional word.

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

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 13 consecutive insertions 5%; 26 consecutive, 10%; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to FIRST POST on MONDAY MORNING (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Stamford Street, London. S.E.1, or on SATURDAY MORNING at the Branch Offices, 8-10, Corporation Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham, 2; 260, Deansgate, Manchester, 3; 26B, Renfield Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

IMPORTANT NOTICE

Owing to the August Bank Holiday, the issue of "THE WIRELESS WORLD" for August 4th must be closed for press earlier than usual.

MISCELLANEOUS ADVERTISEMENTS for insertion in that issue can be accepted up to

FIRST POST FRIDAY, July 29th.

NEW RECEIVERS AND AMPLIFIERS

* * *

DEGALLIER'S End of Season Sale. See section under "Receivers, Supplies, etc."

* * * [7039

25 Gns.—Radios.

11½ Gns.—Biggest

7½ Gns.—Values.

HOMELAND Quality Radios Represent By Far the Finest Values in Britain Today.

YOU Owe it to Yourself to Investigate the Undoubted Truth of This Statement Before You Purchase Your New Receiver.

SEND Today for the New Summer Edition, now ready, of the Homeland catalogue and art treatise, and then get us to arrange a free 6-mon-tration or free trial.

7½ Gns.—The Homeland High Fidelity All-wave Eight, var. selectivity, world tine and distance indicator, etc., etc., A.C. or A.C.-D.C.; also available with push button tuning; table model, 9½ gns.; console, 11½ gns; radiogram, 13½ gns.; or 10 per cent. deposit secures any model.

11½ Gns.—The Homeland High Fidelity All-wave Ten, var. selectivity, with numerous features, another value which is unapproached to-day; also with latest push button tuning; table model De Luxe, 15 gns.; console, 16½ gns.; radiogram, 21 gns.; or 10 per cent. deposit secures any model now.

25 Gns.—The Homeland "Empire Twelve," Britain's finest radio, in every detail of its design, specification and construction a high quality production, representative of the finest elements in advanced American radio engineering.

THE "Empire Twelve" was Designed for You by America's Leading All-wave Superhet Coil Designers.

THE "Empire Twelve" was Exhaustively Tested for You by America's Leading Technical Radio Journals and immediately passed as being in the very forefront of American design.

(This advertisement continued in third column)

RADIOMART

G5NI (BHAM) LTD.

THE SHORT-WAVE SPECIALISTS

We are the oldest Distributors for BLILEY, THORDARSON, TAYLOR TUBES, RME, BASSETT, CONCENTRIC CABLE, HOYT METERS, COLLINS, NATIONAL, ETC. Send us your enquiries. Large stocks carried.

GANG CONDENSERS with Airplane dial, 8 and 80-1. Cost 35 -; few only, 4 11; 2-gang, with Airplane dial, 3 11.

MICROVARIABLES.—All brass construction, latest ceramic insulation. The finest condensers made: 15 mmfd., 1 4; 40 mmfd., 1 7; 100 mmfd., 1 10. Transmitting Type.—.070in. spacing, 15 mmfd neutralising, 2 9; 40 mmfd. Tuning, 3 6. These are quality.

UTILITY 7 6 Famous Micro Dials, 3 9; Radiophone, 0.00016 Short-wave Condensers, 3 6. Shortwave HF Chokes, 5-100 metres, 9d. Centralab Pots, all sizes, 1 6; switched, 2 -; 20,000 ohm Pots, 1 -. Tubular Glass Fuses, 2d. Milliammeters, 25 m.a. upwards, 5 9; super, 6 9.

W.B. 8in. Permanent Magnet Speakers at one-third Cost Extension Type (no Transformer) 7 6. Standard Type (with Transformer) 12 6.

AMERICAN Mains Transformers. Heavy Duty, 350-350 v., 150 m.a., 4 v. 4 a., 4 v. 3 a., 12 6. GE 350-350 v., 80 m.a., 2.5 v. 5 a., 5 v. 2 a., 6 11. Majestic 250-250, 2.5 v. 5 v., 4 11; Pilot 260-260 v., 5 v. CT., 3 11. Ceramic American Valveholders, including octal, 1 - each.

HEAVY DUTY Mains Transformer, worth 45 -, 350-350, 150 m.a., 4 v. 2.5 a., CT, 4 v. 6 a., CT, 12 6; 300-300 v., 80 m.a., 4 v., 3 a., CT, 4 v., 2 a., CT, 6 6. Speaker Transformers, 1 11.

SPEAKERS.—We carry large stocks. Magnavox, Jim., energised, 1,000 or 2,500 ohms, 19 6. Energised 8in., 1,200 ohms with transformer, 6 11. L.T. Rectifiers, 4.5 v., 3 a., 7 6.

PUSHBACK Wire, 6 yds., 6d.; heavy, 9d. Resin-cored Solder, 6d., 6d.; Screened Flex, single, 6d. yd.; twin, 9d. yd. Assorted Solder Tags, 6d. packet. Humdinners, 6d. each.

OUR NEW 66 PAGE MANUAL, packed full of valuable information. Post Free, 7½d.

THE NEW RAYMART CATALOGUE shows dozens of New Short-Wave Components and is yours for 1½d. post free.

SPECIAL OFFERS. Class B Kit, worth 30 -, comprising Driver Transformer, Valve and Holder, 5 -. Dozen wire-ended assorted resistors, 1 6. Order 5 -, post free.

RECTIFIERS.—Westinghouse, in cabinet: input 220 v., output 110 v. amps. Ideal for chargers, etc. Cost over £15. Our price, 59 6.

We are now able to offer a complete range of replacements including those for types PX25, PP5/300, PP3/250, PX1, AC/2Pen, VP4B, TDD4, etc. **All types of Universal Valves** including subcontact, etc. **All Guaranteed** and showing a saving of over 50 per cent. Quotations on receipt of types required. Quantity Discounts to Service Engineers.

A splendid range of short-wave components is always ready for immediate despatch. The right goods at the right prices.

RADIOMART *Telephone: MIDland 3254.*
G5NI (Birmingham) Ltd.
44, HOLLOWAY HEAD, BIRMINGHAM

PREMIER SUPPLY STORES

Have you had our 1938 Catalogue, Handbook and Valve Manual? 90 Pages of Radio Bargains and Interesting Data. Price 6d.

All goods previously advertised are still available.

PREMIER SUPPLY STORES

***POST ORDERS*, JUBILEE WORKS, 167, LOWER CLAPTON ROAD, LONDON, E.5.**
Amherst 4723.

CALLERS—can now obtain their requirements at "Jubilee Works," as well as—
165 & 165a, Fleet Street, E.C.4. Central 2833 and 50, High Street, Clapham, S.W.4. Macaulay 2381.

THE INSTITUTE OF WIRELESS TECHNOLOGY (INCORPORATED).

REVISED SYLLABUS

Candidates for the November Examinations are advised to communicate with the Secretary at once for full details of the Revised Syllabus.

Letters should be addressed to the Secretary, Institute of Wireless Technology, 4, Vernon Place, Southampton Row, London, W.C.I., and marked in the top left hand corner "Revised Syllabus."

HAYNES QUALITY

RECEIVERS and TELEVISION

Demonstrations Friday Evenings 7.30—10 p.m. Lists free

HAYNES RADIO Ltd QUEENSWAY, ENFIELD, MIDDLX.
Howard 1171

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For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes: in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

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Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Stamford Street, London, S.E.1, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post. When sending remittances direct to an advertiser, stamp for return should also be included for use in the event of the application proving unsuccessful.

NEW RECEIVERS AND AMPLIFIERS

(This advertisement continued from first column.)

THE "Empire Twelve" Final Completed Design, tested and reported by "Radio News" in New York; the final paragraph of this review ran as follows: "Such a receiver as described would have been impossible to build a short time ago, and yet is an assured fact to-day."

THE "Empire Twelve" tested and reviewed for you by "The Wireless World," received unstinted praise for its design, technicalities and performance; the summing up stated that this receiver "will arouse the acquisitive instincts of the true wireless enthusiast whose interests embrace every phase of radio communication." (Full reprint of report, with circuit, etc., free on request.)

THE "Empire Twelve" Has Since Been Used and Proved by Delighted Users Throughout the World; its dependability, superlative performance, and its position at the top of all radio receivers has been reported and proved beyond even our own expectations.

THE "Empire Twelve" Has Been Bought by the Most Discriminating of Buyers, where money has been no object, and in preference to receivers costing 90 gns. and over.

THE "Empire Twelve" is Not Only the Finest Set in the Country, but represents the finest value ever offered in radio; the strict curtailment and regulation of trade discounts has made this possible.

THE "Empire Twelve" Carries the Finest Guarantee and After Service Ever Given with a Radio Receiver, 5 full years, with 12 months on all valves.

THE "Empire Twelve" is Guaranteed to be Capable of Tuning in More Radio Transmissions than Any Other Standard Commercial Receiver in Existence; it has more worth while, genuine and up-to-the-minute features than any other radio.

25 Gns. Chassis price, complete with valves and five years' guarantee, licensed by Marconi's Wireless Telegraph Co.; 28 gns., with matched auditorium 20lb. speaker; 33 gns., the "Durban" Table-armchair model; 34 gns., the "Delhi" combination (separate speaker), 2-piece model; 38 gns., the "Sydney" bookcase armchair model; 42 gns., the "Quebec" twin speaker Console; 58 gns., the "Melbourne" twin speaker auto radiogram.

6 Gns. The Homeland new permeability tuned remote control unit is also available for the remote control of your "Empire Twelve" receiver; gives you complete remote control push button (7-station) tuning, including volume, in handsome chair-arm cabinet; the most sensational development in perfected push button tuning yet.

6D. Stamp Brings You Post Free the New Summer Edition of the Complete Homeland Catalogue and Art Treatise, giving you the most comprehensive and illustrated details of everything in this advertisement; technical and constructional details; illustrations of all models, details of the sensational new remote control unit; doublet and double-doublet aerials, reprint of press reviews; full details of our unique guarantee; 10 days' home trial scheme; free demonstration card; H.P. terms, etc., etc.; superbly printed, this new and profusely illustrated catalogue and treatise is something which no reader of *The Wireless World* can afford to miss; send 6d. stamps to cover part cost and postage to-day, to:—

ANGLO-AMERICAN RADIO (AND MOTORS), Ltd. (Dept. W.79), Albion House, 59, New Oxford St., London, W.C.1. (Telephone: Temple Bar 3231). One minute from Holborn or Tottenham Court Rd. Underground stations. Hours: 9 to 7 (Saturday 1 p.m.). [6724

"Foundations of Wireless," Second Edition. 4s. 6d. net. Post free 4s. 11d.

NEW RECEIVERS AND AMPLIFIERS

"SERVICE With a Smile"

HENRY FORD RADIO, Ltd.,

ELECTRONIC House, 22, Howland St., Tottenham Court Rd., W.1. Museum 5675. [0511

ROYAL RADIO Co Established 1908

CHEAPEST House in the Trade for Midwest, Ferguson, Pilot, and other makes of all-wave receivers.

A FEW Demonstration Models, only used in our showrooms, at 40 to 50% discount; car radio sets from £4/15.

SEND 1½d. Stamp for Catalogue.—Royal Radio Co., 5, Buckingham Rd, London, E.18 [7009

ARMSTRONG COMPANY, pioneer firm supplying all British radio receivers in chassis form.

ARMSTRONG 7v. (including Cathode Ray) All-wave Radiogram Chassis, complete with speaker; £7/18/6.

ARMSTRONG 10v. Radiogram Chassis, with 10 watts push-pull output, model R.F.94; £13/13.

ARMSTRONG Latest Catalogue Contains Many New Models, obtainable on 7 days' trial.

ARMSTRONG Co., 100, King's Rd. Camden Town, N.W.1. Gulliver 3105 [6837

FERGUSON, Pilot, Belmont, Portadyne and other makes radio receivers for 1938; wholesale only; send trade card for lists.—Leonard Heys, 36, Henry St., Blackpool. [0566

RADIO CITY PRODUCTS Welcome Enquiries from Enthusiasts who are convinced that nothing but the finest and best in radio is good enough for them. Send for illustrated brochure.—257, Seven Sisters Rd., N.4. [6983

RECEIVERS AND AMPLIFIERS

CLEARANCE, SURPLUS, ETC.

ANGLO AMERICAN RADIO, Ltd. Special clearance of 5 wave-band Crosley De Luxe receivers, brand new in cartons at less than cost, in beautifully figured walnut cabinets of particularly sold construction.

£8/10/- or 17/- with order.—Crosley 8 valve 5-band table receiver, R.F. stage all bands, 4 watts output, A.C. (list 18 gns.).

£10/- or 20/- with order. Crosley 9-valve 5-band table receiver, 10 watts push-pull output, R.F. stage all bands one of the finest radios ever for A.C. only.

DEPOSIT Will be Refunded on Any Receiver Not Approved, limited number only; send cash or deposit now to secure one of these fine receivers; a really unique opportunity; no descriptive material available.—59, New Oxford St., London, W.C.1. [6726

CROSLEY 9v., 5-band, push pull output, brand new; £3 8.—Standard Radio, Dantzic St., Manchester. [7014

FARREN A.C.-D.C. Short Wave Converters, Model "F.1," listed £5/2; price £2/5, complete with valves, brand new, send for leaflet.

GARRARD A.C. Record-Changers Plays eight 10 or 12in. records, £5/5 in sealed cartons; latest model.

HENRY'S, 72, Wellington Av., London, N.15. Stamford Hill 2907. [6663

DEGALLIER'S Offer Limited Quantities Only of All Makes of 1938 Brand New Fully Guaranteed Decontrolled Receivers at 40% and more off list. Ferguson, Belmont, Crosley, Challenger, Midwest, Regentone. All orders cash with order or c.o.d. Call and have a demonstration, or send 1½d. stamp for lists. Be sure not to miss this wonderful opportunity. Remember, we have one sale a year only at the end of the season. Be sure not to miss this wonderful opportunity. Open any time.

NEAREST Point Paddington Station. Maps sent with all catalogues showing all main line stations.

DEGALLIER'S, Ltd., 32, Bathurst Mews, Lancaster Gate, London, W.2 Paddington 2745. [7040

CAR RADIO

ANGLO AMERICAN RADIO (AND MOTORS), Ltd., car radio specialists, contractors to the B.B.C. and many leading concerns.

7½ Gns. (or 16/- deposit with order secures delivery).—The new Crosley "Roamco" De Luxe car radio, just out; a magnificent set of compact dimensions and suitable for any car; this receiver is definitely the equal of any make costing up to 15 gns. and over; offered at a "direct to the public" price while supplies of present consignment last; absolute complete, with easiest fitting instructions, for 12- or 6-volt cars, 3 watts output; send 16 - deposit to-day, balance over 12 months

17/6.—New De Luxe "Streamline" car radio aerials, the most efficient yet, complete, all fittings; sub-chassis aerials, 12 6.—59, New Oxford St., London, W.C.1. [6727

£5/15, Crosley push button; Ward roof aerials, 14 6.—Coulphone Radio, Ormskirk 'Phone: 578 [7022

SINCLAIR SPEAKERS, Alma Grove, Copenhagen St., London, N.1. Telephones telegrams: Terminus 4355. [0592

CAR Radio Expertly and Promptly Fitted; satisfaction guaranteed; reasonable prices.—'Phone: Gerrard 3791. [7029

IMPORTERS of All the Newest American Car Aerials.—Wireless Supplies Unlimited, High St., Stratford, E.15 [0577

A LIMITED Number of the New 1938 Crosley 6v. 5-valve Push Button Car Radios; amazing performance; complete in maker's sealed cartons, £5/5, carriage 1/6; resistance for 12 volts, 4/6.—Cunningham, 353, Eccles New Rd., Weaste, Salford. [7030

WHAT IS YOUR IDEAL SET?

May we ask in your opinion what constitutes an ideal quality Radio Equipment? There is no need to write and tell us you already have an S.S. model, and that you cannot think of anything better—because neither can we. All the same, the fact that our products may satisfy 99% of people only makes us more curious to find out what the odd 1% would like. DO LET US HAVE YOUR OPINION.

1. *How much should it cost?*
2. *Do you prefer a straight or superhet Radio Unit?*
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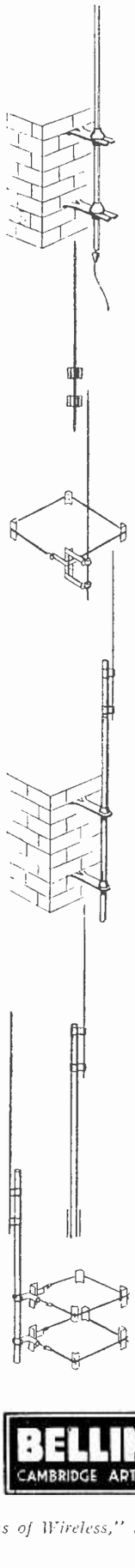

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