VIBRATOR POWER UNIT

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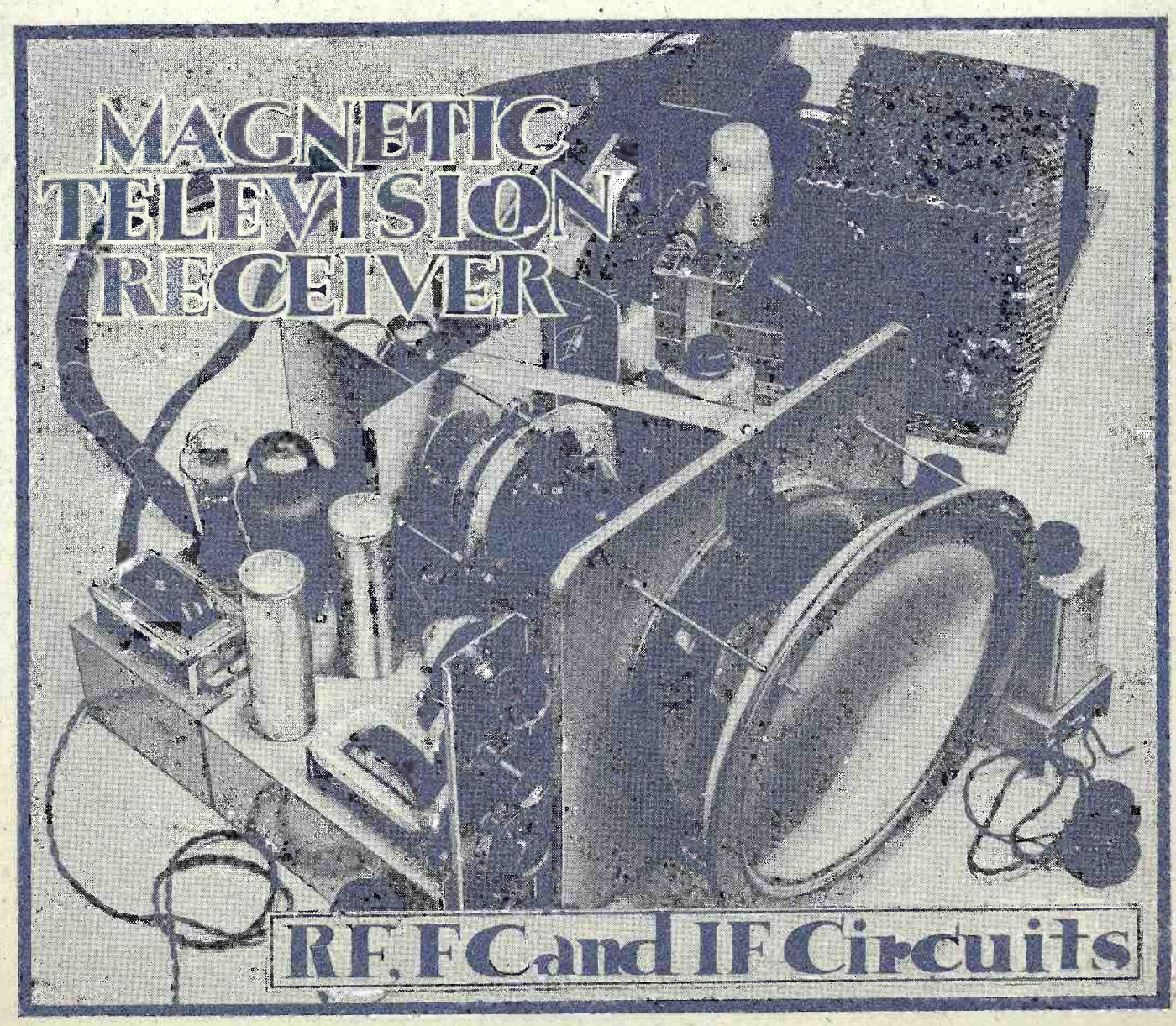
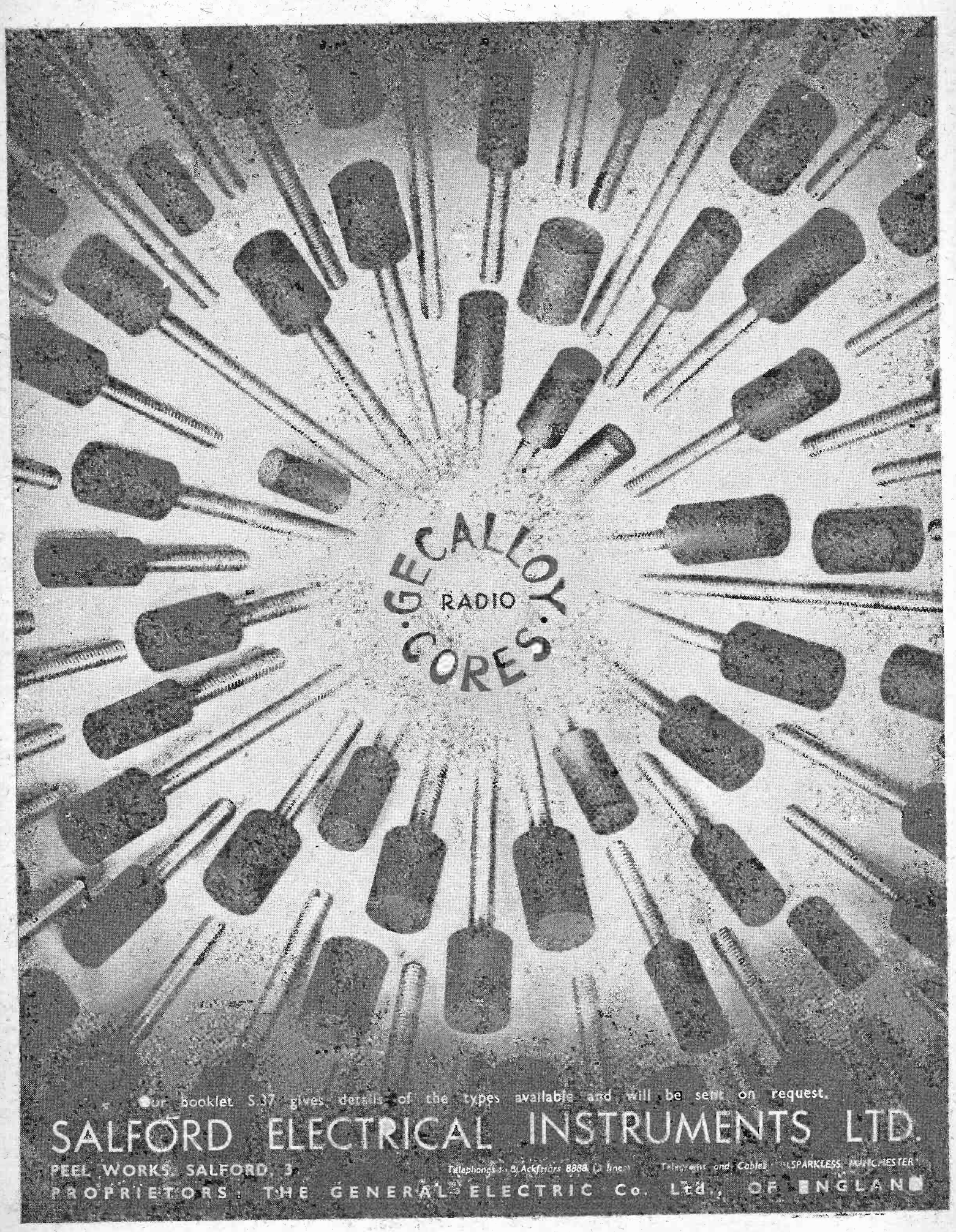
The Wireless World

THE PRACTICAL RADIO & TELEVISION JOURNAL

Thursday, July 6th, 1939



No. 1,036. Vol. XLV. No. 1.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The Wireless World

THE PRACTICAL RADIO JOURNAL

29th Year of Publication

No. 1036. THURSDAY, JULY 6TH, 1939. VOL. XLV. No. 1.

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone : Waterloo 3333 (50 lines).
Telegrams : "Ethaworld, Sedist, London."

COVENTRY : 8-10, Corporation Street.
Telegrams : "Autocar, Coventry." Telephone : 5210 Coventry.

BIRMINGHAM :
Guildhall Buildings, Navigation Street, 2.
Telegrams : "Autopress, Birmingham." Telephone : 2971 Midland (5 lines).

MANCHESTER : 260, Deansgate, 3.
Telegrams : "Iliffe, Manchester." Telephone : Blackfriars 4412 (4 lines).

GLASGOW : 26B, Renfield Street, C.2.
Telegrams : "Iliffe, Glasgow." Telephone : Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home and Canada, £1 10s. 4d. ; other countries, £1 12s. 6d. per annum.

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EDITORIAL COMMENT

Semi-communication Sets

For Long-Range Broadcast Reception

IN last week's issue of this journal a contributor put forward a plea, supported by well-reasoned arguments, for the introduction of a new type of receiver ; something intermediate between the more or less standardised all-wave superheterodyne and the high-performance "communication" set. High sensitivity and selectivity, combined with more flexibility of adjustment than is provided in the average domestic set, were essential features of the design.

That something on these lines is wanted seems to be generally admitted, the only criticism of the proposal being to the effect that the general public is less interested in long-distance reception than formerly. On the other hand, it is freely admitted that range is still the yardstick by which one set is popularly compared with another ; admitting the correctness of this assertion, which has long been an axiom in commercial broadcast circles, a receiver on the lines proposed, with a clearly demonstrable superiority in the matter of range as compared with the general run of its competitors, should have a wide appeal, in spite of its inevitable extra cost.

Our contributor described a tuning and control system such as that advocated as "a joy to operate." In our view, that highly desirable state of affairs cannot be ensured entirely by attention to electrical design ; a rather higher standard of mechanical excellence than the average is essential for its full realisation. As the electrical side is of obviously greater interest and importance than the mechanical, we wireless people have been inclined to neglect what is generally regarded as a matter of detail. We suggest that, however good the electrical design may be, there is little joy in manipulating any kind of apparatus unless the controls operate sweetly. However, the expenditure of a few extra shillings towards this end can work wonders, and there is no reason why a first-class mechanical job should not be turned out within the suggested price limit of £20—always provided a reasonably large demand can be assured.

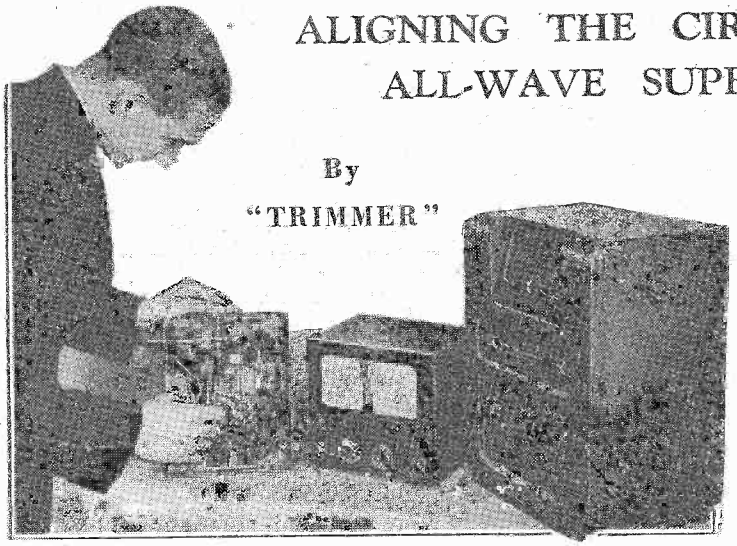
Potential Users

We are confident that there exists such a demand for a real long-range set. As potential buyers there are to be considered not only the wireless enthusiasts—those whose first interest lies in wireless for itself—but, as we have already pointed out, the increasingly large section of the general public that wishes to be well informed on international affairs, and has found in short-wave broadcasting a wonderful source of topical information. For this section of wireless users a set with exceptionally good tuning arrangements is a virtual necessity.

The flexible and, as compared with the ordinary broadcast set, rather complicated tuning and control system described by our contributor is essential for the performance aimed at, and in any case should not present an insuperable obstacle to the success of the "semi-communication" receiver. Those likely to be attracted by such a receiver would not grudge an hour or two spent in mastering its intricacies. It is essential, however, that instruction books for the set should be more comprehensive than the leaflet that, more often than not, suffices for the ordinary broadcast receiver.

Short-wave Adjustments

ALIGNING THE CIRCUITS OF ALL-WAVE SUPERHETS



By "TRIMMER"

PRECISE details of procedure, which will remove most of the possibilities of error when dealing with the short-wave side of a receiver, can usually be laid down for any one model, but between various models there are such differences of design details which affect the procedure that a general treatment of the subject must resolve itself very largely into a series of warnings against pitfalls. However, forewarned is forearmed and, for that reason, it is hoped that this article may be of assistance.

Owing to the need for making a number of check tests on accurately known frequencies the use of a good modulated test oscillator and an output indicator of some kind is very desirable. At the end of this article some notes are given as to the possibilities of doing anything useful in the absence of this test gear, but, apart from these notes, it will be assumed throughout that a test oscillator and output indicator are being used. To avoid possible confusion between references to the test oscillator and the oscillator of the receiver itself the former will be called the signal generator, and any references to oscillator can be taken as applying to the oscillator of the receiver.

The Unwanted Channel

The matter of second-channel reception is so important that we will deal with it first. Normally, the correct oscillator trimming setting of the receiver makes the fundamental oscillator frequency higher than the signal frequency by the value of the fundamental intermediate frequency. If the signal frequency were 18 Mc/s, and the IF 465 kc/s, the correct oscillator frequency would be 18.465 Mc/s. So far as the IF amplifier is concerned, however, it merely demands that there shall be a *difference* of 465 kc/s between the signal and oscillator frequencies, so that an oscillator frequency 465 kc/s below the signal frequency, i.e., oscillator at 17.535 Mc/s would also give a peak signal response. The latter oscillator frequency is known as the second-channel oscillator frequency.

In the example quoted there is a difference of 930 kc/s, or 0.93 Mc/s, between the normal and second-channel oscillator frequencies. From some points of view a frequency difference of 0.93 Mc/s could be regarded as large, but not from the point of view of SW reception. In comparison with 18 Mc/s, for instance, 0.93 Mc/s can only be regarded as small, and it should be easy to appreciate that there is considerable chance that the range of variation provided by an SW oscillator trimmer will be sufficient to take the oscillator tuning through both the normal and the second-channel frequencies. It cannot be laid down as a hard-and-fast rule that with every receiver the second-channel frequency can be reached by oscillator trimmer adjustment, for much depends upon the value of the IF and the maximum capacity of the trimmer, but in the majority of cases it is so.

ESPECIAL care is necessary when adjusting the circuits forming part of the short-wave side of the modern all-wave superheterodyne. Not only do the high frequencies involved tend to cause the adjustments to be very fine and critical, but difficulties often arise due to false signal peak indications, which lead to incorrect alignment.

The fact that the second-channel oscillator frequency is lower than the correct frequency is important. It implies that the second-channel trimmer setting is of greater capacity than the correct setting, so that, if only two peak settings (correct and second-channel) can be obtained on the oscillator trimmer it is easy to decide which is actually the correct one. It is the one involving the lesser capacity.

It should be noted that when changing from correct to second-channel oscillator settings there is no change made in the tuning of the signal-frequency circuits, so that, assuming equal oscillator amplitudes at the two frequencies, the two output peaks will be of equal amplitude. This point raises the question as to what the disadvantage of the second-channel oscillator setting is.

With the oscillator adjusted to the second channel the tracking of the receiver will be upset. The performance of the receiver cannot be normal over the wave range if the oscillator is "working on the wrong beat," and it is, therefore, extremely important to watch the accuracy of the receiver calibration over the scale whenever SW oscillator adjustments are made.

Methods of applying check tests form an important matter where SW adjusting is concerned, so it is of special interest to note that the second-channel effect can be made the basis of a check upon the correctness, or otherwise, of the choice of oscillator trimming peak. If the oscillator trimming has been correctly done and the receiver is tuned to a signal from the signal generator, then if the receiver tuning control is turned the signal should come in again at the point where the frequency to which the receiver is tuned is below that of the signal itself by twice the value of the IF, for this is the condition that brings about second-channel reception. The signal-frequency circuits of the receiver are obviously out of tune to the applied signal under second-channel conditions, but if the amplitude of the signal generator output is brought up sufficiently it is usually possible to pick up the second channel. Alternatively, the receiver tuning could be left alone and the signal generator frequency raised until it is above the original signal frequency by twice the IF. This is the better alternative as it is to be assumed that the exact frequency of a signal generator can be more easily ascertained than that of the circuits of an ordinary receiver; also, there is no possibility of a tracking error introducing difficulties. It should be appreciated that under the conditions of the test the original and the second-channel signal peaks will not be equal in amplitude, but that the whole point of the test is to find out if the signal peaks in at the exact tuning spot corresponding to second-channel conditions. If it does, the oscillator trimming adjustment can be taken as correct and not as being a false peak choice.

The possibility of landing on to the second-channel oscillator setting when trimming the oscillator circuit is, unfortunately, not the only possibility of adjusting to a false peak. In practice it will sometimes be found that quite a number of peak settings can be found when running an oscillator trimmer through its full variation. Of these peaks one will be the correct one, another will probably be the second channel, while the others will be produced by harmonic beat effects. The situation is partly dependent upon the design of the receiver and partly upon the amplitude of the signal generator output. The greater the latter the greater are the

Short-wave Adjustments—

chances of getting additional peaks on the oscillator trimming adjustment, so an obvious precaution to take is to keep the signal generator throttled right down to the lowest workable amplitude while trimming.

The individual treatment that any particular receiver requires depends very much upon the details of its SW arrangements, and it is absolutely necessary to get the hang of these before attempting to carry out SW adjustments. The oscillator circuit merits particular consideration and it is most important to find out what the designer has done in connection with tracking.

As regards tracking it must be appreciated that there are a number of alternative possibilities; moreover, it does not necessarily follow that an adjustable tracking device (if provided) must be in the oscillator circuit. Perfect tracking demands that the oscillator tuning and the tuning of the signal-frequency circuits shall vary throughout the tuning range in such a way that the frequency difference is maintained constant at a value equal to the IF. While it is more commonly the case that any special design features concerned with tracking are associated with the oscillator circuit, there are cases where they will be found in the signal-frequency circuits.

Typical Oscillator Circuits

If the reader has to tackle a receiver for which he has no diagram it will be necessary for him to size up the SW arrangements by inspection of the actual chassis. While it is impossible to give details of every possible arrangement that he may find, it may prove helpful to deal with some of the more common oscillator circuit arrangements.

The diagrams of Fig. 1 are limited to the actual tuned oscillator circuits, and switching details have been omitted. In each case VC represents the oscillator section of the ganged condenser.

Fig. 1(a) illustrates an oscillator circuit in which trimming is provided by C1, while tracking is carried out by the padding of the circuit with C2. The latter is variable so this is a case where the receiver very definitely has a variable tracking control.

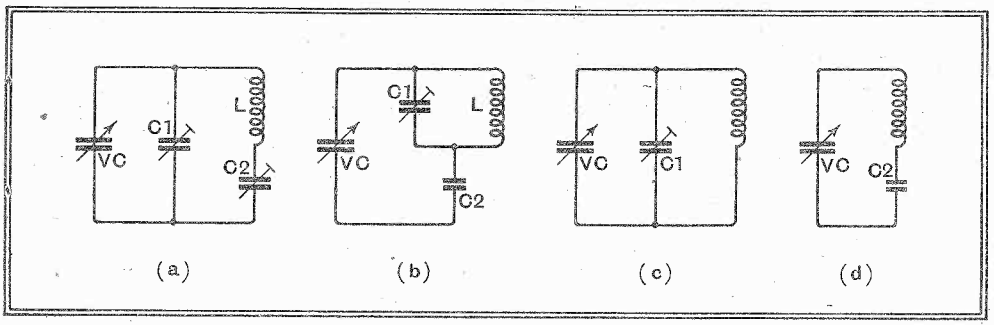
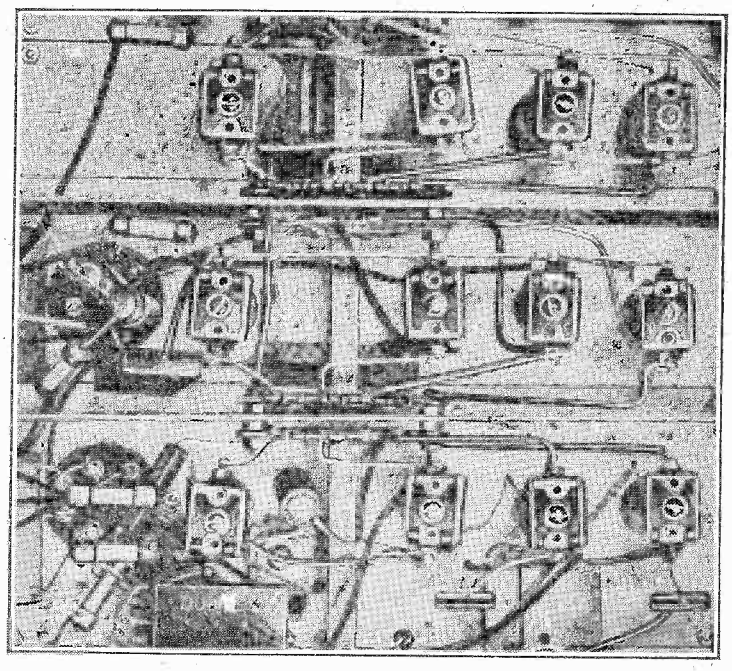


Fig. 1.—Various methods of trimming and tracking the oscillator. (a) Variable trimming by C1; variable tracking by C2. (b) Fixed oscillator padding is provided by C2, but tracking may or may not be fixed. (c) No oscillator padding, but this circuit may still control the tracking. (d) No oscillator trimming.

Modifications of the (a) circuit will be found. In some cases the trimmer condenser will be directed directly across the coil and sometimes the variable padding condenser will be associated with a shunted fixed condenser.

The processes of modern manufacture make it possible to mass-produce coils and condensers with sufficient accuracy to ensure oscillator tracking with a fixed padding condenser, and circuit (b) illustrates a type of oscillator circuit that would apply in such a case. If the designer has relied entirely upon C2 to make the tracking correct it is not, of course, his idea that any tracking adjustment should be necessary at all. This question as to what the designer's intentions are contains the elements of a nasty pitfall, however. Assuming that no diagram or makers' instructions are available, the reader is warned that if he finds that an oscillator circuit contains a fixed padding condenser he should not immediately jump to the conclusion that the receiver contains no variable tracking oscillator adjustment. In some cases it is the designer's intention that the accuracy of tracking shall be variable by adjustment of L, possibly by moving an end-turn, or by adjustment of a loop inside the coil assembly. Close inspection of the coil assembly should, therefore, be made; some of the details observed may prove to be enlightening.

When the oscillator circuit conforms to circuit (c) it is again necessary to be careful. C1 is a trimmer condenser and, so far as the diagram goes, the oscillator circuit does not apparently contain any tracking device. It is possible, however, that the oscillator section, VC, of the ganged condenser contains the secret of the tracking, the plates being specially shaped to provide oscillator tracking on SW. On the other hand, the receiver may be one in which provision for tracking is made in the signal-frequency circuit. (Generally, a receiver with signal-frequency circuit tracking has only one tuned signal-frequency circuit.) Inspection of the signal-frequency circuit should be made and the existence of a padding condenser particularly looked for. In some receivers the circuit of Fig. 1(c) applies to the oscillator, while that of Fig. 1(a) applies to the signal-frequency tuned input circuit. But even if the signal-frequency circuit contains no padding condenser it may still contain a tracking adjustment, for it may be intended that end-turn, or loop, adjustment of the signal-frequency coil inductance shall be made.



This photograph shows the underside of a typical tuner chassis for a superheterodyne with an RF stage. There are two S.W. bands in addition to the medium and long wave bands and the parallel trimmers are mounted directly on the coils.

In some receivers it will be found that the oscillator circuit contains a fixed padding condenser but no trimming condenser, as in diagram (d). It must just be accepted that there is no provision for trimming the oscillator. It is likely, however, that trimming provision will be found in the signal-frequency circuit, or circuits, although there are receivers in which there is no trimming condenser in any of the SW circuits.

Variable IF Value

While giving the SW arrangements of an unfamiliar receiver a look over it will be as well to look specially to see if there is any SW switching associated with the IF circuits. If so, it will probably mean that the receiver uses a higher IF value on SW than on the other bands, so that it would not do to assume that because the receiver happens to be perfectly satisfactory on MW there could be no question of incorrect IF on SW.

Interaction between the signal input and oscillator circuits associated with a frequency-changer valve is a problem arising in SW reception that has received

Short-wave Adjustments—

much attention from valve research workers. Considerable progress has been made towards minimising such trouble, but with the average run of receivers one must be prepared for the possibility that trimming adjustments of the tuned signal grid circuit may have a tendency to "pull" on the tuned oscillator circuit, slightly affecting its frequency.

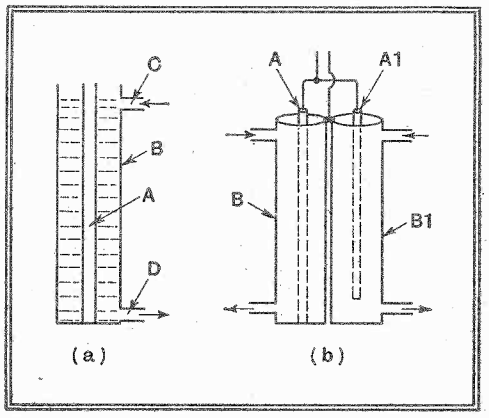
Theoretically, in such a case every change of signal-frequency trimming demands slight readjustment of the trimming of the oscillator. In practice, however, any difficulties introduced by pulling can usually be got over by the process of slightly rocking the ganged tuning control of the receiver while the trimming is being done in the signal-frequency circuit immediately preceding the frequency-changer valve. The signal-frequency trimming control and the ganged tuning control should be carefully and simultaneously adjusted to give optimum peak amplitude. If the pulling effect is such that trimming of the signal-frequency circuit (without rocking the ganged condenser) shows a very pronounced double-humped tuning effect it is to be recommended that the method be tried of setting the signal-frequency trimmer to the point corresponding to the minimum between the two output peak indications and then retrimming the oscillator circuit for maximum peak.

(To be Concluded.)

Dummy Aerials

ABSORBING POWER ON ULTRA-SHORT WAVES

IN order to test the performance of a wireless transmitter without radiating unnecessary energy into the ether, it is common practice to use either a bank of filament lamps, or a number of resistance rods, as an "artificial aerial" in which to dissipate the high-frequency energy. Both give a fair approximation to a true aerial load for medium or long wavelengths, though not for ultra-short waves of the kind used in television. The reason is that the inherent reactances of the load—which count for little on the longer waves—begin to "take charge" on a 6-metre wave, and so must be specially balanced out if the test is to give reliable results. Electric lamp filaments also tend to ignore Ohm's Law as they heat up, and this introduces another uncertain factor.



Water-cooled dummy aerials for use as an artificial load when testing ultra-short-wave transmitters.

The arrangement shown in diagram (a) (from Patent 491794) provides a simple and inexpensive load which is free from both the defects mentioned. It closely simulates the behaviour of a short-wave aerial, and maintains constant characteristics over a sustained test, even when high power is being dissipated. The arrangement consists of a copper rod A, which for a carrier-wave of 45 megacycles should be not less than 4ft. long and $\frac{1}{4}$in. in diameter. This is enclosed in a water-cooled cylinder B of the same length and 3 inches in diameter. The bottom of the rod is welded to the cylinder, and the transmitter under test is connected across the two by terminals at the top.

The combination acts as an attenuating "transmission line" of negligible series resistance, but considerable series reactance, with shunt conductance and shunt capacity across the water dielectric. The characteristic impedance of such a line is constant and independent of frequency. The heat generated is carried away by the water flowing through the tube from C to D.

In diagram (b) two such "load" lines are connected in parallel. It will be noticed that one of the centre conductors A is welded to the bottom of its cylinder as before, while the other, A1, is cut short. This gives a still more compact arrangement than the first, because both branches can be made shorter than the ideal "infinite" line. The reactance of the left-hand or short-circuited line will then be inductive, whilst that of the right-hand or "open" line will be capacitive, so that one residual reactance counterbalances the other.

N.P.L. Annual Visit

IN accordance with custom, the National Physical Laboratory at Teddington was open for inspection on June 27th this year. The equipment on view to those invited covered an enormous range, from tanks for shipping tests and the wind tunnels for aerodynamic measurements to the testing of measuring equipment such as thermometers, engineers' gauges, etc.

The radio section was quite a small part of the whole, but was none the less interesting on that account. The wireless equipped meteorological balloon, introduced last year, was on view and has been modified to give humidity records as well as temperature and atmospheric pressure. This is done by periodically interrupting the steady pressure modulation signals and modifying them to give an indication of humidity.

Direction-finding equipment was very prominent this year, and of particular interest were rotating spaced-aerial direction finders for wavelengths of 5-10 metres and 10-70 metres. The latter has a maximum error of $\frac{1}{4}°$, with a maximum standard wave error of 1-$\frac{1}{2}°$, and a sensitivity of 3μV/m.

A direction finder for shorter wavelengths —2-3 metres—has a rotating loop, the built-in tuning condenser being operated by an arrangement of cords and pulleys.

The cathode-ray direction finder for marine navigation was on view as a working model. The CR tube is mounted vertically and provided with a compass-card. The spot is normally central, but when a signal is received a line appears giving the bearing of the transmitter.

The equipment was arranged with a model seascape having a lighthouse, light-ship and moving ship. Each transmitted distinctive signals in turn, which were audible on a loud speaker and also visible by flashing lamps at the "transmitters." The bearings of these stations could be seen on the CR tube, and in the case of the moving ship, its change of position could be followed with ease.

Field-strength measuring equipment and ultra-short-wave transmitting apparatus were also shown.

Henry Farrad's

PROBLEM CORNER

No. 27.—Shock from the Electric Light Bill

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction:—

1, Land View,
Cromer.

Dear Mr. Farrad,

A friend told me that you helped him very much with his wireless trouble, so I am writing in case you can advise me, although I'm afraid I can't give you very much information to go on.

We only got a wireless last Christmas, and I am convinced that it costs too much to run. The first electric light bill after it was installed gave me a bit of a shock, but the last one, which covers a quarter when the set was here the whole time, is worse still. We have to run the wireless off a lighting socket (it is 240 volts DC here), but the man who sold it assures me that it doesn't take much more current than a 60-watt light, and from the time we have it on I should say our bills might go up 20 per cent., but not 150 per cent.

It is quite an ordinary little set. Do you think the shop man is right about the cost of running? Is there any way I can tell if it is responsible for the big bills?

Yours sincerely,
Isaac McPherson.

Henry Farrad's comments are given on page 17.

Portable Transmitter Power Supply

COMBINED HT AND MODULATOR UNIT

By H. B. DENT (G2MC)

IN any place not supplied with electricity, the provision of HT for a transmitter, be it only a low-powered one, is a difficult problem. It is made no easier when one has to sit down and plan a supply for a portable transmitter, even though it may be assumed that transport of the apparatus does not rely solely on human muscle and endurance, but that a vehicle is available.

The five-metre portable transmitter described in the issue of June 8th last was designed to be as economical as possible consistent with good frequency stability, yet it requires a total input of 27 watts, made up of 10.5 for the valve filaments and 16.5 for the HT supply.

Should it be proposed to modulate the transmitter, the additional apparatus, even if the meanest possible AF amplifier be used, will consume not less than 16 watts. Subdivided into LT and HT requirements this becomes 6 and 10 watts respectively.

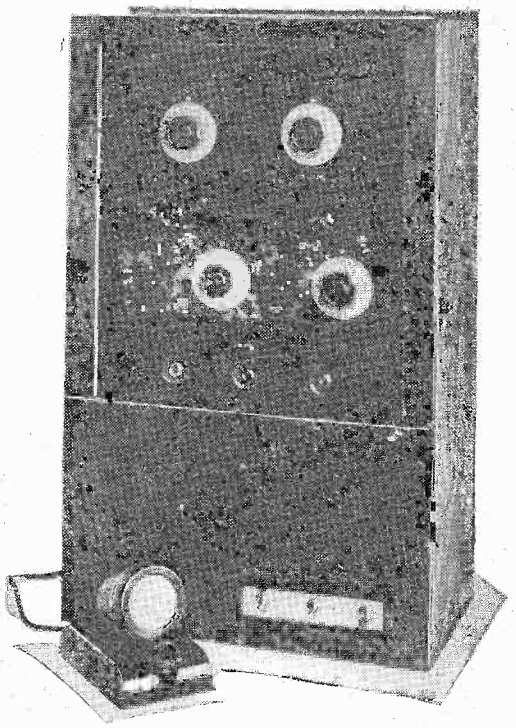
The idea behind this subdivision is that the LT can be derived direct from an accumulator, but unless batteries are used the HT supply must be obtained from a converter of some kind. As conversion of LT to HT will not be 100 per cent. efficient, we must know what proportion of the total power consumed has to be provided at the lower efficiency figure.

In calculating the filament watts the voltage is taken as 6, and not 6.3, as the supply will be derived from an accumulator.

DESCRIBING a unit for supplying HT to a transmitter from a 6-volt accumulator through a vibratory converter. Though primarily designed for portable use, the unit is also applicable to a fixed station lacking an electrical supply.

Now the possible sources of HT supply are batteries, rotary converters, vibratory converters, engine-driven dynamos and hand-driven generators. The last two mentioned we might leave out of our discussion, as, though possible methods, they are not usually employed by amateurs.

Dry batteries of the super-capacity size would power the five-metre transmitter for telegraph work, but if a modulating amplifier is added for telephonic communication, thus increasing the consumption to about 100 mA., batteries seem hardly practicable, though not entirely out of the question provided a sufficient number is used.



Front view of the complete transmitter including the G.E.C. microphone unit. Note the slot out in the right-hand bottom corner for the switches on the modulator chassis.

For portable work either rotary or vibratory converters seem the most practicable, as they are reasonably efficient and not too bulky for easy transport. Which of the two one may decide to use is largely a matter of personal preference. It so happened that the coin in our case showed "heads" and we decided to use a vibrator-type HT supply. Provision also had to be made for telephonic and possibly ICW transmissions, which called for a modulating amplifier, and it was felt that these two parts might well be accommodated on a single chassis, if the dimensions could be kept within the prescribed limits.

These limits are set by the size of the chassis in the transmitter, as it was proposed to house the whole of the equipment in a single cabinet, but excluding the LT accumulator, of course.

As the RF portion of the transmitter requires 250 volts at 60 to 65 mA and a modulator of the most economical type will account for a further 40 mA

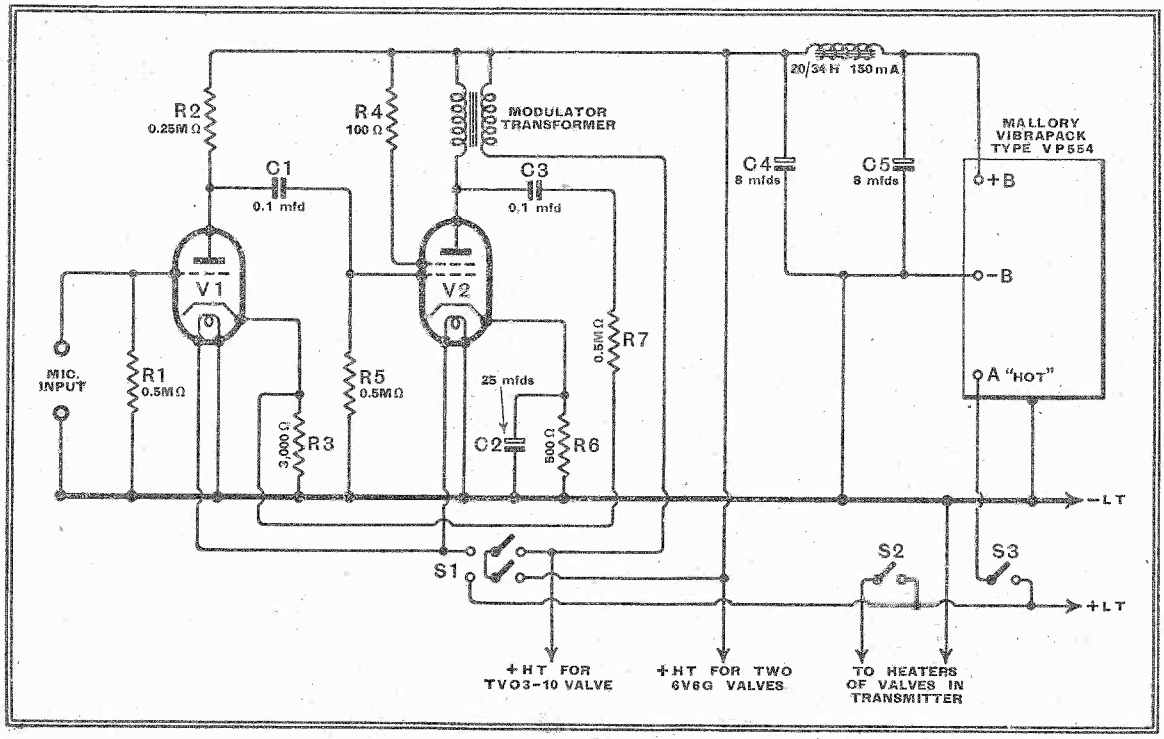


Fig. 1.—Circuit of the two-stage negative feed-back modulating amplifier and vibrator HT supply unit. The switches give complete control of the transmitter.

Portable Transmitter Power Supply—

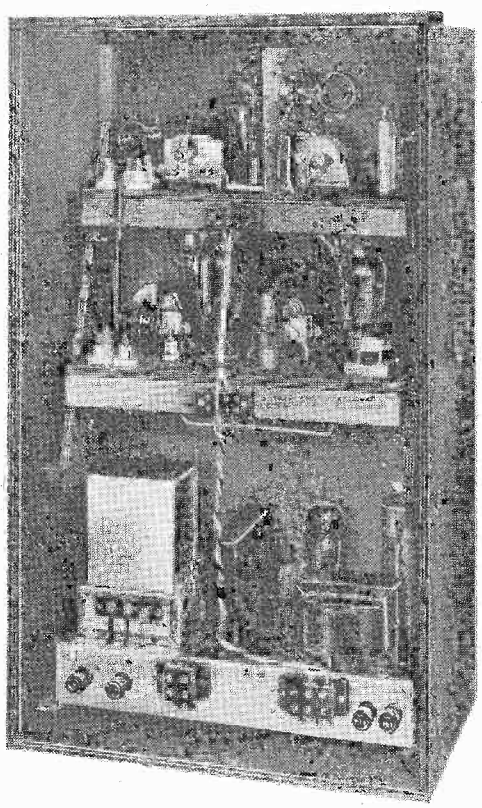
at 250 volts, a vibrator that will handle 100 mA at least is required. The alternative would be two lower-power vibrators, one for each portion of the transmitter, but this idea was rejected on the score of unnecessary expense in the duplication of parts.

Allowing an efficiency of about 50 per cent., the HT supply unit will draw $8\frac{1}{4}$ amps. from a six-volt accumulator, filaments amount to another $2\frac{3}{4}$ amps., so a battery capable of an 11-amp. discharge is needed. As the transmitter will be used for short periods only during a field day with a total operating time of two hours at the outside, a car-starter type of 120 ampere-hours capacity will answer for all ordinary purposes.

Vibrator HT Supply

Certain precautions have to be observed when building a vibratory supply unit; in the first case a correctly designed transformer is essential, and equally important is the inclusion of buffer condensers and resistances of the right values. Their function is to prevent sparking at the contacts, and, in a circuit in which over eight amperes are flowing, very special attention has to be given to these components.

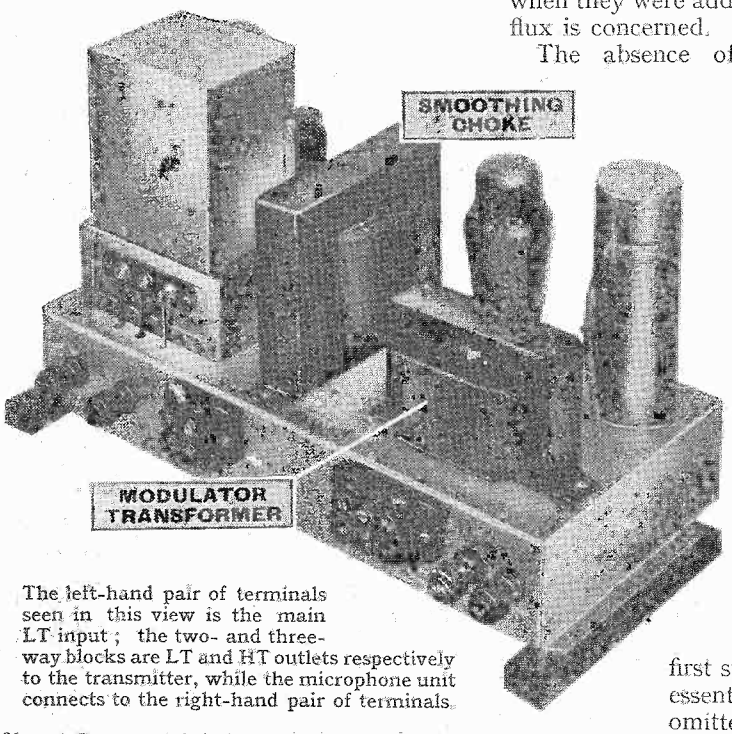
Since absolute reliability is so essential for portable work, it was decided that the



Portable five-metre transmitter complete with modulator and HT unit. The overall size of the cabinet is $24 \times 14\frac{3}{4} \times 8$in.

best way to avoid trouble was to use a self-contained vibrator unit fitted by the makers with the correct transformer and buffer components.

A unit of the kind required and designed to give 100 mA output was accordingly obtained from Masteradio. This is known as Mallory Vibrapack Type VP 554. One of its most attractive features is that the unit will supply this output current at either 225, 250, 275 or 300 volts after smoothing, these voltages being selected by a switch. The unit includes the RF



The left-hand pair of terminals seen in this view is the main LT input; the two- and three-way blocks are LT and HT outlets respectively to the transmitter, while the microphone unit connects to the right-hand pair of terminals.

filters, but not the ripple smoothing filter. A Premier 20/34-henry 150-mA choke and a Dubilier 8-8-mfd. dry electrolytic condenser block, however, satisfactorily discharge this function. Were it not for the fact that a modulating amplifier of fairly high gain will also draw HT from this power pack, a smoothing choke of lower inductance could have been used.

This is a two-stage amplifier which, as can be seen from the circuit (Fig. 1), consists of a triode input valve, resistance-capacity coupled to a tetrode output stage. In order to improve its characteristics a little negative feed-back is applied between the anode of the output valve and the cathode of the triode *via* C3, R7 and R3. Although this leads to a reduction in amplification, without it there is far more than we need for a carbon microphone, yet the output valve alone would not suffice. The first stage uses an Osram H63, while the output valve is a KT63 of the same make. The 6F5G and the 6F6G are the nearest equivalent American types.

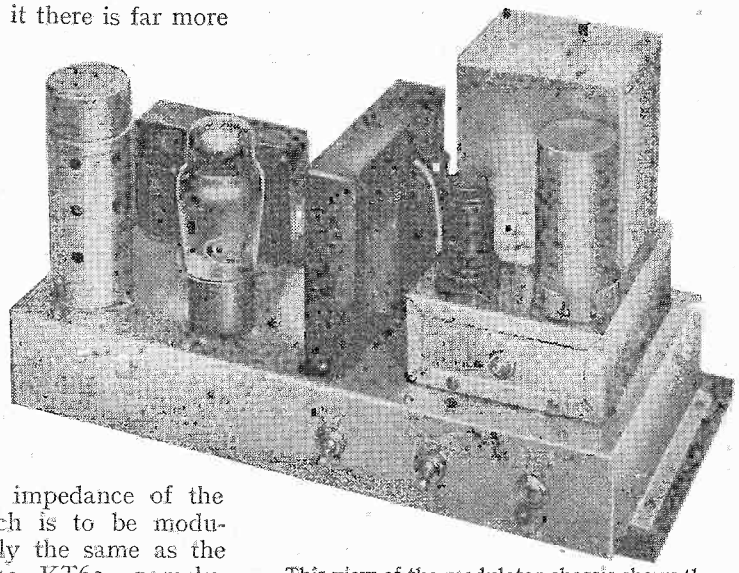
A one-to-one ratio modulator transformer can be employed as the AF impedance of the TVO3-10 valve, which is to be modulated, is approximately the same as the optimum load of the KT63, namely, 7,000 ohms.

Primary and secondary windings of the Premier 10-watt transformer fitted will carry the DC appropriate to a transmitter of this rating, and although the connections were arranged so that the two currents flowed in opposite directions, the speech quality was no different from that when they were additive, so far as the core flux is concerned.

The absence of a volume control, microphone transformer and provision for polarising voltage is an intentional omission, as these are all contained in the microphone unit, the one actually used with this transmitter being the G.E.C. Home Broadcaster. Joined across the input terminals is a resistance R1 which only serves to complete the grid circuit in the event of the microphone connections being removed without first switching off. It is not essential and could be omitted. Should any other microphone be employed this resistance can be replaced by a volume control.

Switches

Complete control of the transmitter is effected by the three switches S1, S2 and S3 in Fig. 1. The left-hand one, and this also applies to their actual position on the front of the chassis, is the modulator on-off switch; the middle one serves a like function for the RF section, while the right-hand one switches on, or off, the HT supply. With the exception of one position on S1 all switches are in the LT circuits. S1 is shown diagrammatically as a double-pole change-over type, whereas in the List of Parts a Bulgin single-pole

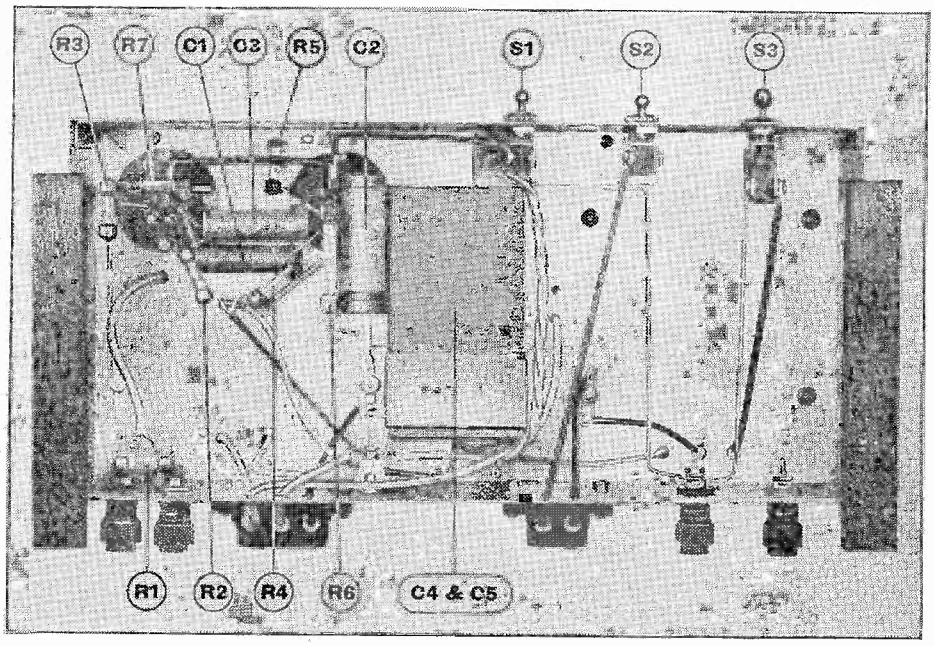


This view of the modulator chassis shows the position of the plug-in vibrator, alongside which is the HT rectifying valve. The small slotted screw on the front of the Vibrapack is the output voltage adjuster.

Portable Transmitter Power Supply—

double throw is specified. This seems to demand an explanation, but first the reason for fitting one of this variety will be dealt with.

For CW transmissions this switch is set to "make" the right-hand pair of contacts which opens the filament circuit of the modulator. By short-circuiting the secondary winding of the modulator transformer the full HT voltage reaches the anodes of the TVO3-10 valve, as its anodes current has to pass through this winding, which is not of negligible DC resistance. The maximum available power



Underside view of the modulator unit with all the components marked for identification.

is generally required when telegraphy has to be used, so one does not want unnecessary resistance in the HT supply line, particularly in a portable transmitter.

Now regarding the switch itself. The Bulgin Type S81T used for S1 has two contacts at each end and the moving one bridges these alternately. There is no external connection to the moving contact. To use it as a single-pole change-over switch one of each pair of end contacts has to be bridged externally. There must, of course, be a complete isolation of all contacts during the change-over process, as one end pair is in the LT circuit and the other pair is in the HT circuit.

The function of S2 is to switch off the filaments of the RF section, but when standing-by for a call, these valves would be kept alight. S3 switches on and off the HT supply, again by breaking the LT circuit.

Switch S2 has to handle 1.75 amps., but the current through S3 is of the order of 8 amperes, so a heavy-duty on-off switch, a Claude Lyons B.A.T. rated at 1,250 watts, has been fitted.

No provision has been made in this amplifier for measuring the anode current of the valves, but this is quite easily arranged by inserting a jack in series with the cathode resistance R6. The first valves take only a fraction of a milliamp., so it is hardly necessary to bother with measurements in this stage.

Much of what has been said in this article is equally true of a fixed station without an electric supply on tap, but while in the case of a portable provision need only be made for a day's supply of LT current, the fixed station will need a continuous supply. Arrangements must therefore be made to have a spare LT battery always ready to hand. Unless home-charging plant is installed, which should be done if at all possible, then at least three six-volt accumulators will be required, one in use, one spare and one at the charging station. With home-charging facilities it would be just possible to manage with two batteries.

LIST OF PARTS.

1 Mallory Vibrapack — Masteradio VP554
1 Smoothing choke, 20/34 henrys, 150 mA, 200 ohms — Premier C150/185
1 Modulator transformer, 1 to 1 ratio, 10 watts — Premier

Condensers:—
1 8-8 mfds., dry electrolytic, 500 volt, peak working, **C4, C5** — Dubilier 0288
1 25 mfds., electrolytic, 25 volt, **C2** — Dubilier 3016/S
2 0.1 mfd., tubular, 350 volt, DC working, **C1, C3** — Dubilier 4603/S

Resistances:—
1 100 ohm, ½-watt **R4** — Bulgin HW37
1 3,000 ohm, ½-watt **R3** — Bulgin HW7
1 250,000 ohm, ½-watt **R2** — Bulgin HW28
3 500,000 ohm, ½-watt **R1. R5, R7** — Bulgin HW31
1 500 ohm, 1-watt **R6** — Bulgin WE10

1 Top cap valve connector (Octal) — Bulgin P96
1 S/P, D/T Toggle switch, **S1** — Bulgin S81T
1 Toggle on-off switch, **S2** — Bulgin S80T
1 1,250-watts B.A.T. S/P on-off switch, **S3** — Claude Lyons No. 056
1 Midget stand-off insulator — Eddystone 1019
2 Octal valveholders, 1⅝in. — Clix X218
1 Terminal block, 2-way — Belling-Lee No. 1154
1 Terminal block, 3-way — Belling-Lee No. 1153
4 Insulated terminals LT+, LT−, Mic., Mic. — Belling-Lee "B"
1 Chassis, aluminium, 12⅝in. × 6in. × 2in., with ½in. wide flange on 6in. sides for fixing — Peto-Scott
1 Valve screen, 1½in. diameter by 4½in. high, with base — Peto-Scott

Miscellaneous:— — Peto-Scott
8 6BA ½in. RD screws and nuts, 9 4BA ⅜in. RD screws and nuts; quantity No. 16 and No. 18 SWG tinned copper wire and sleeving, bracket for fixing 8-8 mfd. electrolytic condenser, 4 4BA soldering tag, 8in. screened sleeving.

Valves:—
1 KT63, 1 H63 — Osram
1 Home Broadcaster microphone — G.E.C. BC1901

Mullard Radio and Television Receiver Servicing. Pp. 46. Issued by the Mullard Wireless Service Co., Ltd., Century House, Shaftesbury Avenue, London, W.C.2. Price 2s. 6d. (2s. 10d. c.o.d.)

THIS booklet deals primarily with the use of the Mullard cathode-ray oscillograph in servicing, and in conjunction with the Mullard frequency-modulated oscillator. The use of this apparatus for the adjustment of IF amplifiers, RF circuits and oscillator tracking is discussed in detail, and the numerous illustrations of the oscillograph traces to be expected will prove of great help to those who are unfamiliar with this kind of equipment. The illustrations, indeed, are a consistently good feature throughout the booklet and alone are sufficient to be of considerable help.

Following the discussion of alignment problems with a visual resonance curve, general RF testing is dealt with, and notes are given on the checking of AVC, modulation hum, by-pass condensers and AFC circuits.

AF apparatus is then treated and includes the checking of stage gain, contrast expansion apparatus and RC push-pull amplifiers. The receiving section concludes with some notes on the checking of HT supply circuits with the oscillograph.

The television section is largely devoted to the important question of the shape of the synchronising pulses, and the use of the CR tube in its determination is dealt with. Not the least valuable feature is the inclusion of a series of illustrations showing correct and incorrect pulse shapes at various points in the apparatus. Both electromagnetic and electrostatic time-bases are treated, and this section concludes by describing a method of measuring the high-voltage supply with the aid of the CR tube.

The booklet is concisely worded and copiously illustrated, there being no fewer than 67 illustrations. It should prove of great interest and help to all who use the CR tube for service work. W. T. C.

The Wireless Industry

NEW store depots have been opened by the General Electric Co., Ltd., at 39-43, John Street, Luton (telephone, Luton 3531-2), and at Beer Cart Lane, Canterbury (telephone, Canterbury 2212-3). Adequate stocks of all standard products will be carried at both depots.

A useful bibliography of the technical publications of the International Tin Research and Development Council is contained in Publication No. 94, which is the report of the Council's activities in 1938. Copies are available from the new headquarters at Fraser Road, Greenford, Middlesex.

Leaflet No. 1310 issued by Marconi's Wireless Telegraph Co., Ltd., describes the "Marconitrack" blind approach beacon receiver, Type A.D.66. The equipment weighs only 35 lb., and can be used for approaching any type of ultra-short wave beacon conforming with international requirements.

Distortion in Transformer Cores

PART III.—DC POLARISATION : INTERMODULATION EFFECTS : CHOICE OF CORE MATERIALS

By N. Partridge, B.Sc. (Eng.), A.M.I.E.E.

THE basic cause and nature of iron distortion in output transformers have been discussed in the two previous instalments. This article deals with the secondary effects that have to be considered before a reasonably complete understanding of the subject can be claimed.

THE examples considered so far have all assumed a resistive load on the transformer and also that the anode currents of the push-pull valves were accurately balanced, so that the core was not polarised. In addition, only one grade of magnetic material has been examined analytically.

A loud speaker does not behave so conveniently as a resistance when constituting an output load. A resistance maintains the same ohmic value at all frequencies,

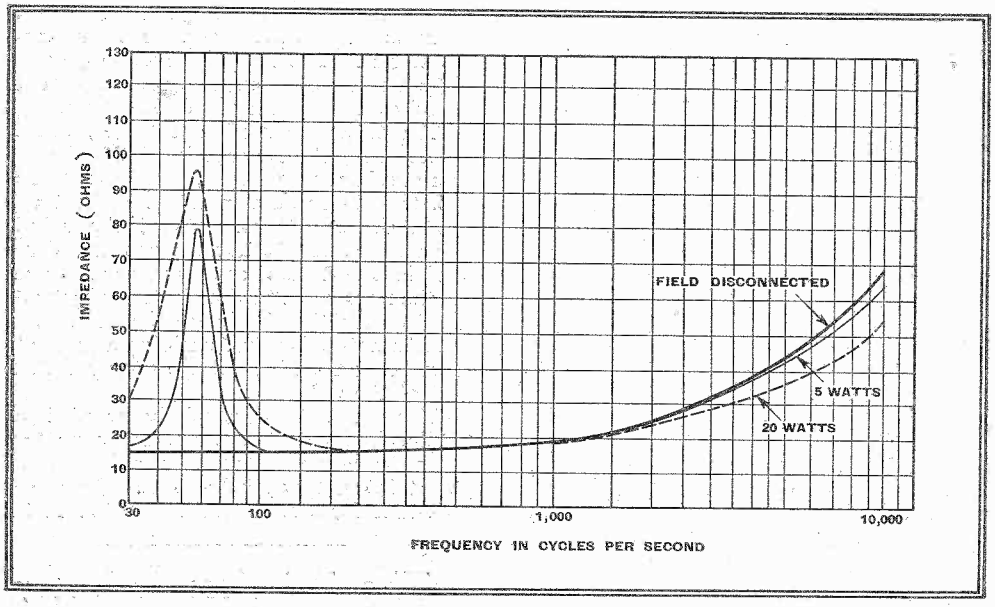


Fig. 16.—The impedance of a moving coil speaker varies considerably with frequency and the field strength. The rise around 50 to 60 c/s accentuates transformer distortion.

but a speaker varies enormously. Fig. 16 shows the impedance curves of the Celestion E55 speaker. These curves were given to the author by Messrs. Celestion, Ltd., and indicate the variation of speaker impedance with frequency and how this curve changes with the speaker field strength.

The sharp rise of impedance at around 50 to 60 c/s, which is common to all speakers, is serious. It causes the value of R in the formula (3) to increase and the transformer distortion will be accentuated as a result. An example on the lines of those given last week will illustrate the point.

Consider an output transformer for two KT66's in push-pull, having 2,800 turns on a 1½in. stack of No. 4 stampings. This is a more lavish design than that given in Example 2 in Part II, and Table 4 shows that the resultant iron distortion is noticeably less when the anode to anode load is 4,000 ohms. Column 4 applies to this condition and states the total percentage distortion at 50 c/s. If the resistive load be

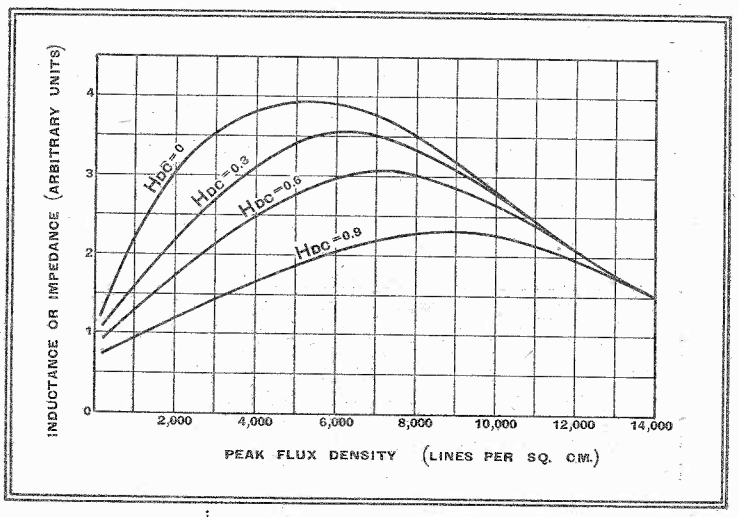


Fig. 17.—The relative inductances of a transformer with varying degrees of polarisation are shown for all values of B. The core material in this case was Silcor 2.

replaced by the E55 speaker (or any other for that matter) the value of R will become much higher than 4,000 at 50 c/s. The AC resistance of the valves is far too high to help very much. R is almost the same as the speaker impedance multiplied by the square of the transformer ratio. Columns 5, 6 and 7 of Table 4 show the total distortion at 50 c/s, when R is equal to 8,000, 12,000 and 16,000 ohms respectively. Although the transformer appears passably good with a resistive load, considerable distortion will be produced in practice when using a speaker in conjunction with high-impedance valves.

It is well known that direct current passing through the primary of a transformer polarises the core and causes a drop in the inductance. One of the advantages of the push-pull arrangement is that the anode currents of the two valves traverse the transformer windings in opposite directions and cancel each other magnetically. But an exact balance of these currents is unlikely unless some special precautions have been taken to ensure it. An examination of the influence of the small out-of-balance currents likely to be met in practice is therefore of interest.

Fig. 8 in Part I showed how the inductance or impedance of a transformer varies with the AC flux density in the core. Fig. 17 repeats this curve together with

TABLE 4

B	Watts Output R=4,000	Zf	Distortion (per cent.)			
			R=4,000	R=8,000	R=12,000	R=16,000
1,000	0.5	28,000	1.85	3.7	5.5	7.4
2,000	2.0	39,000	2.1	4.2	6.3	8.2
3,000	4.6	48,000	2.3	4.6	6.8	9.2
4,000	8.1	52,500	2.5	5.0	7.5	10.0
5,000	12.7	55,000	2.9	5.8	8.8	11.6
6,000	18.0	55,000	3.3	6.6	10.0	13.2

Distortion in Transformer Cores—

three additional curves which show how drastically a polarising current reduces the impedance. The values of the DC magnetising force are marked on the curves and they correspond roughly to out-of-balance currents of 2.5, 5 and 10 mA in a transformer such as that analysed in Table 4. Obviously, the effect of even a small out-of-balance current is not negligible. Formula (3) states that the effective distortion will be increased in inverse proportion to ZF. It follows that some means of securing equality of the

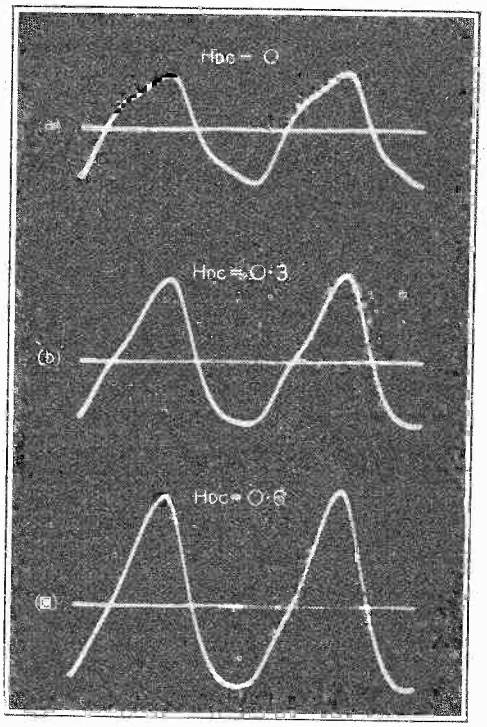


Fig. 18.—Small out-of-balance between the anode currents of push-pull valves is sufficient to reduce the transformer inductance and to add even harmonics to the existing iron distortion.

anode currents should be provided in high fidelity push-pull amplifiers.

Nor is the loss of inductance the only result of polarisation. Fig. 18 gives oscillograms showing the production of even harmonics. At (a) is the current wave form at an AC flux density of 2,920 lines per sq. cm. (no DC component). This oscillogram is the same as the corresponding one in Fig. 3, but the current scale is smaller. Superimposing a DC magnetising force of H=0.3, roughly equivalent to 2.5 mA difference in the anode currents of two push-pull valves, resulted in the wave form at (b). The current is larger owing to the lowering of the inductance and also the wave form is not symmetrical about the zero line. The latter points to the presence of even harmonics. The third oscillogram (c) shows how both effects are magnified by doubling the DC field strength (H=0.6).

The preceding considerations relating to the effect of DC lead to an interesting line of thought. Imagine two widely different frequencies (DC excluded) being fed into a transformer simultaneously, as must often occur in a normal programme. Periodicities of 50 and 500 c/s would suit the case. How can the higher frequency distinguish between the peaks of the 50 c/s current and a direct current? Fig. 19 makes the similarity between the two conditions easily seen. If the current at the lower frequency behaves in the manner of DC when at its peak values, we should expect the higher frequency to be modulated by the lower frequency.

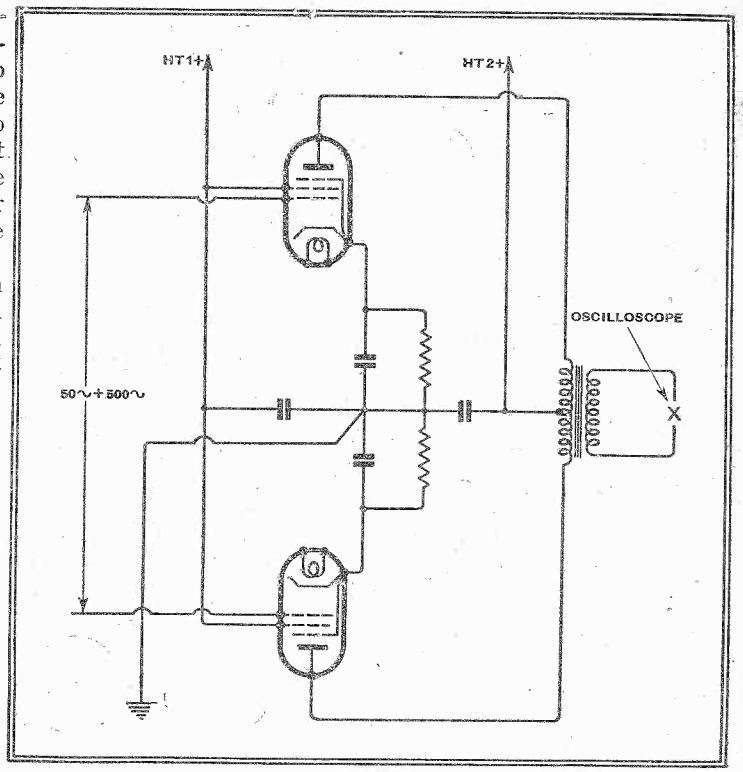


Fig. 20.—The type of circuit employed to obtain the oscillograms reproduced in Fig. 21.

To show that such an effect does indeed take place, a circuit similar to that shown in Fig. 20 was set up. The important points to note about it are: (1) high impedance valves are used, and (2) the transformer is virtually unloaded since the oscillograph has a very high input impedance. The resultant oscillograms, therefore, show the wave form of the open circuit *voltage*, which exaggerates distortion to a maximum as was mentioned in the Appendix to Part I of the series.

Fig. 21 (a) shows the wave form of the 50 c/s output *voltage* when the flux density in the core of the transformer was of the order of 300 lines per sq. cm. At (b) is shown the wave form of the 500 c/s output. The flux density in this case was very small owing to the higher order of the frequency, and, therefore, little iron distortion can be observed. The next oscillogram (c) depicts the state of affairs when the two frequencies were applied together. Note that the 500 c/s wave is not simply added to the wave shown at (a), but it has been modulated as well. The variations of amplitude are

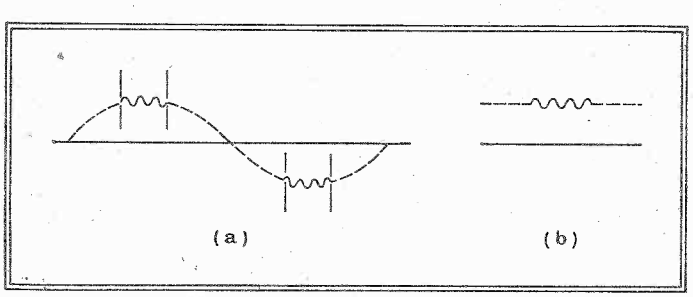


Fig. 19.—Showing the similarity between (a) a high frequency superimposed upon the peak of a low frequency and (b) superimposed upon DC.

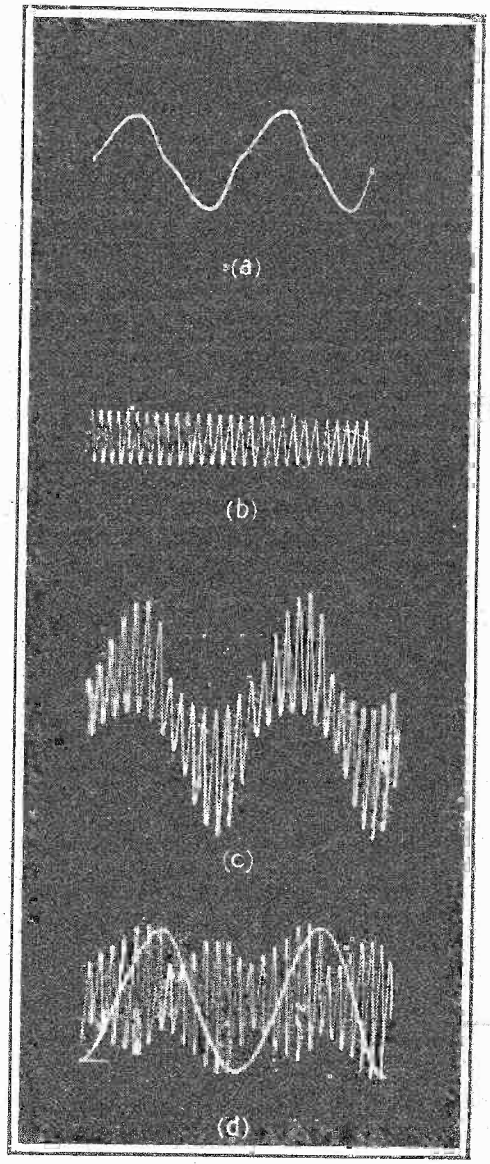


Fig. 21.—The magnetic characteristics of iron are such that high frequencies can be modulated by low frequencies. It is shown in the text that the effect is not very important in practice.

Distortion in Transformer Cores

easily detected, but to make it still more obvious, a device was rigged up that allowed the low frequency voltage to be taken out, leaving only the distorted or modulated 500 c/s wave. This is given in

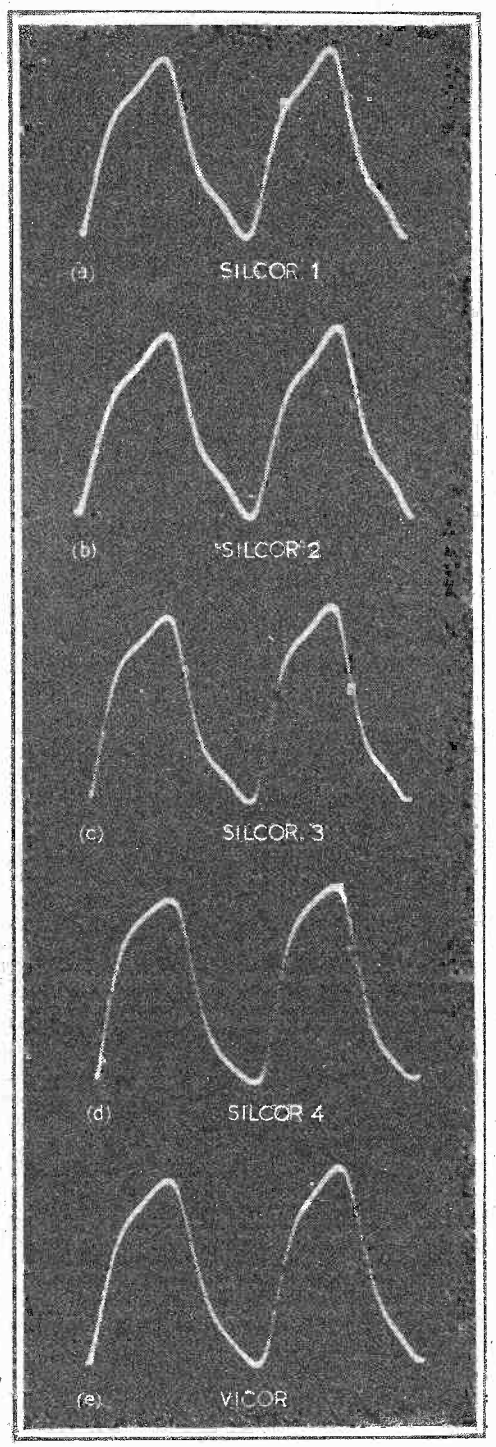


Fig. 22.—The current distortion varies widely with different magnetic materials. The above oscillograms were taken at a flux density of 4,680 lines per sq. cm.

Fig. 21 (d). The sine wave marks the phase relationship of the 50 c/s *current* through the primary, which was responsible for modulating the 500 c/s wave.

In reality the facts illustrated in Fig. 21 (c) and (d) are not quite so simply explained as it might appear from the above. But this is of no immediate consequence. The point is that high frequencies *are* modulated by relatively lower frequencies. Fortunately, several factors are present that prevent this type of distortion from being prominent in practice. The modulated wave can be looked upon as the original frequency plus a number of others superimposed. Using the radio analogy, the 500 c/s has acquired "side-bands." The transformer can again be accepted as the generator of the unwanted frequencies and a method of calculating the distortion in normal conditions can be deduced. Space does not allow of a full description, but it will suffice to say that the effect is negligible compared with that of the harmonic iron distortion to which this article is mainly devoted.

The laminations or stampings for transformers can be obtained in a number of different magnetic materials. All the results described up to this point have applied to the alloy known as Silcor 2, manufactured by Messrs. Magnetic and Electrical Alloys, Ltd., of Wembley. Other possible materials supplied by the same firm are Silcor 1, Silcor 3, Silcor 4, and a rather different alloy known as Vicor. The magnetic characteristics of each are different and it would be reasonable to anticipate variations in the degree of distortion caused by these alternatives.

To investigate this matter, current oscillograms were taken for each material at a

TABLE 5

Material	Percentage Harmonic Distortion (Current). B = 4,680			
	3rd	5th	7th	Total
Silcor 1 ...	17.3	9.3	10.9	37.5
Silcor 2 ...	20.0	11.1	8.6	39.7
Silcor 3 ...	18.2	9.2	6.3	33.7
Silcor 4 ...	15.6	7.8	3.2	26.6
Vicor ...	14.9	8.0	5.6	28.5

flux density of 4,680 lines per sq. cm. The photographs are reproduced in Fig. 22 and the results of the harmonic analyses are given in Table 5. These oscillograms and the distortion figures obtained from them may be compared with Fig. 3 and the point on the curve of Fig. 5 corresponding to B = 4,680. The conditions of test are the same, but the core material is varied. One cannot jump to an immediate conclusion as to the relative merits of these materials merely by consulting Table 5. The basic distortion is not so important as the actual distortion under normal conditions of use and formula (3) told us that this depends upon $x \times \frac{R}{Z_F}$.

R is a constant of the circuit, but x and Z_F depend upon the characteristics of the iron. The values of x are to be found in Table 5 for B = 4,680, but Z_F is not disclosed. A curve similar to that given in Fig. 8 is required for each material. These will be found in Fig. 23. Using the latter curves in conjunction with Table 5 some idea of the merits of the several alloys can be obtained and also some information on how they should be used to the best advantage.

TABLE 6

Material	Z_F	Total Distortion (per cent.)	$\frac{x}{Z_F}$
	B = 4,680		
Silcor 1 ...	460	37.5	.0086
Silcor 2 ...	420	39.7	.0100
Silcor 3 ...	340	33.7	.0105
Silcor 4 ...	265	26.6	.0107
Vicor ...	490	28.5	.0061

First of all, we will consider the result of substituting one in place of another without altering the windings or core area of the output transformer. Obviously, such a proceeding would change the values of both x and Z_F in formular (3) and the excellence of any particular core will depend upon the ratio $\frac{x}{Z_F}$. In Table 6 the total distortion produced by each grade of iron has been set out, together with the relative values of Z_F extracted from Fig. 23. The final column shows the relative distortion figures $\left(\frac{x}{Z_F}\right)$.

To make the significance of this quite clear, an example will be given. Suppose an output transformer has a core of Silcor 2, such as any of those described earlier in the article. If the iron be removed and, say, Silcor 4 substituted, two major changes in the characteristics of the transformer will be brought about. First, the

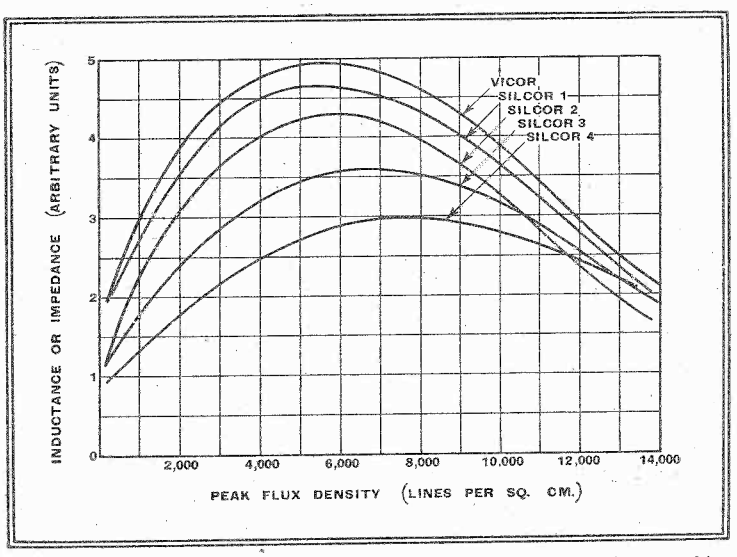


Fig. 23.—This graph illustrates the relative inductances that would be obtained by substituting five different grades of iron in a transformer.

Distortion in Transformer Cores

inductance of the primary will be reduced in the ratio of 420 to 265 (see Table 6) and secondly, the percentage distortion caused by the iron at a flux density of B=4,680 will be increased to 1.07 times its original value. Note carefully that the *iron* distortion will be only slightly increased, but it is possible under certain circumstances that the loss of inductance may considerably increase *valve* distortion owing to the anode load falling below its optimum value.

Looking at each of the samples mentioned in Table 6 in a similar way to that just described, it will be noted that Vicor is outstandingly good. The concluding part of this series will deal with the application of this material to ultra-high fidelity output transformers.

Instead of substituting one type of core for another, the design of the entire transformer might be modified to accommodate the new material. For example, suppose we have a well-designed output transformer with a core of Silcor 4 and, being attracted by the high permeability of Silcor 1, we decide to employ this alloy for the production of an *electrically* similar transformer. The substitution of Silcor 1 for Silcor 4 would increase the inductance from 265 to 460 (see Table 6). Hence one would be justified in reducing the core area in the same proportion in order to end up with the same inductance as the original transformer, which we assumed was adequate. The usual frequency response test would show the new, smaller transformer to be as good as the original large one. But the Partridge Distortion Index would tell a different tale. Since ZF has been made the same for both transformers, the figure of merit given in Table 6 no longer applies, and the ratio of the basic distortion figures (26.6 per cent. and 37.5 per cent.) must be used. Actually, the position is very much worse than this because by reducing the core area the flux density has been correspondingly increased and, therefore, a much higher distortion figure must be taken for the Silcor 1.

These illustrations show that the substitution of a higher grade of core material results in a small improvement in the iron distortion produced by a transformer. But to employ a high grade for the purpose of reducing size and/or weight results in a substantial increase of distortion. It would seem that a good output transformer *must* be large. Also, a large transformer using low-grade iron will give rise to less harmonic distortion than a small transformer having the same inductance but using high-grade iron.

In fact, the terms "high grade" and "low grade" are not at all applicable as far as speech transformers are concerned. The terms originated with reference to mains transformers, where core losses are so very important and one must guard against wrongly imagining that what is good for a mains transformer is necessarily good for a speech transformer.

In Forthcoming Issues

FOUR-BAND TRANSMITTER. Design and construction of efficient and inexpensive equipment using the new tetrode transmitting valve.

Notes on the ELECTRIC GRAMOPHONE. Further information on the flexible high-quality amplifier recently described.

MASTERING MORSE. Aid to practising the code at home.

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DESIGNED for sound distribution in offices, factories, etc., this loud speaker is designed for fixing either to the wall or ceiling by means of the universal bracket with which it is supplied. It is 22 inches in diameter, but stands only seven inches from the surface of the wall.

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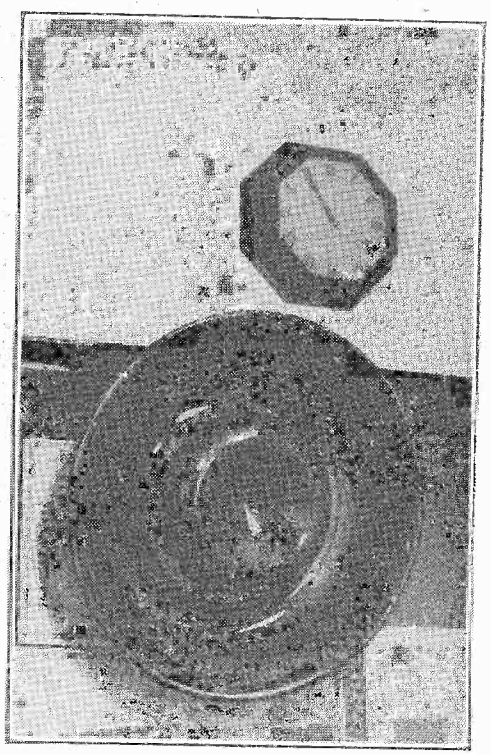
Tests showed the useful frequency response to be from 150 to 5,000 cycles. The important section between 150 and 1,000 cycles is remarkably free from resonances and as a consequence speech is very natural. The output extends, with some attenuation, above and below the limits given, and reproduction of music is excellent as judged by PA standards.



The Allen concentric re-entrant loud speaker.

Impedances to suit all standard outputs can be supplied.

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THURSDAY, JULY 6th.

3, Tennis O.B. from Wimbledon. The Semi-Finals of the Ladies' Singles with a commentary by Thomas Woodrooffe. **3.30,** Gaumont-British News. **3.40,** 257th edition of Picture Page. **4-5,** Tennis O.B. from Wimbledon, continued.

9, Scenes from Henry Sherek's "Dorchester Floor Show." **9.20,** Charles Heslop in "Percy Ponsonby Goes to Wimbledon." **9.30,** British Movietonews. **9.40-10.30,** 258th edition of Picture Page, introducing the Mills Brothers.

FRIDAY, JULY 7th.

2.30-5, Tennis O.B. from Wimbledon. The Semi-Finals of the Ladies' Doubles and the Final of the Men's Singles.

9, Edward Cooper and Patricia Leonard in "Look Here!" a new revue by Nicholas Phipps. **9.30,** Gaumont-British News. **9.40,** "Travelling Light," a description of the contents of a suitcase for a holiday abroad. **9.55,** "Zoo Babies"—Film. **10.5,** Leila Howell, 'cello. **10.15-10.30,** "Sunday in the Country," S. P. B. Mais introduces viewers to his favourite corner of Sussex.

SATURDAY, JULY 8th.

2.30-5, Tennis O.B. from Wimbledon. The Finals of the Ladies' Singles and Doubles, and the Final of the Men's Doubles.

9-10.30, "Gallows Glorious," a special adaption of the play by Ronald Gow. The action takes place in America in 1859.

SUNDAY, JULY 9th.

3, Friends from the Zoo. **3.15,** Cartoon Film. **3.20,** Joan Collier in Songs, with Evel Burns at the piano. **3.30-4,** "The Plough that Broke the Plain"—Film.

8.50, News. **9.5-11.5,** Wendy Hillier as Grace in "The Fame of Grace Darling," a new play by Yvette Pienne.

MONDAY, JULY 10th.

3-4, "Fiat Justitia." Excerpts from Famous Trials of Literature and Drama. Cast includes D. A. Clarke-Smith and Alan Wheatley.

9, Friends from the Zoo. **9.15,** British Movietonews. **9.25,** Musical Bee. **10.5,** Cartoon Film. **10.10-10.20,** "This Motoring," illustrated in verse and cartoon by Reginald Arkell and Harry Rutherford.

TUESDAY, JULY 11th.

3, "Look Here!" (as on Friday at 9 p.m.). **3.35,** British Movietonews. **3.45,** Foundations of Cookery—Marcel Boulestin.

9, Gaumont-British News. **9.10-10.40,** "Inquest," a play by Michael Barringer.

WEDNESDAY, JULY 12th.

3-4.30, "Gallows Glorious" (as on Saturday at 9 p.m.)

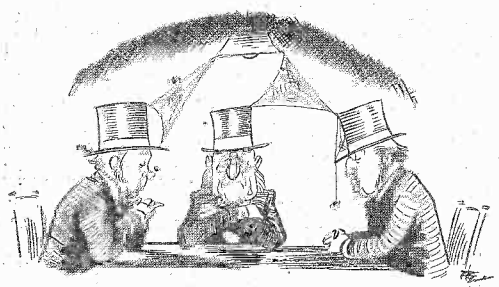
9, Foundations of Cookery—Marcel Boulestin. **9.15,** Cartoon Film. **9.20,** "East End"—Talk. **10.5,** Demonstration of Ballroom Dancing by Alex Moore and Pat Kilpatrick. **10.15,** British Movietonews. **10.25-10.35,** Etienne Amyot, pianoforte.

UNBIASED

By FREE GRID

The Cart Before the Horse

IN spite of the remarks I made the other week in defence of push-button tuning (April 27th), I have received a large amount of correspondence from the old diehard brigade who are always opposed to progress in any form, and spend their lives prating about the good old days which exist only in their imagination. Their chief moan about push-button tuning is that it is a sign of growing laziness, just as though laziness were a vice instead of being, as it is, the great characteristic which distinguishes the human



Diehard Dial Twisters.

race from the beasts that perish; the characteristic which has been responsible for every single scientific advance that has ever been made.

Our early forebears in the jungle invented their primitive method of signalling by means of a drum simply because they were too lazy to hack a way through the jungle and deliver their message in person, and so it has gone on. Broadcasting itself, and now television, exists simply because we are too darned lazy to go to the theatre or lecture hall in person, but prefer to have our entertainment and moral uplift in the comfort of our own homes.

Even some of our manufacturers do not yet appear to realise that the day is fast approaching when the wireless receiver will be permanently banished to the cellar along with the gas meter, and all the other necessary adjuncts of life, all tuning being done by remote control. There are, of course, some minds which move more slowly than others, and for them it is well that the slow and stately system of tuning by dial twisting should be retained as an optional arrangement for bringing in the programmes; that is why sets still have dial tuning in addition to push-buttons.

I have, however, always thought it rather unfair that for the sake of these old-world listeners we should all be compelled to pay for tuning dials and other Victorian relics which we do not want. I have often wondered, in fact, why some progressive manufacturer didn't bring out a set in which dial tuning was optional, and could be bought as an extra by those whose minds were ruled by a sentimental regard for past and bygone things rather than by the cold logic of science. I was, therefore, very gratified when I heard that certain manufacturers were intending to provide this "optional" arrangement.

You can therefore imagine my astonishment and chagrin when I found that the cart was being put before the horse, and that it is the push-buttons and remote control that are the extras, the old-fashioned dial-tuning arrangement being still the fundamental part of the set. In other words, for some inexplicable reason the sentimentally minded diehards are once more being pandered to, and we moderns have to pay for it. If I want a wireless set, therefore, I still have to buy something I don't want in order to get something I do want, so that manufacturers may not offend the tender susceptibilities of the Dundreary-whiskered brigade of dial twisters. As John Henry used to say, "It's all wrong."

You Have Been Warned

IT has always been astonishing to me how some people, who in most respects are the very embodiment of honesty and other forms of moral rectitude, are, in certain things, the very reverse of them. Only the other day, for instance, a well-known bishop of my acquaintance endeavoured to get me to secure for him a well-known make of wireless set at a reduced price, and seemed quite hurt when I told him that if I did that both he and I would be guilty of robbing some unfortunate wireless dealer of his just dues, fully as much as if we had put our hand in his till and taken the money out.

The reason why I raise this point is that I have just been reading a long exhortation in the wireless column of a well-known newspaper on the necessity of watering the wireless earth if good reception is to be maintained in these dry summer days. Apart from the fact that the days are far from dry, the whole exhortation was, to my mind, technically unsound. If you have buried your earth deep enough it won't need any watering, and if you haven't done so, no amount of watering will make any but a temporary difference to it.

The thing which really stuck in my gullet, however, was the statement that, if householders do not pay a water rate for their gardens, they must be careful not to use a garden hose for watering the wireless earth, as if they did so they would be guilty of stealing water from the company. They were told, however, that they were at full liberty to use as much water as they liked if they carted it along in a can.

Morally speaking, I should have thought that if you are bent on robbery it is equally as bad if you take the goods by small instalments as if you take them wholesale.

However, it is the legal rather than the moral aspect of the case which concerns me here. I have no hesitation in stating that unless you pay a non-domestic water rate in addition to the ordinary one you are committing a breach of the law by watering your wireless earth, no matter whether you employ a hose or a watering can, and I feel sure that the barristers among you will support me in my contention. It is *not* in the same category as using a watering can for the flowers.

The whole case was fought out in the courts in 1932 when a wretched woman, who paid only the ordinary domestic water rate, was fined for washing a horse's feet with a watering can, and it availed her little to show that her next-door neighbour, who also paid only the domestic rate, used far more cansful of water on his garden than she did on the horse's feet.

Although the connection between wireless earths and horses' feet is not obvious, it is my contention that they both equally fall outside the category of flower beds and lawns. In any case, as I have

Keep a weather eye lifted.

already shown, it is, technically speaking, a waste of time. If, however, in spite of my words of warning, any of you persist in this foolhardy habit don't forget to keep a weather eye lifted for the water-board inspector.

Tailpiece

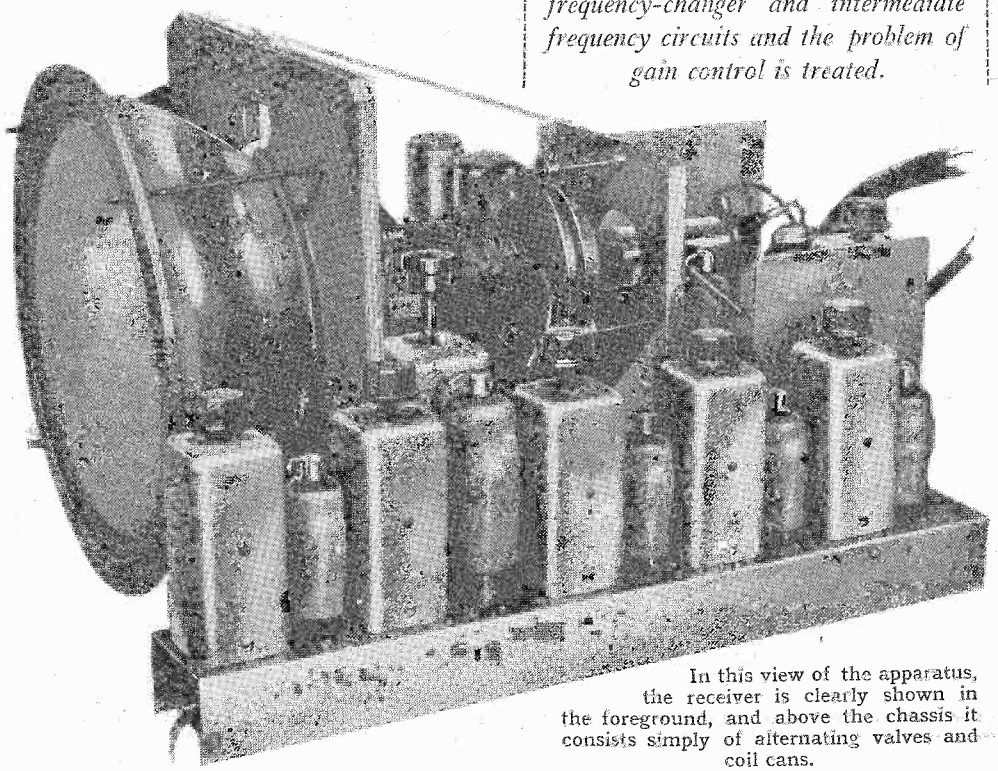
"WHEN choosing a wireless receiver to run off the electric lighting mains," says a well-known woman's journal, "make sure that you get the correct type to suit your mains, which may be what are known as the AC or the DC type. If an AC set is connected to DC mains or *vice versa* its performance may be disappointing." This information ought to be of real help to *The Wireless World* technical staff.

Magnetic Television Receiver

Part II.—RF, FC AND IF RECEIVER CIRCUITS

By W. T. COCKING

THE design of the receiver portion of the equipment is considered in some detail in this article. The discussion covers the radio-frequency, frequency-changer and intermediate frequency circuits and the problem of gain control is treated.



In this view of the apparatus, the receiver is clearly shown in the foreground, and above the chassis it consists simply of alternating valves and coil cans.

AFTER the general preliminary discussion in Part I we can turn to a consideration of the actual receiving equipment. It may be of interest at this point to note that the design of this apparatus was commenced early last November. The paper design, construction of the experimental model and initial testing occupied about two months. After this another month was occupied by general testing and minor modification.

This may seem a long time, but it must be remembered that there are only two hours of day-time transmissions each day. Consequently, in a month only about forty hours' testing on signals is possible. Much development work can, of course, be carried out without signals or with a local oscillator, but for many tests signals are essential.

By the end of January the apparatus had reached practically its final form, and since then to the time of writing it has been used almost daily in *The Wireless World* Laboratory. During this period of four months the apparatus has never failed to give a good picture and no defects of any nature have developed. The utmost confidence is consequently felt in the reliability of the gear.

Constructionally, the apparatus is divided into two main units—receiver, tube assembly and time-base, and the power pack. The former, however, is also really in two parts; there is a main chassis of steel which carries the tube, deflecting and focusing coils and time-base, and a separate aluminium chassis for the receiver—the two being bolted together to form a single unit. This is done for two reasons: first, a steel chassis is necessary for the tube assembly in order to obtain adequate rigidity and an aluminium (or copper) chassis is very desirable for the receiver in order to maintain stability; secondly, the sub-division of the apparatus makes construction easier, since the separate units are more easily wired.

The Receiver

The complete circuit diagram is shown in Fig. 1. The upper part of the drawing represents the receiver proper and the components are carried by the aluminium sub-chassis, while the lower part of the diagram shows the time-base and tube which are carried by the steel chassis to which the receiver chassis is bolted. Ten valves are used in the receiver and five in the time-base. Of these V1 is an RF stage and V2 a frequency-changer; V3, V4 and V5 are IF stages and V6 is a diode detector. Then comes the VF stage V7, followed by a DC restoring diode V8. There is then a combined phase-splitter and cathode-follower V9 and a sync-separator V10. In the time-base V12 and V15 are respectively the line and frame saw-tooth oscillators, and V11 and V14 are diodes through which the sync pulses are applied. V13 is another diode which is provided to damp out oscillation on the line fly-back.

An RF stage is almost essential in a sensitive superheterodyne, for as an RF valve introduces much less noise than a frequency-changer, a much cleaner background in the picture is obtained when it is used than when the frequency-changer is the first valve in the set and the IF gain is increased to maintain the same sensitivity. Although coupled pairs of tuned circuits for the intervalve couplings enable greater gain to be obtained for a given band-width than single-circuits, the latter are adopted in both RF and IF circuits.

There are good reasons for this. The advantage in gain of two-circuit couplings is only retained if the total capacities in circuit are of the same order. With single circuits variable inductances can be used for trimming, but with two circuits this is usually very difficult to arrange and capacity trimmers must be used. This at once makes the total capacity very appreciably higher with two-circuit couplings than with single circuit. As a result their advantage is largely, if not completely, lost. They still retain the advantage of providing better selectivity, however, but this is not important if the selectivity with single circuits proves adequate, as in practice it does. The single-circuit couplings are considerably simpler to produce and adjust.

The RF Circuits

Mazda SP41 valves are used for the RF and IF stages, since they have a high mutual conductance with low capacities, and the input resistance at 45 Mc/s is quite high in view of the mutual conductance. It is only about 2,000 ohms, which may not seem very high, but everything is relative, and it seems high compared with older valves like the AC/SP3 of similar mutual conductance.

The input circuit L1 is tuned, like all the other circuits, by the stray and valve capacities; the inductance is variable for trimming, however. The variation is obtained by a form of spade tuning, for a control knob on the coil screen enables a brass plunger to be inserted to the desired degree inside the coil form. The effective inductance depends on the position of the plunger relative to the coil.

No artificial damping is introduced in this circuit because, in addition to the coil losses, the circuit is damped by the input

Magnetic Television Receiver—

resistance of V1, and also by the connection of the aerial feeder to the primary winding. As the valve resistance is about 2,000 ohms the total effective damping on the circuit with optimum coupling to the feeder is equivalent to a shunt resistance of rather less than 1,000 ohms. The circuit is, in fact, quite heavily damped and gives an adequate band-width in consequence.

The coupling between the RF and frequency-changer valves is by means of the tuned-grid circuit, but in view of the heavy damping which the circuit requires for the desired band-width, it is permissible to use a feed-resistance R4 instead of an RF choke. This represents a considerable saving in cost and space, since it is done in all stages.

The input resistance of the frequency-changer is considerably higher than that of the RF stage, and on this coupling there is no damping introduced by the aerial circuit. The feed-resistance R4 plays a part, but in this case it is given the fairly high value of 10,000 ohms, so that it does not represent a major part of the circuit damping. The result of this is that the circuit L2 is noticeably sharper in tuning than L1.

A triode-hexode frequency-changer is used, despite the fact that an SP42 with separate oscillator will give much more gain. The "gain" of the frequency-changer, in fact, is not far off unity. The two-valve circuit, however, is more complicated and more difficult to set up, and it seems to the writer that the extra valve can be more usefully employed elsewhere.

The so-called modified Colpitt's oscillator circuit is used and consists of L3 tuned by the condenser C8. The coil is former-wound for rigidity and an air-dielectric condenser is used; both are included in the same can and the condenser has an insulated extension spindle for adjustment.

The grid condenser C7 has a capacity of only 10 $\mu\mu$F, this value being selected

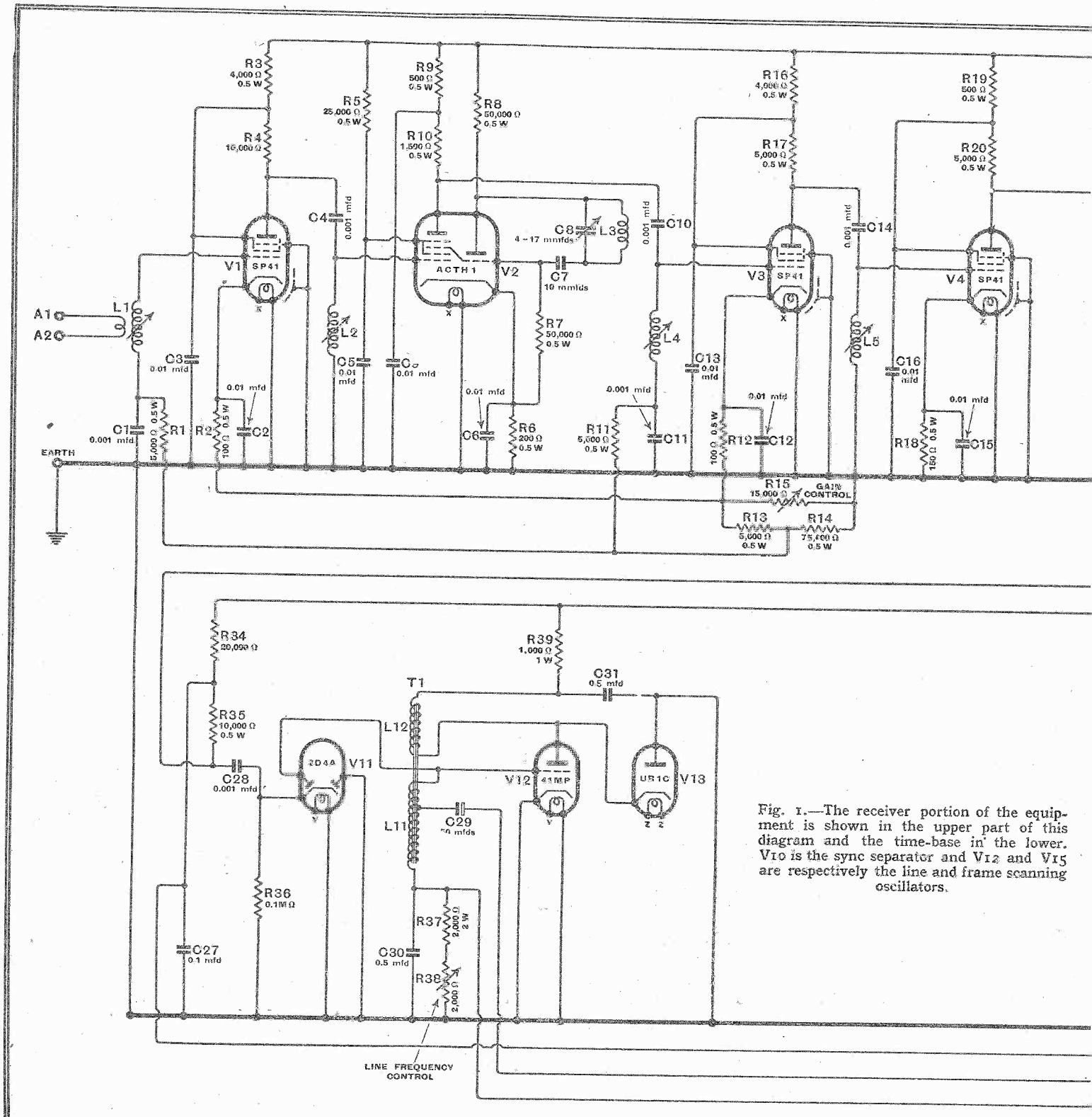


Fig. 1.—The receiver portion of the equipment is shown in the upper part of this diagram and the time-base in the lower. V10 is the sync separator and V12 and V15 are respectively the line and frame scanning oscillators.

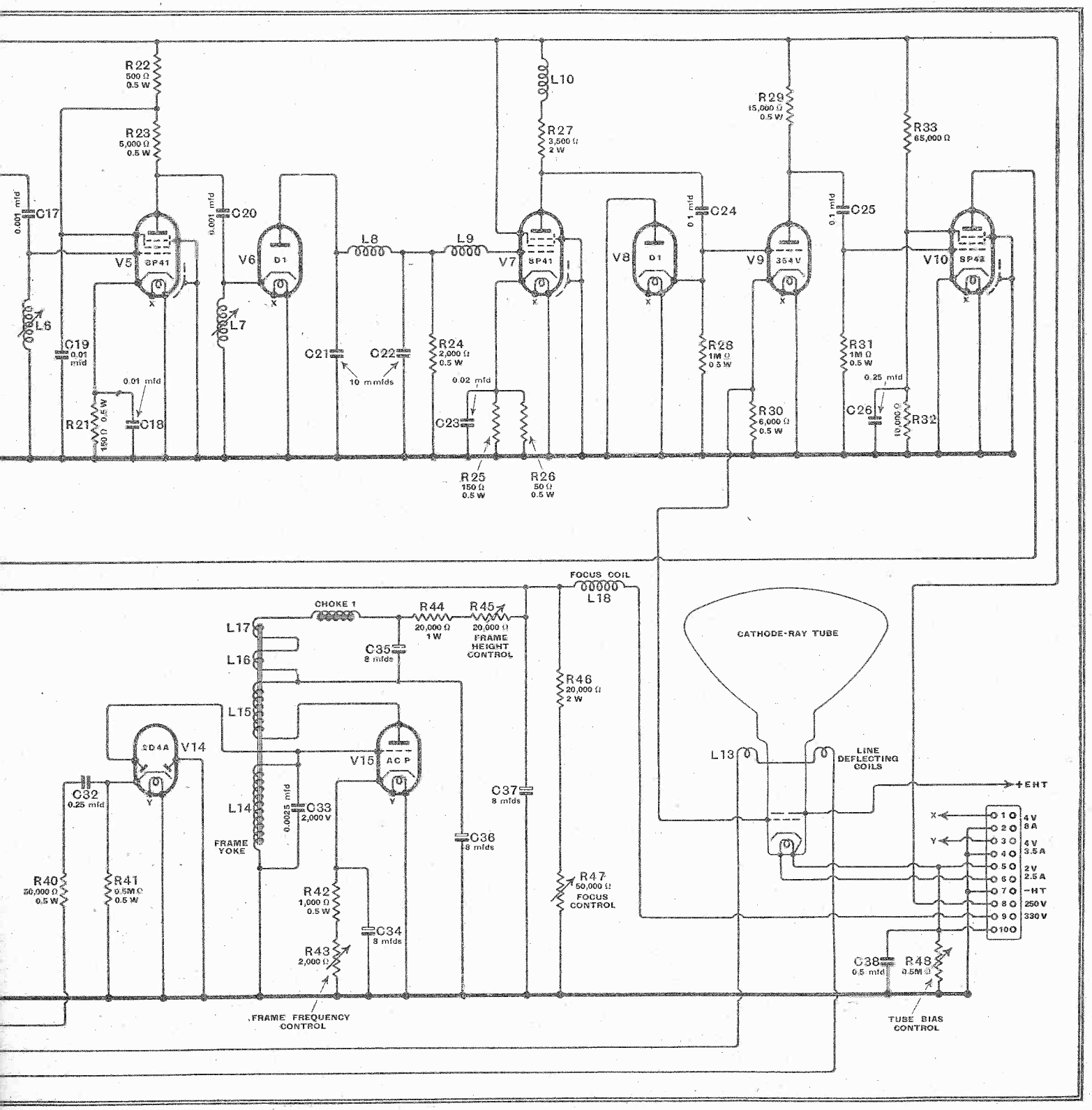
Magnetic Television Receiver—

because it gives the correct amplitude of oscillation. At first, the usual 0.0001 μF. condenser was used, but it was found quite difficult to secure the correct amplitude. It could be done, of course, by careful coil design, but there was no simple control of amplitude apart from damping the circuit by shunt resistance.

This is not a very good course because it makes the oscillator circuit poor and the frequency stability is not very good. At length it was decided to use a good coil which would normally lead to excessive amplitude, and to control the amplitude by the grid condenser. This condenser acts as a coupling between the valve and the tuned circuit, and so we have the desirable result of a good tuned circuit loosely coupled to the valve, both factors which make for good frequency stability.

It is not anticipated that the capacity of C7 will need to be altered from 10 μμF. with the valve and tuned circuit specified, but if for any reason a different valve or circuit is used the amplitude of oscillation is readily adjusted by changing this capacity. The use of the correct amplitude is rather important, because if it is too small the conversion gain falls off, and if it is too great a form of parasitic oscillation is very liable to occur.

The coupling between the frequency-changer and the first IF valve V3 is by the tuned-grid circuit, but L4 is given a value such that with the stray capacities it tunes in the region of 13 Mc/s instead of the 45 Mc/s of the signal circuits. Otherwise this coupling is the same as the RF coupling L2. All the IF couplings are alike and consist of the variable inductance with the coupling condenser in a screening can. In this case C10 is in the can with L4 and is supplied with the coil; this is why C4, C10, C14, C17 and C20 do not appear in the list of parts. For the same reason C8 is not included; it is part of the oscillator tuned circuit assembly.



Magnetic Television Receiver—

Because it is intended that L4 be tuned to the mid-band intermediate frequency and because the capacity on this circuit is higher than on the others the feed-resistance R10 is given the low value of 1,500 ohms. This resistance provides the major portion of the circuit damping, for the input and output resistances of the valves are too high to have much effect at 13 Mc/s. The input resistance is of the order of 25,000 ohms.

The two following stages V4 and V5 have identical couplings L5 and L6 with feed-resistances R17 and R20 of 5,000 ohms. These circuits are thus more sharply tuned, and are, in fact, rather too sharp for tuning to resonance. It is intended, however, that they be mistuned in opposite directions about the mid-band frequency to broaden the band-width.

The last LF circuit is L7 and couples V5 to the diode detector V6. This circuit is intended to be tuned to the mid-band frequency and is consequently damped rather more heavily than the two preceding ones. The feed-resistance R23 to V5 has a value of 5,000 ohms, but the circuit is also damped by the input resistance of the detector. As this has a load resistance R24 of 2,000 ohms, it would have an input resistance of 1,000 ohms only under ideal conditions.

The detector efficiency, however, is only of the order of 50 per cent., which fact alone raises the input resistance to about 2,000 ohms. Other minor factors enter and tend to make the resistance of the order of 2,000-2,500 ohms. The external damping applied to L7 is thus equivalent to a shunt resistance of some 1,400-1,700 ohms.

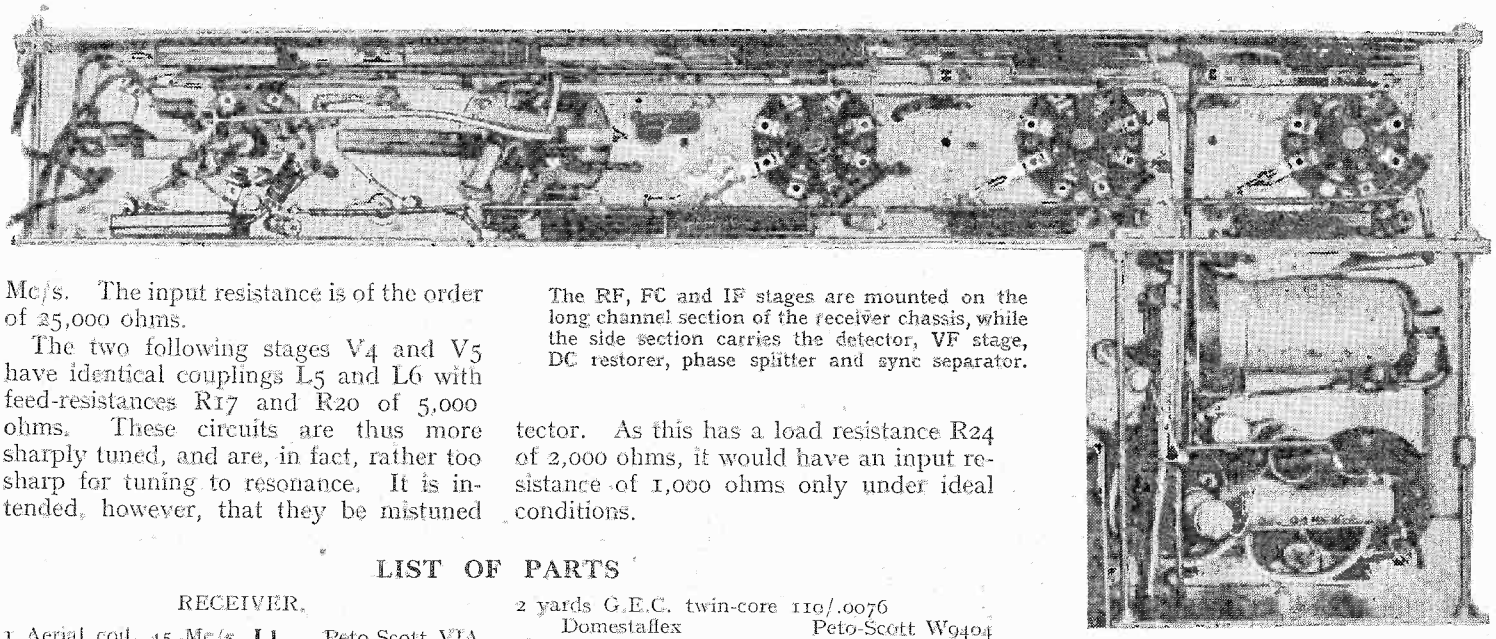
The adjustment of the circuits, and the effects obtained, will be described later in detail, for there are actually several different ways of adjusting them to give different IF characteristics. In general, however, the intermediate frequency is 13 Mc/s, and for double sideband reception all IF circuits are first tuned to this frequency and then L5 and L6 are mistuned by roughly equal amounts in opposite directions.

This greatly broadens the response curve, and naturally the amplification falls also. The gain, however, is considerably higher than if all circuits were tuned to resonance and more heavily damped to give the same response over the pass-band. Moreover, the selectivity is higher.

The choice of 13 Mc/s for the intermediate frequency is dictated by practical considerations. It is found to be quite difficult to prevent harmonics of the intermediate frequency, which are necessarily generated in the detector, from being passed back to the input circuits. Very thorough filtering and screening is necessary for the complete avoidance of this feed-back, and this is often rather difficult to accomplish.

Now if one of these harmonics reaches the input circuits and falls near 45 Mc/s in frequency, it produces an unpleasant background to the picture. The pattern produced depends on the precise frequency relationships, but it usually takes the form of a series of light and dark parallel lines over the picture—generally diagonally across it. In more severe cases the effect is more in the nature of a very dirty background with no very noticeable structure.

The easiest and cheapest way to avoid this trouble is to choose the intermediate



The RF, FC and IF stages are mounted on the long channel section of the receiver chassis, while the side section carries the detector, VF stage, DC restorer, phase splitter and sync separator.

LIST OF PARTS

RECEIVER.

1 Aerial coil, 45 Mc/s, **L1** Peto-Scott VIA
1 RF coil, 45 Mc/s, **L2** Peto-Scott VIR
1 Oscillator coil, 58 Mc/s, **L3, C8** Peto-Scott VIO
4 IF coils, 13 Mc/s, **L4, L5, L6, L7** Peto-Scott VIIF

Fixed condensers:
3 10 mmfds., ceramic, **C7, C21, C22** Dubilier CDS3
2 0.001 mfd., mica, **C1, C11** Dubilier 690W
11 0.01 mfd., mica, **C2, C3, C5, C6, C9, C12, C13, C15, C16, C18, C19** Dubilier 691W
1 0.02 mfd., tubular, **C23** Dubilier 4601/S
2 0.1 mfd., tubular, 350 V, **C24, C25** Dubilier 4603/S
1. 0.25 mfd., tubular, **C26** Dubilier 4606/S

Resistances:
1 50 ohm, ½ watt, **R26** Erie
2 100 ohm, ½ watt, **R2, R12** Erie
3 150 ohm, ½ watt, **R18, R21, R25** Erie
1 200 ohm, ½ watt, **R6** Erie
3 500 ohm, ½ watt, **R9, R19, R22** Erie
1 1,500 ohm, ½ watt, **R10** Erie
1 2,000 ohm, ½ watt, **R24** Erie
2 4,000 ohm, ½ watt, **R3, R16** Erie
6 5,000 ohm, ½ watt, **R1, R11, R13, R17, R20, R23** Erie
1 6,000 ohm,, ½ watt, **R30** Erie
2 10,000 ohm, ½ watt, **R4, R32** Erie
1 15,000 ohm, ½ watt, **R29** Erie
1 25,000 ohm, ½ watt, **R5** Erie
2 50,000 ohm, ½ watt, **R7, R8** Erie
1 75,000 ohm, ½ watt, **R14** Erie
2 1 megohm, ½ watt, **R28, R31** Erie
1 65,000 ohm, 1 watt, **R33** Erie
1 3,500 ohm, 2 watts, **R27** Erie
1 Potentiometer, wire-wound, graded, 15,000 ohm, **R15** Reliance "TW/G"
1 RF choke, **L9** Eddystone 1011
1 Coil, 144.5 μH, **L10** Wearite PO7
1 Coil, 37.5 μH, **L8** Wearite PA6
7 Plug-top valve connectors Belling-Lee 1175
6 Valveholders, British octal, chassis mounting Clix X110
1 Valveholder, 7-pin, chassis mounting. Clix X112
1 Valveholder, 5-pin, chassis mounting Clix XIII
2 Valveholders for Mazda D1 Belling-Lee 357/H
Chassis, aluminium Peto-Scott
2 yards G.E.C. twin-core 110/.0076 Domestaflex Peto-Scott W9404

Valves:
5 SP41, 1 SP42, 1 ACTH1, 2 D1 Mazda
1 354 V Mullard

TIME BASE.

1 Scanning kit, including focus coil, **L18**; frame yoke, **L14, L15, L16, L17**; frame choke, **Ch1**; line deflector coils, **L13**; and shroud, line scanning transformer, **L11, L12** Baird
1 Potentiometer, 0.5 megohm, **R48** Reliance "TW"
1 Potentiometer, 50,000 ohms, wire-wound, **R47** Reliance "TW"
1 Potentiometer, 20,000 ohms, wire-wound, **R45** Reliance "TW"
2 Potentiometers, 2,000 ohms, wire-wound, **R38, R43** Reliance "TW"

Condensers:
1 0.001 mfd., tubular, **C28** T.C.C.451
1 0.0025 mfd., 2,000 V, tubular, **C33** T.C.C.
1 0.1 mfd., tubular, **C27** T.C.C.341
1 0.25 mfd., tubular, **C32** T.C.C.341
3 0.5 mfd., tubular, **C30, C31, C38** T.C.C.341
2 8 mfd., 150 V, **C34, C35** T.C.C. "FT"
2 8 mfd., 450 V, **C36, C37** T.C.C.802
1 50 mfd., 12 V, electrolytic, **C29** T.C.C. "FT"

Resistances.
1 1,000 ohm, ½ watt, **R42** Erie
1 10,000 ohm, ½ watt, **R35** Erie
1 20,000 ohm, ½ watt, **R34** Erie
1 50,000 ohm, ½ watt, **R40** Erie
1 100,000 ohm, ½ watt, **R36** Erie
1 0.5 megohm, ½ watt, **R41** Erie
1 1,000 ohm, 1 watt, **R39** Erie
1 20,000 ohm, 1 watt, **R44** Erie
1 2,000 ohm, 2 watts, **R37** Erie
1 20,000 ohm, 2 watts, **R46** Erie
1 Connector, 10-way Bryce 5C6
3 Wander plugs Clix MP1
5 Valveholders , 5-pin high-voltage Belling-Lee 352/5
Chassis and tube mounting Peto-Scott

Valves:
2 2D4A, 1 UR1C Mullard
1 AC/P Mazda
1 41MP Cossor
1 Magnetic tube, 9in. Baird

Magnetic Television Receiver—

frequency so that none of its harmonics falls near 45 Mc/s. This course permits a perfectly clean background to be obtained with but little screening and filtering. There are several possible bands of frequencies within which interference is absent.

The lowest of these is a narrow band just under 7 Mc/s. As the intermediate frequency is increased above this the clear bands progressively become wider. There is a moderately wide band centred on 10 Mc/s, and one of just over 2 Mc/s in width centred on 13 Mc/s. There is also one of more than 5 Mc/s in width centred about 18.5 Mc/s.

It is an advantage to work in a wide, clear band, but it is inadvisable to make the intermediate frequency too high, since then the difficulty of maintaining stability becomes more serious. On all counts 13 Mc/s proves the best compromise and one which is in practice entirely satisfactory. The factors affecting the choice of intermediate frequency have been dealt with in greater detail in a previous article.[1]

IF Filter Circuits

The detector is a low-impedance low-capacity television diode with a load resistance R24 of 2,000 ohms. The IF filter comprises L8 and L9, with C22 and the input capacity of V7. The condenser C21 is, of course, the capacity through which the diode IF circuit is completed and corresponds to the reservoir capacity of a mains rectifier. It is given as small a value as possible in order to keep the total circuit capacity small.

The coil L8 is chosen to have an inductance which resonates with its self-capacity at about 13 Mc/s, so that at this frequency it offers a very high impedance and gives good filtering in conjunction with C22. Its main purpose is to prevent appreciable IF voltages being developed on the grid of V7, where they would tend to overload this valve and also reduce the IF stability through increasing the possibilities of feedback. The coil used is actually a standard superheterodyne coil, the Wearite PA6 of 37.5 μH inductance. Only one winding is used. This coil was selected because it proved entirely satisfactory, and is an inexpensive standard component.

At frequencies above 13 Mc/s the circuit L8 with its self-capacity behaves as a condenser, and gives very little filtering action to the harmonics of the intermediate frequency. Those in the neighbourhood of 45 Mc/s—the nearest are 39 Mc/s and 52 Mc/s—are especially important, and the second filtering stage is provided to confine them to this circuit. This comprises an USW choke L9, which functions in conjunction with the input capacity of V7.

Before turning to the VF stage, it will be advisable to deal with certain other points in connection with the earlier circuits. V4 and V5 are both run close to their maximum rating to secure full gain and the greatest voltage handling capacity. The HT line is 250 volts and both anode and screen are fed from this through 500-ohm resistances R19 and R22. Decoupling condensers C16 and C19 of 0.01 μF capacity and of the mica-dielectric type are provided. Common decoupling is used for anode and screen circuits. Bias is obtained by means of 150-ohm cathode resistances.

In the case of the RF and first IF valves, it is desirable to be able to vary the grid bias for gain control purposes. This at once introduces difficulties. Merely to increase the bias would also increase the input resistance and change the input capacity. Both would be important in the case of the RF valve, but only the capacity change would exercise an appreciable effect on the performance in the case of an IF stage. Experience shows that the changes of tuning and damping brought about by altering the grid bias do noticeably affect the picture qualty.

Fortunately, the trouble can be overcome by suitably biasing the suppressor grid as well as the control grid. For the SP41 valves, the suppressor bias must be about fifteen times the control grid bias.

This is arranged quite simply by the network shown in Fig. 1. V1 and V2 are each provided with their own initial bias resistances, R2 and R12, of 100 ohms, which also provide decoupling. These resistances are taken to chassis through a common variable resistance R15 of 15,000 ohms, which acts as the gain control. The suppressor grids are taken to chassis, so that the full voltage developed across R15 is applied as negative bias to them.

The control grids are taken through decoupling resistances R1 and R11 to a tapping on a voltage divider connected across R15. This comprises R13 and R14, and the values are chosen so that one-fifteenth of the voltage across R15 is applied as negative bias to the control grids. These valves are also run at a lower anode and screen voltage than the others, the decoupling resistances R3 and R16 having a value of 4,000 ohms.

This system works very well in practice and completely removes any visible effect on the picture quality of bias voltage changes. The control of two stages gives quite a wide range and, except in extreme cases, makes it unnecessary to use an attenuator in the input when receiving strong signals.

[1] *The Wireless World*, March 10th, 1938.

FIVE-METRE DX

Difficulty of Identifying Genuine Signals

WHILST the particular brand of atmospheric conditions that produced the spate of long-distance five-metre signals a few weeks ago is not likely to occur very frequently, it is well to be prepared for any repetition. Its relatively long duration—almost ten days—so focused attention on the 56 Mc/s band that it is nightly being combed with great care for anything resembling a DX signal.

That a few have been heard is evident, for on several occasions British stations calling either French or Italian amateurs have been noted.

From reports received contacts have been effected with one or more Italian stations on five metres during the last week in June. Confirmation of these may be forthcoming in due course.

Unfortunately, the identification of five-metre signals is made more difficult than it need be by the presence of harmonics of amateur stations using the 20- and 40-metre wavelengths and which, in the writer's case, often reach a strength of R9. When a signal of this intensity is proved to be the eighth harmonic of a station 2½ to 3 miles away, one is led to think that a little rearrangement at the transmitter would not be too much to ask.

Apart from the fact that the even harmonics cause unnecessary interference to amateurs using the higher-frequency bands, one of the odd harmonics will fall dangerously close to the A.P. vision channel.

During the next few months it would seem advisable to keep alive to the possibilities of five-metre DX and those who can do so might make a special effort on Sunday, July 9th, as many portable stations will be active, this being the R.S.G.B. 56-Mc/s National Field Day. G2MC.

The Wireless Engineer

IN modern radio receivers there are many uses for biased diode rectifiers; they are used to provide AVC voltages, "quiet tuning" and occasionally for signal rectification. The properties of biased diode rectifiers are fully considered in an article in the July issue of our sister journal, *The Wireless Engineer*, which is published at 2s. 6d., and is obtainable from booksellers or from the publishers, Dorset House, Stamford Street, London, S.E.1.

Another article in the same issue contains a description of an experimental 200-watt ultra-short-wave transmitter and aerial system which has been installed at the National Physical Laboratory for research work on the propagation of waves in the frequency range 100-150 Mc/s.

A monthly feature of *The Wireless Engineer* is the Abstracts and References section, compiled by the Radio Research Board, in which is given abstracts of articles on wireless and allied subjects published in the world's technical Press.

HENRY FARRAD'S SOLUTION

(See page 4)

THE power consumption mentioned seems reasonable for a small receiver, presumably of the AC/DC type. And it could not absorb substantially more in itself without breaking down through overheating. But receivers run on DC mains have, as likely as not, the chassis live. There are a number of points where it would be quite possible for a short-circuit between chassis and earth terminal. If the earth connection is not exceptionally good, being, perhaps, a short copper tube, the short-circuit due to such a fault, as explained in a recent *Wireless World* article,* may not pass enough current to blow the fuse but dissipates in the earth many times the power used by the set itself.

This possibility can be investigated either by getting the dealer to measure the voltage between the earth terminal and a water-pipe earth; or by examining the registration of the electricity meter for measured periods with and without the earth connection. To make quite sure, the aerial should be disconnected at the same time as the earth.

* *April 28th*, 1939.

In Praise of Television

AN ENGINEER'S REACTIONS TO THE PROGRAMMES

By

"CATHODE RAY"

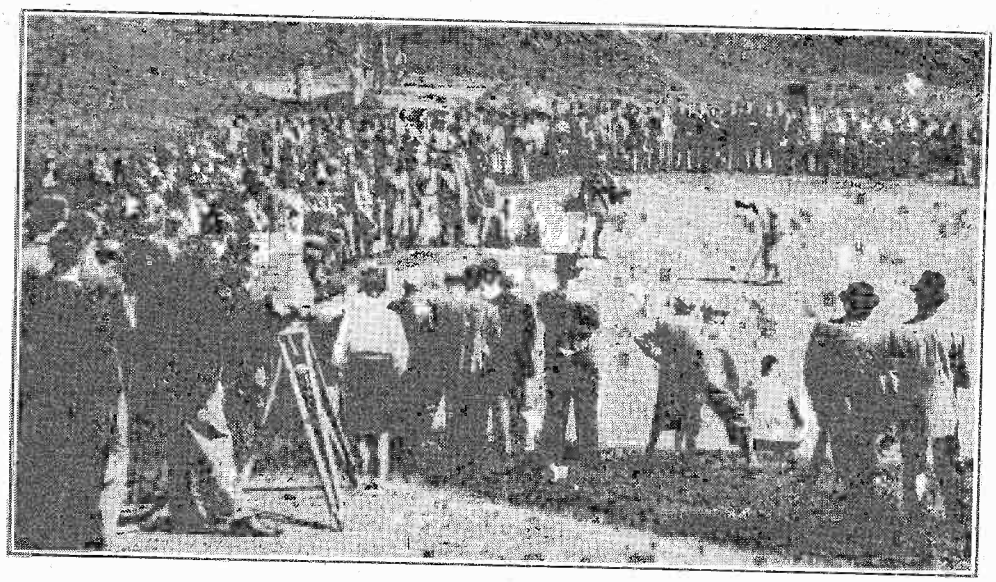
An untouched photograph of a television screen showing the tuning signal transmitted by the B.B.C. to enable the receiver controls to be adjusted accurately before the commencement of the programme.

HAVING no wish to tantalise friends in the north and west, I have hitherto kept off what may be called the viewer's side of television. But now that there seems to be a distinct stirring towards extending the service outside the London region, readers elsewhere may care to have a few non-commercial and non-political views—yes, *views* seems to be the right word—on television from in front of the screen.

The biggest surprise I have had in television—with the possible exception of seeing the theoretically beautiful electron cameras and supersonic light relays actually made to work—is not technical at all. It is the entertainment value. My object in getting a receiver was purely to keep in touch with technical developments, so that when writing to you I wouldn't give myself away by such things as referring to the difficulty of tuning in such a broad signal as the vision channel. It never occurred to me that I might take an interest in the programmes as programmes. Comparing the time and money available for producing films and television plays, it seemed obvious that television could have no more than a novelty appeal to a public brought up to seeing every few days a film costing a fortune, in which each scene has been "shot" of an interviewer's face blinking in the studio lights for five minutes or more on end seems painfully tedious. So the unattractiveness of the entertainment is one of the two stock reasons people give for not buying television (the other, of course, being that "sets are bound to come down in price"). On the other hand, in taking every opportunity of hearing the views of people who either own a set or drop in fairly regularly to see someone else's, I have not heard a single hint that they have been drawn to the screen at first and then have lost interest as the novelty wore off. They are unanimously enthusiastic. And they range from people who are used to a high standard of London entertainment and care nought could keep only one set he would part with his sound broadcast receiver and hang on to the television outfit.

That is not to say, of course, that there is no criticism of programmes. Far from it. But it does go to show that the dealers' claim that people can judge only after having a set in their home is not just sales talk.

I have been trying to get down to the reason for this curious result. It seems to be a complex reason, composed of many ingredients. I don't think that the novelty or wonder appeal can be ruled out altogether. Even now the thought of what is happening when I am able to receive a television programme sometimes (in the American phraseology) kinda gets me.



A recent O.B. of the International Professional golf match. An operator with his camera is to be seen on the left. Major sporting efforts are a feature of the B.B.C.'s transmissions.

anything up to twenty times and the best selected for showing.

The curious thing—and an unfortunate one for the sale of sets—is that the foregoing belief is entirely confirmed by casual views of television in exhibitions, shops, or even friends' homes. After the slick production in the cinema, the sight for technicalities, to hard-boiled engineers who got a receiver for the same reason as mine. It is astounding to find the latter, steeled to derive no more interest or emotion from the most sublime sound than from a test oscillation, sitting down night after night enjoying the television programmes. One person has said that if he

Direct Presentation

Another element in the thing is the acknowledged psychological difference between direct and indirect presentation. There is a widespread prejudice against broadcasting of gramophone records, even when they allow of a higher standard of performance. I have been interested to notice the reactions of my private audience to special outside broadcasts, such as the departure of the King and Queen for Canada. Although technically inferior to the newsreel of the same event broadcast later, they arouse incomparably more enthusiasm. People don't start cheering a newsreel as if they were standing on the kerb while Their Majesties passed by. There must be something in the thought of it actually happening at that moment, instead of merely being reconstructed for dispassionate inspection on a subsequent occasion.

Judged by film standards, these special broadcasts, and in varying degrees almost everything in the television programmes, is intolerably slow. Anything up to 95 per cent. would be cut by a film editor. I am beginning to wonder if people are getting rather tired of being battered and

In Praise of Television—

jerked around the high-spots of the week's action throughout the world in five breathless minutes like a thousand horse-power butterfly, and find the more natural tempo of television something of a relief.

There is another and more subtle difference between the film and television. Films are addressed to people in the mass; television to the individual or family. It is more intimate and personal. The announcers are speaking to you at home; not to a vast audience in an auditorium. The difference can be felt immediately when an ordinary film is televised. If there is a commentator he speaks in the characteristic slightly breathless declamatory style, as if he is afraid of being thrown out before he has said all he wants to.

The "atmosphere" of television that grows on one is perhaps due very largely to the continuity of organisation. One has only to think of favourite sound programme features such as "Band Waggon" or "Monday Night at Seven" to realise how much this counts. Even more in television, where people are seen as well as heard, there is a tendency for the thing to become more friendly than if a lot of competing organisations were striving for one's attention.

Most of these influences are lacking at a casual demonstration. With a limited time available, the programme seems to move too slowly. The people who are doing it are unknown. And so forth.

The Human Touch

Unrehearsed incidents and technical hitches are not too rare to recall the good old days of Savoy Hill, and keep at bay the chill grip of formality, as does the occasional opportunity of studying the reactions of an eminent speaker as a lamp bursts close to the side of his head.

To help offset its disadvantages as regards money and space available for programmes, television has a pull in offering the only means of getting some things. The direct access to special occasions is one. And certain other types of programme could hardly be imagined in any other medium. Another advantage over cinema and theatre (and broadcasting on other wavelengths) is the quality of the sound. It can be quiet yet perfectly clear and as near reality as makes little matter. The speakers are not restricted by the necessity for making their voices heard at the back of a large hall. The sound of fat frying in a cookery talk is so realistic that one instinctively draws one's legs in to keep them out of range of grease spots. This unequalled sound quality goes a long way towards compensating for some loss in picture quality compared with the cinema. Incidentally, the oft-repeated statement that the eye is far more sensitive to visual distortion than the ear to aural distortion, though correct theoretically, is not supported by practical experience. It is amazing how much picture distortion is tolerated and apparently unobserved by regular viewers. Even the phenomenon of the whole scene waving rhythmically in an imaginary breeze due to a mains beat effect arouses no comment.

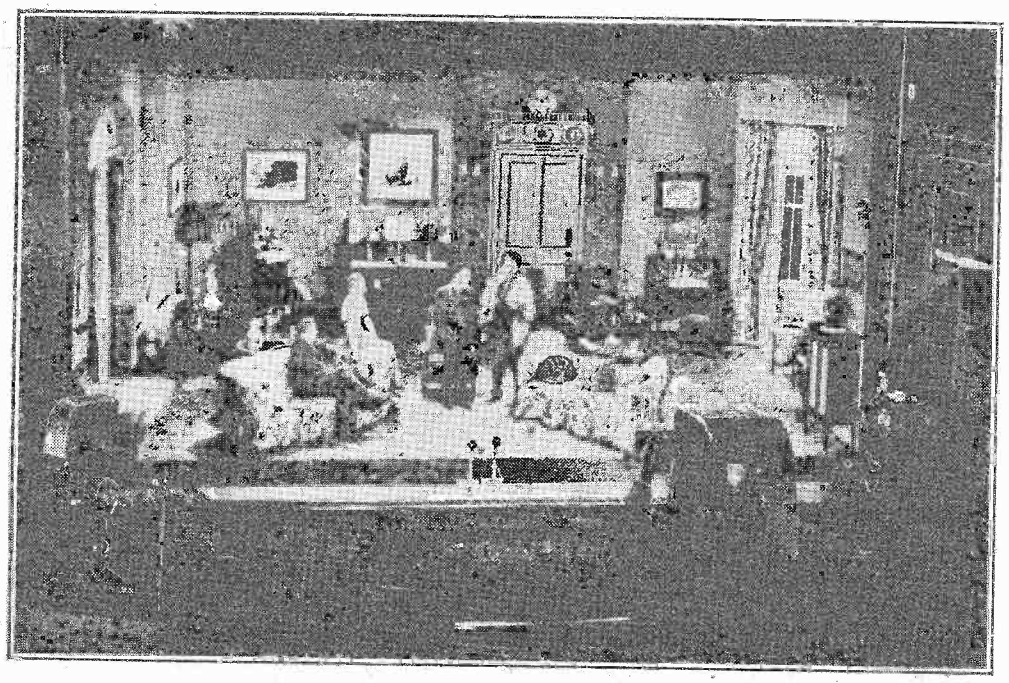
A popular fallacy that is still very prevalent concerns the picture size. Whatever the size of screen, by choosing an appropriate distance it is possible to reproduce the picture exactly the same size—so far as the eye can tell—as a cinema screen viewed from the best seats. After all, a penny held at arms length is in effect larger than the sun. The loudness of sound can also be adjusted to equal what is heard in the cinema. Personally, I prefer it a good deal less. So how can it be objected that in television there is the absurdity of hearing a loud voice come from a tiny figure?

Continuing the comparison with the cinema, I find it impossible to attend one of these places of entertainment without getting at least a slight headache. (To save oculists the trouble of writing, I would say I am capably served already.) Whether this is due to unconscious flicker, or sound that excels more in quantity than quality, or the general assault made by Hollywood on the nerves, I am unable accurately to determine; but so far I have failed to acquire any suspicion of a headache by television viewing. Admitted, the programmes last one and a half to two hours, whereas the films take nearer three to come round to the beginning again; but the headache sometimes shows signs of itself by half-way through. So much for the television eyestrain argument.

Thus far things seem to have improved on expectations. On the other side, I'm not quite so sure as formerly that one can be careless about lighting conditions in the room. The modern cathode-ray tube is so brilliant that one can easily read a book by its light (though I'm not claiming it to be the most economical and convenient illuminant for the purpose), and it looks quite bright in slightly subdued daylight. The real trouble is with the blacks in the picture, which cannot be very black if considerable room light is allowed to fall on the white screen. So although viewing is not spoiled by a shaded light in another part of the room—so long as it is not directly reflected by the glass—the programmes are not very satisfactory on a sunny afternoon unless the curtains are of the really opaque class now more or less obsolete.

The general public often display interest in the running costs. If you tell them it takes about as much current as three ordinary radios, it sounds a lot. But with electricity available in most places at an all-in rate of ½d. to 1d. per unit, the cost for current is quite negligible, being 0.15 to 0.3 pence per programme of an hour and a half. Even if one pays a full lighting rate, or some of the more fantastic prices per unit that are charged here and there, the cost of current is hardly likely to deter a purchaser. The running cost that matters is depreciation of valves and tube. Renewal throughout involves a large proportion of the original total cost of the set; but even if the hours of broadcasting are extended, the hours that normal persons are likely to be able to spend before the screen are not likely to compare with those for which many sound receivers are on—I won't say used. So if the glassware dies from natural causes it might last a good many years. Even so, an allowance of 3d. or more per hour might be needed to cover this item.

The normal television set includes, to some extent, its own servicing equipment. Everybody knows that the cathode-ray tube is the finest fault finder. It is true



Another type of O.B. inaugurated by the B.B.C. is that of transmissions from the theatre. Three television cameras were used when Mr. J. B. Priestley's "When We Are Married" was brought to the screen.

In Praise of Television—

that the one in the set is more or less fixed in its own circuit; but it is marvellous how much it can tell. It is sensitive enough to show time intervals of a few ten-millionths of a second. Compared with sound from a loud speaker, a cathode-ray screen is an open book.

A rather paradoxical thing about a television receiver is that, although working on an ultra-high frequency it is less sensitive than an ordinary wavelength receiver to its position in relation to the aerial. Generally, if the latter is shifted to a different room, the long aerial lead-in reduces the signal strength and increases the noise. But a dozen extra yards of cable between dipole and television receiver has no effect that cannot be counteracted by a slight advancement of the contrast control; and as to moving it around the house there is no objection except from the mover.

My only serious criticism of television is a flattering one. It wastes too much time.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Electric Gramophone

AS no letters have been published referring to the electric gramophone described by Mr. M. G. Scroggie (*The Wireless World*, May 11th, 1939) may I have an opportunity to thank him for this excellent design?

I have written before in your columns on the prevalent "anything will do to play back records" attitude which results in complaints regarding the technical quality of commercial gramophone records, and so it is gratifying to find an apparatus specially designed for record reproduction. I am well aware, of course, that such criticisms are not always unjustified (for the disc recording system and its products are not of a uniform standard), but the flexible tone-control incorporated in Mr. Scroggie's circuit enables an aurally tolerable result to be obtained with inferior quality records.

DONALD W. ALDOUS.

Ilford, Essex.

G2MQ—Call Re-allotted

I NOTICE in your issue of June 29th a letter from your correspondent Mr. P. W. Harris in reference to the pirating of the call-sign G2MQ, and I wish to state that this call was allocated to me in August, 1938.

Surely he could have checked with the G.P.O., the R.S.G.B., or referred to an up-to-date call book to ascertain if this call had been re-allocated before rushing into print and thus avoiding the unpleasantness that may be entailed between myself and my many friends of the air?

It would also have rendered it unnecessary for him to retain my Q.S.L. cards, which I hope he will be kind enough to send to me.

P. F. CUNDY, G2MQ.

London, W.C.2.

WITH reference to my letter regarding the misuse of the call-sign G2MQ, I have this morning been informed by the Engineer-in-Chief's Department of the G.P.O. that this call-sign has now been re-allotted. In justice, therefore, to the new holder of this call-sign, who is fully entitled to make all proper use of it, would you be so kind as to publish this letter in an early issue?

Should there be any further piracy of this call-sign there will now be two of us to deal with the Q.S.L. cards, which may or may not simplify matters.

PERCY W. HARRIS.

Wimbledon, London, S.W.19, June 29th.

"Distortion in Transformer Cores"

IN reading the first instalment of Mr. Partridge's article in the June 22nd issue of *The Wireless World*, it occurs to me that one section might cause some confusion in the mind of anyone not very familiar with the subject. On page 573, column three, the author says "Note that both voltage and current have become distorted. This is to be expected, because the transformer draws a distorted current, and therefore the voltage drop across the series impedance must of necessity be distorted."

That is clear enough, but he goes on to say, "Hence the voltage across the transformer, which is the mains voltage *minus the distorted drop across the series impedance*, must also be distorted."

One would, I think, assume from this that the more distorted the drop across the series impedance, the more distorted would be the voltage across the transformer, whereas the reverse is true under the conditions stated.

Proof of the latter statement is provided by the extreme case referred to by the author in which the series impedance is very high compared with that of the transformer. He says "The current becomes a pure sine wave, and the distortion is transferred to the voltage curve." But his preceding remarks would lead one to argue that if the current becomes a pure sine wave, thus producing a pure sine wave voltage across the series impedance, then the transformer voltage, which is stated to be the mains voltage minus the drop across the series impedance, should also be a pure sine wave. Or, conversely, that if the transformer voltage is distorted the voltage across the series impedance must be distorted.

Actually, of course, assuming sine wave mains voltage, the current does not become a perfect sine wave, so long as an iron-cored impedance is in the circuit, although it may approximate to one. Harmonics must, therefore be present in the voltage across the series impedance, but the *percentage* is so small that the wave appears to be a true sine wave.

If we assume a true sine wave of current, then the transformer voltage harmonics must be present in the applied voltage. The voltage across the series impedance would then be a true sine wave.

I think it should also be made clear that the subtraction of the voltage across the series impedance from the mains voltage to give the transformer voltage, refers to instantaneous values, or the subtraction of one *wave* from another, as so many people are used to thinking in terms of RMS values.

The article in question, and any that follow on the same subject, should be most useful in emphasising the importance of a fundamental cause of distortion that receives far too little attention.

T. A. LEDWARD.

Huyton, Nr. Liverpool.

The Author's Reply

IT is perhaps possible that some readers may find occasions to become a little confused in the course of reading the articles in question. This is unfortunate but arises from the necessity of compressing a book full of information within the limits of four brief instalments. To do this one must present short and simple explanations, and assume that the technical man will amplify the theme for himself . . . as, indeed, Mr. Ledward has done.

My statements are all accurate and do not in any way disagree with those of Mr. Ledward. The voltage across the transformer *is* the mains voltage minus the distorted drop across the series impedance. When the series impedance becomes infinitely great compared with the transformer impedance, the current distortion becomes infinitely small and the current wave form can be as pure a sine wave as we care to imagine it. But in these circumstances, the drop across the series impedance is almost the same as the mains voltage itself. Hence subtracting one from the other leaves only a minute fundamental plus the said infinitely small distortion. But these two "almost nothings" are comparable, and hence a large *percentage* distortion appears in the answer. In other words, a pure sine wave minus a wave of equal magnitude containing an infinitely small harmonic content will leave only the said harmonic content which, although infinitely small, is nevertheless 100 per cent. of things its own size, so to speak.

I thnk that Mr. Ledward's letter in conjunction with my own somewhat sketchy observations will clarify the point in question and materially help readers who have found it to be a stumbling block.

N. PARTRIDGE.

London S.W.1.

Service—Efficient and Inefficient

I HAVE read with interest the correspondence regarding the servicing of receivers, particularly the letter by Mr. J. Parkinson in *The Wireless World* of June 15th. While I agree with him that the term "service dealer" is often applied to dealers who are neither capable nor equipped to repair modern wireless receivers, I should like to point out that there are a number of genuine dealers who can and do provide adequate service facilities.

However, unless manufacturers are prepared to limit their agencies to real service dealers and the public go to them for their service (if not for new sets), then the old complaint of poor after-sale service will continue.

CECIL C. TUE.

High Wycombe, Bucks.

NEWS OF THE WEEK

BROADCASTING AND THE PRESS

The Freedom of Both

SPEAKING at the concluding sitting of the Empire Press Union conference last Friday, Mr. F. W. Ogilvie, B.B.C. Director-General, referred to the words of his predecessor, Sir John Reith, who, when speaking to the conference two years ago, said, "A controlled Press and a controlled broadcasting system means biased and censored news." Mr. Ogilvie continued by saying something about the independence of the B.B.C.

He asked, "Why is it that the Press abroad—in foreign countries principally, but to some extent also in the Empire—so frequently speak of the B.B.C. as 'Government controlled'? Is it because the B.B.C. was set up by Royal Charter, and our friends in other countries know so little of our affairs as not to know this common form of British institution, set up by Royal Charter and Licence, but almost entirely free in the conduct of its day-to-day affairs?"

He rounded off his remarks on the freedom of the Press and broadcasting by recalling the words of Mr. Butler, the Under-Secretary of State for Foreign Affairs, who said, "The rôle of the Foreign Office is to give the Corporation whatever assistance they require, helping them to check the accuracy of their news, getting reports for them on the reception of their broadcasts and so on. But control of, and responsibility for, the broadcasts remain with the B.B.C."

Regarding international broadcasting, the Director-General said, "I believe it has in it more possibilities of good than perhaps any other movement of our time."

U.I.R. REPORT

Short-wave Broadcasting : Synchronisation and Directional Aerials

THE annual summer meeting of the International Broadcasting Union (U.I.R.), which was held under the presidency of M. Antoine Dubois (Holland) at St. Moritz, has now ended. Representatives of the broadcasting organisation of eighteen European countries, of two American broadcasting systems, and of the broadcasting services of the Vatican and Porto Rico, together with representatives of the Post Office Administrations of eight European countries, took part.

The council of the Union have approved the report of the Technical Committee presented by M. Raymond Braillard suggesting that the attention of the Governments should be drawn to the critical situation existing in short-wave broadcasting due to the increased number of stations and their greater power. The urgent necessity of a remedy was stressed.

Directional Aerials

The Technical Committee also stressed the fact that the Montreux Plan provides for a general application of modern methods of synchronisation between transmitters and the use of directional aerials. A special report on this subject is to be submitted to the European Administrations in the autumn.

Another recommendation was that broadcasting stations should adopt as soon as possible the new frequency of 440 c/s for the note A in the treble clef. Several broadcasting organisations have already adopted this standard of pitch.

During the meeting the President announced that the number of receiving sets in the eighty-eight countries in the Union was now 78,000,000 as compared with 69,000,000 in 1937. This represents an increase of approximately 33,000,000 listeners.

The Council re-elected M. Dubois to the presidency of the Union, and the four vice-presidents elected for the year were Dr. K. von Boeckmann (Germany), Sir Cecil Graves (Great Britain), Monsieur E. Nelky (Hungary), and Dr. A. Raestad (Norway).

Dr. H. Giess, who served as president at the Lucerne and Montreux wavelength conferences, is to retire, and in recognition of his services he has been elected a member of the Union's Committee of Honour.

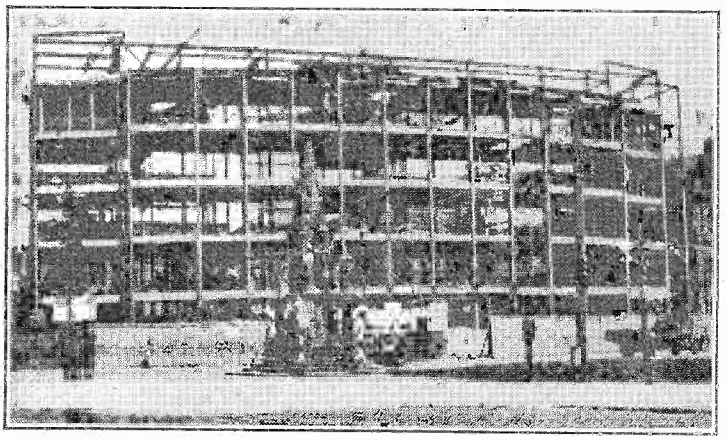
CANADA'S NATIONAL RADIO

The C.B.C. and Private Stations

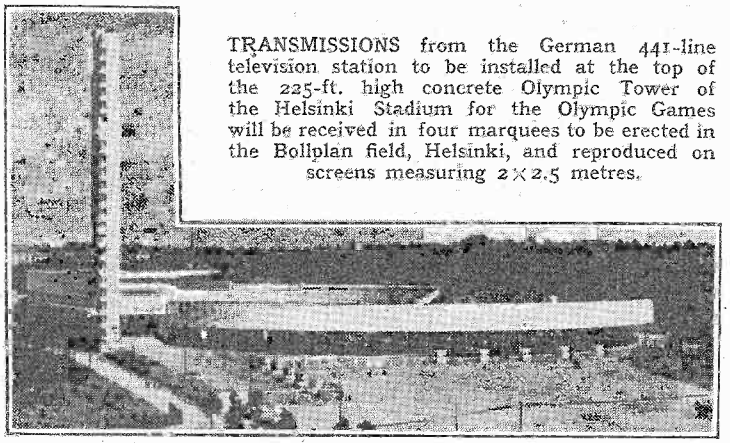
IT was announced in Ottawa last week-end that on September 24th the Canadian Broadcasting Corporation would take over the control of all privately owned stations in the Dominion.

There are, at present, approximately 80 privately owned stations, of which number 27 are affiliated with the C.B.C. Together with the Corporation's 10 stations, these form the Dominion network. None of the commercial stations has a power of more than 10 kW and more than half of them 1 kW or less.

Major Gladstone Murray, the General Manager of C.B.C., recently said that the Corporation has been conceived as an independent public trust of the national interest in broadcasting. Whilst it is independent of the Government of the day it is, of course, ultimately responsible to Parliament for its policies.



BELFAST'S NEW BROADCASTING HOUSE, which is to be opened next year, will become the headquarters of the B.B.C. in Northern Ireland. The six-storey building, which as shown here in the course of its construction closely follows the lines of Broadcasting House, London, will contain two talks studios, two dramatic studios, an effects studio and a large studio with a floor area of 2,670 square feet. The control room will be situated on the fourth floor.



TRANSMISSIONS from the German 441-line television station to be installed at the top of the 225-ft. high concrete Olympic Tower of the Helsinki Stadium for the Olympic Games will be received in four marquees to be erected in the Bollplan field, Helsinki, and reproduced on screens measuring 2×2.5 metres.

THE RADIO INDUSTRY

Lord Hirst at the Annual Meeting of the G.E.C.

AT the fiftieth annual meeting of the General Electric Co., in London, Lord Hirst, chairman and managing director of the company, looked forward to more stable trading conditions which could be brought about in the radio industry by a better understanding between the leading manufacturers.

"The importance of the radio industry to the country," he said, "is not to be measured only by the blessings of broadcasting. It has to be realised that this industry has stimulated and provided much of the funds for extensive research work, particularly in the field of electronics. It is of vital importance to the country that this research work should continue.

"The Government's recent decision to encourage the distribution of broadcast programmes by wire to subscribers' houses may intensify competition from both private relay companies and from the Post Office. The effect of this on the industry will require to be carefully watched in future."

Provincial Television

Lord Hirst, referring to the great increase in the public demand for television experienced since last August, said that the public were now realising that

News of the Week—

television was no longer an experiment but an established factor in everyday life. "I sincerely hope," he said, "that the lead which this country obtained by being first in this field will be maintained by the energetic extension of television to the provinces."

TELEVISION INTERFERENCE

P.S.C. Staff Campaign

TO help in the campaign towards eliminating car ignition interference with television and short-wave reception generally, the B.B.C. has had all its motor vehicles fitted with suppressors. A further step last week was to circularise the staff with a notice earnestly recommending them to fit suppressors to their own cars.

To encourage the staff, a scheme has been inaugurated whereby cars can be fitted free of charge with a set of resistors costing a small sum. These steps are probably the outcome of the relative question put by a viewer at the recent television tea party.

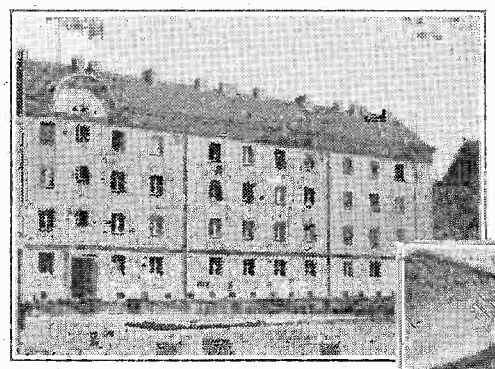
The equipment engineers fit the apparatus according to the recent British Standard Specification, and also make any slight modifications necessary to the wiring of the ignition system.

RADIO FLATS IN BERLIN

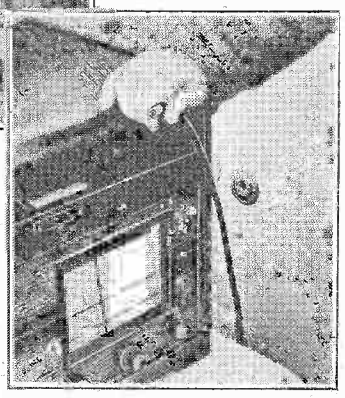
THE first block of 157 workmen's flats was recently completed in the East End of Berlin. Each of the three buildings, which form three sides of a large open square, has one aerial, each of which is fitted with an amplifier situated immediately below the roof at the point of entry of the lead-in. The amplifier output is fed to two rooms in each flat, even in those which consist of one room and a kitchen.

Only members of the Party from pre-1933 are at present selected for these new flats, which cost 18s. per month for one room and 36s. for three rooms. Each flat has in addition a kitchen.

The receiver points in each room consist of a two-pin mains socket and a combined aerial-earth socket.



THE VERTICAL AERIAL is centred on the roof of each of the three buildings of the workmen's flats. The aerial-earth plug and socket is shown below.



SWITCH TO SAFETY

SELECTED from nearly three thousand entries received from ten countries in a recent contest, the slogan "Switch to Safety" has been chosen by the American Radio Relay League to epitomise its campaign for safety among amateurs.

Two entrants submitted the winning slogan, and prizes of $25 each were awarded to George P. Huntley, W6LIP, of Beverly Hills, California, and Joseph A. Hoffman, W2DIJ, of White Plains, New York.

Among the slogans remaining in the final ballot were "You are an Amateur—Death Isn't," "A Ham Alert is a Ham Unhurt," and "Caution, Please—No Silent Keys."

AMERICA'S NATIONAL FIELD DAY

SEVERAL hundred self-powered radio stations were set up during the week-end June 17th-18th in as many remote spots in the United States by members of the American Radio Relay League in order to test their portable equipment under emergency conditions.

This field day was sponsored by the A.R.R.L. to encourage the construction of emergency-powered transmitting and receiving apparatus by its members and to give them experience in operating and making the most of low-power apparatus, special credit being given to those whose transmitters used under 20 watts.

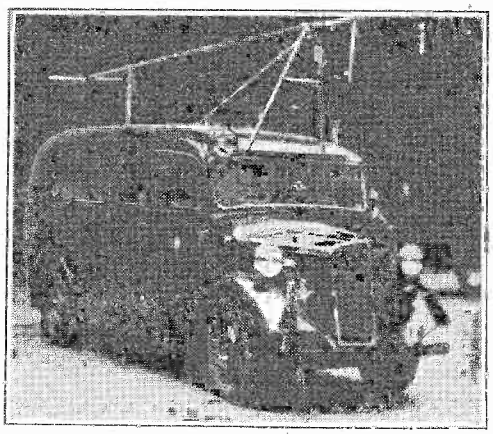
NO LONGER AUSTRIAN

THE former Austrian network of stations has now been completely absorbed in the German broadcasting organisation. On the night of June 20th-21st various changes in wavelengths were introduced, and the stations lost their independence.

Linz (15 kW) now transmits on 1,267 kc/s (236.8 metres), the frequency formerly used by Nuremberg (2 kW), which now shares Innsbruck's wavelength of 578 metres (519 kc/s). Nuremberg and Innsbruck will, together with Salzburg (2 kW), which remains on its present frequency of 1,348 kc/s, relay the Munich programme. These three stations will be working together on 518 kc/s when the Montreux Plan comes into force next spring.

Graz (15 kW) and Klagenfurt (5 kW) now share the former's wavelength, 338.6 metres.

COPENHAGEN FIRE BRIGADE'S mobile transmitter. The aerial mast, shown on one of the two vans now in use, can be raised or lowered by means of a lever near the operating desk inside. The wavelength used is 143 metres while the headquarters transmitter operates on 174 metres. Two main receivers, one at headquarters and another in a suburb, the output from which is fed to headquarters, pick up the radiations from the travelling transmitter. To ensure good reception, a mixer-fader is installed at headquarters.



FROM ALL QUARTERS

Fire Brigade Wireless

FOLLOWING the example of the Oslo Police, the Oslo Brandvesen fire brigade are to be equipped with radio. An order for the necessary equipment has been placed with the Norwegian subsidiary of Standard Telephones and Cables. Similar apparatus, which has been used by the Copenhagen fire brigade for some time, is illustrated above.

No Relays in Tynemouth

As the result of vigorous representations from Tynemouth radio dealers, the town improvement committee of the Corporation has withdrawn its recommendations for the installation of a wireless relay system.

Wind Generator

THE ultra-short-wave radio-telephone link between Lerwick and the Post Office at Whalsay Skerries—the group of islands twenty-five miles away—has been equipped with a wind generator. This dispenses with the need for a continuous supply of fresh batteries and recharged accumulators from the mainland, and ensures an uninterrupted service during the frequent periods when the island is isolated owing to rough seas.

Necessity the Mother of Invention

THE August issue of *World Digest*, the new sixpenny monthly issued by Amalgamated Press dealing with current fact and comment, which is now on sale, includes this story:—Teacher: "Who is the world's greatest inventor?" Willie Wise: "Edison. He thought out the phonograph and the radio so people would sit up all night and use his electric light bulbs."

Polyglottic Request

THE Australian short-wave station, VK2ME, which works on 9,590 kc/s (31.28 metres), now broadcasts requests in English, German, French, Dutch, Italian and Esperanto for reception reports. This station, which, together with two other experimental short-wave stations (VK3ME and VK6ME), is owned by Amalgamated Wireless (Australasia), Ltd., 47, York Street, Sydney, transmits from 5—7 a.m. and from 9.30 a.m.—1.30 p.m. on Sundays and from 4.30—6.30 p.m. on Mondays. During August, Monday's transmissions will be from 3.30—5.30 p.m. All times are G.M.T.

New Radio Society

AT the inaugural meeting of the Pinner and District Radio and Television Society held on June 27th, a committee was appointed to formulate rules which are to be placed before a general meeting to be held at 8 p.m. on Tuesday, July 11th, at 419, Station Parade, Rayner's Lane, Pinner, Middlesex. An invitation is extended to all interested persons in the district.

Pitcairn Radio Wrecked

REPORTS from the South Pacific state that Pitcairn Island, famous as the home of the descendants of the Bounty mutineers, has been severely hit by floods and avalanches. The radio station is silent.

I.E.E. Regulations

THE eleventh edition of the I.E.E. Regulations for the electrical equipment of buildings has just been issued. One section deals with the installation of mains-operated apparatus for radio, acoustic, and visual reproduction. Copies may be purchased from the publishers, Messrs. E. and F. N. Spon, Ltd., 57, Haymarket, London, S.W.1, or from the Institution, price 1s. 9d. in cloth or 1s. 2d. in paper covers (post free).

Random Radiations

By "DIALLIST"

Expensive LT

THOSE who use battery sets in this country regard the supply of HT current as by far the heaviest item in their running costs, LT supply being a much less serious business. But to some who live in out-of-the-way places abroad the supply of filament juice is a very knotty problem. I've just had a line from a reader stationed in a part of Northern Rhodesia where it is impossible to have accumulators charged and the climate does not suit ordinary dry cells. He has tried air-depolariser cells of different kinds and finds them very satisfactory—except for the running costs. One kind of air-cell battery costs £2 10s. and last the best part of nine months—if he is lucky. But he has recently had two duds. A battery of air cells of another make costs £5 5s. and replacements to cover three years' service, £2 17s. On top of that comes the cost of 2,500 miles of rail transport and 500 by motor lorry. Then, of course, there's HT as well. The batteries between them cost each year almost as much as a complete receiving set in this country.

Can You Help?

That's pretty stiff, you'll agree. I'm wondering whether my correspondent couldn't save money on his LT by using an accumulator and charging it from three simple gravity cells of the zinc-copper-copper sulphate type. I have no actual experience of using these for the purpose, though I dimly recall reading some years ago an account of the process by one who had tried it and found it successful. So far as I can remember, the accumulator was left "floating" on the primary cells, which were constantly trickle-charging it. I should be grateful if any readers could give the results of practical experience; some idea of running costs would be most valuable. There are so many readers of *The Wireless World* in lonely spots who have LT difficulties that I am sure that help of this kind would be very much appreciated. And there's another possible avenue for exploration: has anyone tried wet primary cells other than Leclanché for direct filament heating? If so, with what results?

Comparative Tests

IT'S not always easy to satisfy yourself quickly just how good (or how bad!) a performer a set is on the short waves. Conditions are liable to alter so rapidly that if you make a preliminary trial of, say, the 15-megacycle band with a receiver whose performances you know, you can't be sure that signals haven't become weak or wobbly by the time that you have disconnected it and connected up and tuned the set that you want to test. Here's a method that I find useful. Both sets are connected to the mains by means of a two-way adaptor plug; they are also provided with a common earth connection. The lead-in from the aerial is taken to the arm of a SPCO switch and leads from its terminals are run to the aerial terminals of the receivers: a DPCO switch is used in the same way if a dipole aerial is in use. Both sets are now switched on, the volume control of the set under test being placed at its minimum position—or the send-receive switch being turned to "send" if the set is a communication receiver.

A Useful Method

The aerial is switched to the standard receiver and a short-wave station tuned in. This done, the standard set is temporarily silenced and the same station tuned in on the one under test, to which the aerial has, of course, been switched over. You can now change in a jiffy from set to set and see exactly how their performances compare. It is rather important, by the way, to use for the aerial lead-in a large-sized switch of good quality, otherwise undesirable effects may be present. The suggested method has lots of applications besides that of making comparative tests of the sensitivity and selectivity of a pair of receivers. It is very useful for trimming a set, for instance, or for discovering how such things as AVC are behaving.

Twisted Joints

PEOPLE sometimes say that it's a waste of time to solder joints made between lengths of flex. "Twist 'em up tightly," they declare, "and they'll last for ever." Well, that's not my experience, and I'm sure it's not yours, either. A twisted joint answers well enough for a time, but eventually it becomes shaky. Some time ago I fitted extra bits to the LT leads of a portable belonging to my better half, so that she could use a larger accumulator, standing outside the case, when the set was a semi-fixture. It was a rush job, so I twisted up the joints (tightly, too!), meaning to solder them later on. As is so often the way, that soldering didn't get down, and the set later developed an attack of the crackles. The cause wasn't far to seek, for shaking those leads immediately caused a violent outburst. When I took off the insulating tape that covered them those joints *looked* as right as rain, though, of course, they weren't. Now that I've run in some solder all is well. If you must make an unsoldered joint in flex, I believe that the old Army tip is the best: Bare rather long ends, then tie them in a reef knot, pull it really tight and wrap the ends of wire firmly round the knot. If the wires are of different thicknesses, use a single sheet-bend instead of a reef knot.

A Misnomer?

ONE begins to feel that in many of the smaller receivers of to-day automatic volume control is a misnomer. What AVC should do, and what it does if it is well designed and has plenty of reserve gain to play with, is to keep a signal that is not suffering from violent fading steady by increasing the RF gain as it wanes and decreasing it as it waxes. In sets of the kind that I have in mind the reserve of gain is small; hence AVC can bring about no effective increase when a signal fades. All that it can do is to cut down the gain and prevent overloading when the signal rises to a maximum. And even here AVC as fitted is often of no great avail, as one knows by experience! To anyone who knows how good and how effective well-designed and well-applied AVC can be in a large receiver the arrangements found in many of the cheaper sets are a sad travesty of the real thing.

New Voice Recorder

Designed by Merle Duston in America, this new voice recorder affords instantaneous playback of the recording medium without any processing. The sounds are recorded on "Cellophane" or Glassine tape which is treated with certain chemicals. No recording stylus or sound head, in the usually accepted meaning of these terms, is employed but current passes through the tape at the modulating point and produces variable discoloration, in accordance with the originating sounds. Reproduction is by the normal photo-electric cell method. This instrument may be connected to the telephone circuit for recording conversations. A 6in. tape-reel provides 20 minutes' recording and a 7½in. reel lasts for about 1 hour. A single track is used so that lengths may be cut out and filed for reference. Low running cost is an important feature of this equipment.

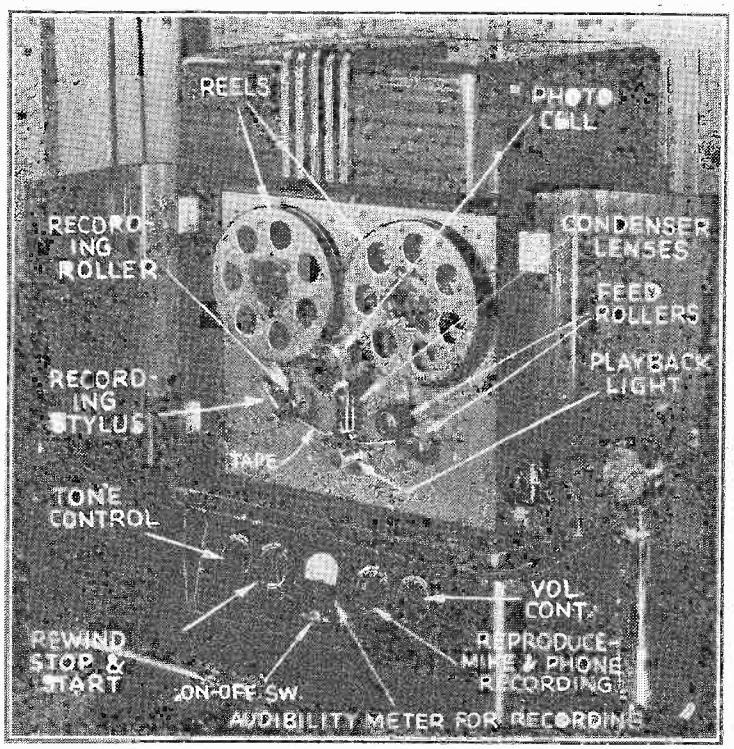


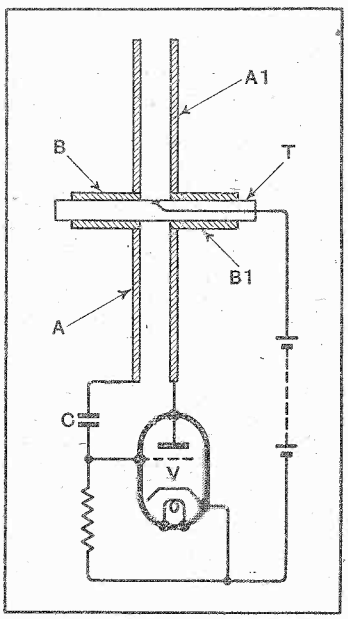
Photo: Courtesy "Radio and Television."

Recent Inventions

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

SHORT-WAVE RESONATORS

FOR ultra-short-wave working the ordinary tuned circuits of "lumped" inductance and capacity are being replaced by special resonator units in which both the capacity and inductance are distributed over a metallic surface. For instance, two flat circular metal members mounted on an axial tube will act as a USW resonator.



Method of generating ultra-short wavelengths.

As shown in the figure, the two discs A, A1 are mounted on bushes B, B1, which slide on a common axial tube T so that the distance between them can be adjusted for different wavelengths. The anode of the oscillator V is connected directly to the disc A1, the other disc A being connected through a small condenser C to the grid of the valve. The high tension supply is connected to the tube T at a point mid-way between the discs, this being an oscillation node. Several valves, similar to V, may be connected in parallel to different points on the rim of the disc A1, in order to build up the energy circulating in the resonator.

Telefunken Ges fur drahtlose Telegraphie m.b.h. Convention date (Germany), July 3rd, 1937. No. 502593.

o o o o

LARGE SCREEN TELEVISION

LARGE television pictures are built up of different sections, each of which is reproduced by its own cathode-ray tube, and then merged on to a common screen. The total number of tubes may vary from four to thirty-six, special methods of scanning being used in order to keep the overall operating voltage as low as possible.

The flyback stroke is made simultaneously in all the tubes, though the forward scans are "staggered." Means are provided for maintaining uniformity of brightness in each tube so as to avoid "patchiness" in the final built-up picture, merging being effected by fading-in each section to its neighbours so as to avoid the formation of intermediate boundary lines. Alternatively, a number of cathode-ray tubes are used to provide rapid line scanning, the comparatively slow framing movements being controlled by rotating mirror drums.

E. N. Muller. Convention date (Luxemburg) October 1st, 1936. No. 503025.

o o o o

SAFEGUARDING C.R. TUBES

IN a cathode-ray receiver using magnetic focusing, it is found that after the set has been switched off, a large spot of light usually appears on the fluorescent screen, and only dies away gradually. Its appearance is due to the fact that the time constant of the circuit supplying the anode of the tube is usually considerably greater than that of the circuit supplying the grid.

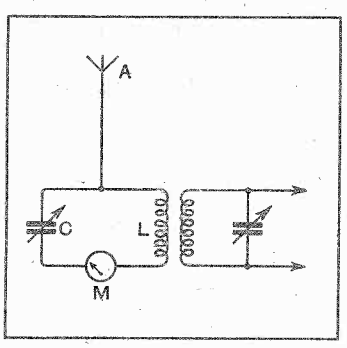
According to the invention, the formation of the spot is prevented by inserting a switch between the low potential end of the leak resistance associated with the control or modulating grid of the tube, and arranging for this switch to be opened automatically when the set is turned off. This prevents the condenser in the grid circuit from discharging too quickly, and so checks the residual emission from the cathode.

Baird Television, Ltd., and D. V. Ridgeway. Application date September 14th, 1937. No. 502351.

o o o o

AERIAL COUPLINGS

THE figure shows a method of coupling an aerial A, particularly of the dipole type, to the oscillating circuit LC of a wireless transmitter or receiver, no direct connection being made either to earth or to any other circuit. Resonance is indicated by a meter M inserted in series with the circuit on that side of L and C which is not connected to the aerial.



Non-earthed aerial coupling system.

The efficiency of the aerial is stated to be increased by this arrangement. In the case of a transmitting set, it is possible to check the tuning of the aerial circuit, and to measure the strength of the transmission (by the meter M) whether the aerial is connected or not. Once the circuit LC has been tuned to the required wavelength, the meter is unaffected by the connection of the aerial, unless the latter is either too long or too short.

H. Mayr. Application date, February 25th, 1938. No. 503698.

o o o o

TELEVISION IMPROVEMENTS

WHEN a common frequency changing stage is used for both the sound and picture signals in a television receiver, it is found that the frequency fluctuations of the local oscillator valve are so large that a wider transmission channel has to be provided in the intermediate frequency stage than should be necessary. This, in turn, lets in a certain amount of interference and "noise" that might otherwise be excluded.

According to the invention, these difficulties are avoided by applying automatic tuning control to the oscillator valve so as to stabilise it at a constant frequency. Any known system of ATC can be used to secure the desired effect.

Telefunken Ges. für drahtlose Telegraphie m.b.h. Convention date (Germany) October 17th, 1936. No. 504029.

o o o o

ELECTRON MULTIPLIERS

TO increase the output, the target electrodes of an electron multiplier are arranged in a number of rows, each set parallel to the main axis of the tube. Each row consists of a number of pairs of electrodes, these being set at an angle of 45 deg. to the longitudinal axis of the tube, so that corresponding pairs of electrodes in each of the three rows can act in cascade to amplify the stream as it passes transversely through the tube.

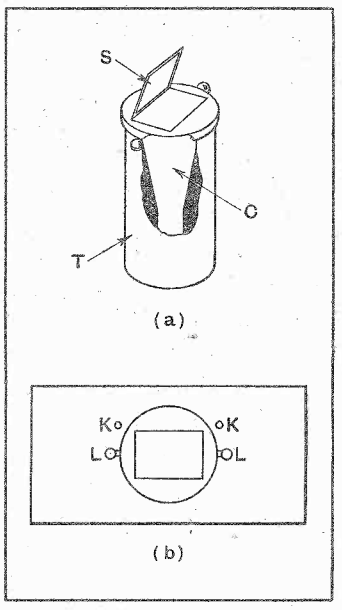
Light falling upon the first row liberates electrons from one surface of each electrode. The liberated stream is first attracted towards the nearest target in the same row, and is then deflected to the nearest target in the second row. From here is passes on to the adjacent target in that row, and then sideways to the nearest target in the third row, where it makes a final impact against the adjacent target in that row, before passing on sideways to the final output or collector. In effect, a number of independent streams are liberated by the first row of electrodes, each stream following its own transverse path from row to row in cascade, until all the streams are united at the common output.

Electrical Research Products, Inc. Convention date (U.S.A.), August 26th, 1937. No. 500170.

TELEVISION RECEIVERS

OWING to the rather limited angle of view, it is necessary to sit more or less directly in front of the viewing screen of a television set. Sometimes one would prefer to sit elsewhere in the room, and it then becomes necessary to shift the receiver bodily. As the cabinet is, in most cases, fairly heavy and bulky, this may be inconvenient and sometimes impracticable.

According to the invention the viewing screen is arranged so that it can be rotated about a vertical axis without moving the cabinet as a whole, and, in addition, it can be moved up and down to a limited extent. As shown in fig. a, the viewing screen S and cathode-ray tube C are mounted in a turret T, which projects a little above the level of the cabinet, and, as shown in plan in fig. b, is provided with lugs L by which it can be rotated bodily through a small angle determined by stops K.



Adjustable mounting for cathode-ray tube.

Since a movement of 90° in all is usually sufficient, the leading wires to the CR tube can be taken up inside the turret, and allowed to twist to that extent, slip-rings not being necessary. To allow for vertical movement, the turret is slung in a cradle supported by a wire, which is wound on or unwound from a drum by means of a hand wheel.

Marconi's Wireless Telegraph Co., Ltd., and A. A. Linsell. Application date, October 5th, 1937. No. 503419.

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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.

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NEW RECEIVERS AND AMPLIFIERS

*DEGALLIER'S "Challenge Radio Corporation."

SEND 2d. stamp for Handsome Illustrated Catalogues Telling of our Superb Range of Receivers; direct public sales policy (saves you 40%), most exceptional value on the market, from a T.R.F. Midget at £3/5 to a 19-valve general purpose receiver, 6 bands, with two P.A. speakers, at 30 gns. 6-page brochure of *Wireless World* report on this set is available; car radio; any known American valve, all 5/6 each; also American P.A. speakers, cabinets, and the Challenger 6-valve A.C. tuning unit, 5 bands 6-10, 12.8-50, 65-200, 190-550, 900-2,000 metres. Hours business 11 a.m. until 9.30 p.m.

DEGALLIER'S, 31, Craven Terrace, London, W.2. Paddington 6492. Nearest point Lancaster Gate Tube Station. [8515

ARMSTRONG Co.—After many years at our old premises at Camden Town we have removed to a new building in Warlters Rd., Holloway, N.7 (see displayed advertisement).

ARMSTRONG Amplifier Division Has Removed to New Premises at 94, Camden Rd., N.W.1. Enquiries for High Fidelity amplifiers and simple feeder units should be made to this address. Catalogues of this apparatus will be forwarded free to those interested.

ARMSTRONG Co. (Amplifier Division), 94, Camden Rd., N.W.1. [8518

R.

RADIO CLEARANCE, Ltd.,

63, High Holborn, W.C.1. 'Phone: Holborn 4631.

GUTHMAN McMurdo Silver Communication Receiver.

WE are Sole Distributors for the United Kingdom of Above Product.

CIRCUIT Superhet., with double regeneration obtained at signal frequency and also at intermediate frequency. As a result, very high sensitivity and selectivity are obtained.

CONTROLS.—R. meter, silencer, tone, aerial trimmer, A.F. gain selectivity, beat oscillator, receiver-send, A.V.C. B.O., on/off; assembled with valves but unwired, £17; wired and aerial tested, £18/18.

BRITISH BELMONT.

RECEIVERS and Chassis Still Available from Stock; as previously supplied.

RECEIVERS, with valves; £7/7.

FOR One Month Only.—Chassis with valves, £5/7/6.

RADIO CLEARANCE, Ltd., 63, High Holborn, W.C.1. Telephone: Holborn 4631. [8680

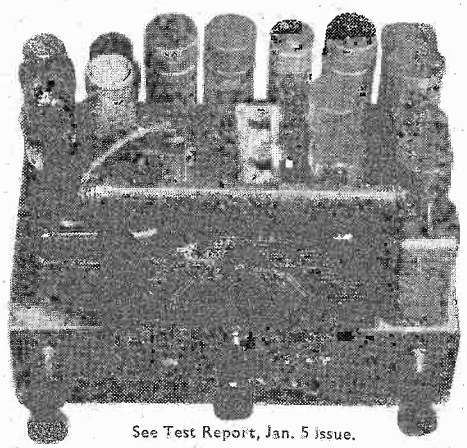
AMAZING Offer.—Famous 7-valve push button 1939 models in makers' sealed cartons, listed 13½ gns.; £5/19/6; list free.—Shippers, 18, Corporation St., Manchester. [0639

ARMSTRONG

100% The "Wireless World" says *"Full marks are due to the designer . . ."* of the

NEW VARIABLE SELECTIVITY
MODEL AW125PP
12-V. 5-BAND ALL-WAVE RADIOGRAM CHASSIS
(12—550 continuous, 1000—2000 m.)

with R.F. Pre-Amplifier, 2 I.F. stages with Variable Selectivity. Manual R.F. gain control and 10 watts R.C. coupled Triode P.P. Output - - - - **17 Gns.**



See Test Report, Jan. 5 issue.

DEMONSTRATIONS daily till 7.30 p.m. Saturdays till 5.30 p.m.
NOTE OUR NEW ADDRESS
ARMSTRONG MANUFACTURING CO.,
WARLTERS ROAD, HOLLOWAY, LONDON, N 7
(Adjoining Holloway Arcade).
Telephone: NORth 3213.

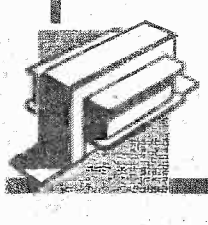
L·R·S — The above, and all ARMSTRONG CHASSIS supplied on Easy Terms by LONDON RADIO SUPPLY COMPANY 11, Oat Lane, Noble St., London, E.C.2 — EASY TERMS See page 6

What is the . . .

Partridge

DISTORTION INDEX

. . . of *your* output transformer? If you are intereted in output transformers that are genuinely distortionless, write to:—



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DEAN STANLEY STREET
LONDON - - S.W.1
Phone: Victoria 5035

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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.

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Wanted

WANTED, modern communication receiver, R.M.E. Hammarlund, National or Skyrider.—146, Palmers Rd., N.11. [8647

EKCO "No H.T." Battery Sets, type B.V.98, new or second-hand; cash or exchange goods (state requirements).—Tidswell, Albert Rd., Barnoldswick. [8653

USED SETS FOR SALE

R.C.A. VICTOR

R.C.A. Victor Luxury Automatic Radio-gramophone, Model V109, Magic Brain electric tuning with remote control, 16 valves, 3 wavebands, in solid walnut enclosed console, as new, cost £130; accept £55.—Harris, Hilltop, Caterham. 'Phone: 250. [8666

ULTRA 25

ULTRA 25 Console, good condition; what offers? Free delivery Greater London.—Lee, 53, Southbourne Crescent, N.W.4. [8656

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FIFTY Unused N.S.F. ½-, 1-, 2-watt Resistors, wire ends, marked, colour coded, 20 different useful sizes in each parcel; 50 for 2/6 only.

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THE Qualifications Required are:—

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PREFERENCE will be given to candidates who have not reached their 45th birthday, and who have the following additional qualifications:—

EXPERIENCE in the design, testing and installation of aircraft radio equipment.

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"Handbook of Technical Instruction for Wireless Telegraphists." Price 21s. net. Post free 21s. 9d.

SITUATIONS VACANT

AIR MINISTRY.

DIRECTORATE OF SIGNALS (CIVIL AVIATION).

APPLICATIONS are invited for appointments as Civilian Wireless Operators at Air Ministry Civil Aviation Wireless Stations.

APPLICANTS, who should not be above 40 years of age on 1st July, 1939, should preferably possess the 1st Class Postmaster-General's Certificate or the Air Operator's Certificate in Wireless Telegraphy and have had experience of radiotelephony, direction-finding and maintenance work. Operators will be required to serve at any Air Ministry Civil Aviation station at home or abroad. At present there is only one station situated outside the United Kingdom manned temporarily by Air Ministry staff.

SALARY is at the rate of 67/- a week, rising by annual increments for approved service to 112/- a week inclusive. Should candidates be required to serve abroad appropriate additional allowances would be paid.

THE first two years of service will constitute a probationary period, and confirmation of appointment will be contingent on an operator passing an examination in all phases of his work.

POSTS will be unestablished, i.e., non-pensionable in the first instance. A proportion of the total staff is pensionable, however, and, subject to the existence of vacancies in the permanent staff, operators may be considered for establishment according to their seniority, conduct and ability, provided that the probationary period has been satisfactorily completed.

REQUESTS by postcard for forms of application should be addressed so as to reach the Under-Secretary of State, Air Ministry (S.I.e.), Kingsway, London, W.C.2, not later than the 12th July, 1939.

SELECTED applicants will be required to attend at the Air Ministry for interviews on the 27th and 28th July, 1939.

NO application will be considered unless the applicant states that he will be able to attend on either of these dates.

NO other arrangements regarding interview can be entertained. [8678

AIR MINISTRY.

A NUMBER of Vacancies Exist for Technical Officers and Assistants II and III at Various Royal Air Force Stations for Work in Connection with the Development, installation and maintenance of wireless equipment.

THE Qualifications Required Are:—

(A) Education to degree standard or equivalent in Physics or electrical engineering, or a sound technical training.

(B) Workshop or laboratory experience in the development of radio communication equipment.

A KNOWLEDGE of the Operation and maintenance of Royal Air Force wireless equipment would be an advantage.

SALARY Scales Are:—

B210—Technical Officers: £275 by £18-£455 by £25-£580 (men); £275 by £12-£347 by £18-£464 (by £25-£580 in exceptional cases) (women).

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THE Appointments Will be Non-pensionable in the first instance.

REQUESTS For the Necessary Form of Application Should be Addressed to the Under-Secretary of State, Air Ministry (S.2A/B.8019), Berkeley Square House, Berkeley Square, W.1, quoting the appropriate reference number and enclosing a stamped addressed envelope. [8597

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FINAL (Grade III) Certificate of City and Guilds of London Institute Examination in Radio Communication;

HIGHER National Certificate in Electrical Engineering;

CERTIFICATE of City and Guilds of London Institute in Radio Service work; or similar qualification; or

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

CURRENT Electricity—Properties of an electric current. Ohm's Law and its applications. Galvanometers and Measuring Instruments. Electro-magnetism. Magnetic materials.

ALTERNATING Currents—General principles. Effects of Resistance, Inductance and Capacity. Resonance.

RADIO—General character of a radio signal. Elementary knowledge of valves and their simple applications.

SUITABLE Candidates Will Undergo a Short Trade Test After Interview in London, and those selected will enter a course of instruction at the Military College of Science, Woolwich. On final acceptance, to depend upon an examination after three week's instruction, successful candidates will be required to give an undertaking to enlist into the Territorial Army (with rank of Sergeant), and will receive a further three weeks' instruction before transfer to their permanent stations. Regular travelling expenses on transfer will be payable.

PREFERENCE Given to ex-Members of His Majesty's Forces, other things being equal.

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SITUATIONS VACANT

CIVILIAN Wireless Instructors Required at Royal Air Force Volunteer Reserve Centres.

INITIAL Rate of Pay £4 per Week, rising to £4/5 a week after a satisfactory probationary period, and thereafter by annual increments of 2/6 per week to a maximum of £4/12/6 per week; candidates must have a sound knowledge of electrical principles and their application to radio and low-power electrical engineering, and be capable of lecturing; suitable candidates will be interviewed, tested and medically examined.

CANDIDATES May be Required to Undergo a Short Course of Instruction at No. 1 Electrical and Wireless School, Royal Air Force, Cranwell, Sleaford, Lincs, before taking up duty, and during this period the rate of pay would be 65/- a week.

APPLICATION Should be Addressed to the Air Officer Commanding, Headquarters, Reserve Command, R.A.F. Hendon, the Hyde, N.W.9, giving full particulars as to previous experience, age, etc. [0638

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Printed in England for the Publishers, ILIFFE AND SONS LTD., Dorset House, Stamford Street, London, S.E.1, by The Cornwall Press Ltd., Paris Garden, Stamford Street, London, S.E.1.

"The Wireless World" can be obtained abroad from the following: FRANCE: W H. Smith & Son, 248, Rue Rivoli, Paris, Hachette et Cie, Rue Réaumur, Paris, and branches; Messageries Dawson, 4, Rue de Faubourg Poissoniere, Paris. BELGIUM: W. H. Smith & Son, 74-75, Boulevard Adolphe Max, Brussels. AUSTRALIA: Gordon & Gotch, Ltd., Melbourne (Victoria), Sydney (N.S.W.), Brisbane (Queensland), Adelaide (S.A.), Perth (W.A.), and Launceston (Tasmania). NEW ZEALAND: Gordon & Gotch, Ltd., Wellington, Auckland, Christchurch and Dunedin. INDIA: A. H. Wheeler & Co., Bombay, Allahabad and Calcutta. CANADA: Imperial News Co., Toronto, Winnipeg and Vancouver; Benjamin News Co., Montreal; Gordon & Gotch, Ltd., Toronto. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd., Cape Town. UNITED STATES: The International News Co., New York.

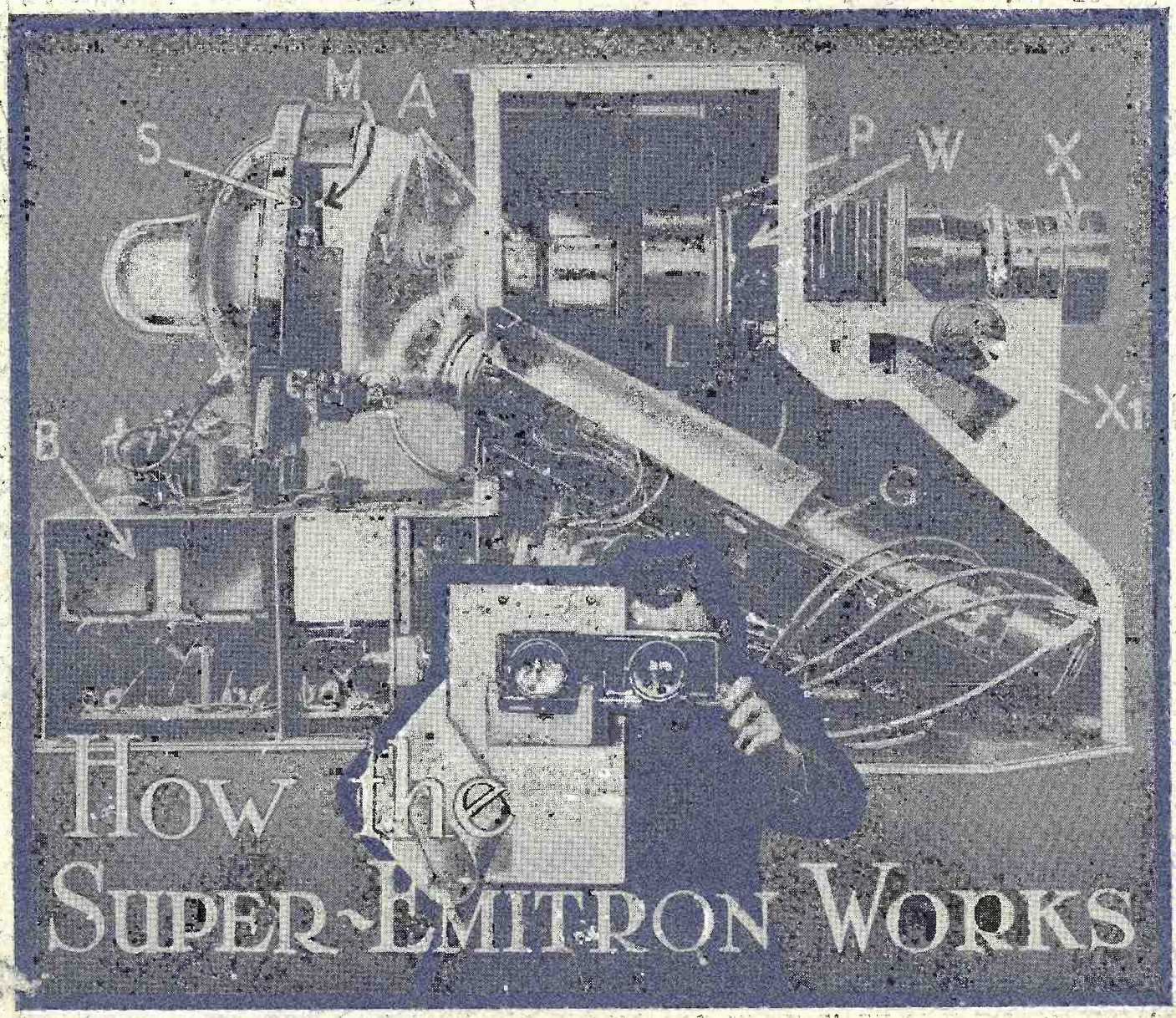
BUILDING A 4-BAND TRANSMITTER

The Wireless World

6D

THE PRACTICAL RADIO & TELEVISION JOURNAL

Thursday, July 13th, 1939



How the SUPER-EMITRON WORKS

No. 1,037. Vol. XLV. No. 2.

The Wireless World

THE PRACTICAL RADIO JOURNAL

29th Year of Publication

No. 1037. THURSDAY, JULY 13TH, 1939. VOL. XLV. No. 2.

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone : Waterloo 3333 (50 lines).
Telegrams : "Ethaworld, Sedist, London."

COVENTRY : 8-10, Corporation Street.
Telegrams : "Autocar, Coventry." Telephone : 5210 Coventry.

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GLASGOW : 26B, Renfield Street, C.2.
Telegrams : "Iliffe, Glasgow." Telephone : Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home and Canada, £1 10s. 4d. ; other countries, £1 12s. 6d. per annum.

CONTENTS

EDITORIAL COMMENT

National Service

Training and Organisation

IN our correspondence columns this week there appear two letters that draw attention to an important point in regard to the service that wireless amateurs—and, indeed, many professionals—might render in time of emergency. The writers of both letters stress, either directly or indirectly, the need for training and organisation. Technical knowledge and proficiency, unless of the right kind, are not enough by themselves.

Most wireless people, and particularly amateurs, tend to be individualists, but individualism is quite out of place in the intricate communication system of the modern defence Services. Team work, precise synchronisation and strict adherence to rules and procedure are essential to a successful wireless service ; there is no room in the National boat's crew for the modern counterpart of the Victorian lady novelist's hero, who "pulled two strokes to everybody else's one." He would be quite as much in the way as the opposite kind of oarsman who could not stand the pace.

Specialised Training

We know that a large number of readers have already offered their services by filling in the National Wireless Register form which appeared in this journal at the beginning of the year. There is reason to believe that this ready response had been greatly appreciated by the authorities, but we now suggest that those who have responded might ask themselves whether their services might not be made more valuable if their present knowledge and experience were supplemented by specialised training, obtained by joining one of the existing Services, or in some other manner. It is the duty of the authorities, in their turn, to see that proper facilities exist for giving such training to those who are willing to devote their spare time to making themselves of greater potential value in the cause of National defence. It is suggested that in this matter the help of existing civilian wireless organisations might well be enlisted ; there can be little doubt that the fullest co-operation would be forthcoming.

Social Tendencies

Television and Decentralisation

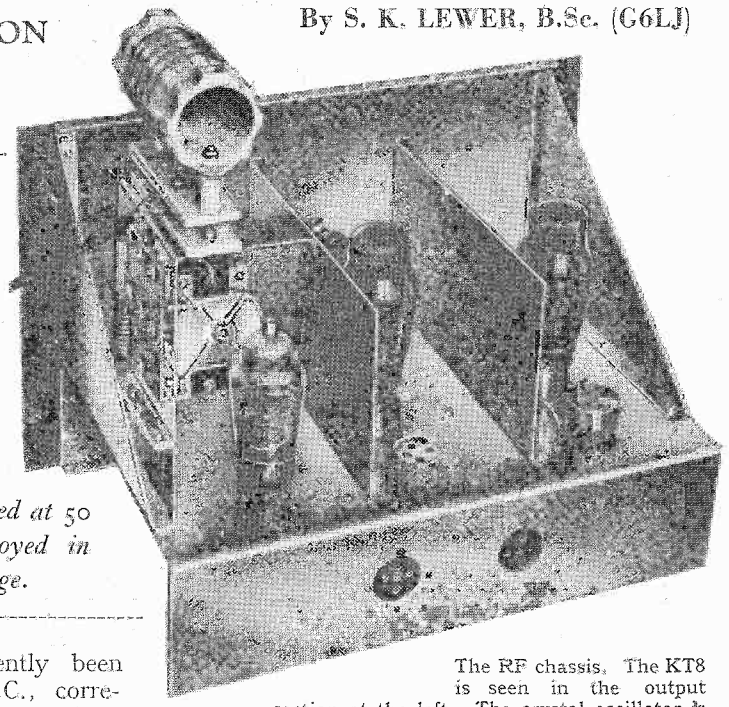
AFTER considering the applications of wireless for those purposes to which, unfortunately, we cannot shut our eyes nowadays, it is refreshing to turn towards its uses in the arts of peace and the cause of humanity.

When Mr. David Sarnoff, President of the Radio Corporation of America, has anything to say on the fundamental implications of wireless he is always worth listening to. In an article entitled "Probable Influences of Television on Society," published in the *Journal of Applied Physics* for July, he says, "With the advent of television a new force is being given to the world. Who can tell what the power to extend vision will mean ultimately in the stream of human life ?" As Mr. Sarnoff sees it, the present tendency towards decentralisation of population will be accelerated by television, which, with sound broadcasting, will provide the principal source of entertainment, education and news to those living in "satellite" areas surrounding metropolitan centres.

Four-Band Transmitter

DESIGNED FOR EFFICIENT OPERATION ON 7, 14, 28 AND 56 Mc/s

By S. K. LEWER, B.Sc. (G6LJ)

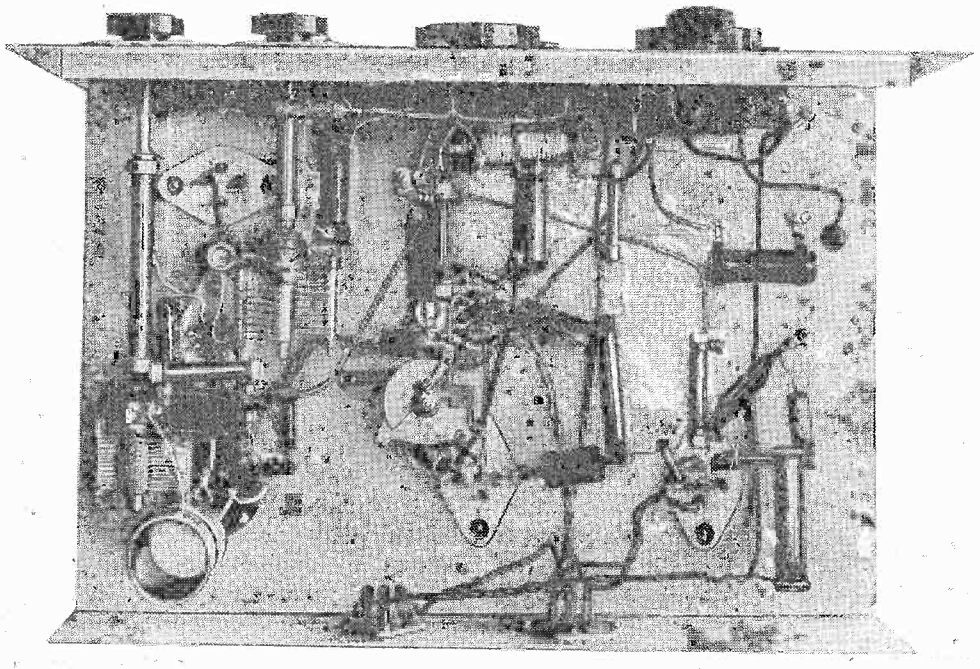


The RF chassis. The KT8 is seen in the output section at the left. The crystal oscillator is located at the opposite end, while the frequency-doubler is in the middle section. The doubler anode coil has been removed from its socket for the sake of clarity. The oscillator anode coil L2 is located between the oscillator valve and the front panel. Note the large aluminium bracket carrying the coil and variable condenser and the special blocking condenser C5.

MULTI-band operation is obtained with this transmitter by using plug-in coils and valves that perform efficiently as frequency doublers. A new beam tetrode, operated at 50 watts input, is employed in the output stage.

WHEN designing a transmitter which is to be efficient, handy, compact and inexpensive, probably the best solution for the average amateur is to adopt the practice, now becoming more and more popular, of having a self-contained transmitter capable of efficient operation on a number of frequency bands. The transmitter described in this article has been found to meet all these requirements, and at the same time it constitutes a reliable driver for a higher power output stage. In itself, however, it is a very efficient transmitter for telegraphy and telephony operation, and the description of it is given from this standpoint.

Briefly, the set is a crystal-controlled, 3-stage, 4-band, CW and telephony transmitter, of rack and panel construction. It has its own power supplies, and no grid bias batteries are required. The maximum RF power output is about 30 to 35 watts at 7 Mc/s, falling to about 10 watts at 56 Mc/s, and British valves are used throughout. The RF stages consist of a KT66 crystal oscillator, a KT66 buffer-doubler, and a KT8 as power amplifier. The modulator utilises two KT66's in Class AB-1, driven by two H63's in a phase inverting circuit. Separate power supplies are provided for the RF section and for the modulator, one U18 rectifying valve being used in each. The KT66 is, of course, the well-known British equivalent of the American 6L6G. The KT8, which has recently been released by the G.E.C., corresponds closely to the American 807 or RK39, but has a standard British 5-pin base. The KT8 has a top anode connection which with internal screening makes neutralising unnecessary and permits an efficient constructional layout, especially for 56 Mc/s working. Because the anode lead passes through the top of the valve, there is no disadvantage in the bakelite base with which the valve is fitted, since the losses in this material as compared with a ceramic base necessitate only a negligible increase in the amount of grid drive, even for frequencies in the 56 Mc/s band. The low price of the KT8, which is well below that of the American 807, is low enough to prevent any criticism on the usual ground that British valves are too costly.



Under-chassis view of the RF unit. The tritet cathode coil L1 is seen in the lower left corner, while the oscillator anode coil socket is in the top left corner. The doubler anode coil socket is seen in the bottom centre, with the neutralising condenser located between it and the doubler valve socket in the middle of the chassis. Note the grid and screen stoppers, R13 and R14, fixed directly to the KT8 socket at the lower right corner of the chassis.

Plug-in coils are used throughout, excepting the tritet cathode coil, and the types of formers used can be clearly seen in the photograph.

The circuits of the four separate units which make up the complete transmitter are shown in Fig. 1.

The KT66 crystal oscillator operates with a 7 Mc/s crystal, and is provided with a rather low screen voltage in order to keep the crystal current well below the danger value. Nothing is lost by doing this, since ample drive is obtainable for the following stages on all bands. The oscillator functions as a tritet only when output is required on the 28 Mc/s and 56 Mc/s bands.

"Straight" Operation

The cathode coil is, therefore, short-circuited for 7 Mc/s operation by bending the tip of one of the moving vanes of its tuning condenser so as to touch the adjacent fixed vane at the maximum setting of the control knob, and the second KT66 acts as a buffer and drives the KT8, all circuits being tuned to the same frequency.

For 14 Mc/s, the tritet cathode coil is again short-circuited, while the anode circuit of the second KT66 is tuned to 14

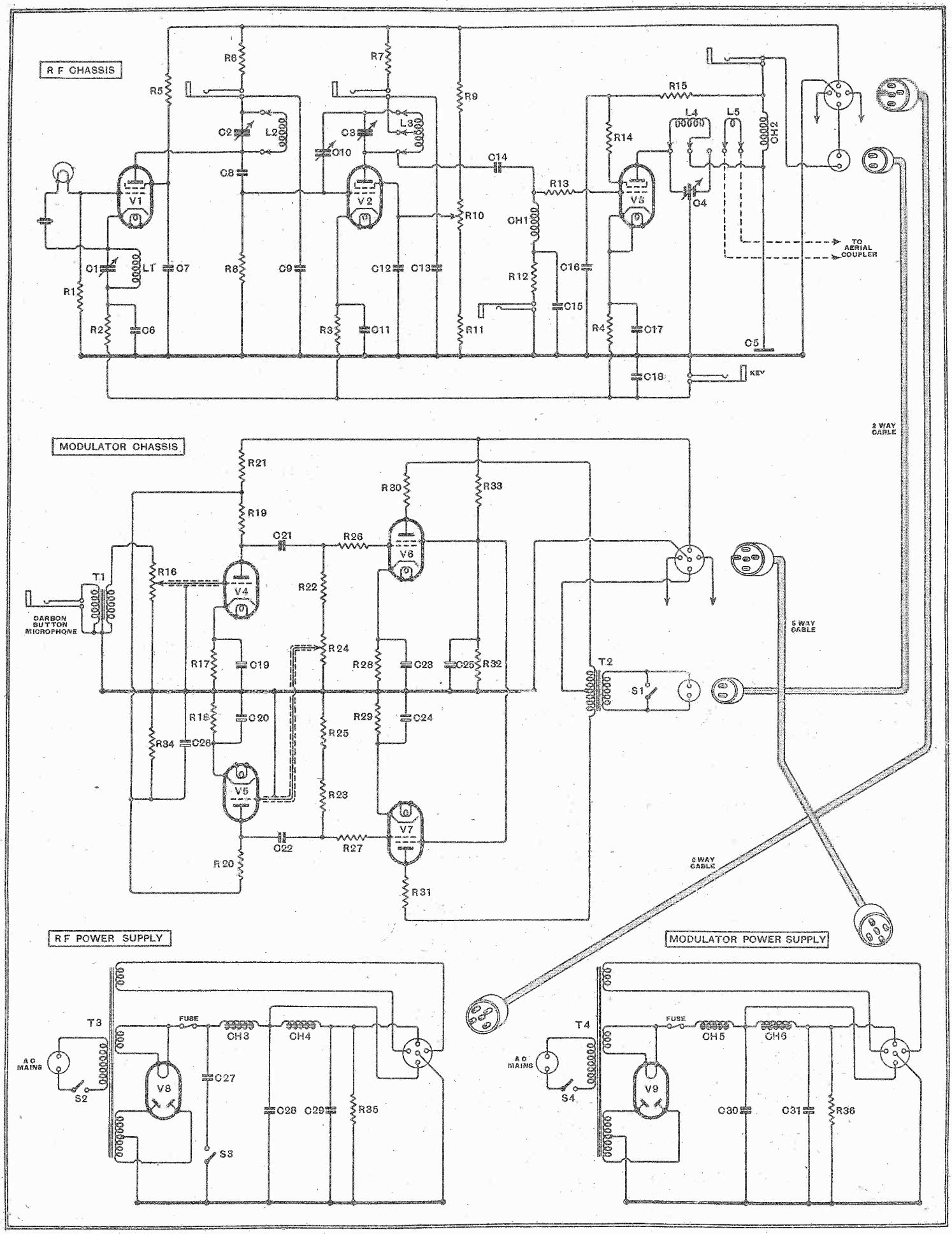


Fig. 1.—Theoretical circuits of the transmitter divided up into its individual units, consisting of RF chassis, modulator and two power supply units. Values of the components can be obtained from the List of Parts in which the circuit references are included.

Four-Band Transmitter—

Mc/s, so that this valve acts as a frequency-doubler. The KT8 gives straight amplification at 14 Mc/s.

For 28 Mc/s the tritet-cathode coil is brought into operation and the oscillator anode circuit is tuned to 14 Mc/s. The second valve doubles the frequency to 28 Mc/s, and the KT8 again acts as a straight amplifier, but with suitably tuned circuits for this higher frequency.

The most satisfactory arrangement found so far for 56 Mc/s operation is to drive the grid of the KT8 at 28 Mc/s and to use this valve as a "power" frequency-doubler. Otherwise, the circuits are tuned as for 28 Mc/s output. Some interesting experiments could be made by quadrupling the frequency either in the oscillator or in the second KT66 so as to have a 56 Mc/s drive available for the grid of the KT8. Since the KT8, however, is an excellent doubler, the arrangement described here may be relied upon to give up to 10 or 15 watts output at 56 Mc/s.

Cathode bias is used in all three stages, and consists of a 500-ohm 10-watt resistance in each case, shunted by a mica condenser of 0.01 mfd. capacity. Grid leak bias is used in addition in each stage, the oscillator having a 50,000-ohm leak R1, while the second KT66 has a 100,000-ohm leak R8 in order to give efficient frequency-doubling. The optimum leak resistance R12 for the KT8 is about 20,000-ohms.

An adjustment for controlling the amount of drive to the KT8 stage, which is rather critical, particularly when using telephony, is effected by a variable potentiometer R10 for providing the screen voltage of the second KT66. This is a 10,000-ohm 5-watt potentiometer, one side of which is connected to earth through a fixed 10,000-ohm resistance R11, while the other side is connected through a 25,000-ohm fixed resistance R9 to the HT line. In this way the screen voltage can be varied between about 100 and 200 volts.

Neutralising

It was found to be necessary to neutralise the buffer stage when it was called upon to act as a straight amplifier, and therefore a centre-tapped anode coil was used for this stage, together with a very small neutralising capacity C10. A suitable condenser is readily made from a single pair of plates taken from an old midget variable condenser and fixed to a strip of high-quality insulating material so that one plate is fixed in position and the other can be rotated on its mounting screw. The spacing between the plates should be about 2 mm. The condenser is light enough to be supported in the wiring, the connecting leads necessarily being very short. A drawing of this condenser is shown in Fig. 2.

Turning to the output stage, it is to be noted that since stable operation with high efficiency at frequencies as high as the 56 Mc/s band is required, all leads carrying RF currents must be as short as possible. With the physical layout adopted in the present transmitter, this is satisfactorily achieved, and at the same time there is no harmful coupling between the grid and anode circuits of the KT8.

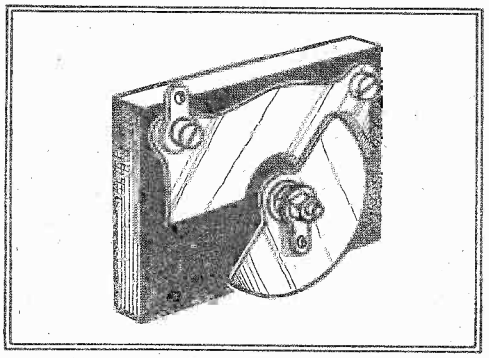


Fig. 2.—Constructional details of the neutralising condenser, which is described in the text.

Neutralisation was found to be unnecessary, even in the 56 Mc/s band.

With a different layout trouble may be experienced from ordinary self-oscillation or from parasitic oscillation. A screen stopper resistance R14 of 100-ohms (1-watt) and a grid stopper resistance R13 of 25-ohms (½-watt) were connected directly at the valve socket pins to suppress a tendency to generate parasitic oscillations. This grid stopper resistance should be kept as low as possible, consistent with stable operation, since the amount of effective drive is reduced as this resistance is made larger. A value somewhere between 10 and 30 ohms is usually sufficient. If the grid and screen stoppers do not result in completely stable operation an anode stopper of about 25 ohms (½-watt) should be tried in addition.

The KT8, being a tetrode, requires simultaneous anode and screen modulation for telephony working, and, of course, for proper modulation characteristics, the L/C ratio of its anode circuit must lie within certain rather narrow limits. The wide range of frequencies covered by the four-band operation calls for a large range of tuning capacity if the L/C requirements are to be observed, and this is conveniently obtained by using a split-stator condenser C4 of 50 + 50 mfd. capacity, with either a single section in circuit across the coil or both sections connected in parallel across the coil. By the use of a three-pin wiring arrangement for the plug-in coils, the second condenser section is

LIST OF PARTS

Variable Condensers:
- 1 50+50 mmfds., **C4** — Eddystone 1081
- 2 60 mmfds. (Microdenser), **C2, C3** — Eddystone 1093
- 1 160 mmfds. (Microdenser), **C1** — Eddystone 1131
- 1 Neutralising condenser, **C10** (see text)

Fixed Condensers:
- 1 Blocking condenser, **C5** (see text)
- 1 0.00005 mfd., mica, **C8** — T.C.C. "M"
- 1 0.0005 mfd., mica, **C14** — T.C.C. "M"
- 1 0.002 mfd., mica, **C18** — T.C.C. "M"
- 1 0.005 mfd., mica, **C16** — T.C.C. "M"
- 8 0.01 mfd., mica, **C6, C7, C9, C11, C12, C13, C15, C17** — T.C.C. "M"
- 2 0.1 mfd., **C21, C22** — T.C.C.341
- 2 25 mfds., electrolytic, 12 V, **C19, C20** — T.C.C. "FT"
- 2 50 mfds., electrolytic, 50 V, **C23, C24** — T.C.C. "FW"
- 2 8 mfds., electrolytic, 500 V, working, **C25, C26** — T.C.C.512
- 4 2 mfds., 1,000 V, working, **C28, C29, C30, C31** — T.C.C.111
- 1 4 mfds., 1,000 V, working, **C27** — T.C.C.111

Resistances:
- 1 25 ohms, ½ watt, **R13** — Erie
- 1 100 ohms, ½ watt, **R14** — Erie
- 2 1,000 ohms, ½ watt, **R26, R27** — Erie
- 2 2,000 ohms, ½ watt, **R17, R18** — Erie
- 1 50,000 ohms, ½ watt, **R1** — Erie
- 1 100,000 ohms, ½ watt, **R34** — Erie
- 2 250,000 ohms, ½ watt, **R22, R23** — Erie
- 2 100 ohms, 1 watt, **R30, R31** — Erie
- 2 10,000 ohms, 1 watt, **R21, R25** — Erie
- 1 20,000 ohms, 1 watt, **R12** — Erie
- 1 100,000 ohms, 1 watt, **R8** — Erie
- 2 200,000 ohms, 1 watt, **R19, R20.** — Erie
- 1 20,000 ohms, 2 watts, **R15** — Erie
- 1 50,000 ohms, 3 watts, **R5** — Erie
- 2 400 ohms, 10 watts, **R28, R29** — Bulgin AR500
- 3 500 ohms, 10 watts, **R2, R3, R4** — Bulgin AR500
- 1 2,000 ohms, 20 watts, **R33** — Webbs Aerovox 933
- 1 2,500 ohms, 20 watts, **R7** — Webbs Aerovox 933
- 1 5,000 ohms, 20 watts, **R6** — Webbs Aerovox 933
- 2 10,000 ohms, 20 watts, **R11, R32** — Webbs Aerovox 933
- 3 25,000 ohms, 20 watts, **R9, R35, R36** — Webbs Aerovox 933
- 1 potentiometer, 100,000 ohms, **R16** — Erie
- 2 potentiometers, 10,000 ohms, 5 watts **R10, R24** — Reliance "TW"
- 2 RF chokes, 1.25 mH, **Ch1, Ch2** — Eddystone 1010
- 1 smoothing choke, 15 H, 120 mA, **Ch6** — Webbs Radio "Apex"
- 1 smoothing choke, 15 H, 150 mA, **Ch4** — Webbs Radio "Apex"
- 1 swinging choke, 5/25 H, 150 mA, **Ch5** — Webbs Radio "Apex"
- 1 swinging choke, 5/25 H, 250 mA, **Ch3** — Webbs Radio "Apex"
- 1 Quartz crystal, frequency 7 Mc/s, amateur band mounted — Webbs Valpey
- 1 Microphone transformer, ratio 1:75, **T1** — Webbs Radio "Apex"
- 1 U.T.C. Varimatch transformer, **T2** — Webbs Radio "Apex" VM2
- 1 Mains transformer, 550-0-550 V, 250 mA; 6.3 V, 4.0 A, 4.0 V, 4.0 A, **T3** — Webbs Radio "Apex"
- 1 Mains transformer, 550-0-550 V, 150 mA; 6.3 V, 4.0 A, 4.0 V, 4.0 A, **T4** — Webbs Radio "Apex"

Miscellaneous:
- 2 large dials and knobs — Eddystone 1098
- 2 small dials and knobs — Eddystone 1099
- 5 4-pin threaded coil formers — Eddystone 936
- 3 Frequentite coil formers — Eddystone 1090
- 1 Frequentite coil base — Eddystone 1092
- 2 insulated brackets — Eddystone 1116
- 1 adjustable bracket — Eddystone 1007
- 2 Frequentite Octal valve holders — Eddystone 1120
- 1 Frequentite 5-pin valve holder — Eddystone 1074
- 6 Octal Valve Sockets, Paxolin — Webbs Radio
- 3 extension controls — Eddystone 1008
- 4 Frequentite sub-bases — Eddystone 1091
- 6 midget jacks — Peto-Scott P72
- 3 jack plugs, — Peto-Scott P40
- 4 toggle on/off switches — Bulgin S80
- 1 crystal holder — Webbs Valpey
- 1 fuse lamp, 60 mA, and holder — Webbs Radio "Apex"
- Plugs, sockets, inter-connecting cables — Peto Scott

Valves:
- 4 KT66, **V1, V2, V6, V7** — Osram
- 1 KT8, **V3** — Osram
- 2 H63, **V4, V5** — Osram
- 2 U18, **V8, V9** — Osram

Four-Band Transmitter—

automatically brought into use in the case of the lower frequency bands by including a connection from the "hot" end of the coil to the third pin.

The values of inductance, the constructional details of which will be given in a coil specification table, have been chosen so that the capacity necessary for resonance in the four bands is close to the optimum value for producing the best "flywheel" effect of the KT8 anode circuit. It should be borne in mind that if the KT8 is operated under any other conditions but those described here, the optimum L/C ratio may be quite different, and a modification to the coils may be required in order to obtain the best performance.

In Forthcoming Issues

REGENERATION: Up-to-date applications of the one principle that offers something for nothing—or very near it—in receiver design.

STEERING BY TELEVISION: Latest uses of wireless technique in navigation, particularly of aircraft.

With the coils and circuit constants employed in this set and with 50 watts input to the KT8 valve the maximum RF output is approximately 35 watts on 7 and 14 Mc/s, 20 watts on 28 Mc/s and 12 watts on 50 Mc/s.

(To be continued.)

Ferranti 1939-40 Programme

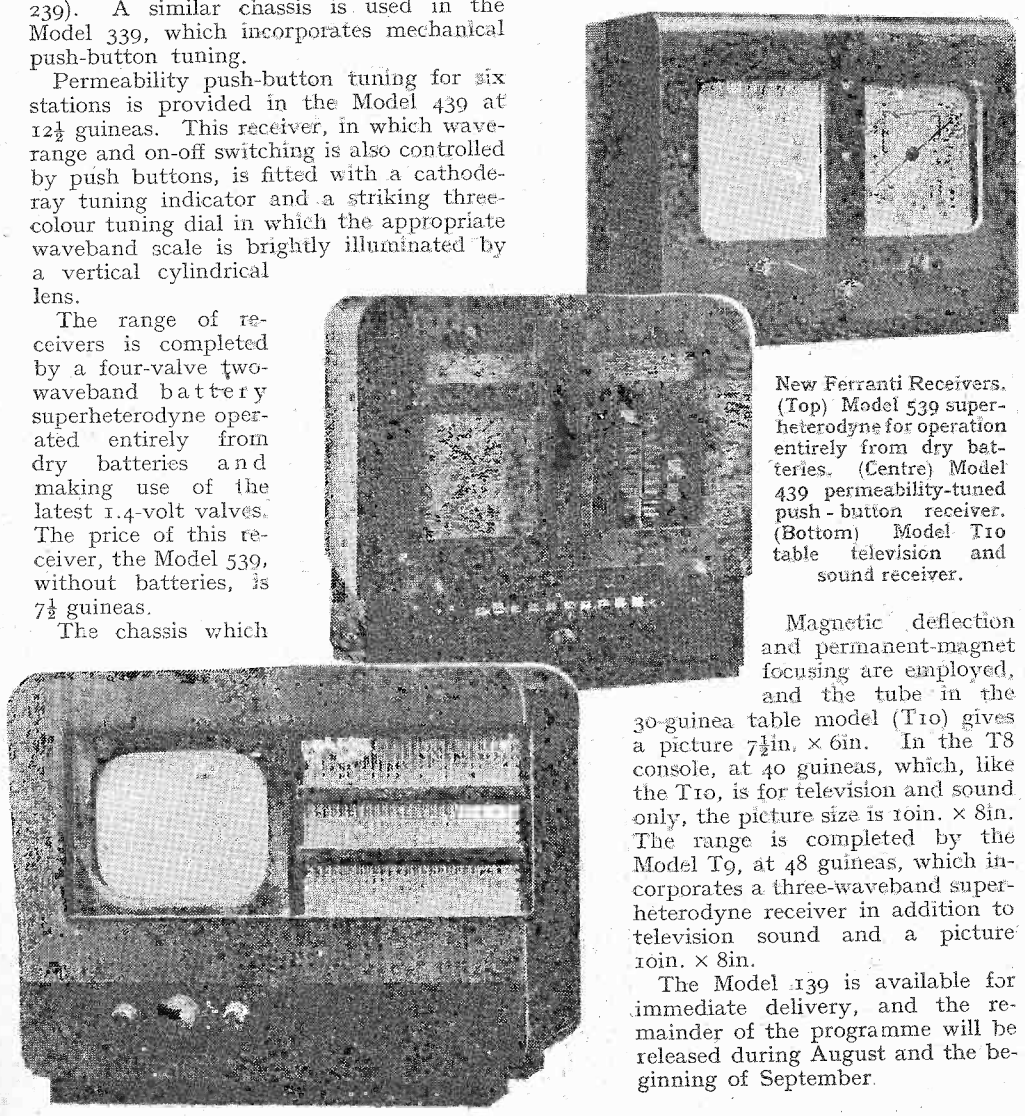
THREE TELEVISION SETS AND FIVE TABLE MODEL RECEIVERS

THE new broadcast receivers in the recently announced Ferranti programme are table models. They include a four-valve (plus rectifier) all-wave superheterodyne, Model 139, at 9 guineas, in a moulded cabinet, or 10 guineas in a walnut cabinet with a larger dial (Model 239). A similar chassis is used in the Model 339, which incorporates mechanical push-button tuning.

Permeability push-button tuning for six stations is provided in the Model 439 at 12½ guineas. This receiver, in which wave-range and on-off switching is also controlled by push buttons, is fitted with a cathode-ray tuning indicator and a striking three-colour tuning dial in which the appropriate waveband scale is brightly illuminated by a vertical cylindrical lens.

The range of receivers is completed by a four-valve two-waveband battery superheterodyne operated entirely from dry batteries and making use of the latest 1.4-volt valves. The price of this receiver, the Model 539, without batteries, is 7½ guineas.

The chassis which forms the basis of the three television receivers is extremely well thought out from the point of view of layout. All components are accessible and they are very evenly distributed on the underside of the chassis, so that both production and servicing are considerably simplified.



New Ferranti Receivers. (Top) Model 539 superheterodyne for operation entirely from dry batteries. (Centre) Model 439 permeability-tuned push-button receiver. (Bottom) Model T10 table television and sound receiver.

Magnetic deflection and permanent-magnet focusing are employed, and the tube in the 30-guinea table model (T10) gives a picture 7½in. × 6in. In the T8 console, at 40 guineas, which, like the T10, is for television and sound only, the picture size is 10in. × 8in. The range is completed by the Model T9, at 48 guineas, which incorporates a three-waveband superheterodyne receiver in addition to television sound and a picture 10in. × 8in.

The Model 139 is available for immediate delivery, and the remainder of the programme will be released during August and the beginning of September.

Henry Farrad's PROBLEM CORNER

No. 28.—The Missing Volts

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction :—

Howell House,
Keston.

Dear Henry,

For a new receiver I am building I need a power unit giving 25 mA. at 300 volts. According to *The Wireless World* Valve Data Supplement, the Osram U10 rectifier gives an unsmoothed rectified output of 300 volts at half-current when supplied by a 250-0-250-volt transformer. As the full rated current is 60 mA., it looked as if it would do, because I reckoned that as 25 mA. is a little less than half the full current the unsmoothed voltage would be a little over 300, and this extra would allow for a slight loss due to the resistance of the smoothing choke.

Well, so far, I have got the transformer and the rectifier valve, and before going any farther I thought I would check the unsmoothed DC voltage. Using a multi-range meter that I believe to be reliable, I found it to be only 228 volts. The meter is 1,000 ohms per volt, so the current taken by it must be less than 1 mA.; and I cannot understand why the voltage is so low. According to the Data Supplement it ought to be 260 even at the full 60 mA. There is no choke to reduce it, and I have checked the AC voltage of the transformer with the same meter—it was over 250. So, as the rectifier is the only other component, it seems that it must be the faulty one. The man I got it from says it is a new one and must be all right, but I notice he has no gear suitable for testing it under the proper conditions. Can you suggest a reliable test?

Yours sincerely,
Philip Cowe.

Why is the voltage lower than expected? Turn to page 41 to see if your solution agrees with Henry Farrad's.

Five-metre DX

REPORTS WANTED

ON the few occasions when it has been possible to devote time to the five-metre band during the week preceding July 6th last, no unusual activity has been noticed, and it can only be assumed that conditions have not shown any tendency to favour DX signals.

It has to be remembered, of course, that location has a profound effect on reception of ultra-high-frequency signals and that reports from different parts of the country are always more indicative of the true conditions prevailing than observations from one or two stations only.

One interesting report just to hand from G6YL mentions reception of some French and Italian stations in the north of England during the last week in June. It is hoped to give more details of the stations heard next week. In order that these reports shall give an exact indication of how the five-metre band is behaving from time to time, reports of any outstanding contacts made or of signals heard will be gratefully received.

G2MC.

Distortion in Transformer Cores

Part IV.—REVISED DESIGN TECHNIQUE TO MINIMISE HARMONIC DISTORTION

By N. Partridge, B.Sc. (Eng.) A.M.I.E.E.

THE nature and extent of harmonic distortion in push-pull output transformers has been examined in detail in earlier instalments. This article, the last of the series, will be devoted to the consideration of ways and means of keeping this distortion under control.

IN designing a transformer for low distortion the first step is to select a "good" magnetic material for the core. In last week's instalment reasons were given for accepting Vicor (manufactured by Magnetic and Electrical Alloys, Ltd., of Wembley) as our starting point. An oscillogram showing the current distortion produced by this alloy at a flux density of 4,680 lines per sq. cm. was reproduced in Fig. 22, but to perform detailed calculations the distortion at all densities must be known. A series of current oscillograms at various flux densities is given in Fig. 24 and the graph obtained by analysing these wave forms is shown in Fig. 25. These two illustrations correspond to Fig. 3 and Fig. 5, which give the same information about Silcor 2. The final requirement is a curve connecting inductance with flux density. Such a curve is contained in Fig. 23, but for completeness it is reproduced here in Fig. 26.

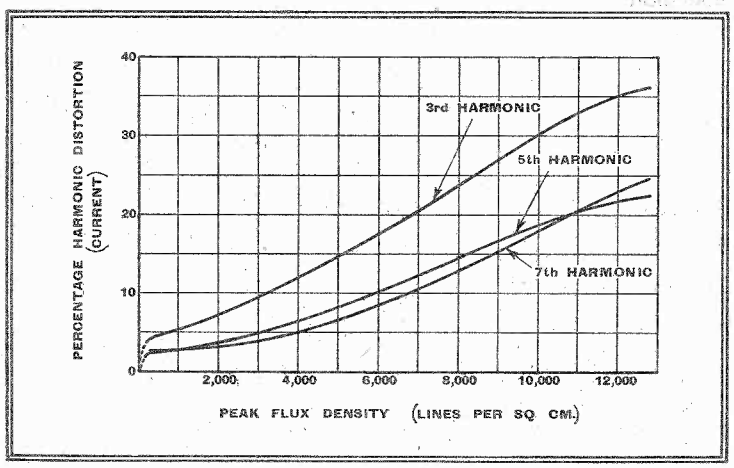


Fig. 25.—The graph obtained by plotting the result of an harmonic analysis of the wave forms of Fig. 24. The harmonics are expressed as a percentage of the fundamental.

Having fixed upon the core material, the second step is to consider how best it may be used. One could design a transformer in the conventional manner and claim an improvement by virtue of the better core. But there would still be one or two rather disconcerting criticisms. For one thing, the *intrinsic* distortion would be high. As can be seen from Fig.

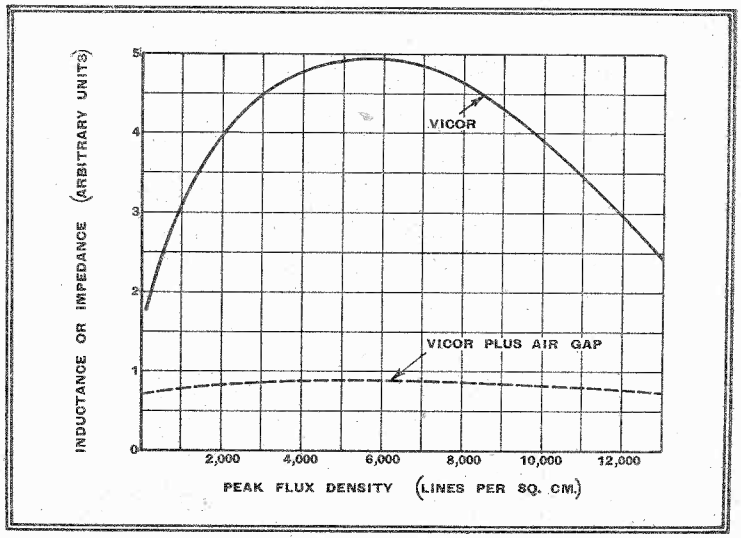


Fig. 26.—The full curve indicates the change of inductance (or impedance) with flux density in the case of a transformer having a closed magnetic circuit of Vicor. The dotted curve applies to a composite core of Vicor plus an air gap (see Table 7).

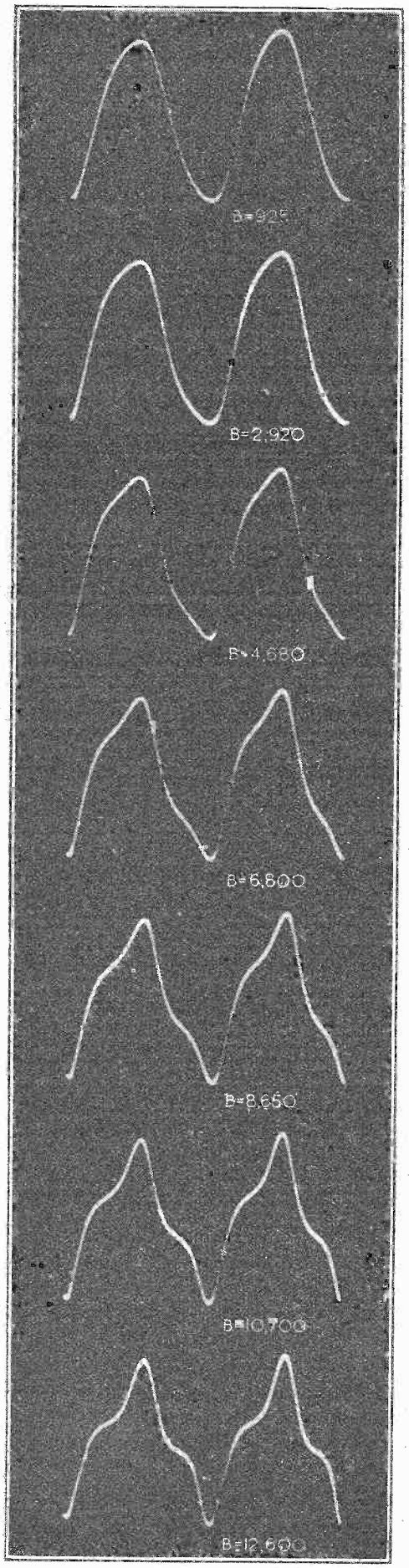


Fig. 24.—The oscillograms show how the current distortion varies with flux density in the case of Vicor. "B" is the value of the peak flux density in lines per sq. cm. The photographs should be compared with Fig. 3 (Part 1), which gave the same information about Silcor 2.

Distortion in Transformer Cores

25, appreciable distortion occurs at quite low densities and it is only the somewhat fortuitous circuit conditions $\left(\frac{R}{Z_F}\right)$ that keep the working distortion within reasonable limits. It would be more satisfying if the transformer in itself could be made distortionless apart from the external circuit. Again, a small out-of-balance between the anode currents of the two push-pull valves will be sufficient to upset all the calculations. And there is still the little matter of frequency modulation which depends upon the external circuit for correction.

There is an extremely simple device whereby most of the troubles and worries mentioned above can be substantially lessened. That is by putting a suitable air gap in the magnetic circuit. Gaps have always been used for chokes and transformers carrying DC, but as far as the author is aware, such a technique has not been deliberately used by manufacturers to reduce intrinsic distortion apart from the question of polarisation.

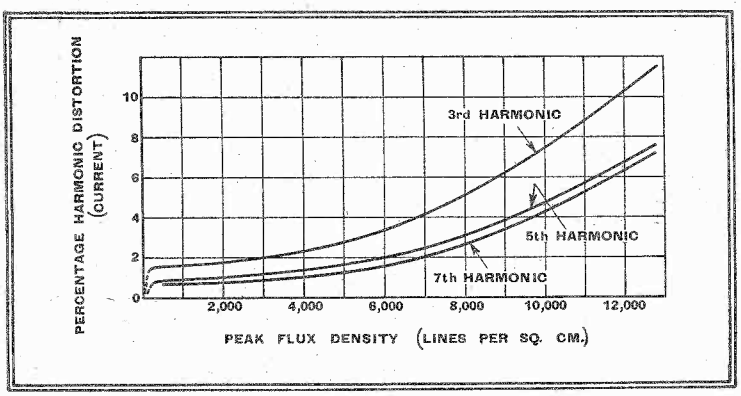


Fig. 27.—The intrinsic distortion of the core is materially reduced by an air gap. This graph should be compared with Fig. 25 which shows the distortion without a gap.

The effect of a gap can be easily understood with the aid of Fig. 26 and Table 7. Suppose a transformer, giving the relative inductances shown in the graph (Fig. 26) has a gap made in its core of a length such that the inductance at B=1,000 is reduced from 3 to, say, 0.73. These figures are, of course, purely relative, and the actual inductances may be anything, depending upon the core area and the number of turns on the primary. Since the impedance has been reduced, a greater magnetising current will flow. But the iron circuit still requires exactly the same current to magnetise it and to supply the various losses, from which it follows that the additional current must be that required to maintain the flux in the air gap. This additional current will be undistorted and will vary *directly* as the flux density.

Table 7 shows an approximate method of estimating the inductance and distortion curves for the composite core consisting of Vicor plus the air gap. Column 1 contains selected flux densities for which the relative magnetising currents taken by the Vicor are shown in column 2. These figures were obtained by testing the Vicor without a gap. The third column indicates the magnetising current required by the air gap, which is proportional to the flux density. The total current is tabulated in column 5, from which the new relative impedances can be deduced. It must be remembered that this method is only approximate because the magnetising currents for the Vicor and the air path are assumed to be in phase, and this is not strictly true.

The new impedance curve is drawn dotted in Fig. 26. The inductance has been greatly reduced by the gap but this is not necessarily important. The earlier examples have shown that any good output transformer has a far higher inductance than is strictly required for the preservation of the bass. Our new curve at least approximates to a straight line. In other words, instead of having an inductance that varies enormously with the signal voltage, we now have an inductance that remains sensibly constant. Another important advantage is that any normal out-of-balance between the anode currents will be far too small to have any effect upon the Vicor, which is protected in this respect by the gap.

Turning to the question of harmonic distortion, a change has occurred here, too. The curves in Fig. 25 give the distortion as a percentage of the fundamental. The air gap has increased the fundamental without altering the magnitude of the harmonic currents, and, therefore, these harmonics will be noticeably smaller when expressed as a percentage of the augmented fundamental. Columns 6, 7 and 8 show the revised distortion figures in the case of the particular gap chosen for the purpose of Table 7. These values have been plotted in Fig. 27.

Because the basic distortion (x) has been reduced to less than one-third of its original value it must not be assumed that

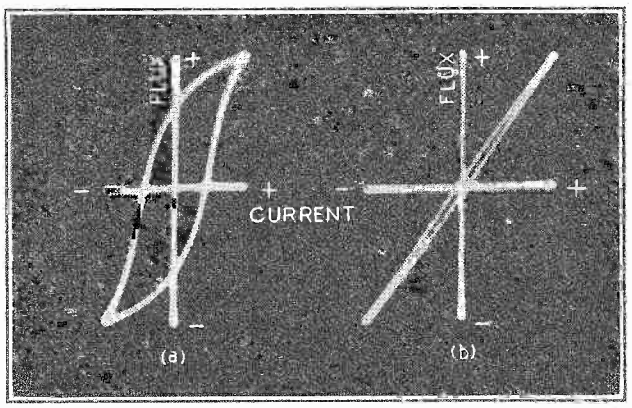


Fig. 28.—(a) shows the relationship between the instantaneous flux density and current in a closed core of Vicor. This approximates to the hysteresis loop. (b) gives the same information in the case of a gapped core. Note that the flux is almost proportional to the current.

a corresponding improvement will be found in the performance of the transformer. Actually, the working distortion has not been altered at all. Unfortunately, Z_F has been reduced just as much as x and the final result remains the same. But what we have done is to reduce the *intrinsic* distortion and make the performance of the transformer less dependent upon the external circuit. This modification is strongly reflected in the curve showing the relationship between the flux in the core and the magnetising current. Fig. 28 (a) shows this curve, which approximates to the hysteresis loop, for the ungapped transformer and Fig. 28 (b) repeats the curve for the gapped core. The latter is brought very close to the ideal, which would be a straight line.

The reader may be wondering why the gap chosen was one which reduced the inductance at B=1,000 in the ratio of 3 to 0.73. At first sight it looks as though a much larger gap would still further reduce the intrinsic distortion and make the transformer behave as though it were air cored. This reasoning is perfectly correct, but there are practical limitations to the possible magnitude of the gap. The larger the gap the lower the inductance, and hence more turns have to be wound upon the primary in order to keep the inductance up to the minimum allowable value. Increasing the turns means using finer wire

TABLE 7

Peak Flux Density	Vicor Magnetising Current	Air Gap Magnetising Current	Total Magnetising Current	Impedance of the Gapped Core	Distortion of Gapped Core (per cent.)		
					3rd Harmonic	5th Harmonic	7th Harmonic
263	4.2	7.8	12.0	71.0	—	—	—
537	7.0	15.8	22.8	75.7	—	—	—
925	10.5	27.4	37.9	79.0	1.5	0.8	0.6
2,920	22.0	86.3	108.3	87.0	1.84	0.95	0.71
4,680	33.2	138.0	171.0	88.0	2.65	1.50	1.17
6,800	48.2	201.0	249.0	88.0	3.87	2.37	1.94
8,650	69.8	255.0	325.0	86.0	5.62	3.50	3.10
10,700	107.0	317.0	424.0	82.0	8.15	5.10	4.95
12,600	168.0	373.0	541.0	75.0	11.2	7.4	6.9

Distortion in Transformer Cores

and obviously the wire gauge cannot be smaller than that which will safely carry the current. Also the DC resistance of the winding must not be permitted to reach too high a value.[1] Again, the leakage inductance must be kept within manageable proportions, and this limits the number of turns that can be employed.

With a view to showing the type of result that can be obtained with Vicor and the gap technique, a transformer was designed on a 1½in. stack of No. 4 stampings to operate with two DA30 valves in Class A push-pull. The harmonic distortion given by this transformer at 50 c/s is indicated in Fig. 29. This should be compared with Fig. 12, which gives similar data relating to a well-designed transformer with a core of Silcor 2. Note that the Partridge Distortion Index[2] for the latter was 0.5 per cent., whereas the gapped Vicor reduces this figure to 0.2 per cent.

All the examples so far have employed the No. 4 stamping. The reason for this is that it is a very popular stamping and serves for the purpose of illustration as well as any other. But the No. 4 laminations are not necessarily the most suitable ones for audio-frequency transformer design. Greater iron section would be an advantage and so would be a slightly restricted window space. The former makes it possible to work at a lower flux density and the latter aids in the reduction of leakage inductance. The No. 56 stamping (Magnetic & Electrical Alloys, Ltd.) is a very good one. The dimensions of both the No. 4 and the No. 56 stampings are shown side by side in Fig. 30 for comparison.

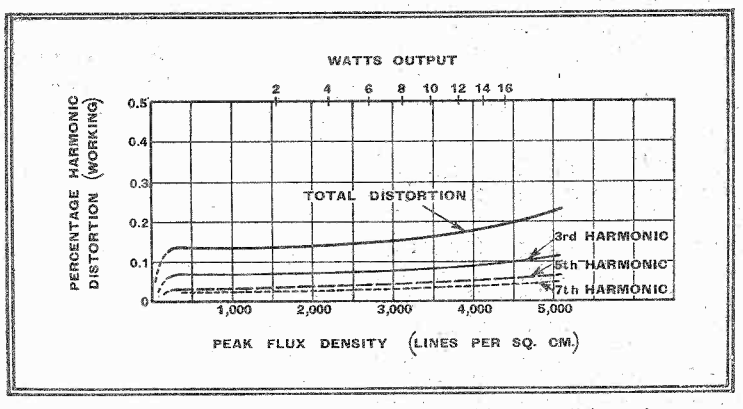


Fig. 29.—The distortion obtained under working conditions from an output transformer using a gapped Vicor magnetic circuit. The Partridge Distortion Index is only 0.2 per cent., which is very low considering the size of the component.

If expense is no great objection, the size of the transformer can be increased and, theoretically, the iron distortion can be reduced to as low a value as one wishes. A large core section with ample window space will permit the winding of a primary with a very high inductance and a large air gap will be possible without jeopardising the bass response. The intrinsic distortion will, by this means, be made extremely low, and, no matter what the external circuit conditions, such a transformer would not produce harmonic distortion. But theory and practice do not collaborate harmoniously in this respect. The larger the transformer the more difficult it becomes to preserve the high-frequency response. Also, owing to the shape of the distortion curves in Fig. 5 and Fig. 25, it requires a very considerable reduction in the flux density to bring about any worth while improvement in the transformer distortion.

The design of a good output transformer is beset with conflicting desiderata. The final solution must be a compromise and the best design is that which gives a well-considered balance of evils. The unpleasantness resulting from the loss of top, the iron distortion, etc., should all be approximately equal as judged by the ear. A superb frequency response is of no avail if harmonic distortion is high; a distortionless core is wasted if all the high frequencies are attenuated. To achieve such a balance requires not only technical knowledge but a wide practical experience as well.

Conclusion

Looking back upon the information brought to light by these investigations, perhaps the most striking thing is the fact that the articles should have been written at all so late in the development of electro-acoustics. Amplifier technique has been subjected to the most rigorous analysis in the cause of fidelity, and has long since reached a very high standard. Speech transformers were used in communication work years before radio was invented and yet, apart from vague apprehensions, nobody seems to have seriously worried very much about the extent of the harmonic distortion they produce.

As far as so-called commercial reproduction goes, iron distortion is not very important. It occurs only at low frequencies, and if true bass is not catered for in the amplifier, then it can do no harm in the transformer. But the subject must be studied with the utmost seriousness by those seeking really high-quality reproduction. Distortion at low frequencies is more dangerous than perhaps the reader has, as yet, appreciated. The characteristics of the ear are such that the sensitivity increases very rapidly from the lowest audible notes up to around 500 or 600 c/s. The effect of this is that *2 per cent. seventh harmonic contained in a 50 c/s note can sound as loud as the fundamental itself.*

This statement is truly amazing, but a few figures will prove its validity. A distortion of 2 per cent. means that the voltage of the seventh harmonic (350 c/s) is 2 per cent. of that of the fundamental (50 c/s). In other words, the seventh harmonic is 34 db below the level of the fundamental. But at a loudness level of 20 db the sensitivity of the ear increases by approximately 34 db between 50 c/s and 350 c/s. Hence the harmonic will sound to the ear as though it were 100 per cent.! One is, of course, assuming that the sensitivity of the loud speaker is the same at both frequencies. If it happens to be greater at 350 c.p.s., then the position is even worse.

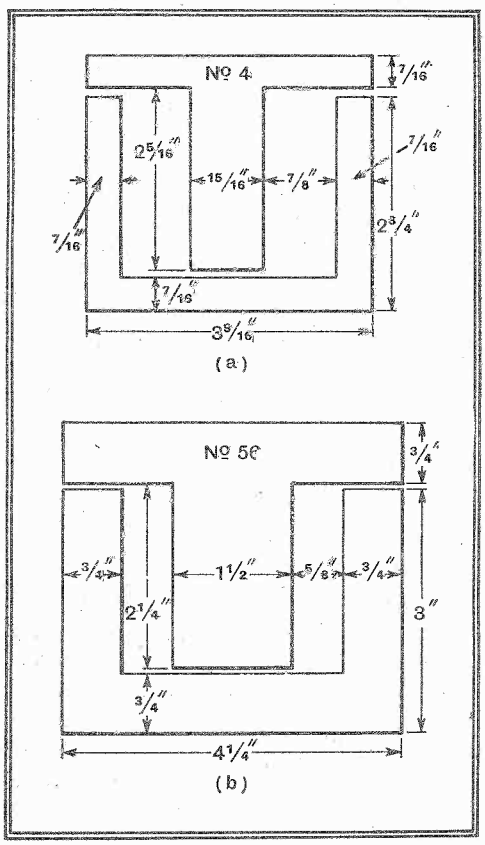


Fig. 30.—All the examples in this series have used the No. 4 stamping but this is not necessarily the best one. The No. 56 presents certain advantages mentioned in the text. The numbers are those of Messrs. Magnetic and Electrical Alloys, Ltd.

Obviously, something must be done about iron distortion. A transformer response curve is only a snare and a delusion when examined alone. The response is important up to a point, but it *must* be considered in conjunction with the transformer harmonic distortion. To do this a simple and standardised method of expressing the distortion is required, and the Partridge Distortion Index is put forward as a tentative suggestion. It may be defined as the arithmetical sum (*not* RMS) of the percentages of the third, fifth, and seventh harmonics produced under working conditions at 50 c/s when the transformer is delivering its full rated output into a resistive load of value equal to the nominal secondary load. By substituting a resistance in series with the primary to take the place of the valve AC resistance, the test can be taken using the 50 c/s mains as the source of power. This scheme eliminates all possibility of valve distortion masking the transformer distortion, and avoids the risk of polarisation.

[1] See "Output Transformers—The Effect of Resistance," *Wireless World*, January 12th, 1939.

[2] See Part II, June 29th issue and also last paragraph of this article.

NEWS OF THE WEEK

SUPPRESSING CAR IGNITION INTERFERENCE

B.B.C. and Post Office Moves

THE B.B.C.'s scheme, announced last week, to encourage members of its staff to fit suppressors to their cars, as the Corporation has already done to its own vehicles in the interests of interference-free reception on the short waves, has brought to light the fact that the War Office and Air Ministry already suppress every internal-combustion engine under their control.

At the recent television tea party, one viewer asserted that the biggest offender, as far as he was concerned, was the Post Office mail van which frequented his area. The reason for this apparent inconsistency by the champions of interference-free reception is that the mail vans are not the property of the G.P.O., but are supplied under contract.

It is learned that the engineering department has already fitted suppressors to more than 100 of its own vehicles which operate within the fifty miles radius of Alexandra Palace and that a committee is now sitting to consider the question of fitting suppressors to all Post Office vans plying within this area. It will, of course, be realised that whilst there are somewhere in the region of two million motor vehicles in this area, the Post Office fleet only runs into four figures. Even so, the cost of such a campaign, which presumably would have to be financed by the Post Office, would be considerable.

Not Television Only

It will be realised from the foregoing that the Post Office is mainly concerned with interference with television reception, which, of course, is not the only field of wireless activity which is affected. This fact is stressed by a correspondent, Mr. E. A. Watson, in the July 4th issue of *The Motor*, who, commenting on the criticism levelled at the B.S.I. specification, which was referred to in our issue of May 25th, writes: "The proposal to introduce suppression on motor vehicles has not been made in the interests of television only. There are more important interests at stake, such as Post Office short-wave links, blind-landing systems and special means of communication. The television user will certainly benefit, but there was no suggestion of the motor trade yielding to the television interests."

"All the tests," he states, "carried out by the Automobile Research Committee of the Institute of Automobile Engineers, and by our own laboratories, together with experience gathered from the trade, have indicated that suppression to the standard proposed, viz., 50 microvolts per metre at a distance of ten yards, will not involve any serious cost or inconvenience, and will not necessitate screening, which, it is admitted, would introduce difficulties."

Opposition to Compulsion

The following editorial note is appended to Mr. Watson's letter: "Mr. Watson, of the technical staff of Joseph Lucas, Ltd., was a member of the Committee. *The Motor* will strenuously oppose any proposal for making the fitting of suppressors on motor-vehicle engines compulsory."

Another Voluntary Effort

The General Electric Company has arranged for television suppressor equipment to be fitted on all its vehicles operating within the television area. The same facilities have been made available, free of charge, to members of the staff for their private cars.

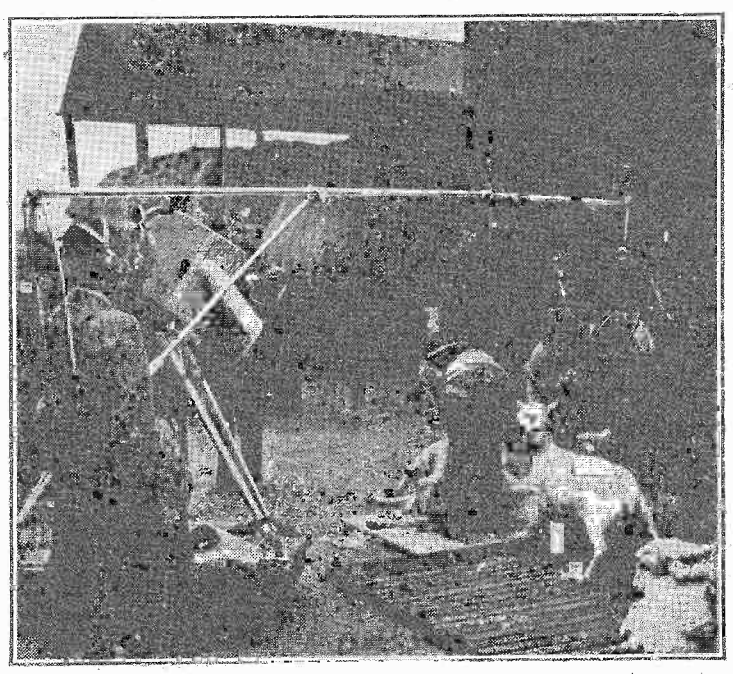
RADIO DEVELOPMENT IN THE WEST

Land's End Station

IN reply to an enquiry by Mr. Alec Beechman, M.P. for St. Ives, Cornwall, the Assistant Postmaster-General, Mr. William Mabane, stated that the Post Office Land's End wireless station is to be entirely reconstructed.

It is stated in *The Western Morning News* that the reason prompting Mr. Beechman's enquiry about radio-telephone ship-to-shore facilities around the western coast was that when on a recent visit to the Scilly Isles he found that the R.M.S. *Scillonian's* transmitter had to be linked with the Post Office station at Portpatrick, Scotland, in order to communicate with Cornish telephone subscribers.

Portpatrick radio station, which together with those at Wick and Grimsby were taken over from the Admiralty by the Post Office after the Great War, has been equipped primarily for experimental purposes in order to develop improved linking apparatus. Equipment similar to that at Portpatrick has been ordered for the station at Niton, Isle of Wight, and it is hoped to open a link service at the end of this year. The reconstruction of the Land's End station will include the installation of link equipment.



TO REPLACE the unwieldy bamboo pole used for television O.B.s, the B.B.C. now employs the metal microphone boom shown above strapped to an engineer's back during a recent O.B. from Bull Cross farm, Waltham Cross. For the purpose of portability the microphone has been fitted with a lighter case.

ANOTHER HIGH-POWER GERMAN STATION

A Significant Silence

AT Oldenburg, which is near the German-Dutch frontier, approximately 30 miles from the North Sea, the German authorities have completed a high-power broadcasting station. This station, the first mention of which was made only a few days ago, will be opened in the early autumn, and will operate on Munich's wavelength 405.4 metres (740 kc/s).

There will, it is understood, be another "general post" in wavelength distribution when this station comes on the air. Munich will use Leipzig's present wavelength of 382.2 metres (785 kc/s), while the latter will use the present Graz-Klagenfurt frequency of 886 kc/s (338.6 metres).

Oldenburg has been enjoying good reception from a local station in Bremen, and there seems no reason for this 100-kW station in this small corner of Germany, unless its transmissions are intended for listeners in Great Britain and Eire.

It is significant that there was no mention of the new station at the Montreux wavelength conference.

NEWS IN POLISH

A Plea from Poland

WITH the introduction last Wednesday of a news bulletin in Polish from Königsberg and Breslau, German stations are now transmitting news in eight languages — English, Dutch, Afrikaans, Arabic, Spanish, Portuguese, Ruthenian and Polish. The last is broadcast nightly from 8.15 to 8.35, and from 10.15 to 10.30 B.S.T.

In this connection it is interesting to record what a Polish correspondent wrote in *The Times* of July 5th regarding Polish broadcasts from England.

He says: "We have read of the continued expansion of the B.B.C. foreign news department, and I understand news bulletins are now given from London in six or seven languages. Unfortunately, as it appears to many here, this extension still follows a curious and perhaps a dangerously negligent course; whereas these bulletins are mainly directed at listeners in either openly hostile or potentially inimical countries —an admirable scheme in itself —Great Britain seems to be making comparatively little effort to cater similarly for her

News of the Week

acknowledged friends and potential allies in Europe.

"Thus we in Poland are still eagerly hoping for news bulletins in Polish to which we can turn daily for accurate information. A further point, by no means unimportant, is that, failing direct broadcasts to Czech and Slovak communities, Polish broadcasts from London are easily understood by these kindred Slavs and would provide a means of counteracting anti-British propaganda in the former Czech State."

LATIN AMERICAN NEWS

Extended B.B.C. Services

SPEAKING in Spanish, Mr. F. W. Ogilvie, B.B.C. Director-General, in the presence of the diplomatic representatives of Latin American nations, inaugurated, at 1.15 a.m. last Tuesday, the extended service of programmes broadcast from the Empire station at Daventry for Latin America. He recalled that when, on March 14th last year, the transmission of news bulletins in Spanish and Portuguese for Latin America was commenced, the B.B.C. did not have the technical facilities at its disposal, due to the exigencies of other services, to offer a satisfactory service.

Two new transmitters having been installed, the B.B.C. is now able to offer a three-hour transmission every night exclusively for Latin America.

The extended programmes commence at 11.20 p.m. and terminate at 2.15 a.m. G.M.T. daily, with news bulletins in Spanish at 11.30 p.m. and 2 a.m., and in Portuguese at midnight.

By radiating the programmes from GSO in the 19-metre band and GSC in the 31-metre band, the whole of South and Central America should be covered.

ABBREVIATED MORSE NUMERALS

THE large amount of space devoted by the general and specialist Press to reviews of our recently published sixpenny booklet, "Learning Morse," proves that the little publication has appeared at an opportune moment. One of the reviewers, writing with an obvious knowledge of the subject that is unusual to find in a lay periodical, suggests that in the abbreviated numerals section the figure 5 should be represented by one dot and not by five dots. Though admitting that the single dot abbreviation is unofficially used by operators, we would point out that the code as printed is that officially sanctioned by International agreement. As already pointed out, alterations put into force by the Cairo Conference are included.

TELEVISION AND THE CINEMA

Film Boycott

THE fact that the B.B.C. is unable to obtain films, except certain news reels, for television purposes was forcefully stressed by Mr. Gerald Cock, Director of Television, at a recent conference. This is amply borne out by a statement made by Mr. S. Eckman, managing director of Metro-Goldwyn-Mayer in this country. He said: "I am authorised to announce on behalf of my company that we shall not permit the use of any of our films, whether they be features, shorts or trailers, new or old, for television purposes.

"I am also of the opinion that exhibitors should not rediffuse public events in their cinemas. Though M.-G.-M. operate only the Empire and Ritz theatres, it is not intended to install a large screen and thus help to popularise a form of entertainment which will only assist in building up competition."

The hostility, so far as large-screen television is concerned, is not shared by Odeon and Gaumont British, who have already equipped a number of London theatres with projection television apparatus.

SCANDINAVIAN AMATEURS

THE Norwegian amateur organisation N.R.R.L. (Norsk Radio Relae Liga) has completed its central transmitter LA1C at Notodden. This station, which comprises two complete transmitters and stand-by equipment, transmits under the heading of QST-LA news of interest to hams on Mondays at 5.30 p.m. G.M.T. on 3,590.5 kc/s and at 5.45 p.m. on 7,181 kc/s, and on Tuesdays at 3.45 p.m. on 3,631 kc/s.

The N.R.R.L., which has done much to reduce the cost of amateur transmitting, including the reduction of the Norwegian transmitting licence fee from 30 to 10 kroner annually, recently announced the introduction, as from July 1st, of an arrangement whereby all QSL cards from members to amateurs abroad will be distributed free of charge.

The first 56-Mc/s two-way QSO between Denmark and Sweden was established recently by OZ7T and SM7UC, who thus become joint winners of a special 56-Mc/s cup, awarded by the Pan-Scandinavian organisation N.R.A.U.

TELEVISION SHOW PLANS

WE understand that the B.B.C. mobile television units well be in daily operation during this year's Olympia radio show. One, installed at the Exhibition, will transmit several stage shows a day for radiation from Alexandra Palace, and also provide closed circuit performances for demonstration on the stands.

The other mobile unit will operate, as last year, at the Zoo.

The two television studios at Alexandra Palace are to be overhauled during the Radio Show.

FROM ALL QUARTERS

New Sets for Old

TWENTY per cent. of the purchase price of a new receiver will be allowed on all old receivers taken in part exchange by radio dealers in Norway from August 1st, when the new agreement adopted by the Norwegian association of manufacturers (Radioleverandorenes Landsforbund) comes into operation. The cost of this arrangement will be equally borne by the manufacturers and distributors.

Advertising Time

THE National Association of Broadcasters has drawn up a code of ethics for broadcasters which is to be submitted to its national convention in Atlantic City this month. This, among many other things specifies the maximum advertising time in broadcast programmes. During the day this would be 3¼, 4½ and 9 minutes for 15-minute, half-hour and hour programmes respectively, while the equivalent evening limits would be 2½, 3 and 6 minutes.

Schwarzenburg Transmitter Fire

THE recently completed 25-kW short-wave station of the Swiss Broadcasting Company at Schwarzenburg, was destroyed by fire last Wednesday. This station, which had so far been testing on 9.535, 11.865, 15.305 and 17.784 Mc/s, was scheduled to begin a regular service to North and South America, Africa and Asia early this month.

English News from France

A NEWS bulletin in English was introduced by French stations last Thursday. This is broadcast nightly between 9.30 and 9.45 B.S.T. from Lille (P.T.T.), 247.3 metres; Radio Normandie, 274 metres; Radio Cité (Paris), 280.9 metres; Radio 37 (Paris), 360.6 metres; and Radio Paris, 1,648 metres. It will be noticed that the transmitters include Government and privately owned stations. Other French stations are broadcasting at the same time news in German, Italian, Spanish, Serbo-Croat and Arabic.

Indian Wireless Training

THE authorities of the Dacca University in Bengal are to establish a Lectureship in Wireless in their Physics Department.

Shanghai-Rome Radio-Telephone

A DIRECT radio-telephone service between Shanghai and Rome has been inaugurated. The station in China is at Chenju, a few miles from Shanghai. This station, which was destroyed by the retreating Chinese troops some months ago, has been restored by the Central China Electric Communication Company, which is a Sino-Japanese concern.

A Branly Stamp ?

A SECTION of the French Press is agitating for the issue of a stamp to "render the homage due to Edouard Branly, the sole survivor of the brilliant 'team' who discovered wireless half a century ago, before this illustrious grand old man of radio receives the honour posthumously."

A. C. Cossor, Limited

AT the first ordinary general meeting of A. C. Cossor, Limited, which was held last Thursday, the chairman, Sir George Godfrey, said that since the new company was formed, February 24th, 1938, it had made an excellent showing, the net profit being £55,889. Mr. J. H. Thomas, managing director, said that the market for radio receivers now appeared to be more stabilised, while that for televisors was steadily on the increase.

Tynemouth's Relay Service

SINCE the note published in last week's issue was written, the Tynemouth Town Council has agreed, by 17 votes to 4 to permit the introduction of a wireless relay system in the borough. The reason given for this reversal of the recommendation of the Town Improvement Committee being that the rediffusion system had been "clothed by the P.M.G. in the attractive uniform of national defence."

Spanish Broadcasting

IN the reconstruction of the broadcasting services of Spain, it has been planned to erect a 120-kW medium-wave transmitter at Madrid and a 45-kW short-wave station at Seville. The latter, which is being built by German contractors, will be constructed for transmissions to America.

Historic Landmark Disappears

ONE of the most historic wireless masts in the country is now being dismantled. The 187ft. tubular steel mast, which was designed by Mr. Andrew Grey, a former Marconi Chief Engineer, was the first of its kind to be used. Built 30 years ago, at the first Marconi's Wireless Telegraph Company's works in Hall Street, Chelmsford, it is now obsolete as the Marconi research station has been removed to Great Baddow, a few miles from Chelmsford.

Indian Village Sets

THE Research Department of the All-India Radio has evolved a superheterodyne village receiver. The set combines a time switch which has already been proved successful.

No Relays in Eastbourne

THE Eastbourne General Purposes Committee has refused an application for permission to operate a wireless relay service in the town.

Magnetic Television Receiver

Part III.—VF AMPLIFIER, TIME BASE AND POWER PACK

By W. T. COCKING

IN this article the discussion of the Magnetic Television Receiver is continued. The vision-frequency amplifier is dealt with and also the DC restoration and sync separation circuits. The time-base and power supply are treated as well.

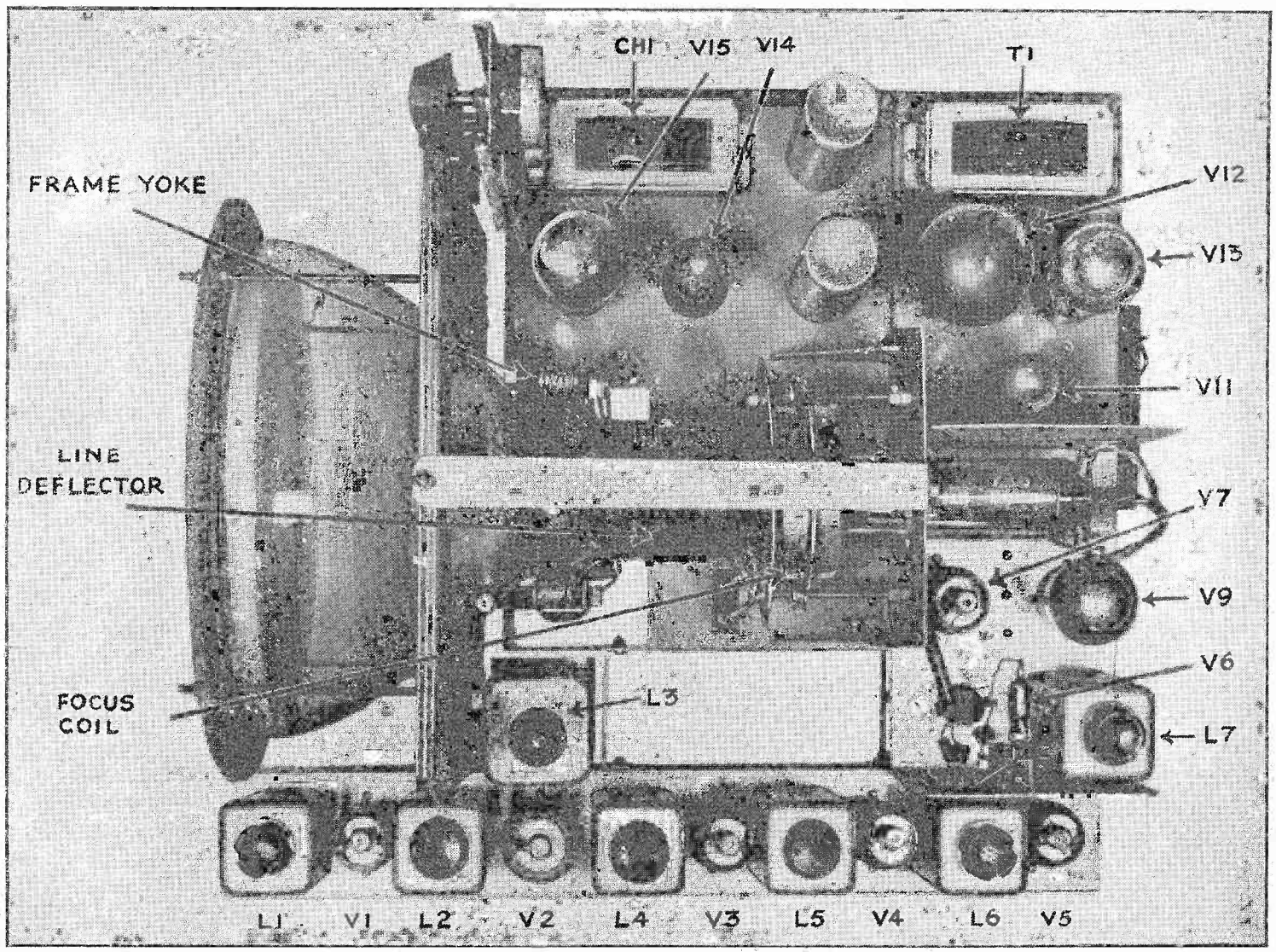
HAVING discussed in Part II the RF, FC, and IF detector stages, we now come to the vision-frequency amplifier. This is an RF pentode fed directly from the detector.

The output of the detector is in the negative sense; that is, the signal voltage changes always take place in a negative direction from the no-signal value, which is very nearly zero. As this signal is applied straight to the VF grid, this valve must be biased close to the grid-current point in the absence of a signal. The signals then always drive the grid negative from this point, and the maximum length of characteristic is obtained.

The valve used is an SP41 with a bias resistance of 37.5 ohms, obtained by using a 50-ohm resistance R26 in parallel with a 150-ohm resistance R25. A coupling resistance R27 of 3,500 ohms is used in the anode circuit, together with a correcting coil L10 of 144.5 μh. Like L8, this is really a superheterodyne oscillator coil, of which only one winding is used; it is the Wearite PO7. The resistance and coil, together with the stray capacities, constitute an impedance which is substantially constant up to about 2.5 Mc/s, and the frequency response is consequently very even up to this frequency.

The output is taken from the anode of this valve, and it is here that the circuit becomes rather unusual and, some may think, uneconomical. Certainly, more valves are used than are necessary to obtain a picture of equally good quality, but they are used to remove any risk of damage to the CR tube and to obtain very good sync separation.

The arrangement used has already been



The general layout of the receiver, time-base, tube, and focusing and deflecting coils is clearly shown in this photograph. The tube is supported at the front by being clamped between a wooden ring and board; the wood is edged with rubber where it contacts with the tube.

Magnetic Television Receiver—

described in *The Wireless World*,[1] and differs greatly from normal commercial practice. The usual course would be to join the tube grid directly to the anode of V7 and to feed the sync separator from a resistance in the cathode circuit of V7, thus saving V8 and V9.

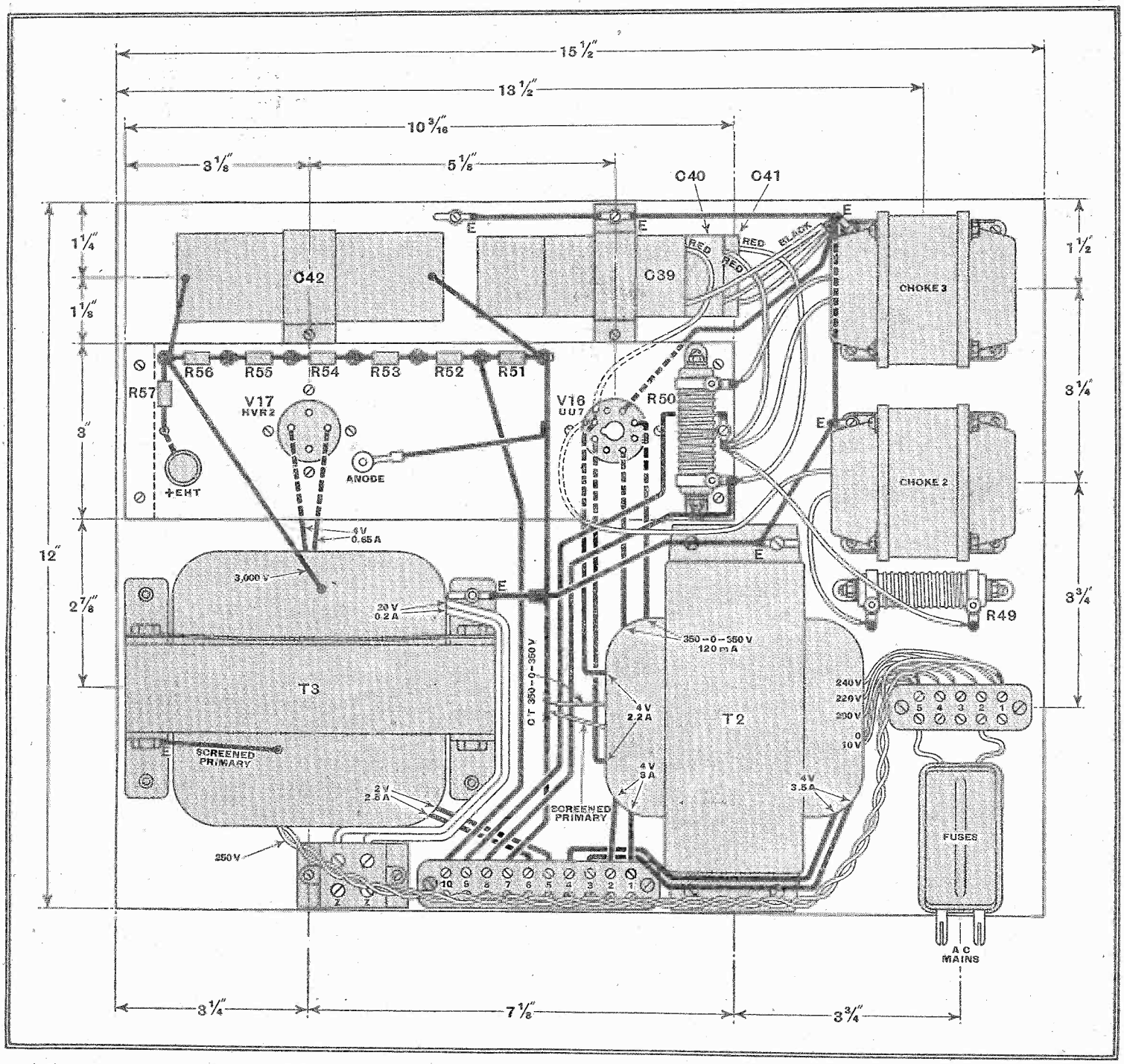
The disadvantages of this are an increase in the input capacity of V7, a rather small signal input to V10, and, most important, a risk of damage to the CR tube. This arises because with the tube grid connected to the anode of V7, it is something like 100 volts positive with respect to chassis. This must be offset by an equal additional grid bias on the tube. Now if V7 fails, the grid of the tube is carried straight up to +HT, and will be up to 150 volts more positive than it should be. There is also risk if V7 is in order, for switching on and off may cause the tube grid to be carried positive, since the various HT supplies and valve heaters take varying times to come into operation and to die away. This can, of course, be overcome by using special interlinked switches, and this is done in some receivers.

Such safety measures are usually troublesome in that they need non-standard components, and some, in particular, are ones which are quite unsuitable for use in experimental equipment. It will thus be seen that the use of a directly-connected tube causes less saving than the cost of two valves and a few resistances, for more complicated safety devices are necessary to protect the tube.

It is felt, therefore, that in this receiver it is better to adopt a circuit arrangement in which these troubles are inherently absent. In the circuit shown no more than a brief positive pulse can be applied to the tube grid through the charging of a condenser.

The tube requires an input in which the picture signal changes are in a positive direction and the sync pulses negative, while the time-base requires the sync pulses to be negative. The time-base cannot be fed directly in parallel with the tube, however, because the picture signal must first be removed. This is done by the sync separator V10 and it also reverses the phase of the signal, so that the sync pulses in its input must be in the positive direction. The tube and sync

[1] *The Wireless World*, Feb. 23rd, 1939.



This diagram shows full details of the construction and wiring of the power unit. A plywood base is used, and so care should be taken to earth the frames of transformers and chokes.

Magnetic Television Receiver—

separator thus require inputs in opposite phase.

The VF stage is accordingly followed by a phase-splitter V9, which is very similar to the arrangement often used in push-pull AF amplifiers. The usual RC coupling is used from the VF stage with a condenser C24 of 0.1 μF and a grid leak R28 of 1 MΩ. A diode V8 is connected across R28 to give DC restoration, since the direct current component of the signal is lost in the coupling, and it is essential if the mean illumination of the picture is to be reproduced correctly at all times and also for proper sync separation.

The diode passes current on the tips of the sync pulses and maintains a charge on C24, which is a good approximation to the missing DC component.

The signal applied to V9 and developed across R28 is always positive with respect to chassis and may reach a peak value of 30-40 volts. The following valve must handle this input and give one output of the same order and in the same phase for the tube, and another output in the opposite phase and, preferably, of greater magnitude for the sync separator. It is obvious also that the no-signal bias should be near anode current cut-off.

A triode with a moderately large resistance in its cathode circuit and a larger one in its anode circuit meets these conditions. Actually a 354-V valve is used with a 6,000-ohm cathode resistance R30 and a 15,000-ohm anode resistance R29. With no-signal the voltage developed across R30 is sufficient to bring the grid voltage towards the anode current cut-off point.

The positive signal voltage excursions increase the anode current and hence the voltage-drops across R29 and R30. The anode voltage falls and the cathode voltage rises. The output at the cathode is taken directly to the tube, and is slightly less in magnitude than the input to V9 because of the negative feed-back along R30. The effective output impedance of V9 on the cathode side is very low on account of the negative feed-back, consequently a good frequency response is secured with a reasonable value for R30, and also it is quite possible to use a fairly long screened lead for the grid connection to the tube.

In the present case no advantage is taken of this aspect of the circuit, for the layout of components is such that a very short grid lead is secured. It should be noted that the direct connection of the tube grid to valve cathode is not attended by the same disadvantages as its connection to an anode. Voltage changes caused by valve failure or by switching now drive the tube grid negatively and do no harm.

As R29 is greater than R30, the output at the anode is greater than that at the cathode in the ratio of the resistances, and this is applied through C25 and R31 to the sync separator V10. The DC component is again lost in this coupling, but owing to the phase of the signal V10 can restore it without the need for an extra diode. It is only necessary to operate V10 without grid bias, and the grid-cathode path will act as a DC restoring diode.

The signal voltages drive this valve grid negatively, and the screen voltage is adjusted so that anode current cut-off occurs at a few volts negative. The characteristic is then swept over only by the sync pulses, and the picture signal itself always falls beyond anode current cut-off.

One component that has not yet been mentioned is C23, shunting the cathode bias resistance of the VF stage. The stage is designed to give a flat response with this resistance unshunted; there is then a small amount of negative feed-back. Using a small capacity for C23 results in the gradual removal of this feed-back at high frequencies, with the result that the frequency response rises also. This proves advantageous in correcting in some degree for the falling characteristic of the RF and IF circuits. Only a small degree of correction is possible in television if phase distortion is to be kept low, but the inclusion of C23 does appreciably improve the picture definition.

Turning now to the time-base, two saw-tooth oscillators are included for generating the line and frame scanning currents. These valves are V12 and V15

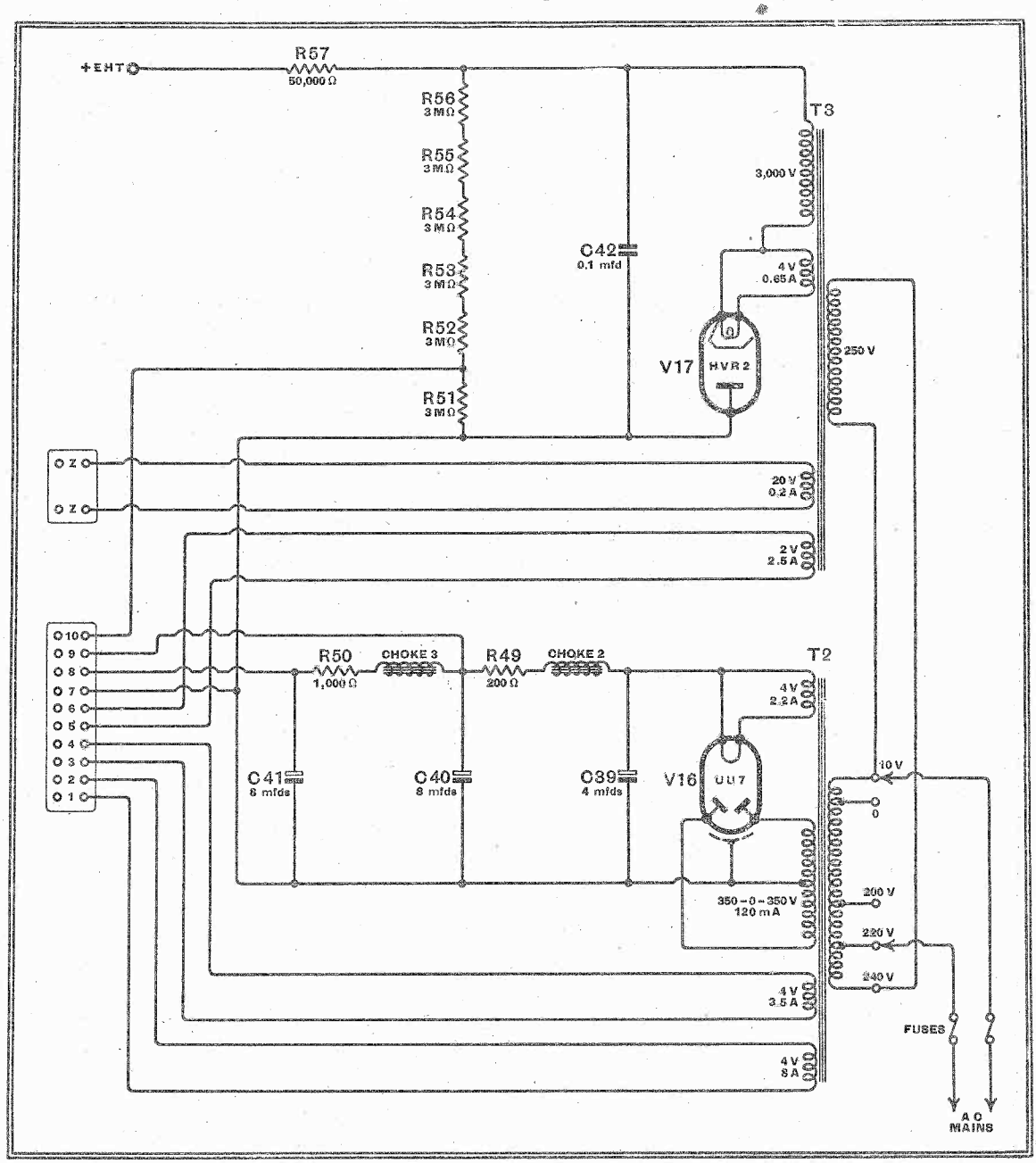


Fig. 2.—This diagram shows the circuit of the power unit. The rectifier V16 supplies HT for everything except the tube, the supply for which comes from the high-voltage rectifier V17.

respectively. The arrangement adopted here is the one recommended by Baird Television, Ltd., the makers of the tube, from whom the necessary coils can be obtained. Its great advantage is its economy, for the whole time-base consumes only about 40 mA at 330 volts, as compared with about 120 mA for the conventional circuits with saw-tooth voltage generators and pentode amplifiers.

In the case of the frame oscillator, giving the vertical deflection, the oscillator coils are also the deflector coils. The coils L14, L15, L16 and L17 are wound on a common iron core, the ends of which are extended upwards and provided with pole pieces between which the neck of the tube is placed. L14 and L15 are the two windings of a reaction-coil oscillator, and L16 and L17 are provided merely to ensure a negligible DC magnetisation of the core.

The Frame Oscillator

At the start of the scan stroke the grid of V15 is at about zero voltage, or only a small amount negative, and the anode potential is fairly high. As a result the anode current rises, but not instantaneously as in a resistive circuit; the current takes time to rise. The changing current through L15 produces a back EMF in it, which acts to reduce the anode voltage, and at the same time it induces an EMF in the grid coil L14 which tends to drive the grid positively. Grid and anode current flow through L14 and L15 respectively and oppose one another in their effect on the core. The net result is a substantially linear rise in the magnetic field with time.

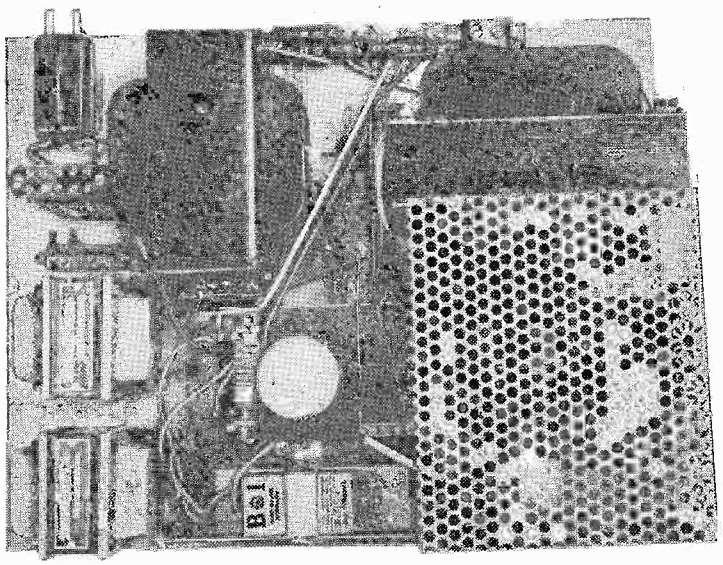
The feed-back action in the valve is, of course, regenerative in that the positive induced voltage in L14 tends to increase the anode current and drive the grid still more positive. After a time, however, the rate of change of anode current begins to fall off, with the result that the grid becomes less positive and the rate of change of current falls off still more rapidly.

When this happens the back EMF across the anode coil changes sign to try to maintain the anode current and the EMF induced in the grid coil also changes sign and drives the grid negative. The grid circuit wins in this battle and the valve is very rapidly driven beyond anode current cut-off. The anode current then becomes zero and the magnetic field collapses.

Actually, on the fly-back the grid may be driven about 2,000 volts negative and the anode about the same amount positive. V15 operates with heavy grid and anode peak currents at low voltages during the scan stroke, and very high grid and anode peak voltages, but zero current, during the fly-back. The valve used must consequently be able to withstand these severe conditions and the coil makers recommend the Mazda AC/P. On account of the high voltage the condenser C33, which shunts L14, must be of 2,000 volts rating.

Although the currents through L14 and L15 are in opposition, their magnetic effects on the core do not balance, and the grid coil predominates. The effect is to deflect the picture off the screen of the tube, and to avoid this it is necessary to balance out the effect of the predominating grid circuit. This is done by means of L16 and L17, which are wound on the opposite side limbs of the core. The mean anode current flows through these and gives a total core magnetisation which is zero and so a central picture.

The saw-tooth current is not permitted to flow through L16 and L17, but flows through C36. In order to prevent these coils from loading the others the choke Ch1 is included in series with them and has an inductance of the order of 100 H.

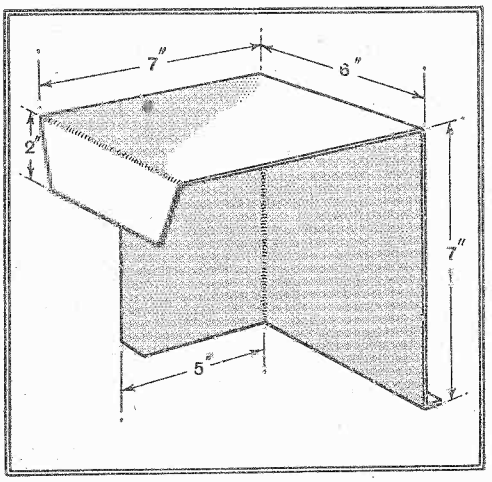


A view of the power unit, showing the protecting screen over the high-voltage equipment.

Two controls are provided. R45 allows the anode voltage to be varied and consequently the picture height, while R43 controls the grid bias and consequently the saw-tooth frequency.

A negative sync pulse is required on the grid, but it cannot be applied directly, because the impedance of the coupling circuits would shunt L14 and seriously lengthen the fly-back time. The pulse is, therefore, applied through the diode V14 from the RC coupling C32 R41. The pulse drives the diode cathode negative so that it becomes conductive and allows the pulse to reach the grid of V15. The fly-back voltage across L14, however, drives the diode anode negative and thus renders it non-conductive.

The line oscillator V12 is essentially the same as the frame, but the oscillator coils are separate from the deflector coils. The mean current no longer affects the position of the picture, and the balancing coils of the frame circuit are unnecessary. A minor point of difference is that the bias voltage is developed by grid current alone through R37 and R38, instead of by both grid and anode currents. L11 and L12 are iron-cored and L11 acts also as an auto-transformer to feed the deflecting coils through C29. These coils are mounted round the neck of the tube and have an iron shroud which has projecting tags for screwing to the frame yoke.



This diagram gives the dimensions of the protecting screen, which is made of 20-gauge perforated zinc.

The valve used here is the Cossor 41MP, and the peak voltages developed on it are certainly not less than those on the frame oscillator, so that high insulation is needed everywhere. The sync pulses are applied as in the frame circuit through a diode V11, and for the same reason.

Anode circuit decoupling is provided by R39 and C31. The resistance is not made variable for a control of picture width, since it has been adjusted to give the correct width with the tube anode voltage used. It is only necessary to vary the picture height by R45 in order to obtain the correct picture ratio. If for any reason a change of picture width is desired R39 can be altered, a lower resistance giving a wider picture and vice versa. With an HT supply of 330 volts R39 should not be less than 500 ohms, or the amplitude may become excessive and the insulation of transformer or valve may break down. Similarly, R44 in the frame circuit should not be reduced below 20,000 ohms.

The Damping Valve

The diode V13 is provided to damp out oscillation on the fly-back. Without this valve the resonant circuit, consisting of L12 with the stray capacities, is kicked into oscillation, and the normal large rise in anode potential is followed by a fall of nearly equal magnitude, then another rise and so on. V13 is non-conductive as long as the anode of V12 is positive with respect to its own cathode, but becomes conductive when the anode of V13 swings

negative. It does this on the negative half-cycles of the oscillation, and these are consequently heavily damped.

As the valve has to withstand high voltages it must be carefully chosen, and the Mullard UR1C is used. This is an AC/DC rectifier with a 20-volt heater. A separate heater winding is in any case necessary for this valve on account of the high peak voltage on the cathode, so that this unusual voltage rating does not matter. The heater winding and its wiring should be insulated for some 2,000 volts.

In the feed circuit from the sync separator to the time-base R34 and C27 are not really decoupling components, although they look like it, and actually act as such at line frequency. They are really the impedance across which the frame sync pulses are developed, and form an integrating circuit.

The time-constant is rather larger than usual, but was chosen experimentally and found to give the best results. With careful setting of the frame frequency control quite good interlacing can be obtained, but it is rather more difficult to secure than with some other forms of time-base, because it is harder to avoid coupling between the two oscillators.

This coupling occurs in two places, through the anode-cathode capacity of V11 and through the magnetic circuit directly between L13 and the frame deflector assembly. The latter is the more important and it seems impracticable completely to eliminate it.

The focus coil L18 is in series with the HT supply to the time-base, and the current through it can be adjusted precisely by R47.

LIST OF PARTS

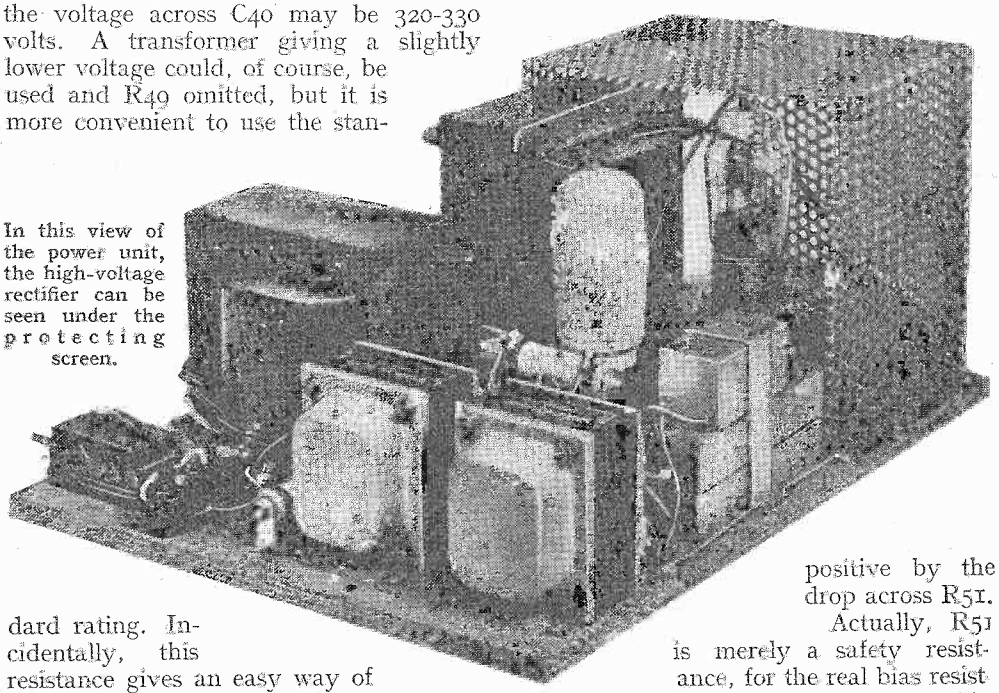
POWER UNIT.

1 Mains transformer Primary, 200-250 V; Secondaries, 350-0-350 V, 120 mA; 4 V, 2.2 A; 4 V, 3.5 A; 4 V, 8 A.	Partridge WW/T2
1 Mains transformer Primary, 250 V; Secondaries, 3,000 V, 0.5 mA; 20 V, 0.2 A; 4 V, 0.65 A; 2 V, 2.5 A.	Partridge WW/T1
2 Smoothing chokes, 10 H, 120 mA, 200 ohms, **Ch2, Ch3**	Sound Sales H10/120
Condensers:	
1 4 mfd., electrolytic, 500 V, **C39**	B.I. E.C.S.20
2 8 mfd., electrolytic, 500 V, **C40, C41**	B.I. E.C.L.40
1 0.1 mfd., 4,500 V tubular, **C42**	B.I.
Resistances:	
1 1,000 ohm, 20 watts, **R50**	Bulgin PR5
1 50,000 ohm, ½ watt, **R57**	Erie
6 3 megohm, ½ watt, **R51, R52, R53, R54, R55, R56**	Erie
1 200 ohm, 20 watts, **R49**	Bulgin PR24
1 Valveholder, 4-pin	Clix X111
1 Valveholder, British octal	Clix X128
1 Connector, 10-way	Bryce 5C6
1 Connector, 5-way	Bryce 5C4
1 Connector, 2-way	Bryce 5C1
1 Fused plug, 2A fuses	Belling-Lee 1114
1 Terminal	Belling-Lee B1001
Baseboard, panel, etc.	Peto-Scott
Valves:	
1 HVR2	Mullard
1 UU7	Mazda
	Reliance "TW"

In the list of parts, for the receiver unit, included in last week's instalment, the six valveholders, British octal chassis mounting type, should have been referred to as Clix X128.

We now come to the power supply unit, the circuit diagram of which is shown in Fig. 2. A standard 350-0-350 volt 120 mA. transformer with 4-volt windings giving outputs of 8 amperes and 3.5 amperes for the valve heaters in the receiver and time-base respectively is used. The rectifier is a UU7 with a 4-μF reservoir condenser C39.

A single stage of smoothing with Ch2 and C40 is used for the time-base HT supply, and a 200-ohm resistance R49 is inserted in series with Ch2 in order that the voltage across C40 may be 320-330 volts. A transformer giving a slightly lower voltage could, of course, be used and R49 omitted, but it is more convenient to use the standard rating. Incidentally, this resistance gives an easy way of adjusting the time-base voltage if different components are used.



In this view of the power unit, the high-voltage rectifier can be seen under the protecting screen.

The time-base is fairly critical on voltage, and if it is too great the picture will not only be too large but the current through the focus coil will be too great, even at the maximum value of R47. It is important to keep the voltage across C40 at about 320-330 volts.

The second choke Ch3 and C41 give additional smoothing for the receiver, and R50 of 1,000 ohms is included to drop the voltage to about 250 volts, or slightly less. The receiver consumes nearly 80 mA. at full gain.

The high-voltage transformer has a 3,000 volt winding and also carries the 2.5-volt winding for the tube heater and supplies 20 volts at 0.2 ampere for the UR1C heater. An indirectly heated rectifier is used for the high-voltage in order to permit time for the tube heater to warm up before the voltage is applied to it.

The peak voltage is 4,250 volts and the 0.1 μF. reservoir condenser C42 is rated for 4,500 volts. It should be noted that the peak inverse voltage across the valve may reach 8,500 volts. This also appears between certain windings on the transformer, and it is essential that a high quality component be used. A poor transformer will soon break down.

As the tube current is very small no smoothing is necessary for the anode supply, for the mean voltage across C42 is nearly equal to the peak voltage—say, about 4,000 volts. A safety resistance R57 of 50,000 ohms is connected in the tube anode lead to prevent damage in the event of a short-circuit.

A bleeder resistance of 12-15 MΩ is connected across C42. It acts as a safety device to ensure that C42 is always discharged a short time after switching off, and it also enables the tube bias to be readily obtained. The tube cathode is joined to the junction of R51 and R52, while the grid is returned through the input circuit to earth. The cathode is thus positive by the drop across R51. Actually, R51 is merely a safety resistance, for the real bias resistance is the 0.5 MΩ variable resistance R48 in the time-base. This is shunted across R51 and is generally used with a value small in comparison with R51. This last resistance is included merely to make certain that there is always a bleeder across C42. Without R51, there would be no resistance shunt across this condenser if an inter-unit lead broke or if R48 developed an open circuit.

The bias supply needs smoothing, but this is readily done by shunting R51 by a 0.5 μF. condenser C38. Again this is in the time-base.

The Controls

The high-voltage transformer has an untapped primary wound for 250 volts, and it is permanently connected across the 250-volt tapping on the other transformer. The mains are connected through fuses in the usual way to this low-voltage transformer, and on voltages other than 250 its primary acts as an auto-transformer to feed the high-voltage transformer.

An examination of the diagram of Fig. 1 will show that, apart from the RF, IF, and oscillator tuning controls, there are six variable resistances. Of these, four are regarded in the nature of occasional controls and their knobs are intended to be inside the cabinet. They are arranged in such a position on the chassis, however, that extension rods are easily fitted so that, if desired, they can be made panel controls. These controls are focus,

Magnetic Television Receiver—

picture height, and line and frame frequency

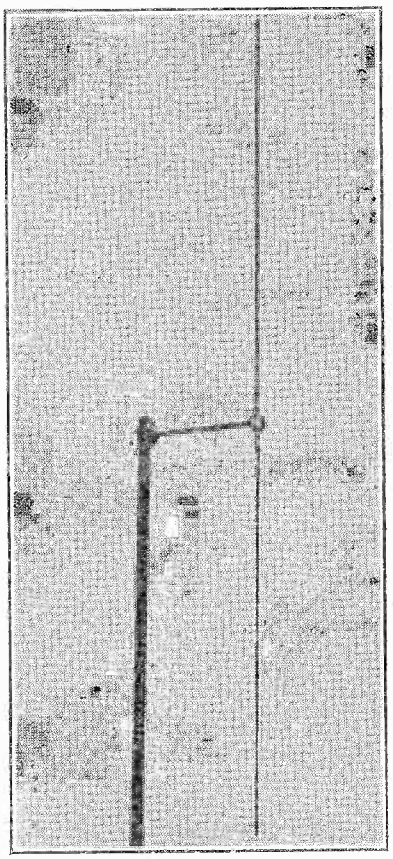
The panel controls are two only—receiver gain and tube bias, which act as brilliancy and contrast controls. These variable resistances are not mounted on the chassis, but are connected to it by long flexible leads so that they can be mounted on the cabinet in any convenient position. Actually, there is no limit to the length of these leads, so that if desired they can be extended for several yards. The two controls can thus be mounted in a remote control box if desired so that adjustments can be carried out at the normal viewing distance. This is, perhaps, an unneccessary refinement, for the controls rarely need adjustment during a programme, but it may appeal to some.

Wolsey Television Aerials

THE outstanding features of these aerials are their low weight (the single dipole weighs only 2½ lb.) and their small wind resistance. The rods are formed by thin-walled aluminium tubes closed at the ends and anodised to resist corrosion.

All interior connections are made inside a waterproof junction box with screwed sockets and rubber seals at all joints. A bracket and bolts are supplied for fixing to a mast or chimney and the price complete is £1 7s. 6d.

A reflector type aerial for masthead mounting can also be supplied and the cast



Wolsey type WT/U dipole aerial.

aluminium mast cap is designed for a 2in. diameter pole. The price is £2 15s.

The single dipole aerial can be supplied for 5-metre work with shortened rods to resonate in the 56 Mc/s band at no extra charge.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Qualifications for Service Personnel

WITH reference to the duel, Cpl. Clarke *versus* Mr. Morrow, it seems to me obvious that Mr. Morrow has got hold of some truth and Cpl. Clarke has taken him the wrong way.

As an ex-member of H.M. Forces and a graduate of the "Signal School," I can truthfully speak from experience.

The facts are these:—

Far many more operators (i.e., those who will operate and do not wish to pull the gear apart) are required than "technical wizards." This is true of all the Services, and time has proved it.

Therefore the Services aim at producing the operator first and telling him just what he needs to know about the gear to work it with efficiency. If he is desirous of increasing his technical knowledge without detriment to his "operator's efficiency," then he is certainly not discouraged.

This is the age of specialisation, and a separate staff is trained to deal with the purely technical side, and this is no doubt a desirable state of affairs, ensuring the maximum efficiency of the communications of the modern fighting services.

STANLEY GARNETT, Sgt. R.A.

Bolton, Lancs.

High-quality Recordings

WE note with interest Mr. Greatorex's suggestion in *The Wireless World*, of June 22nd, that recording companies be persuaded to catalogue records of particular interest on the score of technical excellence. We ourselves would be very glad if they were to do something of this kind, as we have considerable difficulty in finding what we term suitable demonstration records, but we fear that they are not likely to do so, (a) because it would mean admitting that some records were inferior to others, and (b) because it is probable that there will be differences of opinion as to whether a given record is outstanding from a technical point of view.

From the fact that Mr. Greatorex suggests that we might be able to furnish a useful list, it would seem that he has attended one of our demonstrations and that his opinion of outstanding records agrees fairly closely with our own.

As we do not spend our time going through lists of records as released, we are not really in a position to give him the information he requires. It is noteworthy, however, that the percentage of first-class records amongst those released during the last few years is much higher than among the records of five or more years ago.

A useful clue is to examine the outer edge of the record. If there is a "running in" line, it is probably a recent recording. By this we do not condemn all records without a "running in" line. Actually, most of our collection dates back to the time before "running in" lines were general.

Our own collection of records has been selected mainly with the object of demonstrating various features in sound reproduction, and it was necessary firstly that the records should be musically interesting to a mixed audience (which excludes many high-brow records) and secondly, that the parts to be demonstrated should be localised. That is to say that a half-minute extract should suffice to demonstrate the particular feature for which that record was selected. On those occasions when we have run through a few records to see if they were suitable, we have judged them as follows:

(a) Surface noise.
(b) General effect, i.e. quality, musical balance, etc.
(c) "Entertainment Value" (remembering the mixed nature of our average audience).
(d) Whether or not the record discloses any feature in reproduction not already covered by other records we have available.

We ask Mr. Greatorex and others to bear these facts in mind when studying the list below. You have been warned!

Organ pedal note.	Frasquita Serenada ...	Parlo. F.843.
	Intro. and finale ...	Col. DX.457.
Double bass (plucked)	Blues of Israel	Parlo. R.2224.
	Sylvia Ballet	H.M.V. C.2696.
Bass transient Xylophone	Nutty Woods	Col. F.B.2120.
Jazz drums	Blues of Israel	Back of above.
Drum and orchestra	Don Juan (recording slightly high pitched)	Telefunken S.K.2743
Piano	Rhapsodie Espagnole ...	H.M.V. D.B.2375.
	Charlie Kunz (chosen for quality rather than low surface noise)... ...	Rex 8783.
Piano and orchestra	Piano Concerto	Col. L.X.683.
	Piano Concerto	Col. L.X.790.
	Rondo in A Major ...	Parlo. E.11292.
Violin	Albert Sandler	Col. F.B.1769.
	Kriezler	H.M.V. D.A.1627.
Trumpet	Trumpet Voluntary ...	Col. L.1986.
Triangle	Piano Concerto above ...	Col. L.X.790.
Vocal	Tenor voice	Telefunken S.K.B. 02047.
	Paul Robeson (Trees) ...	H.M.V. B.8830.
A few others	Facade	H.M.V. C.2837.
	Prince Igor (50 cycle hum recorded in certain parts of record) ...	Col. L.X.369.
	Fair Maid of Perth ...	Col. L.X.317.
	Rhapsody in Blue ...	Parlo. E.11320.
	Saxophone	Col. F.B.1834.
	Meet me by the Ice-house, Lizzie	Rex. 8745.
	Laudate Dominum (echo very effective) ...	H.M.V. C.2736.
	Bugle Call Rag'... ...	Parlo. F.1077.
	Cinema Organ (Teddy Bears' Picnic)... ...	Reg. Zono. M.R.1750

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

A.R.P. and the Amateur

I READ the letter by Mr. Corsham (G2UV) in *The Wireless World* of June 29th with considerable interest, as I happen to be in charge of the Wireless Section of our O.T.C. We were due to take charge of the second-line communications for the South Bucks Area A.R.P. Council, which includes Slough, when this Council received an intimation from the Home Office that no wireless communication was to be used for A.R.P.

I think that this disposes of the charge that the Home Office are refusing amateurs' services merely because they consider them to be incompetent, since this Section, for whose training I am responsible, is presumably competent—at least I hope so—and, at any rate, is organised and disciplined. Yet, even under these circumstances, the Home Office have refused to allow R/T communication.

I have heard on very good authority that the reason for this is that the signals might be used for D/F. I know very little about D/F, but it seems very improbable to me that an invading aeroplane would carry D/F apparatus capable of taking a bearing on low-power, heavily modulated, unstabilised transmission on 60 Mc/s.

I would be interested to know if any of your readers in this district have received

any of our transmissions. The Section has been going since November, and we have been on the air at intervals since then. Since May, when I took over, we have used the call-sign EC 1—8. We finally decided on a main frequency of 64 Mc/s with subsidiary channels on 62 and 61. The rigs are transmitter-receivers with a two-stage AF. They are exceedingly portable, one man being able to operate one on the march. If anyone has received these transmissions I would very much like reports to be sent to me, c/o The Orderly Room, Eton College, Windsor.

M. C. STANLEY,
Corporal i/c Wireless Section,
Eton College O.T.C.

I HAVE read Mr. Corsham's remarks with much interest, and can heartily endorse his sentiments.

Obviously, the Home Office must realise the value in an emergency of W/T communications over line, and would welcome the help of a highly organised body of amateurs. Unfortunately, however, this, so far as the amateur transmitter is concerned, will mean *de jure* recognition and the continuance in war-time of their stations, which Government Departments, including the Post Office, seem least of all to wish.

Unfortunately, the status of the amateur in this country is still somewhat low, and, despite the activities of the R.S.G.B., we must admit that British transmitters are not so highly organised as our American friends under the auspices of the A.R.R.L.

It is a pity that the R.S.G.B. could not have worked more closely with the R.N.W.A.R., which was almost boycotted by a large number of amateur transmitters in this country, and it remains to be seen whether the C.W.R., "born in the lap of the crisis," can get along better with the R.S.G.B. or without it.

I cannot speak too highly, after six years in the R.N.W.A.R., of the knowledge of operating procedure and organisation that one derives from this experience, and without a similar organised body the present state of amateur transmitting would, in my opinion, be totally unsuitable for emergency work.

My suggestion is that the R.S.G.B. organise at once a body of transmitters who are willing to train themselves in suitable operating procedure on the lines of that used by the Navy and Army, and to keep a separate CW transmitter especially for this work. No doubt the Post Office would willingly grant a suitable frequency channel to be used in conjunction with the scheme when they realised that it was for emergency communication, and not for the endless "rag-chewing" and "QSL-hunting" which goes on on some of the frequencies allocated to us.

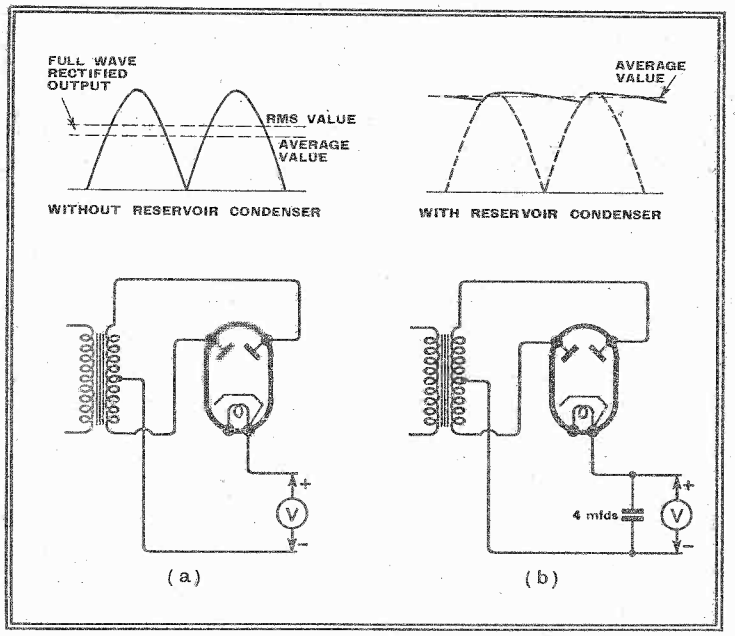
LEONARD H. LEE (G5FH).
Oldbury, Worcs.

HENRY FARRAD'S SOLUTION

(See page 29)

THERE is no need to suggest a method of testing the rectifier because there is no real ground for suspecting that there is anything the matter with it. "Unsmoothed rectifier voltage" means the voltage measured without smoothing choke or condenser, but *with* a reservoir condenser—usually 4 mfds. In Mr. Cowe's test he used only the transformer and rectifier (according to his own statement); so the reservoir condenser was lacking and the voltage across the meter followed the AC half-cycles exactly (see (*a*)) except for a small drop in the rectifier. A DC voltmeter measures the *average* value, which is about 10 per cent. lower than the RMS value. The RMS value is nominally 250 volts in this case; but, as that is presumably at full load, the voltage when loaded only by a voltmeter is slightly over—say, 265. The average value is therefore 238, so allowing for a normal small loss in the rectifier 228 is quite as it should be.

When a reservoir condenser is used, as at (*b*), it charges up to practically the *peak* value of the input—over 40 per cent. higher than the RMS value—and having nowhere to discharge except through the voltmeter it drops only slightly between peaks, and the reading would be perhaps as high as 350 volts. On load it drops to about the values stated in the Valve Data Supplement.

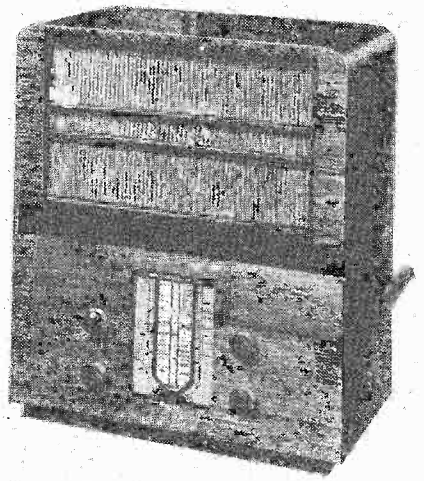


Diagrams illustrating Henry Farrad's solution of Philip Cowe's problem.

McMichael Models 390 and 399

TO meet the demand for a three-waveband AC mains receiver at a price under £10, McMichael have developed the Model 390 three-valve superheterodyne with triode-hexode frequency changer, pentode IF amplifier and double-diode-tetrode signal rectifier, AVC rectifier and output valve. The short-wave range is from 18.5 to 50 metres and an illuminated tuning scale of new design is subdivided into sections for each waveband with an indicating pointer ganged to the waverange switch. The price is £9 7s. 6d.

In the Model 399, which is the battery equivalent of the Model 390, a double-diode-triode is used for signal rectification, AVC and first-stage AF amplification, with a separate pentode in the output stage rated at 400 mW. The price is £8 15s. (batteries 21s. extra).



A sub-divided tuning scale of new design is a feature of the McMichael Models 390 and 399.

Television Programmes

THURSDAY, JULY 13th

3-4.15, "Luck of the Devil," a Parisian fantasia by Lynton Hudson, based on Leonard Sachs' recent production at the Players' Theatre, Covent Garden.

8.15, "The Desert Song," O.B. from the Garrick Theatre of the entire performance. **11.20,** News.

FRIDAY, JULY 14th.

3-5, Wendy Hiller as Grace in "The Fame of Grace Darling," a new play by Yvette Pienne.

9, "La Chauve-Souris" in selections from their repertoire. **9.35,** British Movietonews. **9.45,** Fencing: bouts at Foil, Epée and Sabre. **10.5,** Cartoon Film. **10.10,** Film, "Zoo Babies." **10.20,** E. H. Tattersall: "Club Cricket." **10.25-10.35,** Music Makers.

SATURDAY, JULY 15th.

3, Intimate Cabaret. **3.30,** Cartoon Film. **3.35,** British Movietonews. **3.45,** C. H. Middleton, "In Our Garden."

9-10.30, "Sheppey," a dramatic comedy by Somerset Maugham.

SUNDAY, JULY 16th.

8.50, News. **9.5-10.35,** "Bridge Head," Rutherford Maynes' drama of Irish life.

MONDAY, JULY 17th.

3, Scenes from the Ambassadors Theatre show, "The Gate Revue." **3.45,** British Movietonews. **3.55,** Cartoon Film.

9, "Me and My Girl," the Victoria Palace performance in its entirety. **11.25-11.45,** News.

TUESDAY, JULY 18th.

3-4, Western film, "Whistling Bullets."

9, Cantu (The Mexican Magician) and Oliver Wakefield. **9.20,** British Movietonews. **9.30,** "The Parnell Commission," a reconstruction of the famous forgery investigation of 1888–89.

WEDNESDAY, JULY 19th.

3, Riding School—the whys and wherefores of good horsemanship demonstrated by Major Faudel-Phillips. **3.15,** British Movietonews. **3.25,** Cartoon Film. **3.30,** Punch and Judy. **3.40,** Leonard Henry and Eric Cardi (Conjuror).

9, Rough Island Story—No. 5, "The New World." **9.25,** Cartoon Film. **9.30,** Starlight: Claude Dampier and Billie Carlyle. **9.40,** Gaumont British News. **9.50,** "Heurigen Garden," programme of Viennese songs and dances.

RANDOM RADIATIONS

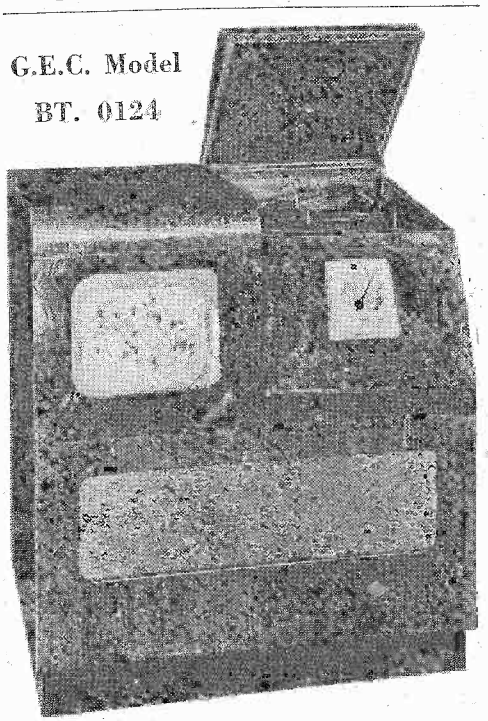
By "DIALLIST"

A Set for a Yacht

A FRIEND of mine wants a new set for use aboard his yacht. Hitherto he's been using a battery superhet worked off the normal 2-volt accumulator and dry HT battery. But the yacht has a large-capacity 24-volt DC lighting set, and it seems that use ought to be made of that. There are three ways of doing it, so far as I can see. The first is to use a nickel-cadmium accumulator HTB, so arranged that it can be charged direct from the lighting set by switching the cells into parallel groups of about 20 volts each. No. 2 is to fit a vibrator unit to provide the HT current. Nos. 1 and 2 both involve a charging board of some kind for the filament accumulator. The third possibility is an AC set worked by means of a rotary converter. Remembering that there is plenty of "juice" available, which of the three do you favour? All things considered, I am inclined to vote for the vibrator unit; but I'd be glad to know the recommendations of any readers who may have had practical experience of this or the other two methods in small ships.

An Omission

IT'S not often that an outstanding item forms part of one of the Empire programmes only and doesn't get into those of either the Regionals or the Nationals. But there was such an item the other day, and why it was made "Empire only" I can't think. I'm referring to "the Indian Police," presented by Mr. E. W. C. Wace, a Deputy Inspector-General of the Punjab, and three other officers of the same province. It was an absolutely first-rate account of life and activities in that fine force, full of interest from start to finish. The Empire programmes are published in few papers, so not many people in this country knew that this item was coming on; yet there must be thousands who would have liked to hear it. In my own little town there are a dozen households with members or relatives or friends in the Indian Police; of course, they all wanted to hear it, but some of them hadn't all-wave or short-wave sets, so I had a bumper audience, with two sets going in different rooms. The item was recorded; I hope, therefore, that the B.B.C. will put it into one of the medium-wave programmes. You'll like it if they do so.



Extensive use has been made of push-button control in this combined television and all-wave auto-radiogram just introduced by the General Electric Co., Ltd. In addition to eight buttons for station selection, there are seven additional buttons for complete television entertainment, television sound only, gramophone reproduction and waverange switching. The picture size is 10in. × 8in. and the price is 72 guineas.

"Passed to You, Please"

HARD, sometimes, is the lot of the dweller of the more out-of-the-way places of the Empire who would buy British wireless goods. I've given some instances before of the difficulties and delays that he may encounter. Here's another that has just reached me. A reader who lives in North-Eastern Rhodesia was advised by the Secretary of the R.S.G.B. that batteries of a certain make and kind might meet the somewhat exacting requirements of the local climate and conditions. In March last he wrote to the makers in this country asking for the address of their South African agents, or those in Southern Rhodesia, if there were such. The company's South African branch wrote on April 17th from Johannesburg that their Rhodesian agents at Bulawayo would give all the information required. He wrote to Bulawayo, asking for prices and particulars, and received, the following month, a reply from them stating that his inquiry had been referred to Johannesburg. They added, rather cryptically, that all inquiries by my reader would be dealt with by the Northern Rhodesia office at 'Ndola!

Still Waiting

'Ndola, he 'ntells me (sorry, but those 'ns are catching!), would be useless, as it's on the western side of Rhodesia; but, hearing a rumour of the presence of agents at Salisbury—his nearest town, a mere 500 miles away—he has written there in hopes that something may happen; but he is quite expecting to be referred to Bulawayo, Johannesburg, or even London, if and when he gets a reply. Meantime, after more than three months, he is still without the batteries that he wants; he hasn't even got the particulars of them or their prices. It appears to be, as is so often the case, the agents who are to blame. British radio firms would do well to see that their agents abroad are selected with care—and kept up to the mark.

Start Point

SO far I haven't had many reports about reception of Start Point from dwellers in the West Country, but those that have come in all speak well of the new station. I shall have the opportunity of trying it on the spot myself in a week or two, for I'm off to camp in Cornwall. When I was last in that county, a couple of years ago, there wasn't a single home station that I could receive well, though I took down a big set with me. It's a queer thing to have to say of a place in England, but we relied both for news and for entertainment mainly on the French stations! I hope I'll find that Start Point has made a big change and that I'll be able to get my news from the home station and not have to go abroad for it. I'm afraid I sha'n't have much time for DX; more's the pity; I should very much like to try the short waves on the west coast of Cornwall.

The Wireless Industry

A SWISS firm wishes to get into touch with a wholesale supplier of thorn gramophone needles. Letters addressed to this office will be forwarded.

Leaflet Com. A-7 issued by Marconi-Ekco Instruments, Ltd., Electra House, Victoria Embankment, London, W.C.2, deals with the RF attenuator, TF360. Designed for use at frequencies up to 25 Mc/s., this instrument incorporates a thermal milliammeter and has a range of 0-120 db.

A second edition of descriptive pamphlet 11a dealing with battery-charging sets has been received from Westinghouse Brake and Signal Co., Ltd., 82, York Way, King's Cross, London, N.

Full details and prices of the new "Tropa" wire-wound potentiometers for use under tropical conditions are included in Catalogue Supplement No. 1 recently prepared by F. W. Lechner and Co., Ltd., 5, Fairfax Road, London, N.W.6.

Hamrad Wholesale, Ltd., 32, St. Lawrence Terrace, London, W.10, have sent us a comprehensive list of short-wave components and materials and technical details of a new 12-valve communication receiver (Type 140). This instrument, which costs £27 10s., is fitted with a crystal gate and covers 9 to 600 metres in five bands.

Club News

Watford and District Radio and Television Society

Headquarters: Carlton Tea Rooms, 77, Queens Road, Watford, Herts.
Hon. Sec.: Mr. P. G. Spencer, 11, Nightingale Road, Bushey, Herts.

Mr. E. L. Gardiner gave an interesting talk on "Five-metre Aerials" at the last meeting. On July 15th Mr. A. W. Birt will demonstrate some portable receiving apparatus for five-metre work.

International Short Wave Club (London Chapter)

Headquarters: R.A.C.S. Hall, Cavendish Grove, Wandsworth Road, London, S.W.8.
Hon. Sec.: Mr. A. E. Bear, 100, Adams Gardens Estate, London, S.E.13.

At a meeting held on June 30th a lecture was given by Mr. M. Westcombe, of the United Insulator Co., Ltd. The lecturer's subject was "HF Insulators," and he illustrated his remarks with lantern slides and also with experiments conducted with cathode-ray oscillograph apparatus.

Slough and District Short-Wave Club

Headquarters: 35, High Street, Slough, Bucks.
Meetings: Alternate Thursdays at 7.30 p.m.
Hon. Sec.: Mr. K. A. Sly, 16, Buckland Avenue, Slough, Bucks.

At the meeting held on June 22nd the evening was devoted to morse practice. A discussion took place as a result of which it was decided that a period should be devoted at every meeting to the consideration of members' difficulties. At the next meeting, on July 6th, Mr. J. Paine gave a talk entitled "Arranging and Operating a Portable Station for the National Field Day." A discussion also took place about plans for a local field day.

South London and District Radio Transmitters Society

Headquarters: Brotherhood Hall, West Norwood, London, S.E.
Meetings: First Wednesday in the month.
Hon. Sec.: Mr. E. Ilott, 30, Montana Road, Upper Tooting, London, S.W.17.

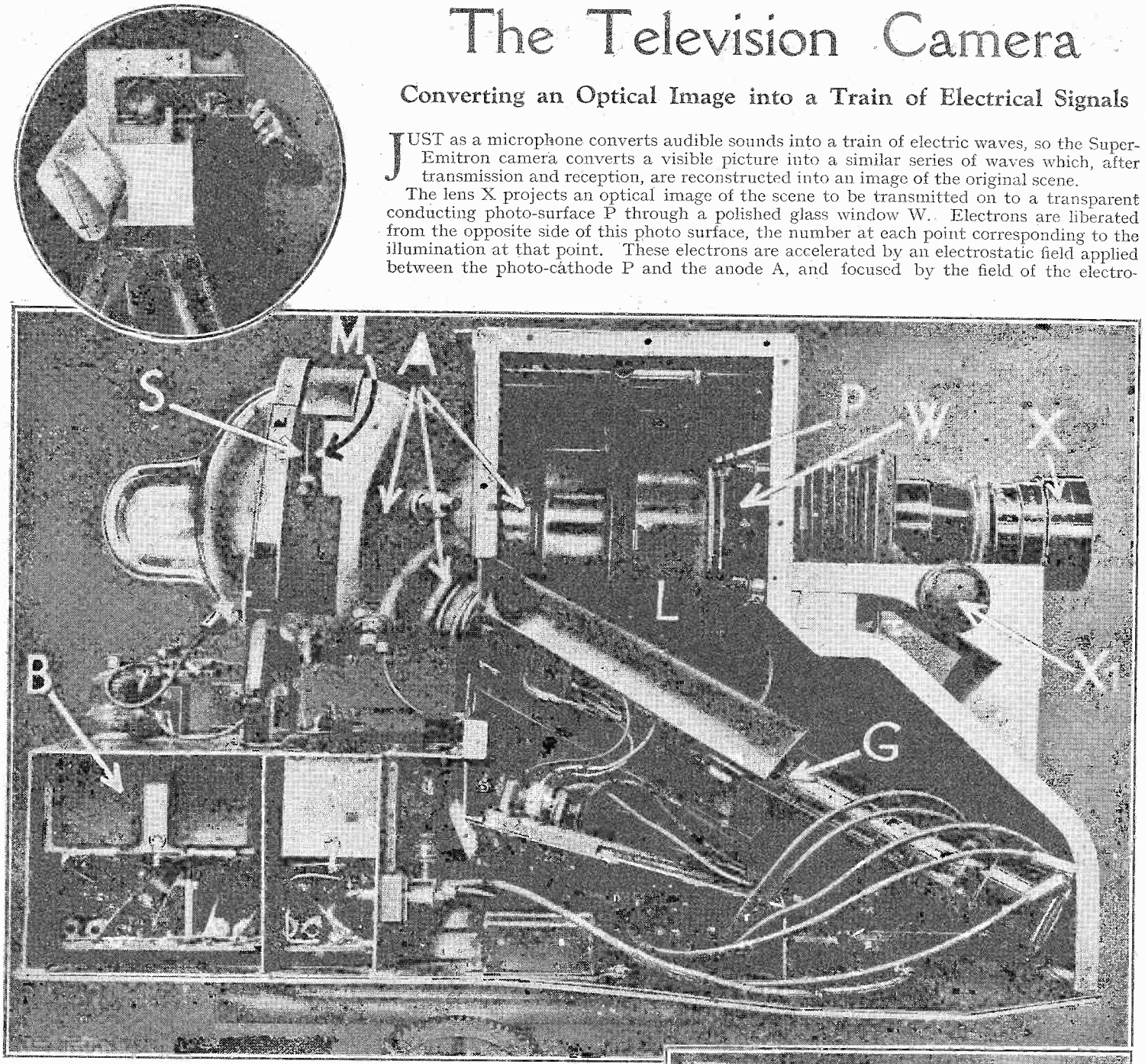
It is desired to call attention to the fact that there has been a change in the name and address of the Secretary. Details are as given above.

The Television Camera

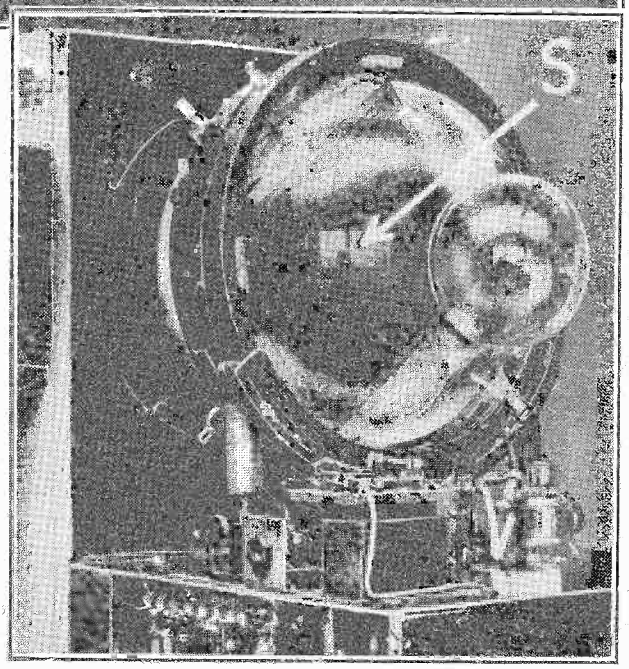
Converting an Optical Image into a Train of Electrical Signals

JUST as a microphone converts audible sounds into a train of electric waves, so the Super-Emitron camera converts a visible picture into a similar series of waves which, after transmission and reception, are reconstructed into an image of the original scene.

The lens X projects an optical image of the scene to be transmitted on to a transparent conducting photo-surface P through a polished glass window W. Electrons are liberated from the opposite side of this photo surface, the number at each point corresponding to the illumination at that point. These electrons are accelerated by an electrostatic field applied between the photo-cathode P and the anode A, and focused by the field of the electro-



A Super-Emitron camera with the protective covering removed to reveal the arrangement of the principal component parts. The enlarged view of a section on the right shows more clearly the mica plate carrying the storing mosaic and signal plate. The photographs were taken by courtesy of Electric and Musical Industries, Ltd., in whose laboratories the Super-Emitron was invented and developed.



S = signal plate. M = storing mosaic. A = second anode. B = head amplifier. L = magnetic electron lens. P = transparent photo surface. W = polished glass window. X = optical focusing lens. X1 = optical focusing control. G = electron gun.

magnet L to form an electron image on the mosaic M. The mosaic is carried by a mica plate, the back of which has a metal coating to form the signal plate S, which is connected to the head amplifier B. The photo-electrons falling on the mosaic are multiplied by secondary emission and produce an intensified charge distribution which corresponds to the electron image and hence to the point-to-point illumination of the photo-surface P. The mosaic is scanned in a series of parallel lines by an electron beam from the gun G. The electrons in this beam neutralise in turn the charges at each point on the mosaic, thus producing a series of potential fluctuations in the signal plate S, corresponding to the distribution of light intensity in the original image. These picture signals are communicated to the head amplifier, and thence through further amplifiers to the modulator of the transmitter.

Short-wave Adjustments

ALIGNING THE CIRCUITS OF ALL-WAVE SUPERHETS

Concluded from page 4 of last week's issue

By "TRIMMER"

WITH regard to the actual making of short-wave adjustments, it should be remembered that hand-capacity effects must be guarded against, and no metal adjusting tools should be used.

Of the large number of different circumstances in which adjustments of the SW side of an all-wave superhet may become necessary, there are two broad possibilities: (1) It may be known that the SW circuits are hopelessly out of adjustment and it has to be assumed that each and every available adjustment will need attention; in other words, the case may be one where the SW circuits have to be lined up "from the raw." (2) It may be a case where the SW performance is down, but one in which it can be assumed that at least some of the SW adjustments are correct.

AFTER discussing in general terms the problems involved in aligning the short-wave circuits of an all-wave superheterodyne, the author proceeds to describe methods of making adjustments in specific cases. Recommended courses of procedure are described.

We will deal with (1) first.

Before attempting to make any SW adjustments there are certain preliminaries to attend to. As previously stated, it is important to make certain that the SW arrangements provided are understood, particularly in connection with the tracking.

It is wise, too, to make as certain as possible that the IF stages are lined up at the correct frequency. This does not imply that the correctness of the IF value is essentially more important on the SW than on the other bands, but there are sufficient possibilities of SW adjustments being tricky without running the risk of having any added complications due to the IF being wrong. In the common case where the same IF value is used on all the wavebands it will usually pay to make sure that the calibration and general performance is quite satisfactory on MW and LW before tackling the SW adjustments. There are some exceptional cases, of course, e.g., the receiver in which an SW padder comes in series with the MW oscillator circuit so that SW should be lined up before MW.

A direct check on the IF stages alone could be made in such a case, and in the special case where the SW band uses its own IF value a direct IF check is most advisable, if the correct IF value is known. (If it is not known, see that the IF circuits are lined up and hope for the best. If trouble is afterwards experienced in connection with tracking keep in mind the element of doubt regarding the IF value).

Apart from exceptional cases it can be taken as a golden rule to leave SW to the last and to get everything perfect on the other bands first.

It will be necessary to decide upon the frequencies to be used for trimming and tracking tests. Strictly, the test frequencies ought to be those specified by the receiver manufacturers, but if these values are not known some frequency near the shortest wavelength of the band should be chosen for trimming and one near the highest wavelength end for tracking.

For shortest wavelengths of 11, 13, 16 and 19 metres respectively, trimming frequencies of 20, 20, 18 and 15 Mc/s respectively will probably prove to be suitable. For a top wave of 50m. a tracking frequency of 7 Mc/s should be tried.

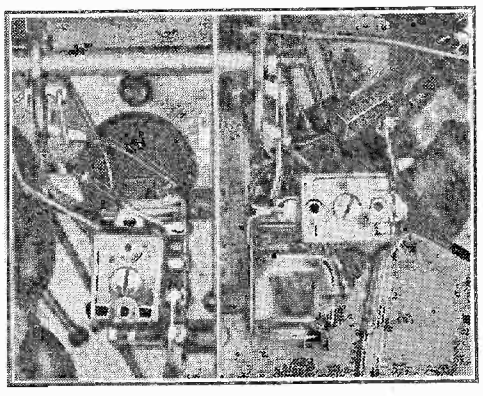
In view of short-wave adjusting work involving a number of tests at different tuning points it is desirable to be able to get the connection between metres and megacycles per sec. without loss of time. The list printed on this page should be useful for rapid reference purposes. To have given a more comprehensive list would have defeated its purpose.

The signal generator may have special SW output arrangements associated with the output leads. If not, it is to be advised that a 400-ohm non-inductive resistance be connected in series with the high-potential output lead from the generator.

With the output indicator connected to the receiver all should now be ready for the actual work to start on the SW circuits. At this point it should perhaps be mentioned that most of the various operations enumerated below take far less time to carry out than to describe. Some of them need only occupy a matter of seconds.

Recommended Procedure

Apply the trimming signal, adjust the main tuning control of the receiver to bring in the signal. It may be necessary to trim up the signal-frequency circuits (quite roughly at this stage). Now run the oscillator trimming through its full variation, noting the number of signal peaks that are obtained. If multiple peaks are found reduce the output of the signal generator in the endeavour to get the alternative oscillator trimmer settings to no more than two. A choice of peak setting must now be made, and if only two are obtainable choose the one involving the lesser trimmer capacity. If there are several residual peaks some will probably be noticeably weaker than others, and in this case pick on one of the smaller capacity ones, taking a stronger in preference to a weaker one.



The short-wave trimmers of a small superheterodyne are shown here.

The receiver tuning should be set as accurately as possible to the calibrated marking for the trimming frequency, and the oscillator trimming adjusted for exact optimum on the chosen trimmer peak setting. Next, trim up the signal frequency circuits, taking care over "pulling" as previously described.

The next move is that of tracking adjustment, assuming that the receiver has variable tracking, and the signal generator tuning and the receiver tuning should be set at the tracking frequency points. Adjust the tracking control for maximum peak output, at the same time slightly rocking the ganged condenser for optimum results. A return to the trimming frequency should then be made and any necessary readjustments carried out.

Wavelength-frequency Relationships

Metres		Mc/sec.	Metres
13	23.08	20	15
15	20	19	15.79
17	17.65	18	16.67
19	15.79	17	17.65
25	12	15	20
27	11.1	13	23.08
31	9.68	12	25
33	9	11	27.27
40	7.5	10	30
49	6.12	9	33
50	6	8	37.5
70	4.3	7	42.9
75	4	6	50
100	3	4	75

Short-wave Adjustments—

Sometimes it may be necessary to make tracking and trimming corrections yet once again.

If all seems to have gone off well, check up on a few signals at frequencies spread over the tuning range, particularly noting if the receiver's calibration holds good, and if the sensitivity keeps up (or at least does not drop abnormally) over the range. If this check gives satisfactory results the job is done.

If it so happens that the work has been carried out starting from the wrong trimming peak, trouble will, of course, be experienced. Any difficulty over tracking should make one immediately suspicious in this respect, and the accuracy of the receiver's calibration is a good tell-tale. Either the second-channel test previously described can be applied to settle the right or wrong peak question or a fresh start made on another peak setting as a trial. Circumstances will indicate which is likely to be the quicker method.

If the receiver has fixed tracking it may sometimes be found that, although the correct trimming setting has definitely been chosen, yet the calibration still remains a little out. If the error is small it is generally legitimate to adopt a little compromise of oscillator trimming. The trimming capacity should be slightly increased or decreased with the object of reducing the average error over the scale and, of course, the signal-frequency trimming should be correspondingly touched up again.

Minor Readjustment

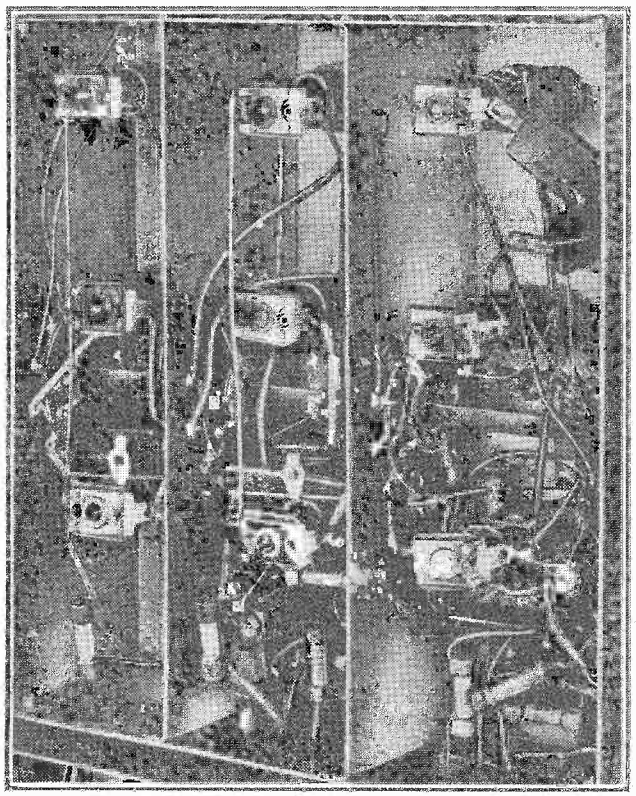
Let us now consider case (2), i.e., the common example of the receiver with SW performance down, but a case where very possibly only slight readjustment may be necessary.

The first move should be to decide whether or not the oscillator circuit adjustments need attention. This is easy to decide by making a test of the receiver's calibration over the scale. If the calibration holds good then the oscillator circuit should be left severely alone and attention concentrated on the signal-frequency circuits. If it does turn out that the oscillator is evidently not tracking properly the oscillator adjustments will have to be tested, and in this case one might as well settle down to the complete job of SW lining-up.

If the receiver is lacking in sensitivity on SW, but there is no sign of calibration errors, it will often happen that a slight readjustment of signal-frequency trimming will work wonders. Some receivers in particular respond to a very marked degree to a touch-up on the input circuit trimmer, and where the "last ounce" is required it will often pay to try the input trimming on outside signals and using the actual aerial with which the receiver is normally used.

If such difficulty is experienced with the SW adjustments that it seems impossible to get them right, the question will arise as to whether there are faults present or whether the adjustments have not been carried out correctly (alternatively, has any one of the available adjustments been overlooked?).

It is hoped that enough has already been said about the possibility of working on the wrong oscillator beat to render it impossible for any reader to be caught in that snag without realising what is the matter. If the receiver seems resolutely to fight against coming into correct calibration, and there is no doubt about the correctness of the oscillator beat, the following points may be worth considering:—(1) Has the receiver been assumed to have fixed tracking when actually there is a variable adjustment in the oscillator circuit? (2) Is the IF correct? (3) Has the wiring of the oscillator circuit been displaced, accidentally or otherwise?



The underside of a typical modern receiver is illustrated here. The set includes one short-wave band in addition to medium and long waves.

As regards (3) it is to be mentioned that quite small displacement of wiring can have marked results. A fact that it might be important to know is that the designers of some receivers have arranged that the deliberate bending of connecting wires shall be part of the SW adjusting (which might lead to an awkward situation if one did not realise this, so it might prove worth while to try a little judicious experimenting with the aid of a prod of insulation material—but proceed very carefully). Incidentally, any lead wire or loop adjustments should always be carried out near the longest wavelength end of the range.

When the receiver's calibration shows up correctly over the range but the sensitivity falls off badly towards one end and signal-frequency trimming does not cure the trouble, it should be suspected that the signal-frequency tuning is not tracking properly with the actual signal frequency. It must be remembered that if the signal-frequency circuits and the oscillator circuit are not together tracking properly the act of tuning in a signal tends to set the oscillator circuit to the correct tuning. That is why we have emphasised so much the importance of watching the receiver's calibration as a check on the oscillator circuit.

When all attempts at adjustment fail to make the SW side of the receiver behave itself, the position, of course, deteriorates into one of fault tracing. The subject of fault tracing, as regards component faults, is outside the scope of this article, but the writer cannot resist giving the hint that whenever it becomes a matter of fault tracing the eye of suspicion should always be directed to any fixed condensers that may be associated with any of the tuned SW circuits.

To conclude these notes the question must now be considered as to what can be done in the absence of a signal generator. In the writer's opinion it is most unwise to attempt complete SW lining-up unless the receiver is of the simplest type or there happens to be no option in the matter. If the job must be tackled the trimming and tracking must, of course, be carried out on outside signals. Added to such difficulties as have already been mentioned there are now additional possibilities of complication such as uncertainty as to the frequency of a chosen signal and lack of a signal just where it is wanted.

The oscillator circuit should not be touched unless results on reception show definitely that it requires attention.

If it is merely a matter of trimming up the signal-frequency circuits this can be done quite easily and satisfactorily on outside signals and any signal well down towards the shortest wavelength end of the range can be used.

New G.E.C. Public Address Equipment

THE principal item in the new programme of PA apparatus announced by the G.E.C. is a 20-watt amplifier with separate bass and treble "uplift" tone controls and automatic gain control. Two separate valves are included for the latter purpose and the introduction of this form of acoustic AVC is of benefit not only in overcoming difficulties with speakers who are unskilled in microphone technique, but also in reducing microphonic feed-back. KT66 tetrodes in class A push-pull are used in the output stage and the price of the amplifier is £28 10s.

A moving-coil microphone specially designed for PA work has been introduced for use with this amplifier. It is mounted in a quickly adjustable socket which may be set at any desider angle, and the price is £6 5s.

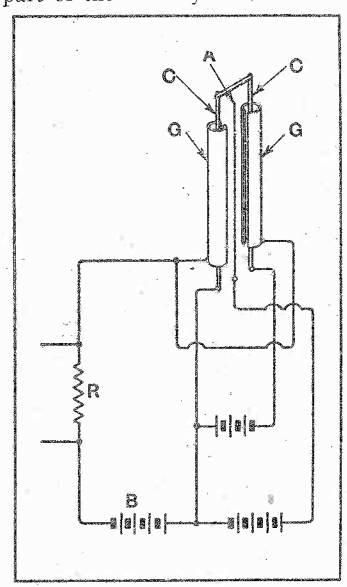
Recent Inventions

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

VISUAL TUNING INDICATORS

THE figure illustrates the construction of an elecron-discharge tube for use as a visual tuning indicator. The parallel legs of the cathode C are enclosed by two cylindrical "grids" G, each with a slit which faces inwards towards a straight-wire anode A mounted parallel to the cathode legs. With this arrangement a change of two volts on the grid is sufficient to make the anode glow brightly under bombardment by the electron stream.

Normally the grids are negatively biased by a battery B to cut-off point, so that the wire is dark. Voltage applied from a resistance R, preferably forming part of the AVC system, tends to



Valve-type tuning indicator.

make the grids more positive, and renders the anode A white-hot when the associated tuning circuit is adjusted to the point of resonance. The glowing wire is easily visible from the side of the tube.

Marconi's Wireless Telegraph Co., Ltd. (communicated by Radio Corporation of America). Application date, September 14th, 1937. No. 502181.

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SCANNING SYSTEM

INCOMING television signals are applied to a detector which is shunted by a resistance in series with a biasing voltage. Both the picture signals and the synchronising impulses produce voltage variations across the shunt resistance, but these, even when added to the steady bias, fail to trigger an oscillator valve until such time as the carrier wave drops below the "black" level at which the synchronising impulse is sent.

In this way the picture and synchronising signals are separated from each other. On the receipt of a synchronising impulse, the oscillator valve is triggered into action, and generates a pulse of current which is used to synchronise the saw-toothed scanning valve. These pulses are of constant amplitude, irrespective of the strength or duration of the triggering voltage applied. They cease when the passage of the synchronising signal reverses the direction of the triggering voltage.

F. W. Cackett (communicated by Telefunken Ges für Drahtlose Telegraphie m.b.H.). Application date August 13th, 1937. No. 500876.

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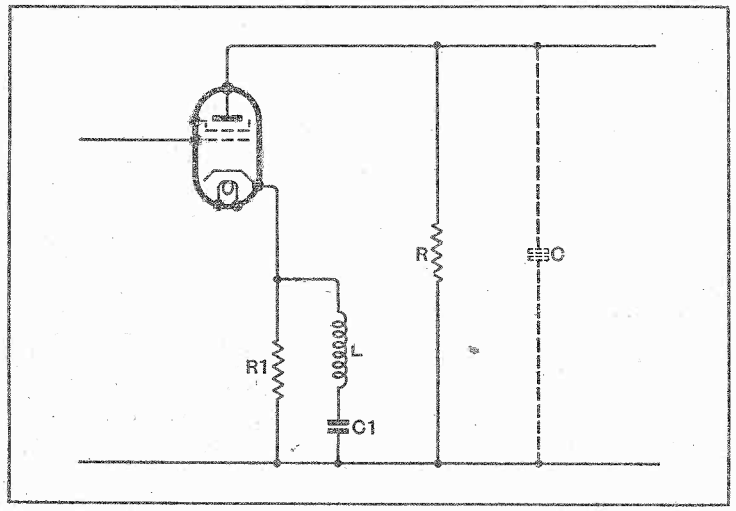
TELEVISION AMPLIFIERS

RELATES to a wide-band amplifier for handling television signals, in which negative feedback is used to reduce amplitude distortion by making the amplification less dependent upon changes in the operating voltages or in the characteristics of the valves employed. In such amplifiers it is found that stray capacities associated with the output circuit still cause a falling off in the amplification of the higher frequencies, and it is the object of the invention to avoid this.

The output impedance of the valve is represented in the figure as a resistance R shunted by a capacity C. The negative feedback takes place across the cathode resistance R1. To some extent, the object aimed at has previously been achieved by shunting this cathode resistance by a condenser of such value that their time constant is the same as that of R and C. But, in practice, it is found that the impedance of this condenser falls too low to operate in the desired way for the high frequencies encountered in television work. Accordingly the cathode resistance is now usually shunted, as shown in the figure, by a condenser C1 in series with



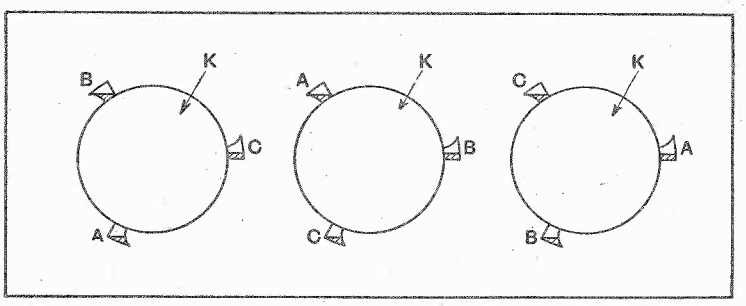
Counteracting stray capacity effects.

an inductance L, the value of which is determined by a mathematical analysis of the circuit conditions.

E. L. C. White and M. G. Harker. Application date October 22nd, 1937. No. 502578.

PRE-SET TUNING ARRANGEMENTS

THE figure shows how mercury switches, A, B and C, can be used for changing the tuning of a wireless receiver or transmitter. The mercury partly fills the triangular chambers, which are mounted on the periphery of a rotatable cylinder K. Different contacts in the chambers are closed according to the position the mercury takes up, under the effect of gravity, as the cylinder is rotated.



Mercury switches for pre-set tuning.

In the first position, for instance, the mercury in the chamber A will bridge contacts arranged near the "pointed" end of that chamber, whereas in the other two figures (which show the cylinder rotated through angles of 120 deg. and 240 deg. respectively), those two contact points are open-circuited, and other pairs of contacts are closed. By arranging the contacts at different points in each chamber, any desired sequence of tuning can be effected by bringing selected condensers or inductances in or out of circuit, as the cylinder K is rotated.

W. A. Beatty. Application date September 4th, 1937. No. 505170.

CATHODE-RAY TUBES

A CATHODE-RAY tube has been developed in which several electron beams are produced simultaneously, each being controlled independently of the others, for the purpose of what is called "multiple spot" scanning.

The invention relates to a tube of this kind, and provides a cathode structure in which a number of mutually insulated strips (which act as electron emitters) are strung over the outside of a hollow rod, along the axis of which runs a heating element. Each of the emitting strips is connected by a separate lead to its own section of a potentiometer or delay network, so that each is controlled in the sequence required for multiple-spot scanning.

J. D. McGee. Application date August 23rd, 1937. No. 502796.

o o o o

PREVENTING "NIGHT EFFECT"

ONE method of avoiding the so-called night effect, when taking bearings on a distant transmitter, is to work on short "impulse" signals which are repeated at a rapid rate. The DF receiver is then arranged so that it accepts the first impulse to arrive, i.e., the one that travels along the ground, but is made inoperative before the space-wave impulse can reach it, after reflection from the Heaviside layer. This necessitates that the receiver be cut out at intervals which synchronise with the frequency of the transmitted impulses.

The specification describes an aircraft installation of this kind adapted to be used for "homing," where it is also necessary to reverse the frame aerial input, at a fairly rapid rate, in order to indicate to the pilot whether or not he is keeping on a straight-line course.

Telefunken Ges für Drahtlose Telegraphie m.b.h. Convention date (Germany), February 4th, 1937. No. 504060.

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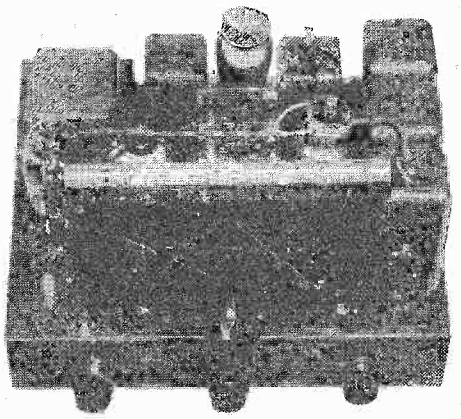

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IMITATED, but unequalled.

WE Invite You to a Demonstration.

A.C.-D.C. Dance Band Amplifier, 10 watts output, complete in case, with moving coil microphone, speaker and cables, weight 22lb., 12 gns.

A.C.-20 15-20-watt Amplifier, 38-18,000 cycles, independent mike and gram., inputs and controls, 0.037 volts required to full load, output for 4 7.5, and 15 ohms speakers or to specification inaudible hum level, ready for use; 8½ gns., complete.

C.P. 20 12-volt battery and A.C. Mains Model, as used by R.A.F., output as above; 12 gns.

A.C.-20, in portable case, with Collaro motor, Piezo pick-up, etc., £14; C.P.20 ditto, £17/17.

50-WATT Output 6L6s, under 60-watt conditions, with negative feed back, separate rectifiers for anode screen and bias, with better than 4% regulation level response, 20-25,000 cycles, excellent driver, driver transformer, and output transformer matching 2-30 ohms impedance electronic mixing for mike and pick-up with tone control, complete with valve and plugs; £15.

COMPLETE in Case, with turntable, B.T.H. Pieco pick-up and shielded microphone transformer; £20.

80-WATT Model, with negative feed back; £25, complete.

120-WATT Model with negative feed back; £40, complete.

250-VOLT 250 m.a. Full Wave Speaker field supply unit; 25/-, with valve

ALL P.A. Accessories in Stock; trade supplied.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2814. [8241

"PARTRIDGE P.A. Manual," free to trade, from N. Partridge, B.Sc., A.M.I.E.E., King's Buildings, Dean Stanley St., London, S.W.1. [0631

QUALITY Amplifiers and Microphone Equipments for Hire or Permanent Installation.—Harmony House, 116, Cambridge Rd., Southport. [8505

AMPLIFYING Equipment, P.A. vans for sale or hire. Booklet on request.—Alexander Black, Ltd., 55, Ebury St., S.W.1. Sloane 6129. [0599

PUBLIC Address Contractors Can Hire P.A. Vans; loud speakers, microphones and equipments of all types from Hire Dept., Grampian Reproducers, Ltd., Kew Gardens, Surrey. Tel.: Richmond 1175-6-7. [0618

RIBBON Microphones, 7 models, from £3/19/6, list free; 15 watt high gain, high fidelity, 4 stage amplifier for ribbon microphones, £12/10; 30 watt ditto, £18. —Holiday and Hemmerdinger, Ltd., 74, Hardman St., Manchester. [8622

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NEW LOUD-SPEAKERS

SINCLAIR Speakers for All Types.—Alma Grove, Copenhagen St., N.1. [0603

GET the Most Out of Your Set with an Epoch Loud Speaker, the supreme reproducer.
HALFORD RADIO, 31, St. George St., W.1,

SOLE Manufacturers of Epoch Loud Speakers, output transformers, etc., and also of the famous Halford Phantom Radio Set. [0632

SAVE Pounds.—1½d. stamp for list British and American P.A. Speakers. Example: P.A. unit with transformer weighing 23lb., incorporating curved cone, 47/-.—Degallier's, 31, Craven Terrace, London, W.2. [8554

LOUD-SPEAKERS

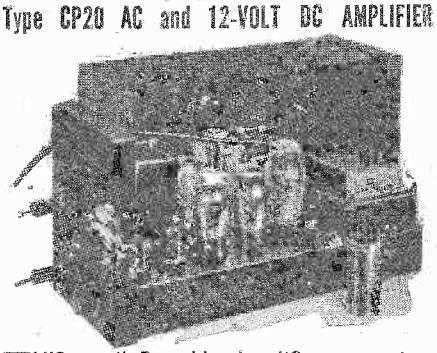
SECOND-HAND, CLEARANCE, SURPLUS, ETC.

VAUXHALL UTILITIES, 163a, Strand, W.C.2.—Rola G.12 P.M. speakers, 62/6; G.12 energised, 50/-; brand new with transformers. [8676

3,000 4in. to 14in., including several Epoch 18in. Speakers from 5/6 each, P.M. and energised —Sinclair Speakers, Alma Grove, Copenhagen St., N.1. [0591

VORTEXION 15W

Type CP20 AC and 12-VOLT DC AMPLIFIER



THIS small Portable Amplifier, operating either from AC mains or 12-volt battery was tested by "THE WIRELESS WORLD," October 1st, 1937, and has proved so popular that at Customers' demand it remains unaltered except that the output has been increased to 17.2 watts and the battery consumption lowered to 6 amperes. Read what "The Wireless World" said :—

"During tests an output of 14.7 watts was obtained without any trace of distortion so that the rating of 15 watts is quite justified. The measured response shows an upper limit of 18,000 c/s and a lower of 30 c/s. Its performance is exceptionally good. Another outstanding feature is its exceptionally low hum level when AC operated even without an earth connection. In order to obtain the maximum undistorted output, an input to the microphone jack of 0.037 volt was required." The two independent volume controls enable one to adjust the gain of the amplifier for the same power output from both sources, as well as superimpose one on the other, or fade out one and bring the other up to full volume. The secondary of the output transformer is tapped for loudspeakers or line impedances of 4, 7.5 and 15 ohms."

AC and 12-volt CHASSIS with valves, etc. **£12 12 0**
Or in Rexine Case with Collaro Motor, Piezo P.U. and Mike Transformer..... **£17 17 0**
AC only CHASSIS with valves, etc. **£8 18 6**
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Gauze Case for either chassis 12/6 extra.

SEND NOW FOR FULL DETAILS.

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TO SERVICE MEN

Bargain Offer!!!

A SERVICE KIT FOR **17/6**

This Service Kit comprises:

4 VOLUME CONTROLS. 20,000, 50,000, ½ meg., 1 meg.
72 RESISTORS. Assorted, colour coded resistors, ½ to 2 watts.
2 DOZ. CONDENSERS. Assorted tubular, electrolytic and mica condensers.
1 STEEL CABINET. A very useful steel cabinet with partitions for above, screws, etc.

VALUE £4 for 17/6

KIT No. 2 comprising resistors and condensers only, as above, **12/6.**

KIT No. 3 comprising volume controls and cabinet only, **6/6,**

SPECIAL OFFER !!!
Fully shrouded Transformers by America's largest manufacturer. While they last.

All 230 v. primary and fully impregnated.

T28708—375/375 v. 150 m/A., 6.3V5A. 2.5V5A. 5V3A	15/-
T19610—350/350 v. 150 m/A., 2.5V6A. 2.5V2A. 5V3A	12/6
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T7326—350/350 v. 100 m/A., 6.3VCT. 3A. 5V3A	8/6
T7307—350/350 v. 80 m/A., 6.3VCT. 3A. 5V3A	7/6
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T1113AB—110/230 v. 500 watt Auto Transformer	29/6

The following chokes are interleaved and impregnated.

T7007—250 m/A., 135 ohms, 20–8 Hy., cadmium shrouded	12/6
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RADIOMART Telephone: MIDland 3254.
G5NI (Birmingham) Ltd.
44, HOLLOWAY HEAD, BIRMINGHAM

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Pamphonic Reproducers Ltd. (*Associated with PYE Ltd.*)
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'Phone: EUSton 1727.

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A.C.S. RADIO specialists in short wave apparatus, communication receivers, including Hallicrafters, National and R.M.E. transmitting equipment, valves and components. Send for free catalogue to A.C.S. Radio, 16, Gray's Inn Rd., W.C.1. Holborn 9894-5. G2NK, Technical Manager. [0550

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CONVERT Your Set into a Radiogram at Minimum Cost; surplus cabinets from noted makers under cost of manufacture (undrilled); 30/- upward; motors at wholesale prices.

"FIT-A-GRAM" Cabinet, 31 x 17 x 15; 21/-.

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INSPECTION Invited; photos loaned to country customers.

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ALL Types of Rotary Converters, electric motors, battery chargers, petrol-electric generator sets, etc., in stock, new and second-hand.

A.C.-D.C. Conversion Units for Operating D.C. Receivers from A.C. Mains, 100 watts output, £2/10; 150 watts output, £3/10.

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ELECTRADIX Rotary Converters for A.C. Radios on D.C. Mains; alternators 50 to 500 cycles; mains motors and motor generators for 1 to 600 cells; petrol engines and switchgear.—218, Upper Thames St., London, E.C.4. [0619

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ALL Recording Discs and Materials in Stock, tracker units, £4/7/6; recording motors, £3/17/6.—Write for further details, Will Day, Ltd., 19, Lisle St., W.C.2. [0595

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ALL Types of American Tubes in Stock of Impex and Arcturus makes at competitive prices.

WE Can Also Supply a Full Range of Guaranteed Replacement Valves for Any British non-ring. American or Continental type at an appreciably lower price.

SEND for Lists of These, and also electrolytic condensers, line cords, resistances, etc.

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1- and 3-phase Motors, ¼ to 5 h.p., surplus stock, first class condition.—Tel.: Reliance 1693. Easco Electrical Service, 18, Brixton Rd., S.W.9. [0642

COMPONENTS

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PREMIER SUPPLY STORES.

PLEASE See Our Displayed Advertisement on page 5. [0488

GARRARD A.C. Record-changers, Model R.C.4a, plays eight 10- or 12-inch records, brand new; £5/5.

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RYALLS RADIO, 280, High Holborn, London, W.C.1, offer new goods, post free.

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AMPLIFIERS, A.C. 200-250v. output 16 watts A.C. from pair 6L6 push pull, 3 stage, ample volume for driving extra speakers available. Complete with valves, and pair of elliptical speakers, wired up ready for use; 72/6, carriage paid.

SPEAKERS, pairs, brand new, elliptical cone speakers, made by first class firm, quality of reproduction outstanding, push-pull pentode transformer, fields 325 ohm for smoothing choke, 8,600 as bleeder, circuit available, handle 10-15w.; 14/- pair.—Ryalls Radio, see above. [8374

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COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

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RADIO CLEARANCE, Ltd.,

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SPECIAL Offer During July.

ROTHERMEL Piezo High Fidelity Speakers

MODEL R.95, 7in. cone, will handle 5 watts; 9/11.

MODEL R.105, 10½in. cone, will handle 6 watts; 11/6.

ABOVE Can be Used in Conjunction with Existing Moving Coil Speaker, connect across primary of speech transformer; to use independently a choke must be connected between the receiver or amplifier output; in the event of push-pull, connect to the 2 anode terminals of output transformer, ignoring C.T.

T.C.C. 3 mfd. 450-volt Working Wet Electrolytics, can type, one-hole fixing; 1/6 each.

POLAR ½ and ¼ Resistances, good selection; 4/6 a gross.

PHILCO American Mains Transformers, 200-250 volt, 6.3 volt 3 amp., 5 volt 2 amp.; 7/6 each.

POLAR N.S.F. Tubular Condensers, our selection; 4/6 gross.

PLESSEY 8 Mfd. Can Electrolytics, 350 volt working, 7d. each; 6 mfd. Can Electrolytics, 450 volt working, 8d. each.

GRAHAM Farish 0.001 and 0.002 Mica Condensers; 8d. dozen.

GRAHAM Farish Short Wave Valve-holders, ceramic type, 4-pin; 3d. each.

GRAHAM Farish Grid Leak Holders, 6d. dozen; pot dividers, wound on glass, 150 and 350 ohm., 3d. each; pilot bulbs, 6.3 volt 0.3 amp., 3d. each.

BULGIN Grid Caps, screened, 4d. each; Bulgin S.P.S.T. twist switches, 6d. each; Bulgin D.P.D.T. twist switches, 9d. each.

9-WAY Group Boards, 4d. each; 5-pin reversible valve-holders, base board or chassis, 3d. each.

BRADLEY Ohm Volume Controls, with switch, 600,000 ohms; 8d. each.

B.I. 25 Mfd. 25-volt Tubulars, 4d. each; B.I. 4 mfd., 200-volt tubulars, 5d. each; 2-piece valve cans., 6d. each; rubber grommets, small, 3d. dozen.

BULGIN 30-watt Mains Resistances, tapped, 195-250 volt; 2/- each.

ALL Orders Over 5/- Carriage Free; under this amount sufficient postage must be included with order.

ALL Enquiries Must Enclose 1½d. Stamp.

RADIO CLEARANCE, Ltd., 63, High Holborn, London, W.C.1. Telephone: Holborn 4631. [8681

RADIO SUPPLIES, the cheapest mail order house in the country, score again with another spectacular purchase.

THE Latest 1939-40 Crossley 10-valve Receiver, five wavebands, covering 7 to 2,000 metres, including television sound, 10-watt beam power push-pull output stage, seven push buttons for automatic tuning, large slide-rule type dial calibrated with boldly printed station names in colour, illuminated waveband indicators, slow motion manual tuning, full A.V.C., band pass I.F.s, 10in. auditorium speaker, cathode ray tuning indicator, a beautiful, massively built cabinet finished in selected veneers, to harmonise with every modern furnishing scheme, all in sealed carton; £8 each.

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1939 "Automatic" 5-valve Car Radio, fits any car, easily installed, 6-volt operation (medium wave), £3/15/6; medium and long wave, £4/10/6.

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JUST a Few Brand New "Weston" 5-valve Car Radios, 2 wavebands, push buttons, 6-volt operation; £4/5 each.

ANY of the Above Car Radios, for 12-volt operation, 3/6 extra.

"COLLARO" Automatic Record Changers, brand new, sealed carton; £4/15.

ROLA G12 P.M.s, with multi-ratio output transformers, sealed carton, £2/12/6; Rola 8in. P.M.s, with matching transformer, 8/- each.

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BRAND New Midget 4 m.f.d. Condensers, 350-volt working, cardboard case; 3/- doz.

RADIO Record H.F. Pentodes, equivalent to Mazda, A.C.V.P.1, boxed, 3/- each; Belmont 80s, 1st grade, boxed, 2/3.

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3 Only.—Ever Ready 4-valve all-wave A.C. Receivers; £1/17/6 each.

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1 Philco 471 1937 Model 4-valve Superhet, A.C., all-wave, £2/12/6; 1 Philips 794A 1937 model 5-valve Superhet, A.C., all-wave, shop soiled cabinet, £3.

ALL the Above-mentioned Sets are Complete with Valves, and in cabinet in perfect working order.

ORDER Early and Save Being Disappointed; a suitable amount must be included to cover postage, etc.

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MORE SPECIAL CLEARANCE BARGAINS

45 gau. Eureka 10 m.a. enamelled Res. Wire, 108 ohms per yd., ¼ lb approx., 200,000 ohms, 3/- for ¼ lb. reel; **36** gau. enam. ditto, 100 m.a., ¼ lb. approx., 8,000 ohms, 1/-; **33** gau. enam. ditto, ¼ amp., 1/- per ¼ lb. reel; **29** gau. enam. ditto, 1/- per ¼ lb. reel; **27** gau. enam. ditto, ¼ amp., 10d.

BARE Res. Wire, **48** gau. Nickel Chrome Wire, 700 ohms per yd., 6/- per ounce; only 4 lb. left. 5 lb. of Heating Strip, chrome, ⅛ × 16 thou., 2/6 per ¼ lb.

SLIDER RES. KIT, for Home Rheo Constructors, 250 watt size, porcelained steel tube, 2¼in. × 6in., two cast end brackets, slider-rodtb rush and guide-handle, nuts, etc., ready for assembly, all new, 5/-. Oxydised Resistance Wire, 4,800 ohms of 100 m.a., 5/-, or any of six other gauges up to 110 ohms for 2 amps., 5/- reel.

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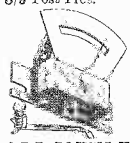
3/9 Post Free.



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ONE HUNDRED 10-watt Moving Coil Magnets by Darwin. New 4-claw 4½ lb. weight, 4/- each, post 1/-.

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60 NEW 3-VALVE unwired Battery Sets with oak cabinet, aluminium panel, lettered, fitted 2 varia. condensers 13 × 7 × 6. Suitable A.R.P. valve or crystal set, 10/-. 2/- post and packing.

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100 ELECTRIC DRILL STANDS. Massive Wolf Geared rise and fall with counterweight. Suitable large or small machines, 7/6, carr. fwd.

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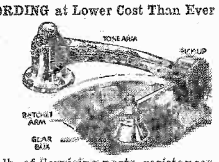
DIX MIPANTAS METER, 19/6, VALVE ANALYSERS, AC/DC, £5. **Cossor** Ganging Oscillator, £12/10/-. Earl Webber Oscillator, £9/10/-. Baldwin Henlog Inductance Bridge, £6/10/-. Baldwin Mufer, £8. Logohm, 70/-. **VALVES** for Transmitters; 40-watt AT40, 4/6.

MORSE or MUSIC. HOME SOUND RECORDING at Lower Cost Than Ever

The **FEIGHT RECORDER** fits any Radiogram, positive drive, worm gear and rack. Complete ready for use, only 37/6. Super Feigh Fidelity Set, 42/6. Tracking Gear only 21/-. Either 3/3 doz. metal blanks can be used or the glass-coated simplets, 10in., 3/- each.



Have you got our NEW SALE LIST? FREE for stamped addressed envelope.

GREAT BARGAIN in 5/- PARCELS. 10 lb. of Servicing parts, resistances, tubulars, micas, variables, wire, sleeving, vol. controls, coils, magnets, chokes, switches, terminals, mouldings, etc.

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218, UPPER THAMES STREET, LONDON, E.C.4

Telephone: Central 4611

COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

VAUXHALL.—Hivac valves, all types. Flat sheet aluminium, 12in.×12in. 3/-, 18in×18in. 5/6.

VAUXHALL.—T.C.C. dry, 8 mfd., 2/6; 600v. aluminium containers; T.C.C. 600v. dry, cardboard containers, 8 mfd., 1/9.

VAUXHALL UTILITIES, 168a, Strand, W.C.2.—Ask for free list; metal rectifiers, HT10 10/-, HT9 9/-. [8677

MAINS RADIO DEVELOPMENT Co. Offer Immediate Delivery, carriage paid, call mornings; telephone Tudor 4046; stamp for list 227A.

DUBILIER Mica Tag Condensers, 0.00005, 0.0001, 0.0002, 0.0003, 0.0005 mfd.; 3d., 2/6 dozen.

ERIE 1-watt Colour Coded Unused Resistors, any size, 50 ohms to 5 megohms, your selection; 3d., 2/6 dozen; 2-watt, 6d.

CENTRALAB Latest Potentiometers, long standard spindle, unused, all sizes, 5,000 ohms-2 megohms; 2/-, with mains switch 2/3.

TUBULAR Condensers, 400-volt working, wire ends, best make, 0.0001-0.05 mfd., 4d.; 0.1 mfd., 4d.; 0.25, 0.5 mfd., 6d.

CLIX Unused Chassis Valveholders, 5-pin, 7-pin, 3d. each; all American sizes, 6d. each; best sleeving, 1½d yard.

FIFTY Unused N.S.F. ½-, 1-, 2-watt Resistors, wire ends, marked, colour coded, 20 different useful sizes in each parcel; 50 for 2/6 only.

MAINS RADIO DEVELOPMENT Co., 4-6, Muswell Hill Rd., London, N.6. Tudor 4046. [8559

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Printed in England for the Publishers, ILIFFE AND SONS LTD., Dorset House, Stamford Street, London, S.E.1, by The Cornwall Press Ltd., Paris Garden, Stamford Street, London, S.E.1. "The Wireless World" can be obtained abroad from the following: FRANCE: W. H. Smith & Son, 248, Rue Rivoli, Paris, Hachette et Cie, Rue Réaumur, Paris, and branches; Messageries Dawson, 4, Rue de Faubourg Poissoniere, Paris. BELGIUM: W. H. Smith & Son, 74-75, Boulevard Adolphe Max, Brussels. AUSTRALIA: Gordon & Gotch, Ltd., Melbourne (Victoria), Sydney (N.S.W.), Brisbane (Queensland), Adelaide (S.A.), Perth (W.A.), and Launceston (Tasmania). NEW ZEALAND: Gordon & Gotch, Ltd., Wellington, Auckland, Christchurch and Dunedin. INDIA: A. H. Wheeler & Co., Bombay, Allahabad and Calcutta. CANADA: Imperial News Co., Toronto, Winnipeg and Vancouver; Benjamin News Co., Montreal; Gordon & Gotch, Ltd., Toronto. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd., Cape Town. UNITED STATES: The International News Co., New York.

DESIGNING SPEAKER HORNS

The Wireless World

6D.

THE PRACTICAL RADIO & TELEVISION JOURNAL

Thursday, July 20th, 1939

No. 1,038. Vol. XLV. No. 3.

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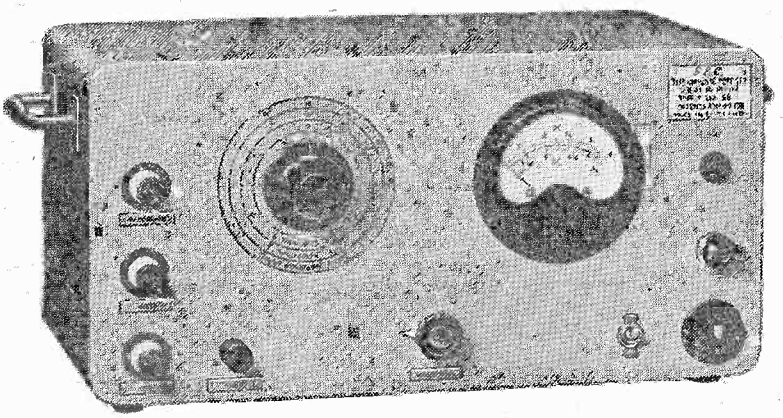

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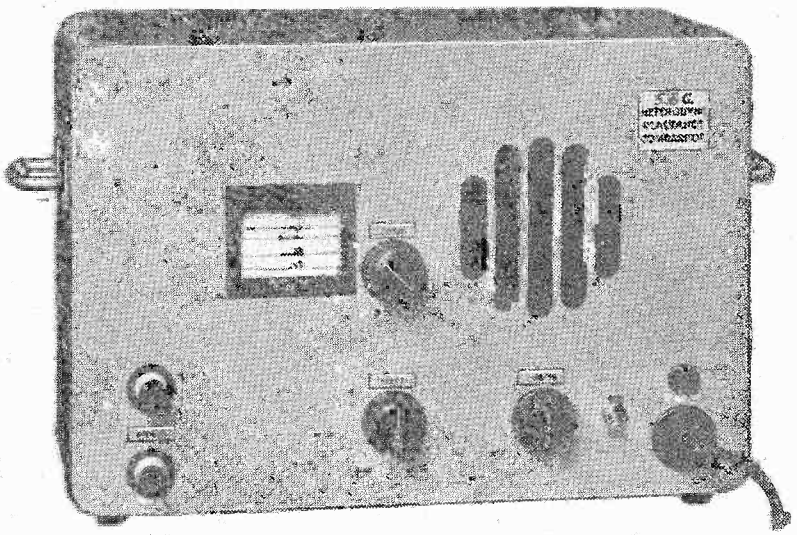

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THE PRACTICAL RADIO JOURNAL

29th Year of Publication

No. 1038. THURSDAY, JULY 20TH, 1939. VOL. XLV. No. 3.

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone : Waterloo 3333 (50 lines).
Telegrams : "Ethaworld, Sedist, London."

COVENTRY : 8-10, Corporation Street.
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GLASGOW : 26B, Renfield Street, C.2.
Telegrams : "Iliffe, Glasgow." Telephone : Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home and Canada, £1 10s. 4d. ; other countries, £1 12s. 6d. per annum.

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EDITORIAL COMMENT

Radiolympia, 1939

Widening the Appeal

EVERYONE concerned with the organisation of the forthcoming Wireless Show — now little more than a month ahead of us—is to be congratulated on the determined and genuinely painstaking efforts that are being made to ensure that the Exhibition may be of interest to the widest possible circle of visitors.

Of late years there has been a tendency to cater mainly for the ordinary listener ; that is understandable enough, as the success of an Exhibition is, rightly or wrongly, always judged first and foremost by its attendance figures. If plans for the forthcoming show come to successful fruition, that hypothetical individual, the "average listener," will have at least as much as hitherto to attract him, while those whose first interest lies in technical matters—or in the means, rather than the end, of broadcasting—should find more to their taste than for many years past.

Every Wireless Interest

There is also a welcome tendency to introduce non-broadcast aspects of wireless ; though such exhibits will be mainly connected with communications in the Services, they give a foretaste of an annual Exhibition of the future which will serve as a focal point of the year for every radio interest—a forum, market place and social rendezvous that no one professionally or otherwise concerned with any aspect of the subject could afford or wish to miss.

The element of surprise is still regarded as an essential part of an exhibition ; it is indeed a perfectly legitimate lure to attract attendance, and one that should not be forgotten by those concerned. One "surprise" that we should like to see is the announcement of a drastic reduction in the price of valves. Without in any way wishing to exaggerate the cost of valve maintenance, it is certain that the fear of heavy expenses for replacements operates as a powerful deterrent against the purchase of high-performance multi-valve sets.

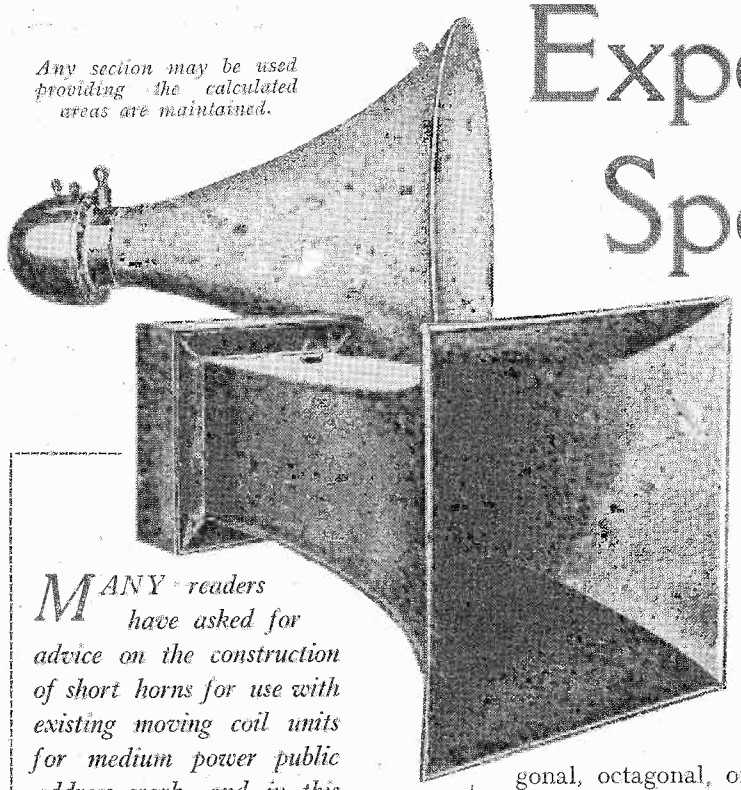
Picture Quality

Some Misapprehensions

CORRESPONDENCE from readers living outside the area of the London Television Service, and particularly those abroad, would suggest that few of these correspondents realise the high standard of excellence now attainable in the received picture. Quite innocently, and with the best possible intentions, we ourselves seem to be partly responsible, and a word of explanation will not be out of place.

We have rigidly set our faces against any retouching of photographs of television screens used for reproduction in the pages of the journal ; as the majority of other photographic illustrations are retouched in order to emphasise details, it is natural that the television pictures suffer by comparison. Again, it should be emphasised that television photographs are "stills" of moving pictures, and it is well known that there is apparently more detail in a moving picture than in a still. Taking into account the losses in the various processes incidental to reproduction, it is inevitable that no photograph we publish can do full justice to the excellent quality now attainable in the original.

Exponential Loud Speaker Horns



Any section may be used providing the calculated areas are maintained.

MANY readers have asked for advice on the construction of short horns for use with existing moving coil units for medium power public address work, and in this article the method of calculating the curvature to fit predetermined requirements is reduced to its simplest form.

HOW TO WORK OUT THE CURVATURE OF THE SIDES

IT is not proposed in this article to give a complete survey of all types of exponential horn, as this would include the narrow throat type, the design of which is intimately bound up with the shape of the air chamber and the mechanical properties of the driving unit. A book could be written on this branch of the subject, but the design of a short exponential horn for use as a "directional baffle" with an existing moving-coil loud speaker is comparatively simple and is frequently asked for by amateurs who wish to try their hand at building one for themselves.

They will be well advised to adopt a plywood horn of square section, as this considerably simplifies the calculation and marking out of the side walls, as well as the work of final assembly. There is no other special reason for using a square section, and if the reader fancies a hexagonal, octagonal, or circular section and feels competent to build it, he will be able to use the same method of calculating the areas at different distances along the axis.

These areas are calculated in the exponential horn on imaginary plane surfaces at right-angles to the axis passing through the centre of the diaphragm. The required area, A, at any given distance from the throat is given by the formula—

$$A = A_o e^{bx} \quad \ldots\ldots (1)$$

where A_o = area of throat, x = distance along axis from throat, and b = the flaring constant (of which more later).

Mathematicians would describe the equation as an exponential series and would recognise e as the base of natural or Naperian logarithms. Fortunately, we can derive e^{bx} from tables of common logarithms after multiplying by a conversion factor[1] and the calculation is reduced to a simple rule of thumb, in which the various steps are given at the head of each column in the worked-out example.

Before we can begin to work out the areas we have to assign a value to the flaring constant, *b*. This is governed by the lowest frequency which the horn is required to transmit without attenuation and is given by the equation

$$\text{Flaring constant } (b) = \frac{4\pi \times \text{cut-off frequency}}{v}$$

where v = velocity of sound.

If we make a rule to work out all lengths in feet this can be simplified to

$$b = 0.011 \times \text{cut-off frequency} \quad \ldots\ldots (2)$$

There is another factor governing the lowest frequency which the horn will radiate properly, namely, the diameter of the mouth or flare. It is as well to calculate this early as it saves the labour of

TABLE OF OFFSETS

$A_o = 0.25$, $b = 1.65$ — Square section horn, Cut-off frequency 150 c/s, Throat 6in. square. — Minimum width of mouth = 1.88ft. = 1ft. 10½in.

(1) Distance along Axis x	(2) bx	(3) bx × 0.4343	(4) Anti-log of Column (3) $= \frac{A}{A_o}$	(5) Column (4) multiplied by A_o $= A$	(6) Square Root of Column (5) Width of Side	(7) Width of Side
ft.				sq. ft.	ft.	in.
0	—	—	—	—	—	6.0
0.25	0.4125	0.1791	1.51	0.378	0.614	7.4
0.5	0.8250	0.3583	2.28	0.570	0.755	9.1
0.75	1.2375	0.5374	3.45	0.862	0.928	11.1
1.0	1.6500	0.7166	5.21	1.30	1.14	13.7
1.25	2.0625	0.8957	7.87	1.97	1.40	16.8
1.5	2.4750	1.0748	11.9	2.97	1.72	20.7
1.75	2.8875	1.2540	17.9	4.49	2.12	25.4
2.0	3.3300	1.4331	27.1	6.78	2.60	31.2

Required minimum width of mouth is developed at 1.6ft. (19.2in.) along axis from throat (see Fig. 2 (a)).

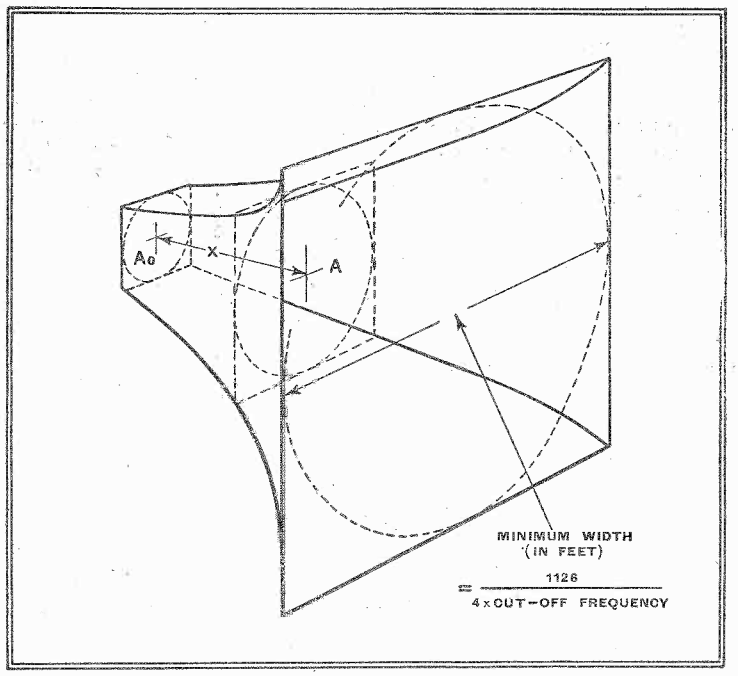


Fig. 1.—The starting point of the calculation is A_o, the area of the throat. Before the area A at any distance x along the axis can be worked out it is necessary to decide on a low-frequency cut-off which will determine not only the rate of expansion but also the width of mouth at which the horn may be stopped. Provided that the relative areas are preserved, the section may be of any convenient shape.

[1] Footnote for those who like to see the intermediate steps, $e^{bx} = 10^{bx \times 0.4343}$ = the antilogarithm of $bx \times 0.4343$.

working out too many cross-sectional areas beyond the required length.

It is usual to fix the minimum flare diameter (length of side in the case of a square section) at one-quarter the wavelength of the lowest frequency to be transmitted. Again on the assumption that we shall be working throughout in feet we have

$$\text{Flare diameter (feet)} = \frac{1126}{4 \times \text{cut-off frequency}} \quad \ldots\ldots (3)$$

We are now in a position to set to work, and as an example we will take the case of loud speaker with a 7-inch diaphragm for which a small square-section horn is required, principally for speech. For this purpose we shall assign a cut-off frequency of 150. This requires from equation (3) a flare 1.88ft. square and a flaring constant, from equation (2), of 1.65. A throat 6 inches (0.5ft.) square will fit nicely over the diaphragm and gives us a throat area (A_0) of 0.25 sq. ft.

Cross-sectional Areas

The next step is to work out the areas, and their equivalent offsets in width of side, at convenient intervals along the axis. We will choose 3-inch (0.25ft.) intervals and set the working out in tabular form. The first column contains the distance x of each station along the axis, measured from the throat. For the second column we multiply by the flaring constant, in this example, 1.65. This is the exponential index, and to convert it to a common logarithm in order that it may be taken out of ordinary log. tables it is multiplied in column (3) by 0.4343. Column (4) is the anti-logarithm of the previous column of figures and gives us the value of e^{bx} which from equation (3) is the same as A/A_0. It is now only necessary to multiply by A_0 (0.25 in this example) to arrive in column (5) at the cross-sectional areas. Taking the square root, column (6) gives the width of the side of the horn at any distance *along the axis*.

Columns (4), (5) and (6) have been included for completeness, but they are not strictly necessary. Since we are using log. tables anyway we may as well add the log. of 0.25 (the throat area) to the figures in column (3), then divide the sum by 2 to give the square root, add the log. of 12 to bring to inches, and then take out the anti-log. for the final column. It will save a good deal of time and trouble if the decimals are retained and the wood marked out with the aid of a rule subdivided in tenths.

That is the end of the calculations, but there is one graphical process before the plywood sides of the horn can be marked out for cutting. It will be seen from Fig. 2(a) that the regular intervals along the axis become progressively longer when they are measured along the curvature of the horn. To find the shape of the side when it is flattened out it is necessary to re-draw Fig. 2(a), taking distances along the curve by means of dividers and mak-

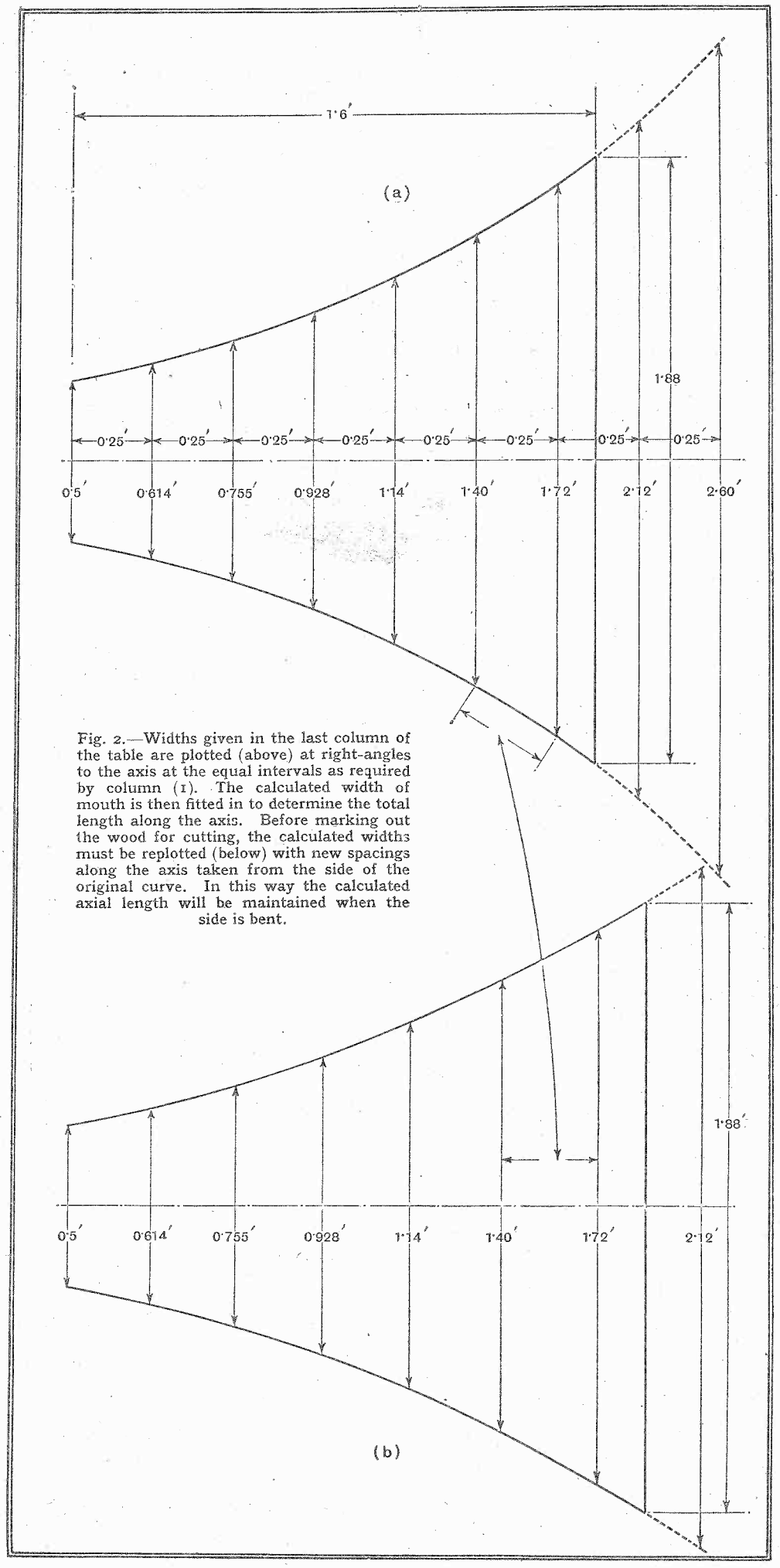


Fig. 2.—Widths given in the last column of the table are plotted (above) at right-angles to the axis at the equal intervals as required by column (1). The calculated width of mouth is then fitted in to determine the total length along the axis. Before marking out the wood for cutting, the calculated widths must be replotted (below) with new spacings along the axis taken from the side of the original curve. In this way the calculated axial length will be maintained when the side is bent.

Exponential Loud Speaker Horns

ing them the new intervals along the axis as in Fig. 2(b). The widths at each station across the axis are, of course, the same as those of the equivalent station in Fig. 2(a).

The point at which the development of the flare may be stopped is also found graphically by fitting in the previously calculated minimum flare width (1.88ft.) at right-angles to the axis until it just touches the curve on both sides. In our particular example this position is reached in Fig. 2(a) at a distance along the axis of 1.6ft. (19.2 inches) from the throat. This represents the length of the finished horn; the length of side before bending will be slightly greater and will be given by the replotted curve of Fig. 2(b).

The reader will no doubt have his own ideas as to how the corners are to be joined. Either internal wood fillets or external metal angle pieces are obvious suggestions. In marking out the sides allow a margin for chamfering depending on the thickness of the ply; the calculated curves represent the *inner* surface of the sides. There is no need in a short horn to struggle with too great a thickness of wood, as the curvature will itself impart considerable rigidity. Standard 4- or 4½-mm. ply sheet would be about right for the example quoted.

Five-metre DX

CONDITIONS FOR NATIONAL FIELD DAY

THE high spot in five-metre activity for the period July 6th to 14th was unquestionably the 56 Mc/s National Field Day held on Sunday, July 9th last. With so many stations active the stage was set for some real DX if conditions were at all favourable.

The opinion formed by the writer was, however, that only slightly better than average conditions prevailed, as apart from one period during the afternoon no signals over 100 miles were logged, nor were other stations heard working over exceptional distances.

G2MV, in Old Coulsden, is understood to have worked G6CW in Nottingham, who was also heard at the writer's station for a brief period calling "Test" on CW at 4.50 p.m.; signals were RST559. He was heard also by G5MAP on the South Downs, which would be about 140 miles from G6CW. G5MAP informed the writer that he had also heard G6DH (Clacton) at ninety miles.

During a brief talk with G8ST it was learnt that signals believed to be from GW6AA on Snowdon were received. Owing to rather bad motor car ignition interference some doubt exists concerning the accuracy of the call sign, but if the time tallies with GW6AA's log it might be taken as confirmation. If the station was located on Snowdon, one would expect the call sign to be suffixed by "P," denoting a portable station; possibly the local interference accounts for G8ST missing this part of the call sign. The distance in this case would be about 185 miles.

While discussing conditions with G3CUP, who was located at Tattenham Corner, Epsom Downs, it was learnt that G5OJ is believed to have heard the Belgian station ON4DJ, which would be about 200 miles distant.

It is essential, however, to wait until all the logs of stations active on this day have been examined and the results correlated before any conclusions can be drawn.

Assuming that conditions are in the main just moderately good, the data so far available leads one to conclude that with present-day five-metre equipment reliable communication can be effected with quite low power up to about fifty miles, with an extension to 100 miles if both transmitter and receiver are favourably situated.

The French station heard by G6YL and mentioned last week is F8VC, located in Paris. This station was received at 7.8 p.m. G.M.T. on June 24th last. Telephony was employed and signals were R6. Between 7.10 and 7.20 p.m. G.M.T. the same evening G6YL also heard the Italian station I1IRA at R8. The following afternoon at 3.32 p.m. G.M.T. I1TKM was received, calling CQ on CW, but signals were very weak. Confirmation has been received that both these stations were in operation at the times stated. As G6YL is located in Northumberland the Italian station could not be less than 800 miles distant, while F8VC would be about 450 miles.

Conditions improved during the week commencing July 10th last, but no listening was done by the writer until Wednesday evening, when at 10 p.m. G.M.T. G8JV, near Nottingham, was worked for a brief period. Deep fading rendered the exchange of messages difficult. At times G8JV peaked to RST568, but within two minutes had fallen to inaudibility. This form of fading is occasionally noticed on signals over 100 miles, but generally does not occur until after about 9.30 p.m. G.M.T. Early evening seems to be the best time for effecting contact with stations over this distance.

About a quarter of an hour later the same evening, G6CW, also near Nottingham, was heard, but the bad fading precluded more than a brief exchange of reports on reception.

G2MC.

Henry Farrad's PROBLEM CORNER

No. 29—Intermittent Loss of Volume

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction:—

90, Fays Way,
Vectorford.

Dear Henry,

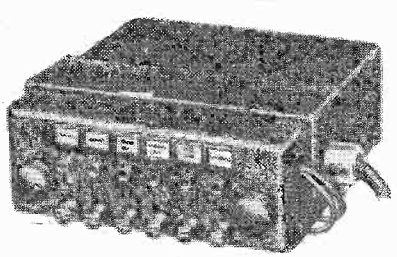
A neighbour with whom I want to stand well has tried to get me to tell him what is wrong with his set—evidently he thinks because I have a meter I'm a complete serviceman. Actually I have very little experience of this sort of thing, but I have succeeded in getting some data on the problem, and perhaps you can help me through.

The complaint is intermittent loss of volume. The receiver is quite an ordinary type of AC superhet—FC, IF, diode det. and output pentode, with valve rectifier and energised loud speaker. I brought the thing over here for test, because these intermittent faults never occur when you are waiting for them. When the volume drops it does so pretty badly, but doesn't seem to be distorted except, perhaps, for increased hum. I noticed, though, that there was very obvious distortion if I tried to bring the volume back to normal on the volume control. Owing to the fault vanishing just as one is bringing tests to bear on it, the only meter result I can report is a considerable rise in HT volts coincident with the fade.

Can you deduce anything from this that would limit the scope of inquiry, because I don't want to waste endless time over it?

Yours gratefully,
Fred New.

Can you spot the fault? Think it over and then turn to page 65 to see if your solution agrees with Henry Farrad's.

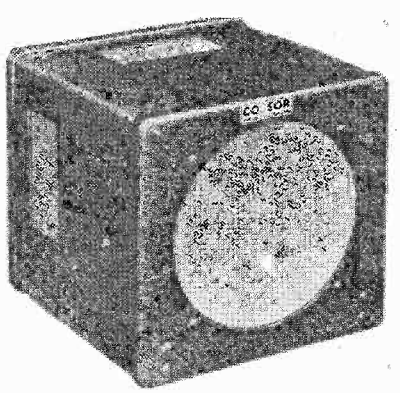


Cossor Car Radio

TUNING in this new receiver is controlled entirely by push-buttons, and as a result the design is remarkably compact. There are two units which can be mounted together or separately. The tuner unit contains the frequency-changer valve and the six pre-tuned circuits for two long- and four medium-wave stations. The trimmers for each circuit are adjusted by knobs on the front panel, and the wavelength range is indicated on each push-button.

The remainder of the circuit is contained in the loud speaker cabinet. There are two IF stages for greater sensitivity and AVC control than is available from the average home set, and these are followed by a double diode triode and a pentode output valve. High-tension current is derived from a synchronous vibrator which eliminates the usual rectifier valve.

Two models are available for 6- or 12-volt electrical equipment, and the price in each case is 11 guineas. A master key switch costs 8s. 6d. extra, and roof-top or under-chassis aerials are available at small extra cost.



The new Cossor Model 85 car radio receiver is divided into two sections with the frequency changer valve and pre-tuned circuits in the dashboard unit (seen left).

Steering by Television

PRACTICAL DETAILS OF PROPOSED SYSTEMS

A NAVIGATOR does not require to know any particular language, nor even to understand the Morse code, if he can receive the televised picture of a compass scale on which his bearings are clearly marked. At the moment, the technical difficulties of sending and receiving such a signal probably outweigh this advantage, but we can anticipate a time when they will not.

In the simplest type of DF system, the wireless operator measures the time between the receipt of a non-directional signal transmitted from the beacon station

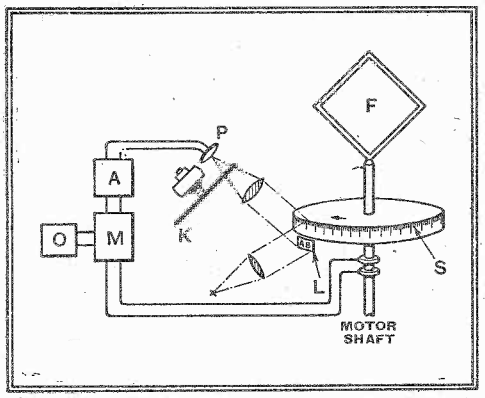


Fig. 1.—Televising the compass card.

as the rotating beam is passing through, say, geographical North, and the moment when he receives the same rotating beam at maximum strength. As the beam rotates at constant speed, the time interval, as measured on a chronometer, gives him his bearing relatively to the beacon. But, of course, he must know Morse in order to be able to read the identification signal of the beacon and to distinguish between the characteristic cardinal-point signals.

The arrangement shown in Fig. 1 is designed to give the same information in pictorial form to a navigator who need have no special wireless training. The beam is radiated from a frame aerial F which is rotated at constant speed by a motor. A compass scale S is provided at the base of the frame and rotates with it. Suspended just below is a label L, which carries the identification letters of the beacon station, but which does not rotate with the aerial F and scale S.

A ray of light is focused on the fixed label L and moving scale S, and the reflected rays are passed through a scanning disc K to a photo-electric cell P which feeds television signals through an amplifier A and modulator M. The latter is also supplied with carrier-wave frequency from a high-frequency source O, and the modulated output is fed back to the rotating frame aerial through brush contacts. The beacon transmits a picture showing the identification label L together with the particular point of the compass through which the beam is passing at any given moment. The distant ship or aeroplane is provided with a non-directional television receiver, on which the navigating officer sees his bearing line projected visually on to the screen as the rotating beam swings across the craft. The line and framing frequencies for the television receiver are supplied as synchronising impulses radiated by a non-directional aerial associated with the rotating frame.

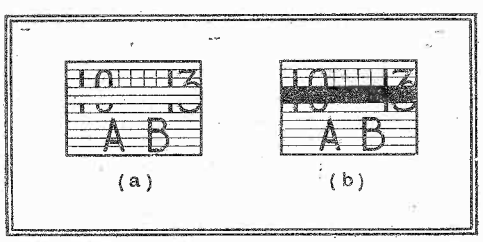


Fig. 2.—What the navigating officer sees.

Instead of superposing the picture of the compass scale on the rotating beam, it can be radiated from a non-directional aerial with two or three scanning lines omitted, so that the received picture appears as shown in Fig. 2(a). During the "blank" interval, radiation from the non-directional aerial is cut off, and the rotating frame aerial is automatically brought into action to radiate a beam which swings progressively forward. As it cuts across the receiver the blank space is filled up with a black bar as shown in Fig. 2 (b). The bearing line is that which bisects the length of the black bar when this appears most intense.

Another method of getting a "picture of one's position" is to take separate bearings in rapid succession on two different beacon stations, say, from an aeroplane in flight, so that each observation is converted into a straight-line trace on the fluorescent screen of a cathode-ray tube. If the change-over from one beacon to the other is made sufficiently quickly both of the straight-line traces will "persist" on the screen, and the point where they intersect then identifies the position of the moving craft.

This arrangement is illustrated in Fig. 3, where A and B represent two known beacon stations. Two input circuits are coupled to the receiver, one tuned to the wavelength of A and the other to the wavelength of B. A mechanically driven switch connects the two circuits alternately and in rapid succession to the receiver, so that one produces the trace A A1, and the other the trace B B1. The point O where the two lines intersect shows the actual position of the craft on a transparent map M, which is placed over the fluorescent screen F so that it is properly orientated with respect to the known geographical location of the two land stations A and B.

ALTHOUGH the application of television to DF is as yet a vision of the future, there are no fundamental difficulties in the way, and in this article details are given of a few systems which have already been the subject of patents.

One of the worst hazards a pilot has to face is fog, particularly when it obscures the landing field. In this emergency a pair of overlapping wireless beams are sometimes used to mark out an approach path to the aerodrome. The approach

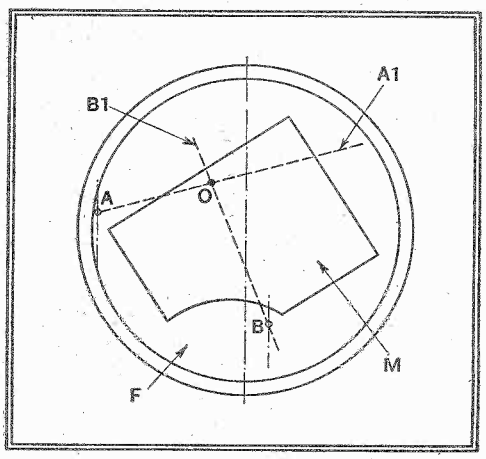


Fig. 3.—Position of craft shown by the intersection of two lines of light.

path leads to another radio beam, down which the pilot can safely glide to earth. Once the pilot enters the guide-way marked out by the beams, he keeps to it by watching the instruments on his dashboard. If the visibility is so bad that he can see nothing outside his cabin, he must fly "blind" until he lands.

Here, again, television can go one better. It is possible to project a picture on to the dashboard of the machine so as to show the course it is taking through the air, relatively both to the landing field and to any buildings or other obstacles which may surround it. In this way the pilot can see at all times exactly where he is in relation to his surroundings, although direct vision may be completely blotted out by fog.

Steering by Television—

Fig. 4 illustrates the method employed. The aerodrome is provided with, say, three rotary frame aerials A, B, and C, at least two of which are directed towards the approaching machine, and follow its flight constantly by keeping the signals received from it always at maximum strength. The different angles through which the frame aerials must be turned during this operation are automatically "repeated" through a telemotor connection to two indicators or pointers, which are mounted over a map of the aerodrome situated in a central transmitting station. The point of intersection of the indicators will then "follow" the actual movement of the machine in flight.

The whole "picture," including the stationary map of the aerodrome and the moving "point of intersection," is then televised to the machine, so that the pilot sees on his dashboard a picture of the landing-field and its surroundings, together with a moving spot of light which represents his own machine travelling through the air. By watching the spot of light as it moves over the fluorescent screen he can follow his actual course of flight when landing.

A somewhat simpler scheme has also been designed to give the pilot a sufficient—though less detailed—indication of his position and surroundings as he approaches an aerodrome in fog. In this case the landing field is provided with a number of short-wave transmitters, spaced at intervals along its sides, while the aeroplane carries a dipole aerial which is "backed" by a reflector, so as to make it highly directional. The DF aerial on the approaching machine is driven by a motor, so that it constantly swings up and down, and to and fro, over the area of the landing field.

In this way the directive aerial is made to "scan" the field of view of the aerodrome. It feeds the signals it picks up to a cathode-ray tube, so that the position of each of the beacon stations appears as a spot of light on the fluorescent screen. The tube is mounted on the dashboard of the machine, where the pilot sees an outline of the landing-field, marked out by the spots representing the beacon transmitters, so that he can tell his position relatively to the field at any given moment.

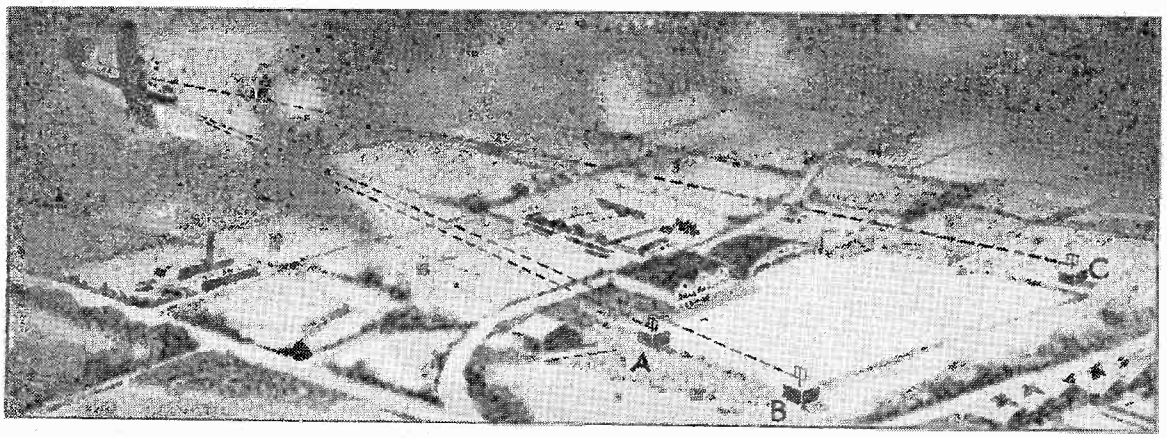
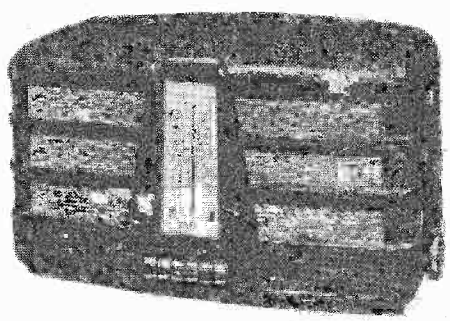


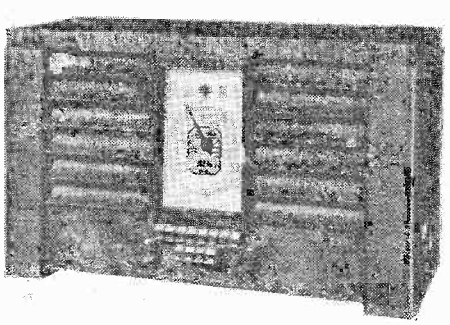
Fig. 4.—Arrangement of the three locator receivers as used in "television" system of blind landing.

More G.E.C. Receivers

THREE more sets, designated the 4040 series, have just been added to the G.E.C. range. They are two-waveband superheterodynes with a four-valve (plus rectifier) circuit and wave-ranges covering 192-550 and 1,000-2,000 metres. They are fitted with mechanical push-button selection of six stations on either the medium or long waveband. Prices are as follows: AC



G.E.C. all-wave battery superhet Model BC4066 and, right, two-waveband AC receiver Model BC4040.



Model BC4040, 8½ guineas; AC/DC Model BC4045, 9 guineas; battery Model BC4046, £7 19s. 6d. (less batteries).

Console models for both AC and AC/DC mains are now included in the 4050 series. They are the Model BC4054 at 14 guineas and the Model BC4051 at 14½ guineas.

There is also a new battery receiver (BC4066) at 11½ guineas (less batteries). It includes a short-wave range and there are twelve push-buttons, four for switching and eight for station selection. The rotary-type dial is provided with a pilot light.

Club News

Ashton-under-Lyne and District Amateur Radio Society

Headquarters: 17a, Oldham Road, Ashton-under-Lyne, Lancs.
Meetings: Wednesday evenings.
Hon. Sec.: Mr. K. Gooding, 7, Broadbent Avenue, Ashton-under-Lyne, Lancs.

Members are very busy getting the new club-room ready and apparatus is being installed. The annual general meeting was held on June 28th. In future meetings are to be held every Wednesday evening, with business meetings once a month.

Our cover picture is made up from photographs reproduced by courtesy of "Flight."

British Sound-recording Association

Hon. Gen. Sec.: Mr. F. J. Chinn, 14, Tirlemont Road, South Croydon, Surrey.

Several members recently visited the new H.M.V. personal recording studios in Oxford Street. The apparatus was fully described to them by Mr. E. G. Huntley.

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne, Sussex.
Hon. Sec.: Mr. T. G. R. Dowsett, 48, Grove Road, Eastbourne, Sussex.

At the last meeting, Mr. S. M. Short gave an interesting lecture and demonstration, his subject being "Valve Characteristics."

Radio Physical and Television Society

Headquarters: 72a, North End Road, West Kensington, London, W.14.
Meetings: Friday evenings.
Hon. Sec.: Mr. C. W. Edmans, 15, Cambridge Road, North Harrow, Middx.

At a recent meeting Mr. C. W. Edmans gave a lecture entitled "Alternating Current Bridge Measurements with Home-made Apparatus." The lecturer brought with him a great deal of apparatus lent to him by Dr. C. G. Lemon and the Mullard Company.

Preparations are being made for the Society's Field Day, which is to be held in the Dorking district towards the end of August.

Slade Radio

Headquarters: All Saints Parochial Hall, Broomfield Road, Slade Road, Erdington, Birmingham.
Meetings: Alternate Thursdays at 8 p.m.
Hon. Sec.: Mr. L. A. Griffiths, 47, Welwyndale Road, Erdington, Birmingham.

The following programme has been arranged by the Society:—

July 27th.—Lecture by Mr. Burr, of the Mullard Wireless Service Co., Ltd.

August 17th.—Lecture and demonstration by Mr. N. B. Simmonds, entitled "Propulsion and Control of Model Railways from DC and AC Mains."

August 20th.—Direction-finding tests.

August 24th.—Latest receivers reviewed and demonstrated.

September 7th.—Construction night. Exhibition and discussion of members' own-built apparatus.

September 17th.—5-metre DF field day.

September 21st.—Lecture on "Television," by Mr. G. W. Stockton, of the General Electric Co., Ltd.

September 23rd-24th.—Night DF test.

Slough and District Short-wave Club

Headquarters: 35, High Street, Slough, Bucks.
Meetings: Alternate Thursdays at 7.30 p.m.
Hon. Sec.: Mr. K. A. Sly (G4MR), 16, Buckland Avenue, Slough, Bucks.

At the meeting held on July 6th an interesting talk was given by Mr. Houchin on "Transmitters of a Quarter of a Century Ago." The lecturer's talk was followed by a demonstration of the working of various portions of old transmitters. There was then a discussion on DX conditions, and it was decided to draw up plans for a regular working schedule to be kept by members. A very popular feature of the meeting was the query corner, when members were asked to submit their difficulties to the meeting at large.

At the next meeting Mr. Paine will give a talk entitled "Arranging and Operating a Portable Station for the National Field Day."

The Vogad—

AND OTHER VOICE-OPERATED DEVICES

By "CATHODE RAY"

IN these modern times the old story of "Open, Sesame!" has lost most of its flavour of magic, and become almost commonplace. It is, in fact, quite possible to arrange for a cavern door, or anything else, to obey a pre-arranged word of command. It only needs a few amplifiers, filters, and relays. This has been done, if I remember rightly, on various occasions, but only as a stunt. It is generally more convenient for such mechanisms to be set in motion by light, and there is at least one firm—in America of course—that makes a living out of light-operated door openers, chiefly for shop entrances, restaurant service rooms and private garages. With these it is not even necessary to speak; the mere approaching shadow of the person or headlight of the car is enough to make the door spring open.

Although this is quite useful, it still seems to border on the stunt class. There are, however, quite a number of voice-operated devices that are working unobtrusively every day. The operation performed usually consists of controlling amplification, or—an extreme case of the same thing—switching something on and off. The principle is always the same—amplifying the voice electrically and using the resulting current or voltage to effect the control—but the details are sometimes quite complicated.

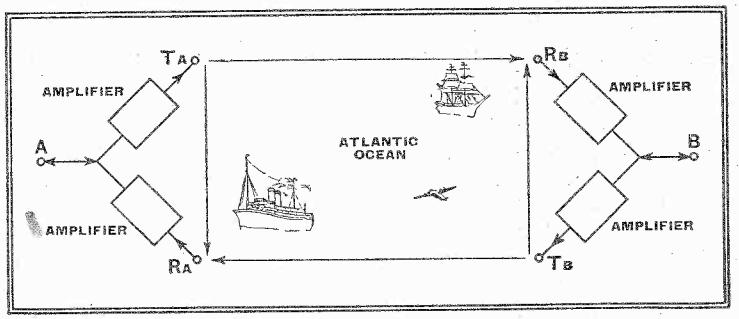


Fig. 1.—This diagram illustrates how, when telephony is carried on between standard instruments over a radio link on a common wavelength, there is a danger of oscillation being set up at each end unless voice-operated switches are used.

A voice-operated switching system made an important contribution to the first regular transatlantic telephone system, opened at the beginning of 1927. This was before short waves came into general use for long-distance work, and the transmission was—and is—carried out by high-power long-wave stations at Rugby and Rocky Point. The longer the wavelength of course the smaller the frequency, and the greater the proportion occupied by a given frequency band such as that necessary for telephony. Even after this band had been reduced to a minimum by eliminating one of the two sidebands and the carrier wave, it was considered not permissible to use separate frequencies for each transmitter. Of course, that made things very difficult because the receivers had to pick up the weak signal from the other side, and yet not be swamped by the signal from the same side, which, even when the receivers were placed several hundred miles away from their own transmitters, was hundreds or even thousands of times as strong.

The mere fact of receiving from the same side as well as from the far side is not in itself out of order, because in the ordinary local 'phone we are accustomed to having the earpiece reproduce our own voice as well as the distant one. The real trouble lies in the difference in strength. For, of course, transatlantic telephony is not very much good unless it can be done through the ordinary home Post Office instruments, in which both incoming and outgoing speech is carried over the same pair of wires.

The outlines of the system can be shown as in Fig. 1, in which A and B are the instruments between which the call is being made, and T and R are transmitters and receivers respectively. The voice of A is radiated from T_A and picked up by R_B, whence it is sent through the exchange to B. Similarly for B-to-A speech. To make A's voice audible to B a very large amount of amplification is needed between R_B and B; so much, in fact, that unless something is done about it the amount re-radiated by T_B and arriving back at R_B is more than enough to set up continuous oscillation around this short loop. It may even happen that oscillation occurs all the way round R_B T_B R_A T_A.

Well, one possibility would be to use a send-receive switch at each end, so that when A was talking T_B and R_A would be cut off, or at least very considerably damped down, and *vice versa*. But if you have any imagination you can picture the confusion that would arise with operators on both sides of the Atlantic trying to keep the switches in step with one another, and with two subscribers trying to get as many words for their pound-a-minute as possible. The only way out of the difficulty is to make the voices themselves do the switching. And that is what was done. The British and American telephone engineers each worked out their own systems, both of which turned out to be effective, although quite different.

The Americans went in for quick-acting relays, very ingeniously balanced and interlocked. Our Post Office adopted what seems to be a simpler scheme, using valves. Even though it is simpler it is too complicated to describe fully here[1] but the general idea is that when B speaks the voltage set up in the system at the B-end by his voice is rectified and used to overbias a valve in the circuit between R_B and B, so that B's voice arriving at R_B can get no farther, and at the same time holds the way open between B and T_B. When he stops speaking this way is interrupted, and a fraction of a second after this has been safely done the circuit between R_B and B is restored. Things are so arranged that both paths are never open simultaneously. It was necessary to work out the timings of all the circuits and control units very carefully to ensure this, and particularly to avoid closing up both lines at both ends if A and B speak together. It is only when conditions are exceptionally bad that this can happen.

British and American Systems

Now that amplifiers are used extensively in telephone systems to give good audibility over long distances, and the circuits are becoming more and more complicated, this voice-operated switching is very useful for avoiding conditions in which the amplification around a circuit is greater than the losses; that is to say, conditions which cause oscillation. With their usual genius for snappy titles the Americans have named this type of instrument the vodas (Voice-Operated Device, Anti-Singing). Unfortunately for us broadcast listeners, the singing referred to is just what we call oscillation, not literal crooning. I am sorry to disappoint you in this way.

The Americans still favour mechanical relays for the switching, while the G.P.O.

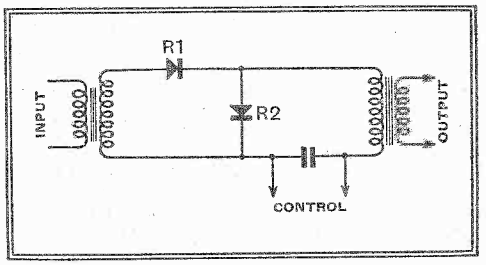


Fig. 2.—The essentials of the system in which metal rectifiers are used to provide automatic control.

has been adopting metal rectifiers for the purpose. Any rectifier is just a resistor

[1] There is a full description in the *Bell System Technical Journal*, Oct., 1927, p. 736, and the *Post Office Electrical Engineers Journal*, April, 1927, p. 65.

The Vogad—
that varies in resistance according to the voltage. Generally, the resistance drops rapidly one side of zero volts—positive, shall we say?—and rises rapidly the other side. So, if the voltage is varied, positively or negatively, the resistance is varied. That is what happens in a valve where the control voltage is generally applied to the grid. The great advantage is that the grid does its controlling without passing any current—or, at any rate, very little. Where control current is permissible, it may be more convenient to use a small metal rectifier as the variable resistance. By applying sufficient negative control voltage the conducting path can be interrupted almost entirely.

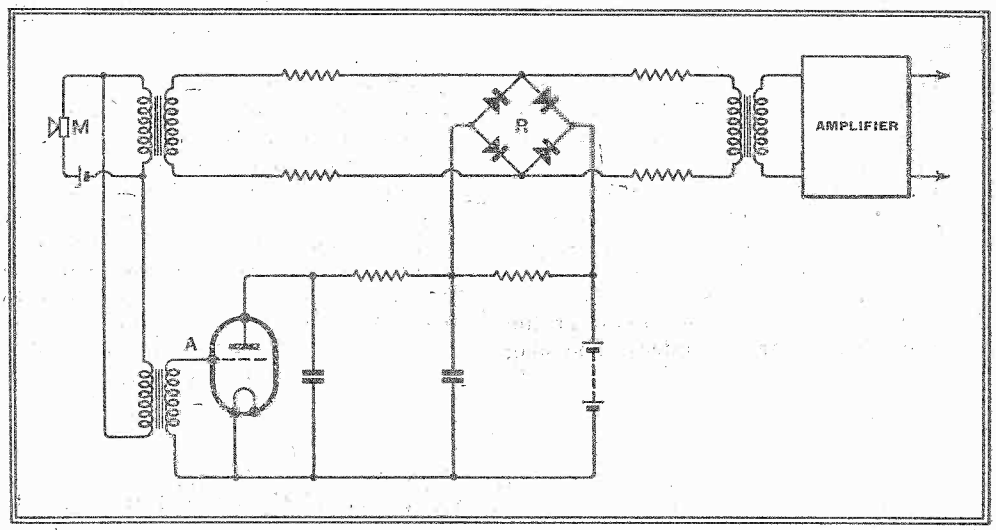


Fig. 3.—Method of using metal rectifiers in audio AVC systems to prevent overmodulation due to large transients, and to hold the output reasonably constant when the average input departs from the normal.

A good example of the use of this is in the Post Office loud-speaking telephone. If you are a big business man, or want to be thought one, you have this type of 'phone in your office so that you are saved the trouble of lifting an instrument to your face and can talk and hear wherever you are. Of course, amplifiers are necessary because of the distance from the mouth to the microphone, and again from the loud speaker to the ear. The problem is similar in some respects to the transatlantic 'phone, for if both ways are open at once the sound from the loud speaker affects the microphone, is amplified, drives the loud speaker, and so causes continuous oscillation round the loop. The solution is basically the same.

How the Vodas Works

Looking at Fig. 2, suppose R1 and R2 are two parts of a metal rectifier, such as the Westinghouse H type, rated at a maximum of 10 mA. When no voltage is applied at "control" they are of approximately equal resistance, and cause a small loss between "input" and "output" (the transformers are just to step up or down to the most suitable impedances). The AC signal at this stage is so weak that the resistance of the rectifier is nearly constant over its small amplitude, and it is therefore not seriously distorted. If, now, a DC control voltage is applied, in one direction it will reduce the resistance of R1 and increase that of R2, practically wiping out any loss; in the other, the resistance of R1 is made much higher than that of R2, and the loss is so great that the circuit is practically interrupted.

In practice a balanced push-pull arrangement is used, and the control voltage is derived from the change in anode current in a valve, to the grid of which rectified speech voltage is applied as bias. When properly designed, the switching of the circuits is done speedily and automatically by the voices, and no undignified effects occur. I have spoken on the telephone to the inventor of this system, without being at all aware that he wasn't using the ordinary 'phone. Over a short line it *is* possible to tell, partly by hearing the background noise fade in and out as the switch acts, and partly because of the reverberation due to the person speaking at a distance from the microphone.

Now that transoceanic telephony is carried out almost entirely on short waves, it is not so difficult to keep the two radio channels apart. But another problem remains. It is essential that the transmitter should not be overmodulated by the speech, for that would not only cause distortion but would involve the risk of a transmitter breakdown. If the amplifiers are set so that there is no chance of overmodulation when the loudest talker shouts into the most efficient instrument connected by the shortest line, the average results are too weak; and when a quiet speaker at the end of a bad line drops his voice, and his microphone is perhaps a bit "packed," the transmitter is likely to be modulated only 1 per cent. or even less, and the chances of hearing it across the Atlantic or Pacific above the inevitable "noise" are very slight. Statistics show that half of the conversations are 15 to 40 db. below the maximum ($\frac{1}{30}$th to $\frac{1}{10000}$th of the power), even at a single local exchange. Taking into account trunk lines and connections between different exchanges the variations are naturally wider still.

Audio AVC Systems

A skilled control operator can adjust the gain of the amplifier to even out these variations and keep the transmitter working somewhere nearer maximum effectiveness on all calls and throughout any one call, but the closer he approaches this ideal the greater the danger that an unexpected cough or exclamation will send the transmitter sky-high. So automatic limiters were introduced to prevent the modulation from exceeding a safe level. But it is obvious that the proper thing to do is to make the whole control automatic. Electric devices can be made to carry out adjustments far quicker than the smartest operator. One thinks of the AVC in the domestic receiver, keeping the carrier wave constant regardless of fading (within reason). It seems a simple matter to apply this to the audio amplifier and keep the speech volume constant. In fact, audio AVC is sometimes used in public address amplifiers to counteract the effects of a speaker who turns from side to side or marches about the platform.

The latest equipment of this sort used in telephony, devised by the American Bell System,[1] and called by them a Vogad (Voice-Operated Gain-Adjusting Device), is much more subtle, being designed to exercise the judgment of a skilled operator but to act on it much more rapidly and precisely. Unlike ordinary AVC systems, in which part of the output is rectified, and

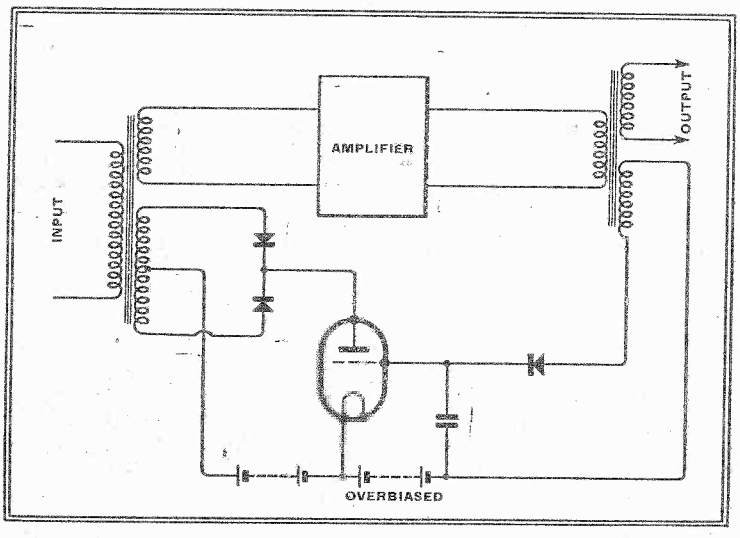


Fig. 4.—An alternative audio AVC arrangement which is largely employed by the G.P.O.

[1] A similar device was designed by the G.P.O.

The Vogad—

the resulting voltage used to bias back one or more valves in the amplifier, it does not bring up the amplification (and consequently the noise) to maximum between words or sentences. It leaves the amplification where it was, and adjusts it only if the next speech is below or above normal. Furthermore, if a loud click or other sudden noise occurs, it does not shut down the amplification long enough to miss a word or syllable, nor does it flatten out speech, and take away the expression by making every part exactly the same loudness. It imposes a limitation by preventing any one sound from overmodulating the transmitter, and it prevents the average loudness of the voice over a short period from being too low; but within that period a certain amount of variation is allowed. So it is not difficult to imagine that the whole arrangement is fairly complicated and nicely adjusted in its timing. Details are given in *Proc. I.R.E.* for April, 1939.

The principal method of control is the same as in our ordinary variable-mu AVC, elaborated by the use of push-pull in order to reduce distortion, but it is supplemented by metal rectifiers used in such a way as to control amplification smoothly instead of suddenly as in the vodas. A rough idea of this part of the scheme can be gained from Fig. 3. Suppose M is a microphone coupled to an amplifier. If a link circuit is inserted, in which a metal rectifier "bridge," R, is placed amidships, and the resistance of R is varied over a wide range, the proportion of speech current that is diverted into the shunt R is likewise varied. The variation can be done by the speech itself, after having been amplified and rectified by an auxiliary amplifier A.

Contrast Expansion

The G.P.O. loud-speaking 'phone also uses metal rectifiers in an audio AVC system to avoid trouble if the big business man happens to have his mouth close to the mike when he roars. Part of the output (Fig. 4) is rectified and used to neutralise the grid bias of a valve, causing its anode circuit to conduct and impose a load through rectifiers connected to a winding in the input transformer.

A certain amount of "noise" being inevitable in all communication systems, we have already seen that it is an advantage for the speech or other matter transmitted to be as strong as possible so as to stand the best chance of drowning the noise. If the speech drops to perhaps 1 per cent. of maximum, it is only in very quiet systems that it is still so much louder than the noise as to make the latter inaudible; hence the vogad. If one wants to restore the original variations in loudness, which have been compressed at the transmitter, it is necessary to use volume expansion at the receiver. The whole scheme is thereupon called a compandor. This composite word is more than just an abbreviation; it should impress on one that the compressor and expander (to use the technically correct terminations) are parts of one system, and it is very little use employing expansion at the receiver if a corresponding system of compression is not used at the transmitter. That is why, when I wrote about volume expansion some time ago, I discouraged it. The B.B.C. does a certain amount of compression, but it is done according to the judgment of a "programme engineer" with a view to giving the best results with ordinary receivers. A volume expander at the receiver would have to know exactly what was being done at every moment in the B.B.C. control room, and, as that follows no mechanical law, it just can't do so.

Then why, you ask, doesn't the B.B.C. install vogads, or something of the sort, instead of advertising for more programme engineers (i.e., engineers with a bias towards music or musicians with a bias towards engineering)? Of course, broadcasting is quite different from telephony, because the artistic element is important, but no doubt the volume could be compressed according to a definite principle that could be exactly neutralised at the receiving end by an expander. The snag is that only a minority of listeners would think it worth spending several pounds extra for the benefit of this system, and the majority would be penalised for their sake.

Even in America, where broadcasters are more concerned with reaching the maximum number of listeners for the benefit of their advertising sponsors than with æsthetic niceties, automatic controllers have generally not found much favour. Peak limiters are rather different; they are used to save the apparatus from accidents that might occur quicker than a human wrist could turn back the control knob. Even they are not beyond criticism; at least if they are allowed to take over any part of the controller's duties, as happened when the B.B.C. were trying out an automatic limiter during the Promenade Concerts last year, with deplorable results from the musical point of view.

Well, there seems to be more in this voice-operated business than I thought, because, in spite of not going into the circuit details, I have used up too much space already. So perhaps I had better not say anything about the invention, mothered by necessity in the U.S.A., for silencing the receiver whenever speech (i.e., advertising) occurs in the musical programmes.

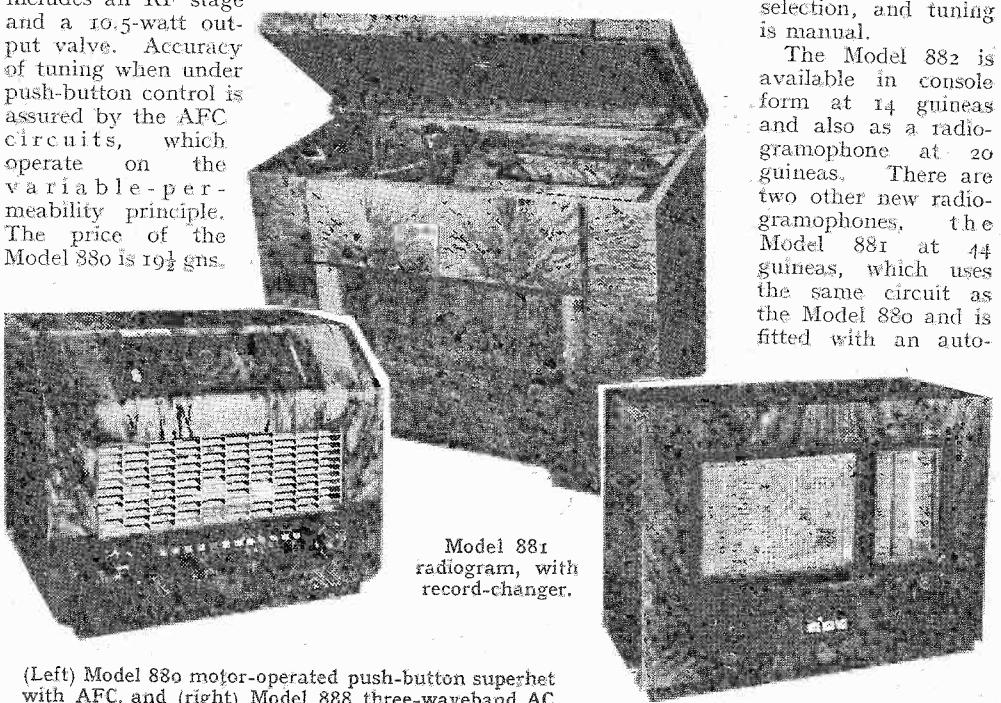
Marconiphone Exhibition Models

FIVE TABLE MODELS, A CONSOLE AND THREE RADIO-GRAMOPHONES

THE leading table model in the list of new receivers which have been added to the Marconiphone range is the Model 880, which incorporates the "Auto Drive" self-operating tuner. This is essentially a motor-driven push-button set with "cruising" control for manual operation. The six-valve (plus rectifier) circuit includes an RF stage and a 10.5-watt output valve. Accuracy of tuning when under push-button control is assured by the AFC circuits, which operate on the variable-permeability principle. The price of the Model 880 is 19½ gns.

Push-button selection for five stations is provided in the Model 882 AC superheterodyne at 10½ guineas, which employs a four-valve (plus rectifier) circuit with permeability tuning. The same circuit forms the basis of the 9-guinea Model 888, but in this receiver push-button control is limited to wave-range selection, and tuning is manual.

The Model 882 is available in console form at 14 guineas and also as a radio-gramophone at 20 guineas. There are two other new radio-gramophones, the Model 881 at 44 guineas, which uses the same circuit as the Model 880 and is fitted with an auto-



Model 881 radiogram, with record-changer.

(Left) Model 880 motor-operated push-button superhet with AFC, and (right) Model 888 three-waveband AC receiver with push-button waverange control.

Next there is Model 879, at 14 guineas, for operation from AC/DC mains. This is a four-valve (plus rectifier) superheterodyne with pre-tuned push-button selection of eight stations. Output is 6.5 watts.

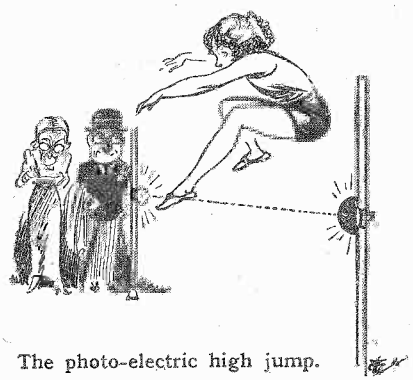
matic record-changer, and the Model 890 at 24 guineas, which has a five-valve (plus rectifier) circuit with pre-tuned press-button selection of eight stations and automatic frequency control.

UNBIASED

By FREE GRID

Photolympia

I WAS delighted, but at the same time amazed, to read in the correspondence column of one of our more ponderous dailies a suggestion to the effect that at the next Olympic Games to be held in this country, use should be made of a photo-electric beam to replace the wooden one in the high jump. The purpose of making the jumpers leap over a photo-electric



The photo-electric high jump.

beam is to ensure that they have cleared the height properly. Very frequently a high jumper will just lightly scrape the wooden bar as he goes over. If one of the judges happened to notice it, the jump would be disallowed, but quite often it passes unobserved. With the photo-electric beam, of course, there would be an automatic indication if it were cut, no matter how brief the period of cutting.

You can well understand my delight at the suggestion, for it does show that people associated with sporting matters are at last beginning to realise that some progress has been made in applied science since the golden age of Greece, and that there is no need to use the clumsy and antiquated methods of judging sporting events which they have employed since the original Marathon race was run. Who knows but that one day they may even wake up to the fact that things like throwing the discus are long out of date, and should be substituted by modern things like hurling the one-metre signal with a one watt transmitter.

The reason for my amazement at the suggestion is that the man who makes it has the effrontery to put it forward as his own idea which he has evolved in the thing he calls his mind. Actually, the thing is as old as the hills, and I myself drew attention to its use five years ago in a well-known girls' school at which I was a visitor. I am reproducing the sketch which I published then, showing one of the girls clearing the bar, while I and the headmistress are watching her.

The arrangement was introduced into the girls' school, as I explained at the time, because it was found that the girls were able to clear much higher levels than was the case when the old-fashioned wooden bar was used. The reason for this is that owing to the peculiar psychological make-up of women, there is a certain element of fear that they will get their legs entangled in the wood bar, and this is, of course, absent with the photo-electric one. I think that it is highly probable that the same thing exists in the case of men, and that the Olympic Games authorities would be amazed at the much greater heights that would be cleared if they adopted the photo-electric high-jump bar.

Programme Bottling

I WAS very interested in the recent article describing a "home" installation for recording on steel tape. To my mind such a device is long overdue and ought to be incorporated in every high-class receiver. The B.B.C., with their usual pig-headedness, usually waste half their best programmes by giving one on the National wavelength and one on the Regional wavelength at the same time, and a device such as this is badly needed so that one of the programmes can be bottled for later consumption. The price seems a bit stiff, however, but I see that gradual payments can be made. They will have to be very gradual in my case as I haven't yet recovered from the disastrous effects of Ascot.

It's an Ill-wind . . .

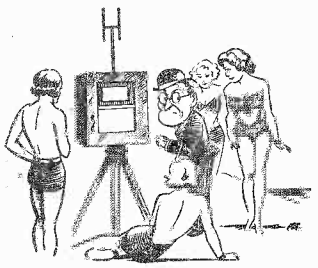
I HAVE, in the course of a long and somewhat varied life, seen a great deal of service in the cause of wireless in many lands, and under very diverse conditions, and have long ago learned to be surprised at nothing—or at least I had until a rather embarrassing experience befell me recently when undertaking some interference-tracking work at a well-known seaside resort. Actually the investigations into the interference which have just been brought to an abrupt and unexpected conclusion, have been going on intermittently ever since television has been in being.

When I was first invited to tackle the job I was, I must confess, not particularly enthusiastic, as I naturally ascribed the trouble to one of the usual sources, more especially as exceptionally sensitive sets have to be used owing to the distance from the Alexandra Palace. I first began to be seriously interested in the trouble when, after over a year's work, I sat down to collate the information I had gathered and made the remarkable discovery that the level of interference rose steadily after Easter, and reached a peak in August, after which a very rapid decline set in until, in mid-winter, it was almost non-existent.

If television interference had any connection with atmospherics, this state of affairs would have been perfectly normal, as atmospherics always increase during the warm summer months; in fact, I began seriously to doubt the hitherto accepted fact that atmospherics were practically non-existent on ultra-short wave lengths. I even went so far as to prepare a paper to be read before a certain learned society on the discovery of a new type of atmospheric, and was only just saved in the nick of time from thus making a fool of myself, by the unearthing of the true cause of the trouble.

Among the other peculiarities of the interference was that it reached its peak only at certain hours of the day, although when the weather was warm, and there was moonlight, it was evident also in the early night hours. The most startling discovery, however, was that it was strongest when I took my portable testing apparatus down to the beach, and I wasted a lot of time trying to work out a theory of electrostatic charges being generated by the friction of the sea-water on the shingle.

I was rather hindered in my investigations by the hordes of so-called bathing beauties who infest our seaside resorts at this time of the year, as they continually pestered me to take their photographs, being under the impression that my apparatus was a cine-camera, and that I was an R.M.A. agent, collecting data for the selection of the Beauty Queen who is to preside over Radiolympia this year. Eventually I and my apparatus were compelled to take refuge in a bathing tent, and it was this very fact that led to the solution of my problem, as I found that in the



Hindered by so-called bathing beauties.

bathing tent the interference was so severe that it practically blotted out everything. Even then I should not have tumbled immediately to the cause of the trouble had not one of those sudden gales, for which our climate is so famous, sprung up one morning and blown away several of the bathing tents, my own included, with rather embarrassing results.

I suppose that I ought to have known from my earliest school-day experiments, in producing static charges, that the vigorous rubbing of the skin with a rough towel would be bound to produce trouble on ultra-short wave lengths. Try it yourself and see.

The Influence of RED "E" VALVES *on Set Design*

ALL-ROUND IMPROVEMENTS IN PERFORMANCE AND QUALITY

ALTHOUGH the past year or two has seen no radical developments in receiver design, with the exception of automatic tuning, there has been an immense advance in performance and reproduction. Even the most modestly priced British receiver today shows an incomparable improvement over its prototype of 1936 and 1937.

The part played in this progress by Mullard Red "E" Valves is worthy of special note, for their outstanding advantages have solved many of the problems which previously faced the designer.

Both in mechanical construction and electrical characteristics these valves represent a fundamental advance. Their small physical dimensions have facilitated chassis layout, while at the same time setting a new standard in reliability and freedom from mechanical noise. Their unique principles and characteristics have contributed in no small measure to Quality reproduction, and have given real entertainment value to short-wave listening.

In the table below, a typical "E" Valve combination is described. It clearly illustrates the opportunities which now exist for including desirable refinements in receivers of practically every price group.

TYPE	DESCRIPTION	OUTSTANDING FEATURES	EFFECT ON SET PERFORMANCE
ECH3	Triode-Hexode Frequency Changer	High Conversion Gain (0.65 mA/V); small optimum heterodyne voltage; low heater consumption.	Improved performance on short waves, particularly in respect of low noise level and reduced frequency drift.
EF9	Variable-mu H.F. Pentode	Operates on "Sliding Screen" principle. Improved variable-mu characteristics; high slope; low anode current.	Reduced modulation distortion.
EBC3	Double-Diode-Triode	Specialised design and "E" construction result in great efficiency when employed as L.F. amplifier in R.C. coupled circuits.	High Voltage Gain with minimum distortion.
EL3	Output Pentode	Power Output—3.25 Watts at 5% distortion; 4.5 Watts at 10% distortion.	Quality reproduction with ample output for normal requirements.
AZ1	Full Wave Rectifier	Good regulation characteristic.	Dependable performance.

The Mullard Technical Service Department will be pleased to supply comprehensive data or reply to any enquiries in relation to the Mullard "E" Series.

Mullard Red "E" Valves

THE MULLARD WIRELESS SERVICE CO. LTD., Century House, Shaftesbury Avenue, W.C.2

Magnetic Television Receiver

Part IV.—CONSTRUCTION AND OPERATION

IN this last article dealing with the Magnetic Television Receiver, the construction and operation are discussed in detail. The adjustment of the scanning gear and focusing arrangements is treated, as well as the setting of the receiver controls for the best definition in varying circumstances. Some notes on the performance obtainable are also given.

By W. T. COCKING

IN the previous articles the general arrangement has been discussed in detail, and we now come to the practical topics of building the apparatus and afterwards adjusting it. Little need be said about the actual construction, for most points will be clear from the drawings. In the receiver all connecting leads are very short and must be kept so. The arrangement of wiring and earthing points must be carefully followed; in particular, the earthing leads for suppressor and metallising must be short and of heavy-gauge wire (No. 16).

It is sometimes said that a single-point earth connection for each stage is the best, but this is not so in this case. It was actually tried, and the amplifier was found to be somewhat unstable; rewired as shown in the drawings, it was completely stable.

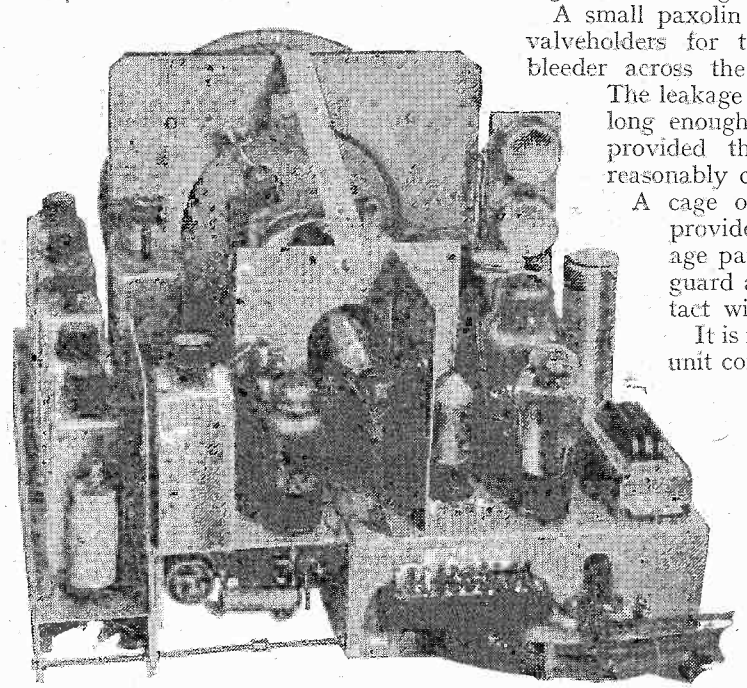
No aerial terminals are provided on the chassis, it being intended that a short length of feeder be attached to the two primary leads from the aerial coil and taken to terminals or sockets mounted on any convenient part of the cabinet away from the output end of the receiver. Similarly with the earth. A stout lead should be attached to any convenient part of the chassis and taken to an earth terminal on the cabinet.

Earthing

The use of a good earth is an essential safety precaution, but is rarely necessary from the point of view of performance. Never operate the equipment without a good earth attached, especially when experimenting. Normally, there is no danger without an earth, but it is quite possible for the entire chassis to become live if a transformer breaks down in a certain way. A severe and even dangerous shock might then be obtained from the chassis. If the chassis is properly earthed, however, such a breakdown would cause no danger; actually, there would be a short-circuit and the fuses would blow and save the apparatus from further damage.

In constructing the time-base do not forget that all leads attached to grid or anode of each oscillator are at high potential—up to about 2,000 volts. They must be well spaced from chassis and from other wires and components.

The valveholders used in this unit are of high-voltage type, for the insulation of the ordinary wafer socket is quite inadequate. As the HT supply to this unit is only 330 volts—a value lower than that adopted in many AF amplifiers—the experimenter may feel that no special precautions are needed and be tempted to poke about inside at random while it is working. If he does he will be liable to get an unpleasant shock, although hardly a dangerous one. The rapid changes of current through the coils on the fly-back generate a back EMF of some 2,000 volts, so handle even this so-called "low-voltage" equipment with due respect.



This rear view of the equipment shows the receiver on the left and the time-base on the right.

The focus coil is carried by three lengths of 2BA rod, but is not fixed rigidly. As will be seen from the photographs, each rod carries a brass collar with a V-shaped groove in its periphery. The focus coil is held in these grooves, and its position can be adjusted by screwing the collars along the rods.

The power pack is built as a separate unit on a plywood base. This is used because otherwise a heavy-gauge steel chassis would be needed to give sufficient rigidity for the weight of the transformers and chokes. Do not forget to join all transformer and choke frames together and to negative HT, which is earthed. In fact, all accessible metal parts should thus be earthed, to prevent them from acquiring a static charge.

A small paxolin panel carries the two valveholders for the rectifiers and the bleeder across the high-voltage supply. The leakage paths have been made long enough for the voltage used provided the apparatus is kept reasonably clean.

A cage of perforated gauze is provided over the high-voltage part of the equipment to guard against accidental contact with it.

It is intended that the inter-unit connections shall not exceed one yard in length, otherwise the heater voltage drop may be excessive. They are better shorter than a yard, but this length is satisfactory.

For the 4 v. 8A. and 4 v. 3.5 A. heaters use twin 110/36 flex, and for the 2 v. 2.5 A. winding use twin 70/36 flex. The three HT and tube cathode leads can be ordinary well-insulated flex, and the 20 v. 0.2 A. leads should be of motor-car ignition cable. A small voltage drop here is not important, but high insulation is necessary. For the tube anode use a length of really heavily insulated cable; the ordinary ignition cable is hardly good enough.

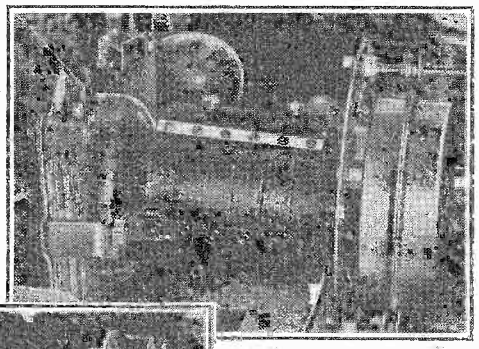
Mounting the Deflecting Coils

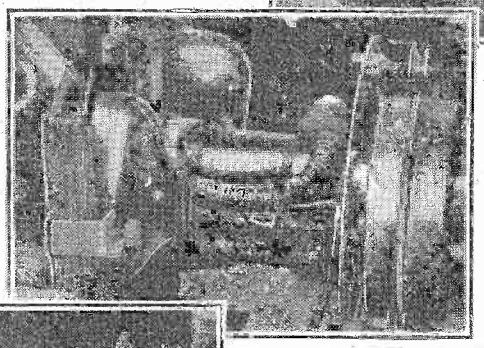
Before mounting the tube it is convenient to slip two or three thin rubber bands over the neck. The tube pushes in from the front, a slot being provided to pass the projection carrying the anode cap. When the tube is home, turn it a little clockwise so that the cap is in a convenient position; then place the clamping ring in front and run on the four retaining nuts. These must be tightened so that the tube is securely gripped without throwing excessive strain on it. It will

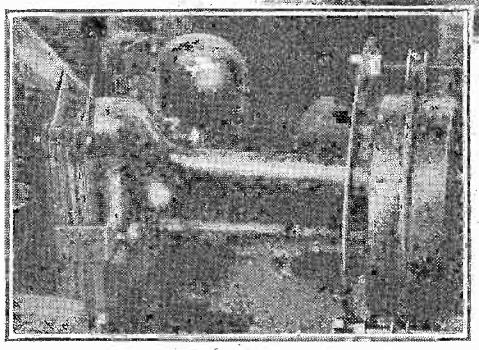
be found that finger-tightness is entirely adequate.

In doing this care should be taken to tighten up the nuts evenly a little at a time, so that the tube is kept square in its mounting and passes centrally through the focus coil. A small amount of adjustment can be made afterwards, for the rear piece of the tube clamp can be moved somewhat relative to the chassis on the bolts holding it to the chassis. The clamp should be moved lengthwise on these bolts until the flange on the tube at the junction of the neck with the conical end is between the pole pieces of the frame yoke.

The next thing to do is to mount the line deflector coils. These are curved to fit round the tube neck, one above and one below. It is here that the rubber bands will be helpful to hold them in place while the fitting is being carried on. The coils must be placed horizontally with equal gaps between them on each side and as near the conical part of the tube as possible. If the coils are not horizontal the top and bottom of the picture will not be at right-angles to the sides. In other words, the picture will be a parallelogram, but not a rectangle. If the two coils are fitted with unequal gaps on the two sides, then top and bottom of the picture may not be parallel.







These photographs show the CR tube in place and illustrate the fitting of the line deflecting coils. In the first picture the coils are absent, in the second they are held in place by rubber bands, and in the third the shroud is fitted.

When satisfied that the coils are in their correct position, fit the shroud. This is opened out to pass round the coils, and held together by a couple of nuts. The two projecting tongues are clamped under the side screws on the frame yoke. The focus coil should be brought forward, keeping its axis parallel to the tube, until it is about three-quarters of an inch behind the line deflector coils.

The LT and grid connections to the tube are made by means of wander plugs. Looking at the tube from the rear, the base has three sockets unequally spaced. The grid socket is the one most widely spaced from the others; if this is underneath, the left hand of the top pair is for heater, and the right hand for heater and cathode. It is important that this right-hand socket be the one which is joined to socket No. 10 on the terminal block. No damage will result if the LT leads are reversed, but there will be a severe black hum band across half the picture.

Before switching on, turn the tube bias control R48 to maximum, thus giving full bias. Allow a minute or two for the tube and valves to warm up and then reduce R48 slowly. If all is in order the blank raster should appear on the screen. If a spot appears, neither time-base is working, and steps should promptly be taken to find out why. If there is only a vertical line, then the line time-base is inoperative, while if there is only a horizontal line it is the frame time-base which is out of action.

Normally, the line time-base is audible, giving a high-pitched whistle, sometimes with an attached rattle. This comes chiefly from V13, and is a useful indication that the time-base is working. It can be very largely suppressed by fitting a small canvas bag over this valve.

The raster will probably be blurred, and the focus control should be adjusted to correct this. If it is found that the correct focus point lies outside the range of R47, the focus coil should be moved along the neck of the tube. For any position of the coil there is a certain coil current for correct focusing, and, conversely, for any coil current within limits there is a critical position of the coil for focusing.

The range of control afforded by R47 is limited, and so the coil position must be correctly chosen.

When satisfied that the time-bases are operating correctly the receiver should be attended to. Turn R48 to full resistance and switch off. Allow at least two minutes before doing anything else; in other words, give C42 ample time to discharge. *Make a rule of doing this.*

Incidentally, in normal use it is advisable to black out the picture by R48 before switching off and to see that this resistance is at this end of its travel before switching on. Conditions are then better for the tube, for there is much less risk of the screen being burnt.

When first putting the receiver into operation it is necessary to adjust the IF and RF circuits, and it is convenient not to have the high voltage on the equipment while doing this. The HT rectifier V17 should be removed before switching on, therefore, and it is also as well to disconnect the tube anode lead at *each end*. The high voltage will then be on the transformer secondary only.

The easiest way of lining-up the amplifier is with a test oscillator, which need not be modulated. Disconnect R24 from chassis and insert a low-range milliammeter. Clip the oscillator output to the grid of V5, removing the normal grid clip, and with full oscillator output at 13 Mc/s adjust L7 for maximum output. Transfer the oscillator output to V4 and adjust L6, and so on until L4 has been adjusted with the oscillator output to the grid of V2.

Then check over the adjustments of all four IF couplings. All circuits are now in line, but the band-width will be rather too narrow for really high definition. Except when the receiver is a long way from the transmitter, when it is best to broaden the response on the vision signal itself, the next step is to widen the pass-band. To do this adjust the oscillator input until a convenient deflection is obtained on the detector meter—say, one milliampere. Then screw up L6 until the meter reading is halved. Then increase the input to bring the detector current back to its original value, and unscrew L5 until the current falls to one-half.

Adjusting the Receiver

This procedure has been found to give a pass-band which is very nearly symmetrical about 13 Mc/s and which is about 3 Mc/s in width. The band-width can be further broadened by more mistuning these circuits, but it is advisable to leave this until signals have been received. In some districts a compromise between band-width and sensitivity may be necessary.

The next step is to attach the aerial and to tune in the vision transmitter. If a pair of phones is available connect them in series with a condenser of 0.1 μF or so between the tube grid and chassis. One setting of C8 will be found at which the sound transmission is audible, and another at which the vision signal comes in. The characteristic sound of the frame sync pulses will be recognisable at once, but the line pulses will be inaudible unless the phones are exceptionally good.

Tune in the vision signal on C8, and L1 and L2, and then get the CR tube in operation. If no phones are available, this preliminary tuning will have to be done on the tube, and it is then more difficult to distinguish between the vision and sound signals. Whichever is tuned in, light and dark patches will appear on the screen, but their appearance will be greatly affected by the setting of the line frequency control in the case of the vision signal, but not much affected with the

sound signal. In this latter case, moreover, the light and dark patches are always horizontal.

Make sure the tube bias control is set for maximum bias; that is, R48 should be set for its full resistance. *Switch off*. Wait a minute or two, insert the rectifier V17, connect up the tube anode lead at each end, and switch on. Wait a minute or so for the rectifier to warm up and with the gain control at minimum (R15 at full resistance), reduce the tube bias gradually until the raster is visible. Then increase the bias until the raster is *just* blacked out. Then turn up the gain control. A series of black and white patches and lines will appear on the screen and will probably be chasing one another over the screen. Set the gain control to give moderate brilliancy and adjust the frequency controls.

Start with the frame hold. As this is turned it will be possible to distinguish amid the pattern on the screen a horizontal black line moving vertically. The rate at which it moves depends on the setting of R43 and over a small range of settings R38. The pattern will change rapidly and over a small range of settings the picture will appear and lock in firmly. Now carefully adjust the focus control R47 for maximum sharpness of the horizontal scanning lines.

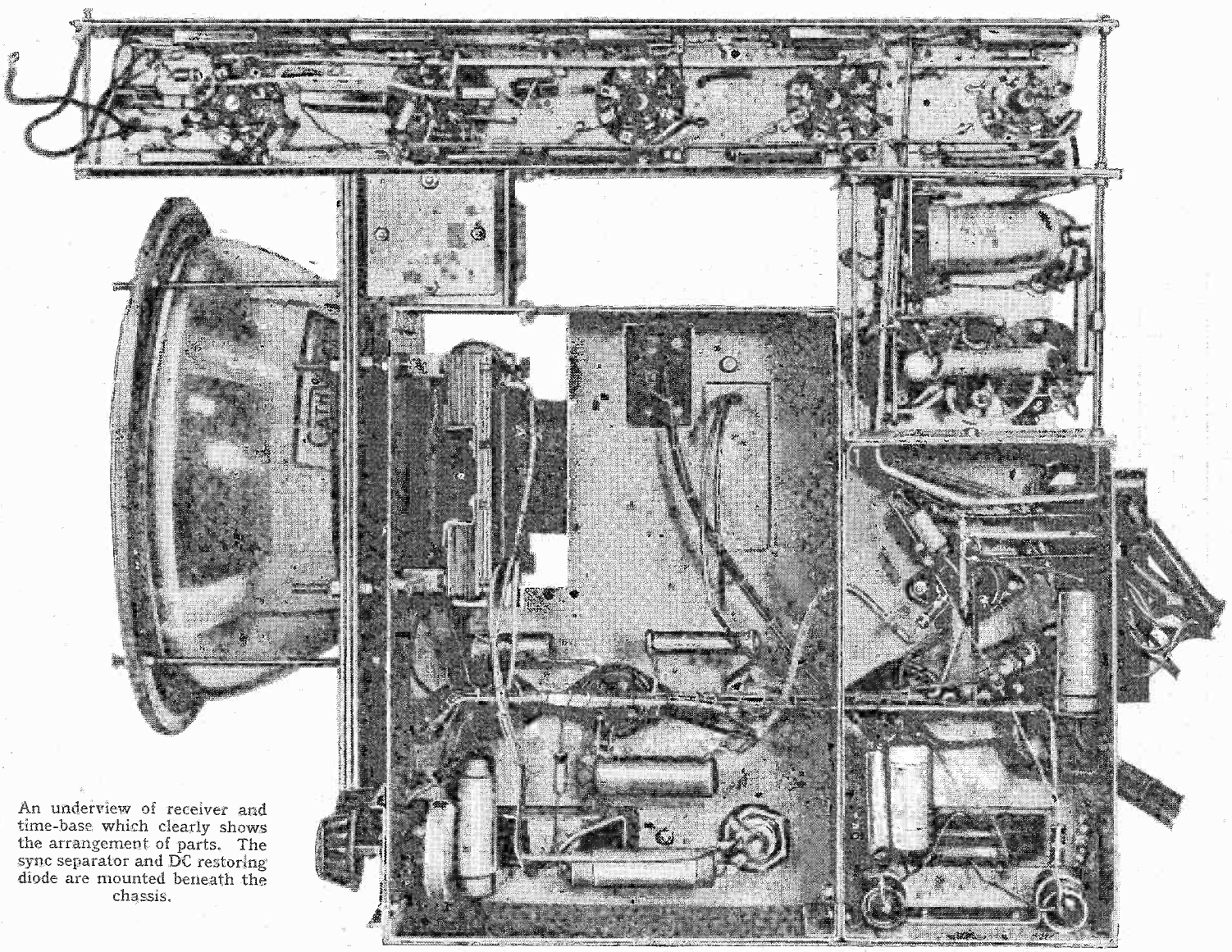
Receiver gain and tube bias should now be adjusted for the best picture. At first the tendency will probably be to make the picture too black and white, so that a soot and whitewash effect is obtained. A very bright contrasty picture is so secured, but the detail in the black, and often in the white also, is lost. Normally, the settings of the two controls should be so related that any further reduction in tube bias makes the frame fly-back lines visible in black parts of the picture. Ideally, this tube bias would be always correct and it would be independent of the gain control setting. In practice, the controls are to some extent interdependent, due to imperfections in the DC restoration, tube characteristic, transmission and so on. It will be found, however, that the optimum tube bias does not vary much and is quite close to the value first found by blacking out the raster with no signal.

of the frame frequency control should remedy matters. If the picture ratio is incorrect, it can be adjusted by R45; the circle in the tuning signal at the beginning, and the adjustment signal at the end of a transmission should be a circle, not an oval.

Before going any farther it is probably advisable to spend an hour or so watching the picture at normal viewing distance and making a few notes of any defects. The synchronising is very good in this equipment and should hold throughout a programme without attention. If the controls are untouched, the picture will not lock in straightaway when it is next switched on, because the controls are affected by temperature to some extent. If the controls are not touched, the picture will lock in after about five minutes and remain stable.

Normally, therefore, it is advisable to switch on 5 or 10 minutes before the start of a programme. The picture can, of course, be synchronised straightaway by using the controls, but then further readjustments may be needed during the warming-up period of 10 minutes at most.

The most likely defects to be found at



An underview of receiver and time-base which clearly shows the arrangement of parts. The sync separator and DC restoring diode are mounted beneath the chassis.

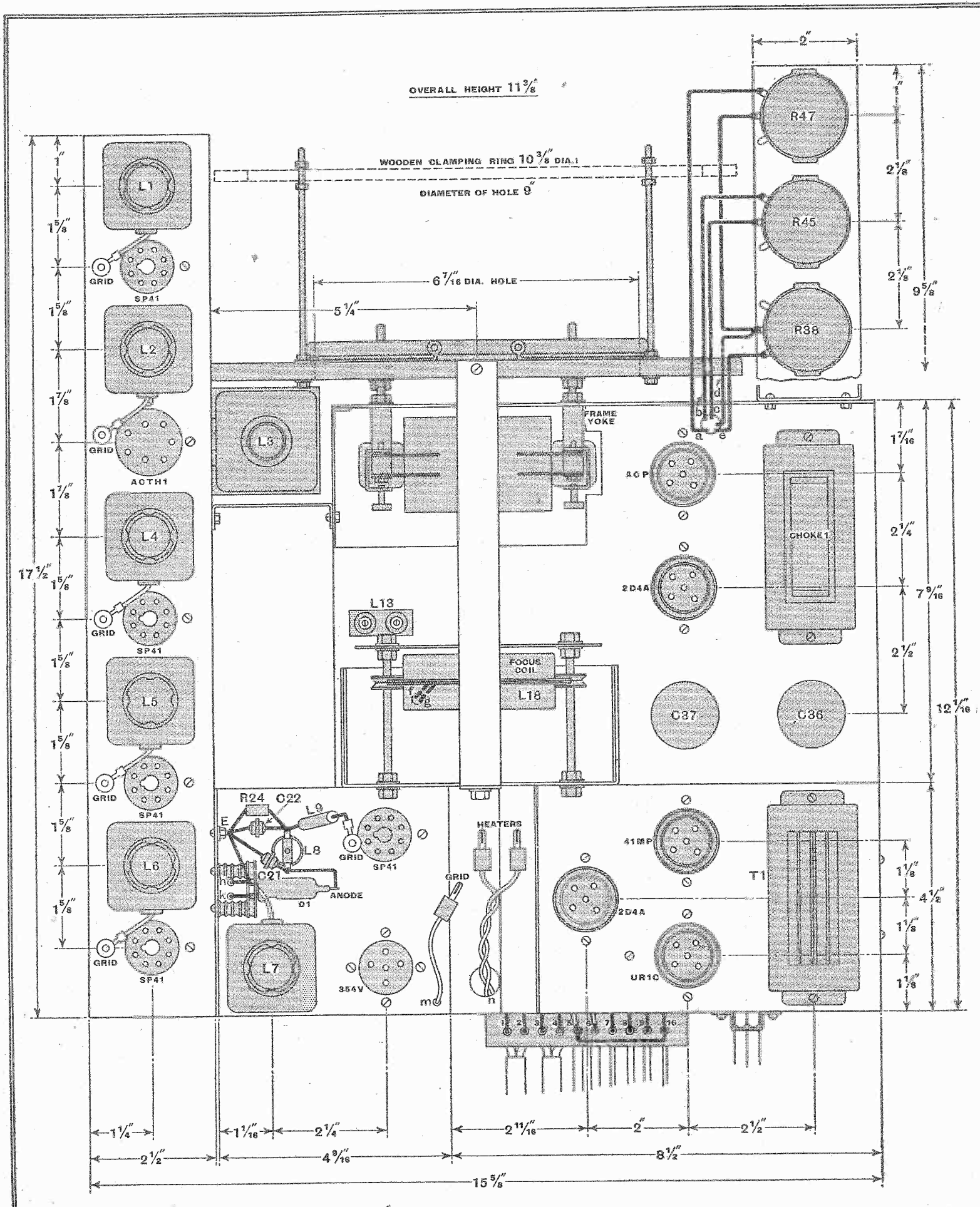
this line or band will lock in at the top or bottom of the picture and disappear.

Then turn the line frequency control

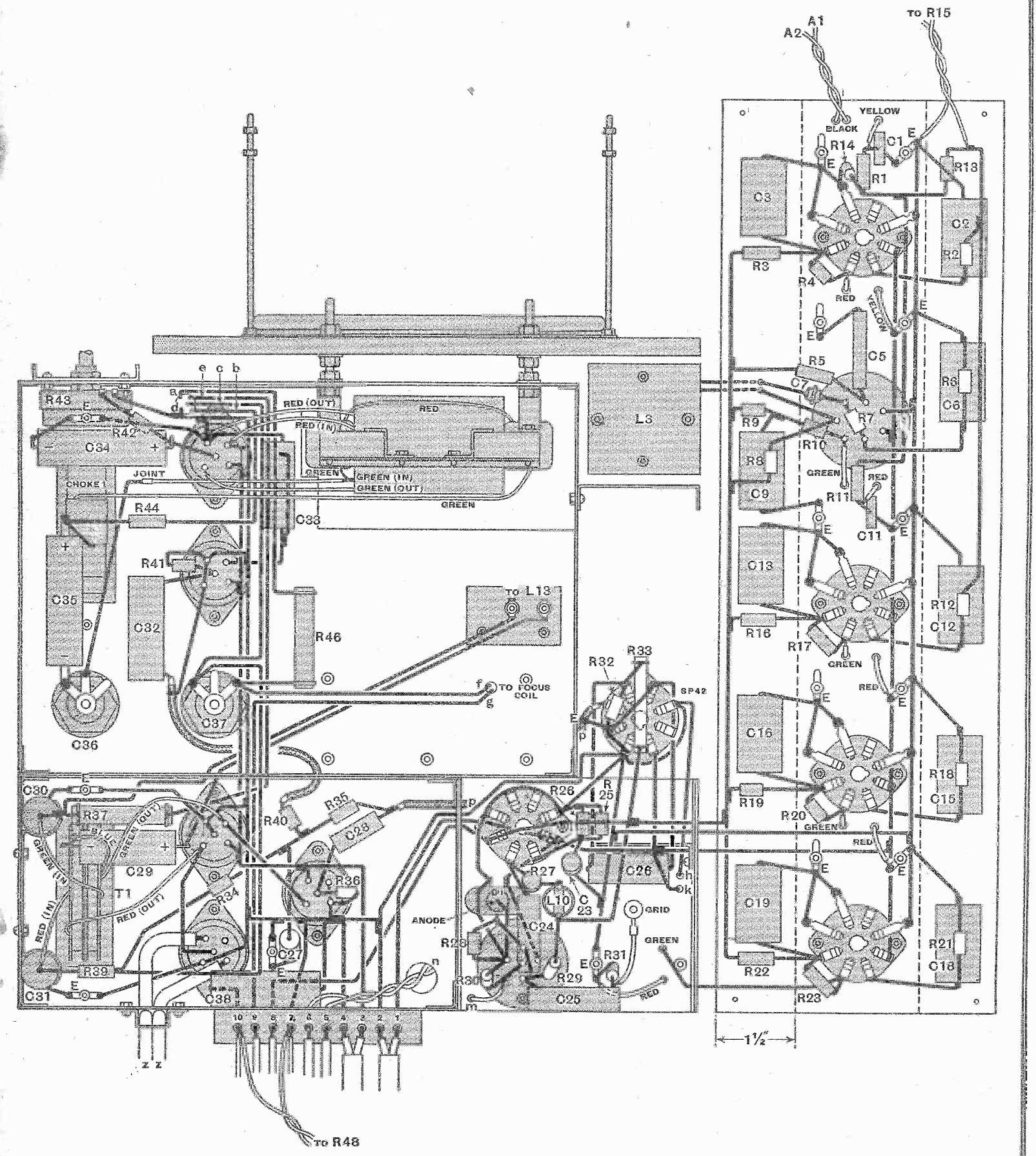
Close examination of the picture may show that proper interlacing is not secured. If this is the case, a *slight* readjustment

this early stage are a cut-off on one side of the picture *before* the edge of the screen and a picture which is not centred on the

"THE WIRELESS WORLD" MAGNETIC TELEVISION RECEIVER—PRACTICAL W



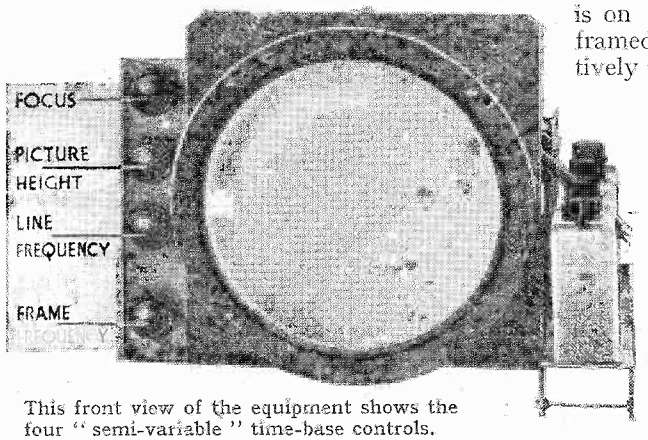
RING DIAGRAM OF THE COMBINED RECEIVER AND TIME BASE CHASSIS



Magnetic Television Receiver—

screen. The former is caused by the beam hitting the side of the tube, usually at the shoulder where neck and cone join. It will occur if the line deflector coils are too far back on the neck towards the focus coil, but is usually caused by the focus coil being incorrectly set. This effect can normally be avoided and the picture centred by adjusting the focus coil by means of its supporting collars. Not much tilting of the coil should be needed—never so much that the coil is forced askew against the neck of the tube.

Now for the question of definition. This should be judged at about normal viewing distance, certainly not at less than two



This front view of the equipment shows the four "semi-variable" time-base controls.

feet, and with moderate brilliancy. Unless the tube focus is poor, the vertical definition depends on the number of scanning lines and is unchangeable. It is the horizontal definition that should be judged.

Note especially the edges of vertical lines. A black line on a white background may be fuzzy on its right-hand side; that is, the black changes gradually to white. This indicates that the high frequency response is not good enough and the effect of mistuning L5 and L6 a little more should be tried.

Alternatively, and often better, single-sideband reception can be tried. Mistune C8 so that the brilliancy drops to about half and then turn up the gain control. This about doubles the effective band-width and is the condition which the writer usually adopts. Mistuning C8 on one side will probably bring in interference from the sound transmitter. If this is found, mistune on the other side of the point giving the strongest signals.

It is usually advisable also slightly to mistune the two RF circuits on either side of resonance, especially when strong signals are received.

At certain settings of C8 transient distortion may occur. This takes the form of an oscillatory change of current on transients. A black bar on a white ground affords a good test. On the left-hand side the signal changes from white to black, and following the initial change there may be a greyish line visible on the black body of the bar. The effects are more noticeable on the change from black to white in the right-hand side. Immediately adjacent to the bar transient distortion will produce an abnormally bright band followed by one which is slightly less bright than the correct background shade.

If present in very small degree, this effect is very useful in increasing the apparent sharpness of the picture. There is no harm in a very small amount, but its presence should not be detectable as such at the normal viewing distance, only on close inspection of the picture.

If for any reason the received signal is very weak, a clean background will not be obtained on account of valve hiss. The use of a good aerial is thus advisable. The sensitivity is such that with all circuits at resonance a bright picture can be secured in *The Wireless World* Laboratory on a few inches of wire for an aerial. This is on the eighth floor of a steel-framed building, which very effectively screens the laboratory, so that an internal aerial is very poor indeed. Definition and background are both poor, however.

As the band-width is increased by mistuning the circuits the definition improves, and as the aerial is increased in size to compensate for the reduced sensitivity, so the background improves. At normal band-width for high-definition, the sensitivity is still adequate for a poor indoor aerial and the background is reasonably good, although some signs of the valve noise can be detected.

With the normal outdoor dipole and reflector, of course, a very strong signal is obtained and nothing like full gain is needed.

The precise arrangement needed in any individual case depends upon local conditions and the distance from Alexandra Palace. Up to about 10 miles a vertical dipole will probably suffice; this can be centre-fed or end-fed through a quarter-wave matching section. The latter is often more convenient to erect, but does not seem to be quite as efficient.

Beyond 10 miles a centre-fed dipole with reflector should certainly be used. The farther away the receiver is from the transmitter the more important does height become, and at distances of more than a few miles the aerial should always be out of doors and as high as possible. It should be connected to the receiver by a twin-wire feeder of 70-80 ohms impedance, such as the Belling-Lee HF Low Impedance Transmission Line.

In conclusion, it may be remarked that this equipment is for vision only and it is intended that a separate receiver be used for the sound channel. Where possible this should be a straight set and one RF stage with a reacting grid detector will usually be adequate. It can, of course, be fed from the same aerial. A superheterodyne is not advised, owing to the danger of serious interference troubles arising through the use of two oscillators.

As already stated, the receiver has had a very lengthy testing period in *The Wireless World* Laboratory and has proved reliable and capable of an exceedingly good performance. The brilliancy is adequate for daylight viewing provided that direct sunlight is excluded from the room and the synchronising is stable and reliable. The definition is very high and the focusing is good. It is not perfectly even over the whole raster, for it deteriorates somewhat on the left-hand side; except at unusually great brilliancy, however, even here it is barely noticeable. The frame scan is not perfectly linear; the non-linearity, however, is confined to the extreme top and bottom of the picture, where it is rarely noticeable. At the top the first few lines are too widely spaced and at the bottom the last few are too closely spaced. This non-linearity is occasioned by the extreme economy of current consumption in the frame scanning oscillator.

These points are mentioned in order that no one should think his equipment is defective if he observes them. They are all small and are not noticeable in ordinary viewing, but they can be detected on a close and critical examination of the raster.

The Wireless Industry

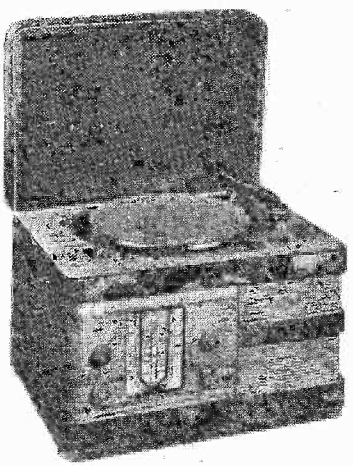
H. McCARTHY, Ltd., have removed their Sales and Service Department from 92, Queensway, Bayswater, to Wyndham Works, Oldham Terrace, Acton, London, W.3. Details of new Hartley Turner and McCarthy apparatus will be announced shortly.

Vortexion, Ltd., 182, The Broadway, Wimbledon, London, S.W.19, have just issued a folder containing a series of leaflets dealing with their amplifiers and PA equipment.

The Chloride Electrical Storage Co., Ltd., have introduced a further 1½-volt LT battery for use with the new all-dry battery sets. It is the Drydex No. H116r, which measures $3\frac{7}{8} \times 2\frac{5}{8} \times 5\frac{1}{4}$ inches and is priced at 3s. 9d.

A brochure describing the "Talkomatic" record-reproducing equipment and its applications has been received from Anglo-Scottish Scales, Ltd., 5, Charles Lane, St. John's Wood, London, N.W.8.

McMICHAEL MODEL 903.



The receiver chassis in this neat table-model radiogram is similar to that of the Model 390 recently released and is a three-valve (plus rectifier) superhet with a double diode pentode in the final stage. Tone correction on the gramophone side is effected by introducing selective negative feedback. The price of the Model 903, which is for operation from AC mains, is £14 17s. 6d.

NEWS OF THE WEEK

GERMAN TELEVISION PUSH

Oversea Market and People's Receiver

ALTHOUGH there is at present no regular television service in Germany, despite the fact that the Post Office has completed the second mountain-top transmitter, the German authorities are not slow in seizing every opportunity afforded to create an oversea market.

Recently a South American television demonstration tour was undertaken. This started in Buenos Aires during the World Postal Congress, and after some weeks there has since visited Rio de Janeiro and Santiago de Chile and will later go to Guatemala. The demonstration apparatus consists of cameras, a transmitter and receivers and the 180-line cable telephone-television system.

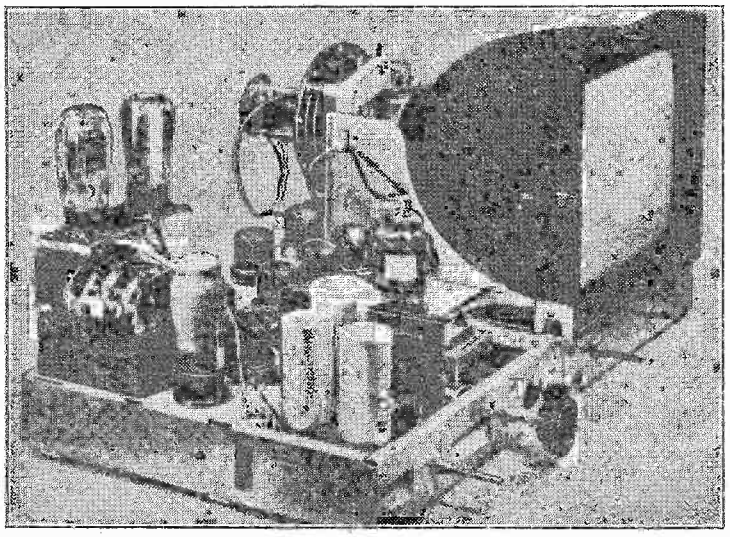
The apparatus for the Italian television service has been supplied by the German Post Office. The first public-demonstration transmissions from Monte Mario, Rome, are to be given this month.

People's Television Set

Only one television receiver will be seen at this year's Berlin Radio Exhibition which opens on July 28th. It is to be called the television standard receiver and has been designed by the five firms concerned in German television developments who will manufacture some 5,000 by the end of this year.

The new set, full technical details of which have not yet been disclosed, is a table model. It covers television sound and vision channels only and will cost some fifty pounds. A feature of the receiver is its flat-ended square cathode-ray tube which gives a flat picture 19.5 by 22.5 cm. Dr. Ohnesorge, the Minister of Posts, states that the price to be fixed for the television receiver will remain unchanged for some years to come.

The German television O.B. vans will be brought out from their resting places for the radio exhibition demonstration transmissions—they have not been used for a public transmission since last year's show. The Minister of Posts has announced that further television O.B. vans will be operated in Nuremberg, Munich and other cities connected to Berlin by television cable. When a television service does begin, Berlin will thus be able to relay scenes from these cities.



A FEATURE of Germany's People's television receiver, which will be the only televisor on view at the German radio show, is the flat-ended square tube.

CANADIAN RADIO CHIEF IN ENGLAND

MAJOR GLADSTONE MURRAY, general manager of the Canadian Broadcasting Corporation, arrived in England last Thursday accompanied by Mr. L. W. Brockington, K.C., chairman of the Corporation. It is understood his main objective is to discuss with the B.B.C. the possibilities of regular programmes from England for transmission from the C.B.C. network, which, when it takes over control of all the privately owned transmitters in September, will total nearly 100 stations.

CANADA'S RECEIVER SALES

Production Figures Doubled

SALES of receivers in Canada in the first quarter of this year, which were the highest since 1932, showed an increase of more than 20 per cent. on the first quarter of 1938. Accompanying this sales increase production was doubled as compared with the first three months of last year. The actual figures were: sales 40,073, as against 33,075; productions, 33,611, as compared with 15,648. Nearly half the sets sold during this period were purchased in Ontario, with Quebec second with well over a fifth of the total.

The number of receivers licensed in Canada in the fiscal year ended in March, according to preliminary figures, was 1,221,000. The previous year's figure was 1,104,200.

WESTERN ISLES RADIO-'PHONE SERVICE

BY the inauguration of a radio-telephone service the Barra Isles and the southern portion of South Uist, which lie off the West Coast of Scotland, will be linked to the mainland for the first time. The service, which was opened to the public last Thursday, is operated from Oban, Argyll.

The Oban - Barra telephone circuits work on ultra-short-waves, the island radio station being at Breivig, a few miles to the north of Barra. The circuits are extended to South Uist Island by means of submarine cables to Loch Boisdale.

BROADCASTING IN HYDERABAD

A Regional Scheme Started

THE Nyzam of Hyderabad's Government has been operating a low-powered broadcasting transmitter for some time, preparatory to installing four transmitters for a linguistic regional service. So far, two Marconi transmitters have been erected, one near Hyderabad city and the other at Aurangabad.

The medium-wave transmitter near Hyderabad is located at Suroornagar, eight miles from the city. The transmitter supplies an unmodulated carrier input of 5 kW to the aerial. Operable on any wavelength between 200 and 545 metres, the actual frequency being used is 730 kc/s (411 metres). Studios in the city are connected to the transmitter by overhead and underground cables.

The transmitter at Aurangabad, which is 320 miles north-west of Hyderabad city, is primarily intended as a relay station with a very limited field. It is very low-powered, delivering a 500-watt unmodulated carrier input to the aerial. The allocated wavelength is 319.1 metres (940 kc/s).

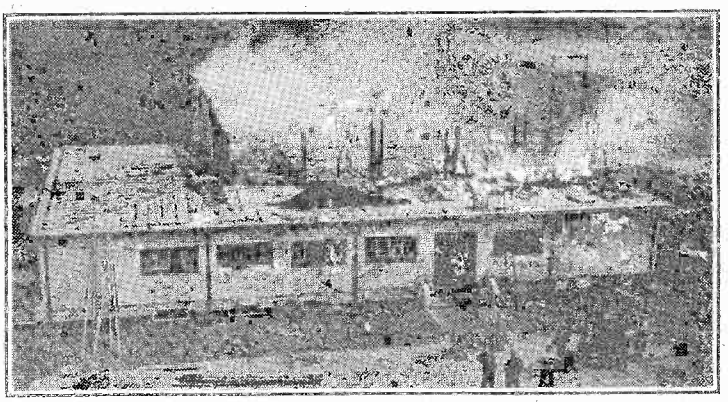
The scheme in Hyderabad, the premier Indian State, is, of course, in no way associated with All-India Radio's programme of extension in British India.

WIRED WIRELESS

Initial P.O. Expenditure

CENTRAL LONDON, Edinburgh, Birmingham and Manchester will be among the first places to be equipped for the proposed Post Office wired broadcasting system.

In order to obtain Parliamentary authority for the expenditure necessary to initiate the service, a sum of £50,000 for the Post Office was included



SCHWARZENBURG, Switzerland's first short-wave transmitter for her people abroad, as it appeared after the fire which, as recorded last week, destroyed the station. It was entirely Swiss built under Marconi licence, and an order has been placed for a replica, which it is hoped to have completed early next year. In the meantime, Swiss transmissions will, as in the past, be transmitted from the League of Nations station at Prangins.

News of the Week—
in the supplementary estimate for £11,929,950, which was issued last week.

PRICE REDUCTIONS

German Receivers and Valves

THE German radio industry has considerably reduced the prices for the new season's sets. A four-valve superhet covering the short waves can be purchased for as little as £8 16s. at par. One of the cheaper sets, a four-valve superhet at Rm. 236, is the first of its type to give daylight reception in Berlin of the Droitwich long-wave transmitter without interference from the powerful Deutchlandsender.

Replacement valves have also been reduced in price by as much as 30 per cent., although valves used by manufacturers have retained their old prices.

FROM ALL QUARTERS

Papal Wireless Blessing

HIS HOLINESS THE POPE has decreed that the Plenary Indulgence which is bestowed with the Apostolic Benediction, *Urbi et Orbi* (to the city and to the world), extends to those who receive the benediction by wireless in exactly the same way, and under the same conditions, as those who are actually in his presence.

450 Kilowatts

RADIO-NATIONAL, the new high-power French broadcasting station at Allouis, will be opened by the Minister of Posts, Telegraphs, and Telephones on July 22nd.

D.C.C. Wire

AMONG items recently placed on exhibition in the Science Museum, South Kensington, is a machine, which was used from about 1837, for covering wires with silk and cotton. It was at one time owned by Mr. W. T. Henley, one of the pioneers in this field, and was probably made by him.

Television Aerial Connectors

A SPECIFICATION for standard plug-and-socket connectors for television aerial feeder cables has just been prepared by the Radio Manufacturers' Association. Two separate designs have been standardised, one being for co-axial cable only.

Radio on Trans-Asiatic Expedition

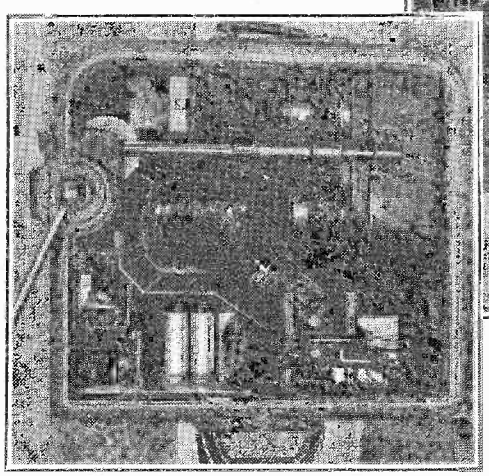
CONTACT between the three motor vehicles which will be used for the Lawrence Thaw Trans-Asiatic Expedition will be maintained by a two-way ultra-short-wave radio-telephone link. The equipment has been installed by General Electric (U.S.A.). Quarter-wave "fishing-rod" aerials are fitted to each vehicle. The expedition, which recently arrived in France from the U.S.A. is expected to arrive in Bombay next spring.

Characteristic Curves

ALL our readers know something of the characteristic curves of valves, but how many of them—even those who are amateur photographers—know what is meant by the characteristic curve of a film or plate? Yet every film and plate is scientifically graded under its characteristic curve. This mystery is explained in this week's issue of *The Amateur Photographer*, dated July 19th. It is a special holiday number, and every phase of holiday use of the camera and how to secure really good mementoes is discussed.

Radio Air-raid Sirens

IT is reported that the Government has been supplied with details of the radio-controlled air-raid sirens installed in Manchester. Simultaneous or independent control of the city's sirens is operated from a central transmitter.



GERMAN 441-LINE TELEVISION APPARATUS, including camera, film-scanner and amplifying equipment, has been installed at Monte Mario, Rome, in readiness for the opening of a television service. Similar equipment has been ordered for Milan. The interior of the Fernseh camera supplied is shown on the left.

AVIATION STATIONS IN INDIA

SHORT-WAVE stations, providing additional communication for the trans-Indian air route, and Adcock direction finders, are being erected by the Posts and Telegraphs Department at various places on the route, and are expected to be completed this year. Medium-wave transmitters and complementary receivers were installed last year at six different places, and the present work will complete the chain of stations.

Apart from the work on the main trans-Indian route, the new short-wave station at Poona is expected to assist greatly in the collection and distribution to aircraft of meteorological information.

SUNDAY TELEVISION

ON the ground that the transmission of theatrical television performances by the B.B.C., "a semi-Government service," is an injustice to the "living" theatre, a campaign for the Sunday opening of theatres is to be launched by theatre managers.

Television Programmes

Sound 41.5 Mc/s — Vision 45 Mc/s

An hour's special film transmission intended for demonstration purposes will be given from 11 a.m. to 12 noon each weekday. The National or Regional programme will be relayed on 41.5 Mc/s from approximately 7.45 to 9 p.m. daily.

THURSDAY, JULY 20th.

3, Stanley Holloway, Jean Colin and Edward Cooper in Cabaret. **3.30**, Gaumont-British News. **3.40**, Cartoon Film. **3.45**, Hand Block Printing—the ancient craft of printing designs on textiles by hand.

9, Tommy Handley, Eve Lister and Bennett and Williams in Intimate Cabaret. **9.30**, British Movietonews. **9.40**, "Sunday in the Country," No. 5—The South Cotswolds. **9.55**, Bernard Shaw's "The Man of Destiny."

FRIDAY, JULY 21st.

3-4.30, "Sheppey," a dramatic comedy by Somerset Maugham.
9-10.30, "Suspect," a drama by Edward Percy and Reginald Denham.

SATURDAY, JULY 22nd.

3, The Jacquard Puppets. **3.15**, Gaumont-British News. **3.25**, Animal Cartoons. **3.35**, Demonstration of Bee Keeping. **3.45**, Cartoon Film. **3.50**, Claude Dampier and Billy Carlyle.

9, Cabaret (as on Thursday at 3 p.m.). **9.30**, British Movietonews. **9.40**, Cartoons by Van Dock. **9.50**, A Darts match. **10.5**, Film. **10.15**, Music Makers: Joan Davies (pianoforte).

SUNDAY, JULY 23rd.

9.5, Lilli Palmer and Barry Jones in "One Night, One Day . . .", a comedy by Cecil Madden. **10.25**, Music Makers: Betty Humby (pianoforte).

MONDAY, JULY 24th.

3-4.30, "Bridge Head," Rutherford Mayne's drama of Irish life.

9, Guest Night No. 8—Is Modern Sport a Good Thing? **9.30**, British Movietonews. **9.40**, "Re-view," songs and scenes from bygone shows. **10.10**, Cartoon Film. **10.15**, Cartoons by H. M. Bateman.

TUESDAY, JULY 25th.

3-4.30, "Suspect" (as on Friday at 9 p.m.).

9, Intimate Cabaret, with Iréne Prador (songs) and A. C. Astor (ventriloquist). **9.30**, Gaumont-British News. **9.40**, "Circumstantial Evidence": a "telecrime" by Mileson Horton. **10**, Film. **10.10**, C. H. Middleton. **10.20**, Music Makers: Mildred Dilling (harpist).

WEDNESDAY, JULY 26th.

3, O.B. of bicycle polo at Roehampton Club. **3.20**, Vanity Fair. **3.35**, Diana Ward, songs. **3.40**, Gaumont-British News. **3.50**, "This Cruising," illustrated in verse and cartoon by Reginald Arkell and Harry Rutherford.

9, Rough Island Story—No. 6 "Steel and Steam." **9.25**, British Movietonews. **9.35**, Vanity Fair. **9.50**, Cartoon Film. **9.55**, "For Your Delight"; programme of songs and dances. **10.25**, The Planet Mars: Dr. Waterfield.

Random Radiations

By "DIALLIST"

African SW Stations

STRAIGHT from the horse's mouth—in other words, from a reader living in those parts—comes some information about certain African short-wave stations that may be of use to DX'ers. Mafeking, in Bechuanaland, broadcasts regularly on the 49-metre band between 7 and 8 p.m. GMT. This band also contains, of course, the well-known Johannesburg and Capetown transmissions, which are on from 4.45 to 8.30 p.m. GMT. Then, still on the 49-metre band, there's Lourenco Marques, in Portuguese East Africa, which works every evening, closing down at 8 o'clock GMT. This station also uses a 25-metre channel. Salisbury, in Southern Rhodesia, relays its 440-metre transmission on 50 metres every evening from 6 o'clock to 8 GMT. The opening announcement is: "This is Salisbury and Bulawayo, calling from the G.P.O., Salisbury." Bulawayo's short wavelength is 48.8 metres. I've given all the times in GMT for the sake of readers abroad as well as those in this country.

Battery Progress

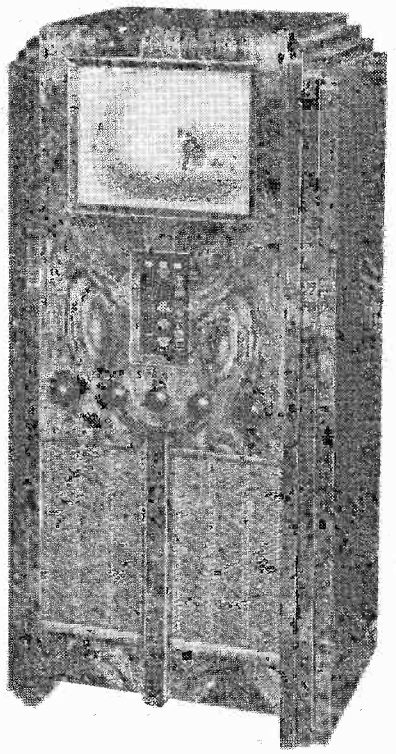
IT'S wonderful what strides have been made in the production of dry batteries and particularly of wireless HT batteries during the past few years. Some tests that I made recently show that the standard capacity battery of to-day is, despite its far lower price, a better performer than those of five or six years ago. When 120-volt HT batteries appeared at 6s. and even at 5s. I feared the worst. It didn't seem possible to turn out a reasonably good battery containing 80 cells for the money. But it has been done and that's something of a triumph. It is especially good that the British-made battery has driven its foreign-made competitors right out of this market in a fair and straight fight. Not so long ago, you saw foreign batteries everywhere. They came from France, Switzerland, Germany, Belgium and other Continental countries. Now you'd find it difficult to get hold of one. American competition, which used to be considerable, has also ceased to exist for the plain and simple reason that we can now make good batteries so cheaply by up-to-date methods that it no longer pays to import them.

And the Battery User

Users of battery-operated receivers have benefited vastly by the improved methods of battery-making. To look at the position from one viewpoint, they can now obtain a good HT battery for less than a low-grade, poor performer used to cost. And there's more in it than just reduced running expenses: the battery user is getting better quality from his set than he did. One of the big troubles not so long ago was the fall in EMF which took place during an evening's run. The HT battery had perhaps been resting for 20 hours before the set was switched on. In that time recuperation might have raised its EMF from 95 to 105 volts. A poor battery very soon loses a large part of what it has gained by recuperation when it is placed under a fair load; hence, though the set might start at 6 p.m. with 105 volts available for its plate circuits, this figure might be down to under 100 by 6.30 and the decline would continue at a less rapid rate during the rest of the run. In those days nearly all sets had separate grid bias batteries; if the GB was correct at 6 p.m. it would be far too high before the evening was out, with inevitable evil effects on the quality.

End-of-Evening Distortion

There may have been an enthusiast here and there who reduced this grid bias voltage from time to time during an evening—it would have to be from time to time, since each lessening of the negative bias would mean a heavier HT current drain, and therefore a quicker fall in the HT voltage. But most listeners, if they adjusted the GB at all, did so only at long intervals. In the modern set you have three favourable factors. For the same (or better) performance the HT current drain is smaller, mainly owing to valve improvements; the HT battery itself is better able to stand up to the load imposed on it owing to its more effective depolarising arrangements; the vast majority of battery sets now have automatic grid bias. If the last is properly arranged so that the section of the HT battery devoted to grid biasing is under the same load as the rest of the battery, the grid bias falls automatically, keeping pace with the fall in the plate voltage. End-of-the-evening distortion, once so noticeable a feature of the set worked from a standard capacity HT battery, has thus become a rarity.



BAIRD MODEL T.25.—Of the five controls in this new television receiver, only one is devoted to television and is used for picture contrast. The remainder control the four-waveband superheterodyne receiver. The vertical scale has individually illuminated wavebands and is calibrated with station names. The picture is 10in. × 8in. and is viewed directly through a plate glass window. The overall dimensions of the receiver, which consumes 150 watts, are 44½in. × 21in. × 16½in. and the price is 47 guineas.

Why Not Valves?

IT'S a pity that our valve manufacturers can't drive their foreign competitors off the market, as the battery manufacturers have done, by beating them at their own game. At present, foreign-made valves can be sold in this country at prices below those of British-made articles. It therefore pays to import them and the numbers coming in during a year reach vast totals. I've long believed that our valve makers could very quickly stop this and benefit themselves enormously if they would drastically reduce the prices that the public has to pay for their wares. Why is it that one sees so few sets containing more than four valves at the outside? It's mainly because the man in the street shies at a large number because he's afraid of the possible cost of replacements. Why are valves worked long after they're worn out? Normally because new ones would cost more than the set is worth. American sets containing quite a number of valves don't sell too badly here; and those who buy them don't work their valves till they drop, for cheap renewals are nothing to worry about. If only our makers would adopt a really bold price policy, I'm sure that its good results would surprise them.

HENRY FARRAD'S SOLUTION

(See page 50)

IF distortion is introduced by turning up the volume control, it must be due to overloading of some part; but, as the volume control effects the signal level only in those parts following it, the overloading must be there. If the fault causing the loss of volume were located somewhere in advance of the volume control, the signal level would not be increased above normal anywhere in the set and there would be no overloading. As in the type of set described the volume control is normally just before the output stage, the fault must, therefore be in the output stage, output transformer, or loud speaker. As the fault appears when the set has been moved to another house, extension speakers or wiring can be ruled out. Moreover, nothing that could happen on the speech coil side of the transformer, external or internal, could cause a considerable rise in HT volts. And it is doubtful that the rise caused by even a total interruption of current to the output stage could be described as considerable, and as output can be obtained the current cannot be totally interrupted. The only fault that would cause such a rise seems to be a short-circuited field winding, the drop in volume being due to the loud speaker running on its residual magnetism only, so that the output stage would be grossly overloaded before volume could be restored to normal by the volume control. The increase in hum confirms this diagnosis.

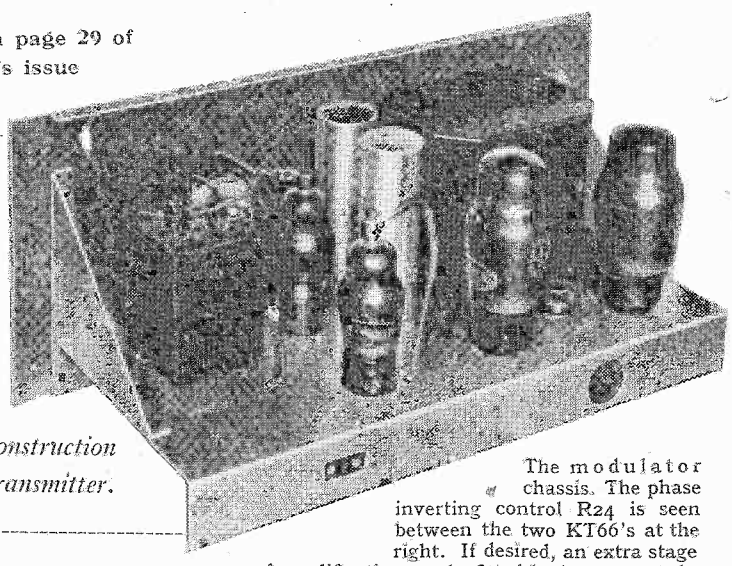
Four-band Transmitter

MODULATING EQUIPMENT, POWER SUPPLIES AND CONSTRUCTIONAL DETAILS

Continued from page 29 of last week's issue

By S. K. LEWER, B.Sc. (G6LJ)

IN this instalment the author deals with the design of the modulating amplifier, power supply units and then describes the construction of the complete transmitter.

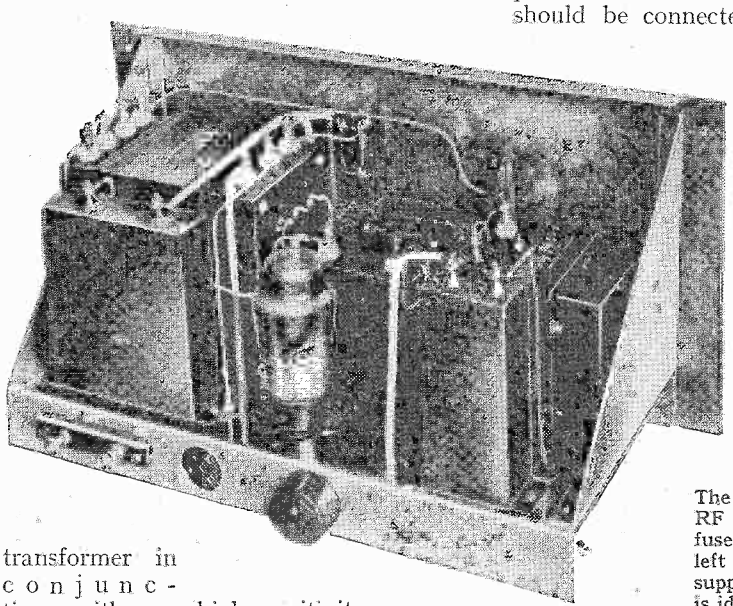


The modulator chassis. The phase inverting control R24 is seen between the two KT66's at the right. If desired, an extra stage of amplification can be fitted in the space at the left.

AS amateur transmitting licences permit the use of telephony on all the allotted frequencies, modulation equipment forms an essential part of all amateur transmitters. The modulator designed for this set conforms closely to present-day conventions and a detailed description is not considered to be necessary. It may be mentioned, however, that the phase-splitting circuit which is used here is highly satisfactory and gives no trouble from hum, which sometimes occurs with circuits where half of the total anode resistance of the phase-splitting valve is connected between the cathode and earth. In the present construction the initial H63 stage V4 was arranged to be driven direct from the microphone transformer in conjunction with a high-sensitivity carbon button microphone. Space has been left on the chassis for a pre-amplifier stage in case higher gain should be required for a less sensitive microphone.

A battery fed pre-amplifier, consisting of two low-gain resistance-coupled triode stages, in conjunction with a moving-coil microphone, has been used to feed the modulator unit with excellent results, the sensitivity and quality both being highly satisfactory.

The modulation transformer has a difficult function to perform and a high-quality transformer of really adequate dimensions is a worth-while investment. In this transmitter a U.T.C. Varimatch type VM2 was used and has been found to be completely satisfactory. For correct impedance matching the two KT66 modulator anodes should be connected to the pins numbered 8 and 11, while 9 and 10 should be connected together and taken to the HT line. The secondary winding, which is connected in the lead feeding the anode and screen of the KT8, is obtained by joining the pins 3 and 4 and connecting to 2 and 6. A switch, S1, is provided to short-circuit the secondary winding when the modulator is not required so as to avoid the dangerous voltage surges which would otherwise occur as a result of keying the cathode current in the KT8.



The power supply for the RF chassis. The open type fuse is seen in the lower left corner. The power supply for the modulator is identical with this, except that the 4 mfd. reservoir condenser C27 mounted just above the fuse is omitted.

The RF chassis and the modulator chassis each have their own separate power supplies. For the former the power supply is designed to give either 550 volts for telegraphy or 480 volts for telephony. The reduction to the lower voltage is necessary when modulating in order to avoid exceeding the safe working limits of voltage and current. The switching is very simply effected by arranging a 4-mfd. condenser, C27, in series with a switch, S3, across the input to the filter. With the condenser connected in circuit, the output voltage is about 550 volts, and when it is switched out of circuit for telephony working, thereby converting the filter to the choke-input type, the reduction to about 480 volts is effected, and there is the added advantage that the regulation of the power supply is improved just when it is most needed.

The transformer for the RF power unit is rated at 250 mA for the 550-0-550 volt winding, and has one 6.3 volt 4A winding for the heaters of the RF valves, which are all connected in parallel, and one winding to give 4.0 volts at 3.75A for the U18 rectifier.

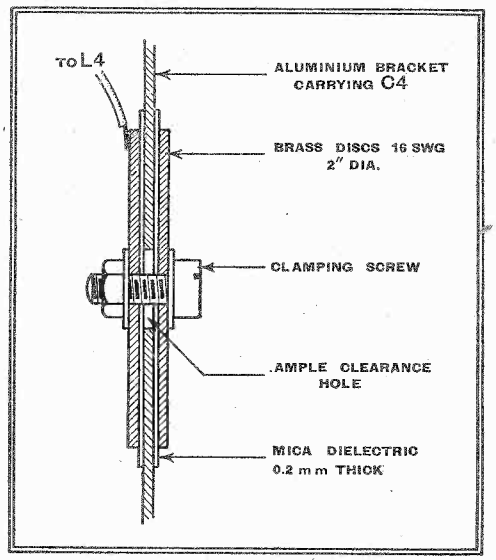


Fig. 3. — Constructional details of the blocking condenser C5 described in the text. The assembly is held together by the simple screw and nut in the centre, and it must be clamped tight. Good insulation is essential.

The modulator power supply is very similar, except that the HT winding of the transformer is rated at 150 mA and no input condenser is required in the filter.

A bleeder resistance (25,000 ohms, 20 watts) R35 and R36 is connected across the output of each power unit, and serves

Four-Band Transmitter—

not only to maintain good regulation of the power supply, but also to discharge the filter condensers when the circuit is switched off. In the interests of safety, however, it is wise not to rely on the bleeders for discharging the condensers when making adjustments to any part of the transmitter, but to make certain by short-circuiting the condensers with a wooden-handled screwdriver after switching off the mains input.

The chassis size chosen for the power supply units is the smallest that can accommodate the components selected for them, and another inch in the front-to-back dimension would give greater latitude in the assembly.

A fuse has been fitted in each power unit, and is connected between the rectifier filament winding on the HT transformer and the filter. The fuse consists simply of a piece of 1 amp. fuse wire held between two terminals about 1 inch apart mounted on a strip of ebonite. This strip is fitted to the back of the chassis, and clearance holes of ample size are made in the back to accommodate the terminal fixing nuts. It would be a worth-while improvement, however, to fit covered fuses in the interests of safety, since the fuses are at high voltage to earth.

With the power supply described here, the KT8 cannot be worked to its maximum capability, since this would require an anode potential of 600 volts. If desired, the power supplies could be rearranged so that the KT8 is fed separately from an Osram U20 rectifier with a suitable transformer to give the necessary higher voltage. The U20 is rated at 850 + 850 volts maximum and will deliver 125 mA of rectified and smoothed current.

The form of chassis construction adopted in this transmitter is quite clearly seen in the photographs. Aluminium sheet $\frac{1}{16}$ inch thick is used throughout. The two triangular end-pieces (and the interstage screens on the RF chassis) provide sufficient rigidity for the chassis and panel, while the open ends allow ample ventilation for the heat dissipated by the resistances mounted underneath.

All panels are 17 inches wide, and the chassis width adopted here is 15 inches, as this size suited the racks available. The RF panel is $10\frac{1}{2}$ inches high, while the chassis is 10 inches deep and $3\frac{1}{2}$ inches high. The modulator panel is 7 inches high, and the chassis 7 inches deep and $1\frac{1}{2}$ inches high. The power supplies have chassis of the same size as the modulator, but their panel height is $8\frac{1}{2}$ inches. The height of the four panels on a single rack, plus adequate clearance for the KT8 anode coil, is 40 inches.

The KT8 anode tuning condenser C4 is mounted on a large bracket cut from a sheet of $\frac{1}{16}$-inch sheet aluminium held by screws to the chassis and the adjacent partition screen. A large rectangular hole is cut in the top of this bracket to allow the five sockets of the coil holder to pass through. The blocking condenser C5 is constructed from a sheet of brass, 3 inches square, clamped against the side of the bracket by means of small ceramic bushes and brass screws, and separated from it by a sheet of mica about 0.2 mm. thick. If there is any difficulty in obtaiing ceramic bushes, the need for any insulating bushes at all may be obviated by using two brass plates instead of one to provide capacity to the bracket, clamping them together on opposite sides of the bracket with a sheet of mica between adjacent surfaces. A large clearance hole should be made in the bracket for the clamping screw. A suitable construction for such a condenser is shown in Fig. 3.

The oscillator and buffer coils are wound on *Eddystone* 4-pin DL9 threaded formers, having 14 threads to the inch, the wire used being 24 SWG enamelled. The coils for the KT8 anode circuit are wound with 14 SWG enamelled wire, *Eddystone* Frequentite formers being used for all except the 56 Mc/s coil, which is self-supporting and is attached directly to the pins in the Frequentite sub-base. The coil specification table gives all the necessary winding data, while in Fig. 4 is shown the coil connections for each band.

COIL SPECIFICATION TABLE

Number of Turns:

Frequency in Mc/s.	Oscillator Anode L2	Buffer/Doubler Anode L3	P.A. Anode L4	Link L5
7	14	16 c.t.	12	2
14	7	10 c.t.	6	1
28	—	4 c.t.	4	1
56	—	—	3	1

The 5 coils for the oscillator and the buffer-doubler are wound on Eddystone 4-pin DL9 formers, $1\frac{1}{2}$ inches in diameter, and having 14 threads to the inch. All the coils for the buffer-doubler are centre-tapped.

The coils for the P.A. anode circuit for 7, 14, and 28 Mc/s are wound on Eddystone Frequentite formers, $2\frac{1}{2}$ inches in diameter. The 7 and 14 Mc/s coils are wound with the turns double spaced, and the 28 Mc/s coil is wound with turns quadruple spaced. The 56 Mc/s P.A. anode coil is self-supporting and is 1 inch in diameter, the 3 turns being spaced to occupy a length of $1\frac{1}{4}$ inches.

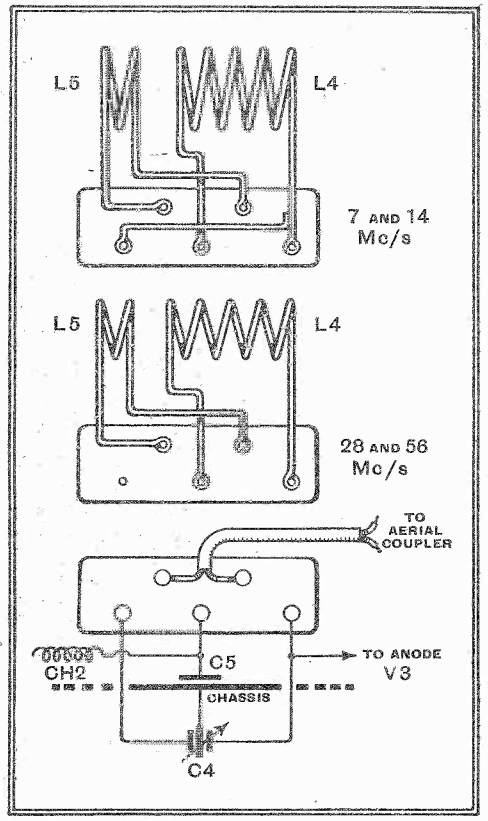
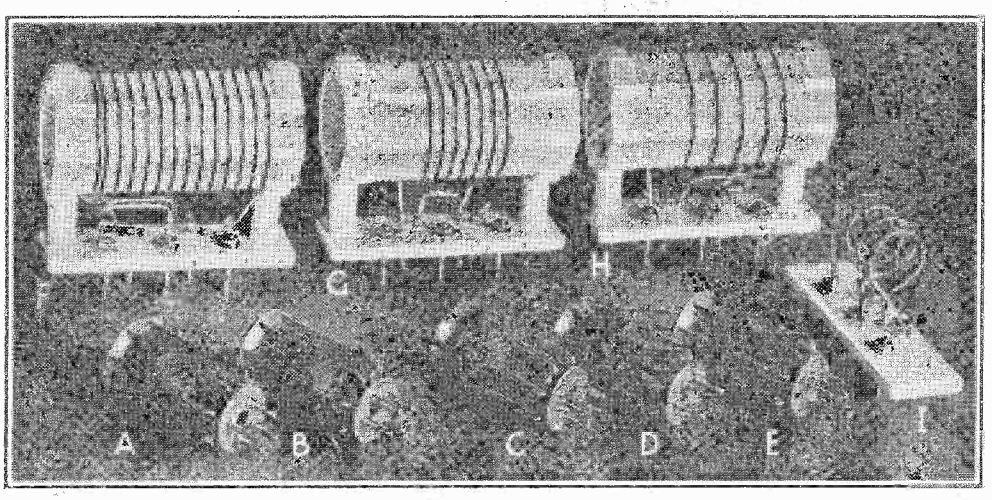


Fig. 4.—The connections to the pins of the former assembly carrying coils L4 and L5 for the different wavebands are shown above, which includes also a sketch of the connections to the fixed base portions.

Link coupling is used to transfer the energy from the KT8 anode circuit to the aerial circuit coupler, which is several feet away from the transmitter. The link coil L5 consists of one or two turns of 14 SWG enamelled wire (see table), coupled to the HT end of the anode coil L4. Two pins are available on the coil sub-base for connections to the link coil, and the link itself consists of a length of 72-ohm cable running to the corresponding link on the aerial coupler. The design of the aerial



The complete set of coils. Oscillator anode L2 : (A) 7 Mc/s, (B) 14 Mc/s. Buffer-doubler anode L3 : (C) 7 Mc/s, (D) 14 Mc/s, (E) 28 Mc/s. PA anode L4 : (F) 7 Mc/s, (G) 14 Mc/s, (H) 28 Mc/s, (I) 56 Mc/s.

Four-Band Transmitter—

coupler is not included here, as it will depend so much on the particular conditions existing at individual stations with regard to the number and type of aerials available for use on the four bands that any one design will only meet a single case.

The tritet cathode coil L1 consists of 7 turns of 22 SWG DCC wire, wound with turns touching on a 1½-inch diameter Paxolin former. This coil is permanently connected across the cathode tuning condenser.

In the modulator, the grid leads to the two H63's are screened as indicated in the circuit diagram. This serves to prevent pickup of AC hum and RF energy by these leads.

Midget jacks are fitted on the RF chassis so as to permit the measurement of (1) oscillator anode current, (2) buffer-doubler anode current, (3) KT8 grid drive current, and (4) KT8 anode current. A separate milliammeter connected to a single plug thereby serves to measure the performance of each stage in the most economical way. An Avominor is admirably suited for use with this transmitter, since it has ranges very conveniently chosen for measuring the grid and anode currents and also the HT supply up to 600 volts.

A further jack is fitted on the RF chassis for keying, and a microphone jack is included on the modulator, but in the case of the latter, some modification of the jack connections will be necessary if a pre-amplifier is to be used instead of the direct input from the carbon button microphone.

Interconnections between the four chassis are made by means of plugs and flexible cables. A five-pin socket is fitted on each chassis, and two separate five-way cables, each having a five-pin base taken from an old valve fitted at each end are used, one for the RF chassis and the other for the modulator. Suitable five-pin cable plugs are, however, available if one prefers to use them. A further plug-and-socket connection and a two-way cable is required to connect the modulation transformer secondary into the KT8 anode and screen HT line.

(To be concluded.)

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

"In Praise of Television": A Viewer's Views

IT was with considerable interest that I noted "Cathode Ray's" remarks in *The Wireless World* of July 6th, and in particular his reference to the amount of picture distortion which is tolerated by viewers.

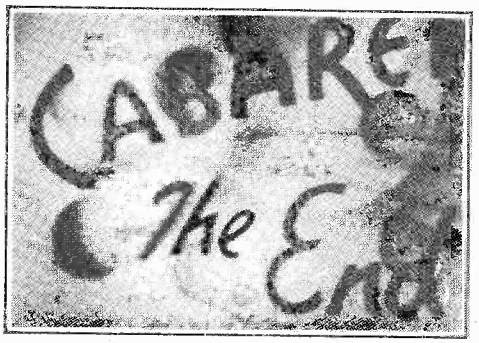
While "looking and listening in" to television in Birmingham the amount of interference—which is very excessive at times—that may be tolerated on the picture without annoyance is far in excess to that on sound. The interference, which is mainly due to cars and omnibuses, is, of course, intermittent, but when reproduced from the loud speaker is most ear-splitting. Yet at the same time on the screen only a few "blobs" of white light can be seen, which appear to move over the picture from place to place.

The receiver consists of two RF stages tuned to the vision frequency, frequency-changer, four IF stages which are tuned to 8.5 Mc/s, with a band-width not exceeding 3 M/cs. These are followed by a diode rectifier and one stage of VF amplification. The second harmonic of the oscillator is used to produce the intermediate frequency. The cathode-ray tube is one of the latest of the Mullard Electromagnetics, type MW22-1, with a screen diameter of 9in.

Sound is received on a separate receiver connected to the anode of the vision-frequency changer. This gives a first intermediate frequency of 5 Mc/s, which may be picked up at 60 metres on the auxiliary receiver.

This arrangement, which has been developed by Mr. S. T. Bolus, of Hall Green, Birmingham, has given very good results.

Photographs have been taken on various occasions by myself with the aid of a Zeiss Ikon 515 camera, which is fitted with a Nettar 4.5 lens and auxiliary lens for close work. The prints enclosed were exposed on an orthochromatic film (speed $\frac{18}{10}$ deg. Din) at f/4.5 for one second at a distance from the tube of approximately 8.5in.



Both Mr. Bolus and myself feel that the foregoing may appeal to a large section of your provincial readers and encourage development in areas which are at the moment inadequately covered by Alexandra Palace.

A. H. PECKMORE.

Sparkhill, Birmingham.

[One of our correspondent's photographs is reproduced.—ED.]

Qualifications of Service Personnel

LIKE many other critics, Corporal Clarke, in his letter appearing in *The Wireless World*, June 29th, by the simple expedient of divorcing a sentence from its context, has—presumably at least to his own satisfaction—attempted to change completely both the meaning and inference of a statement in my article on "Wireless in the Services." In addition, he has been guilty of mis-quoting my actual words.

If Corporal Clarke had taken the trouble to read the article in question more carefully than he appears to have done, he would have realised that in it, as a first principle, I compared the technical training of Services operating personnel with that of commercial wireless engineers; arising from this comparison I stated that "such a standard of technical knowledge is unnecessary and may even be undesirable." I am indeed sorry to disappoint my critic, but I am quite unable either to alter or to qualify this statement. May I remind Corporal Clarke that a large proportion of the design work entailed in the development of Service wireless equipment is carried out by civilian technical and scientific officers at the various establishments and that one of the necessary qualifications for such posts is the holding of a University Honours Degree

Again, your correspondent makes use of yet another misstatement. He states that I lay stress on the use of analogies. What I did say was that an instructor should *augment* his explanations by the use of easily understood and familiar analogies. This is a recognised and a sound practice in the teaching of elementary electrical theory and if Corporal Clarke will refer to the various Service handbooks he will find the same use made of analogies which he condemns. This would appear to be ample justification, if such be necessary, for the statement of my own experience as an instructor.

I do not feel it incumbent upon me to occupy further valuable space in replying to the remainder of your correspondent's letter, containing, as it does, inferences which are in no way justified by the text of the article.

Cambridge. G. LESLIE MORROW.

Frequency and Phase Modulation

WE have read with interest the letter of "Heptode" and "Pro Bono Radio" on frequency and phase modulation, and there seems to be some doubt as to the distinction between these. In fact, "Pro Bono Radio" says that in actual practice the name frequency modulation is given to a process that is nothing more nor less than simple phase modulation. I take it that by this he means they are the same thing.

If he cares to make the experiment of listening to a phase modulated transmission on a receiver designed for frequency modulation, he will agree that radio engineers are correct in making some distinction between the two systems.

Suppose we take a modulating current of amplitude (A) and frequency (f) cycles per second, having an arbitrary phase angle (θ). We may represent the instantaneous current:—

$$i = \text{A} \sin (2\pi ft + \theta).$$

The instantaneous phase ϕ is given by

$$\phi = (2\pi ft + \theta)$$

The instantaneous pulsatance is

$$\frac{d\phi}{dt} = 2\pi f$$

The instantaneous frequency is

$$\frac{1}{2\pi}\frac{d\phi}{dt} = f$$

In both frequency and phase modulation the phase angle θ is varied sinusoidally at the modulation frequency μ.

Thus, a frequency modulated current may be expressed as:—

$$i = \text{A} \sin (2\pi ft + m_f \sin 2\pi\mu t)$$

where m_f is the modulation index for frequency modulation and corresponds to the depth of modulation in the case of the amplitude modulated wave.

In frequency modulation $m_f = \frac{\Delta_f}{\mu}$ where

Δf is the maximum deviation of frequency from the frequency f. Thus, the instantaneous phase

$$\phi = 2\pi ft + \frac{\Delta f}{\mu} \sin 2\pi\mu t$$

The instantaneous pulsatance is

$$\frac{d\phi}{dt} = 2\pi f + 2\pi\Delta f \sin 2\pi\mu t$$

The instantaneous frequency is

$$\frac{1}{2\pi}\frac{d\phi}{dt} = f + \Delta f \sin 2\pi\mu t$$

Thus, the frequency varies sinusoidally about the frequency f at the modulation frequency.

A phase modulated current may be represented by :—

$$i = A \sin (2\pi ft + m_p \sin \mu t)$$

where m_p is the phase modulation index and is $= 2\pi\Delta f$.

Thus, the instantaneous phase is

$$\phi = 2\pi ft + 2\pi\Delta f \sin 2\pi\mu t$$

The instantaneous pulsatance

$$= \frac{d\phi}{dt} = 2\pi f + 4\pi 2\mu\Delta f \sin 2\pi\mu t$$

The instantaneous frequency

$$= \frac{1}{2\pi}\frac{d\phi}{dt} = f + 2\pi\mu\Delta f \sin 2\pi\mu t$$

In this case the amplitude of the frequency excursion is $2\pi\mu\Delta f$ and this is clearly dependent on the modulation frequency.

Thus, if a phase modulated transmission were received on a receiver designed for frequency modulation, the output would rise lineally with the modulation frequency because the frequency excursion, and hence the depth of modulation (on a frequency modulation basis) would rise with frequency. This would give a "top boost" to the programme.

At this stage, it may be pointed out that the Armstrong system of modulation produces amongst other things an infinite series of systems of phase modulation, and as it is to be used on frequency modulation receivers the modulation is first given a "bass boost" in order that the modulation characteristic may be linear for all frequencies. This converts the transmitted programme into frequency modulation.

D. I. LAWSON.
Cambridge. D. WEIGHTON.

IT SEEMS to me that "Heptode" and "Pro Bono Radio" are wandering slightly from the point at issue in discussing whether the Armstrong system is frequency or phase modulation.

In my original letter I suggested that "frequency, or, as it is sometimes called, phase modulation," might be used as a radio link between projected television stations.

I used the wording quoted because, when discussing the Armstrong system in this connection with a high official of the Post Office Engineering Department, he corrected my use of the term "frequency modulation" and said that it was "phase modulation." Who was I to arbitrate between *The Wireless World* and another authority? I therefore availed myself of the Englishman's prerogative of compromise.

Incidentally, I have since discussed the original suggestion of a frequency or phase (as you will!) modulated radio link with a number of technical experts, including Mr. Baird, and they are unanimously of the opinion that the suggestion is well worth trying.

The chief difficulty, that of synchronisation, could be overcome by sending the synchronising tone over the music line and filtering out at the receiving end, in the same way that transmitters using a common wavelength have been synchronised by the B.B.C.

HOWARD HEATON.
Radio Correspondent,
Birmingham *Sunday Mercury*.

Call-sign Piracy

I WOULD be glad if you could give publicity to the fact that my call sign G4AB is being consistently pirated on 1.7 Mc/s, which band I have never used. I would be glad of any information which might lead to the location of this station, which is apparently situated near Bristol.

Burleigh, J. B. BURTT, G4AB.
Stroud, Glos.

I THANK you for publishing my letter together with that from Mr. Cundy. In view of Mr. Cundy's accusation of discourtesy, may I state the following facts?

Mr. Cundy asks why I did not check with the G.P.O. before "rushing into print." This is exactly the procedure I immediately adopted, for the Post Office were informed on the day I received the QSL cards in question. Beyond receiving an official acknowledgment of my letter I received no further information until the morning of the 29th June, when I immediately communicated with you direct.

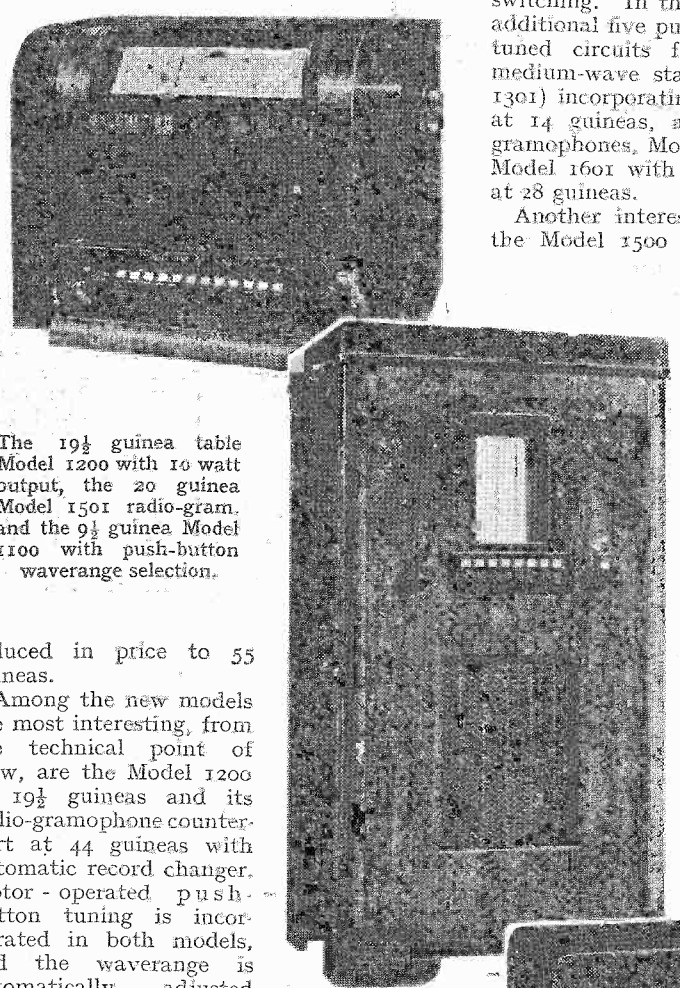
I think, then, that I can be acquitted of any discourtesy in this matter.

Wimbledon, PERCY W. HARRIS.
London, S.W.19.

New H.M.V. Sets

Important Additions for the 1939-40 Season

THE H.M.V. programme for 1939 is a comprehensive one. Many of the more recent releases have been carried over and the Model 801 radio-gramophone has been reduced in price to 55 guineas.



The 19½ guinea table Model 1200 with 10 watt output, the 20 guinea Model 1501 radio-gram. and the 9½ guinea Model 1100 with push-button waverange selection.

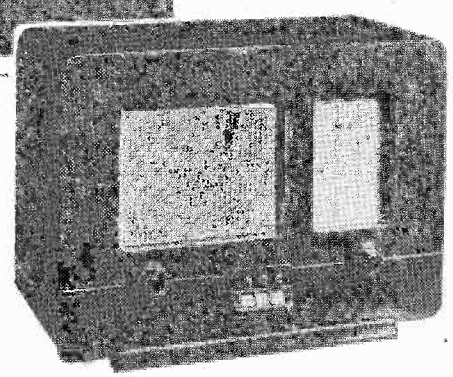
Among the new models the most interesting, from the technical point of view, are the Model 1200 at 19½ guineas and its radio-gramophone counterpart at 44 guineas with automatic record changer. Motor-operated push-button tuning is incorporated in both models, and the waverange is automatically adjusted when a button is pressed. The mechanical tuning arrangements are backed by an AFC system with discriminator diodes in which the IF valve acts also as a DC control valve. The circuit includes an RF stage, and the output valve is a 10.5-watt beam tetrode with negative feed-back. The Model 1200 uses the H.M.V. "hypersensitive" pick-up.

A four-valve (plus rectifier) circuit forms the basis of the new Model 1105 at 9 guineas and the Model 1104 at 10½ guineas. The former is manually tuned, but has three push-buttons for waveband switching. In the Model 1104 there are an additional five push buttons controlling pre-tuned circuits for two long- and three medium-wave stations. A console (Model 1301) incorporating this chassis is available at 14 guineas, and there are two radio-gramophones, Model 1501 at 20 guineas and Model 1601 with automatic record changer at 28 guineas.

Another interesting radio-gramophone is the Model 1500 with push-button tuning, based on the current Model 1102 and costing 24 guineas.

To complete the range, there is the AC/DC table Model 1350—the counterpart of the AC Model 1103, introduced last April. This is a four-valve (plus rectifier) superheterodyne with push-button control for eight pre-tuned stations.

This brings the total number of current sets up to twenty-eight, made up as follows:—Four battery receivers, nine table-model mains sets, three consoles, twelve radio-gramophones (six with automatic record changers).



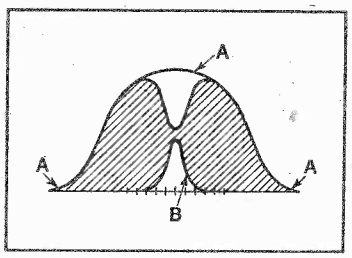
Recent Inventions

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

TUNING BY EAR

THE effect on the resonance curve of a set fitted with A.V.C. is such that it is impossible to tune into a given station accurately by ear alone. The set is therefore usually fitted with a visual tuning indicator.

The object of the invention is to modify the normal effect of



Resonance curve modified to facilitate aural tuning.

AVC upon an incoming signal in the immediate neighbourhood of the resonance point, so that a pronounced "peak" of signal strength is produced at that point, whereby accurate tuning can be carried out by sound without any visual aid. To secure this effect, the detector used to develop the AVC voltage is opposed by a second detector which is fed from a more "selective" stage of the receiver than the first. If, for instance, the curve A represents the AVC control voltage developed over a given frequency range, the curve B represents the more selective voltage. As the two voltages are opposed, the "throttling" effect of the net AVC voltage is represented by the shaded curve.

Aga-Baltic Radio Akt. Convention date (Sweden) May 15th, 1937. No. 504421.

o o o o

"SCRAMBLED" TELEVISION

THE object is to transmit a television programme which, instead of being available to every receiver within range, is deliberately distorted or "scrambled," so that satisfactory reception is only open to subscribers, who must, of course, be provided with means for restoring the transmitted picture to a normal condition.

At the transmitting end, the usual aperture plate, through which the scanning beam is passed before it reaches the cinema film or other picture to be televised, is replaced by a plate formed with a slit of zig-zag or other irregular shape. In other words, the usual flat ribbon of light, representing one scanning line, is given an irregular outline. In this way the picture signals are altered so that they would produce merely a confused mass of light and shade if received on an ordinary set. To restore them, an aperture of similar outline must be used in the receiver. To increase the degree of secrecy, the aperture plate may be made much longer than a single scanning line, and may be moved forward at intervals so that the actual aperture constantly changes its outline. The receiver is fitted with a similar arrangement, which is synchronised to that fitted to the transmitter.

S. L. Clothier and H. C. Hogencamp. Convention date (U.S.A.), October 6th, 1936. No. 503327.

o o o o

INCREASING PICTURE CONTRAST

RELATES to means for increasing the contrast of the light and dark parts of a televised picture, as compared with the contrast between the parts of medium light intensity. The desired effect is produced by inserting, in the path of the electron stream flowing through a cathode-ray transmitting tube, a diaphragm with a triangular notch having S-shaped sides. The discharge stream is focused into a flat "band" of electrons, so that more or less of the electrons are cut off by the notch as the stream is traversed to and fro by the deflecting plates of the tube, on its way to the mosaic-cell screen at the farther end of the tube. This increases the effective light intensity in the non-linear manner desired.

Radio-Akt. D. S. Læwe. Convention date (Germany), October 2nd, 1936. No. 505167.

o o o o

D.F. SYSTEMS.

IF the circular radiation from a non-directional aerial is combined with the figure-of-eight radiation from a frame aerial, in the phase shown by the + and − signs in Fig. 2, the resulting field will be heart-shaped, as shown by the thick curve H. If the phase of the circular field is reversed, the direction of the heart-shaped field will also be reversed, so that it lies on the opposite side of the vertical line XY. If this phase-reversal is repeated at high speed, the line XY will mark out a navigational course along which signals of equal strength will be heard.

Fig. 1 shows how the necessary phase-reversal is obtained. The non-directional aerial A is fed from a tuned circuit L C through a rotating condenser M, the fixed plates of which are connected in pairs across the inductance L, while the moving plates are connected to the aerial A. The speed of rotation determines the rate of phase-reversal.

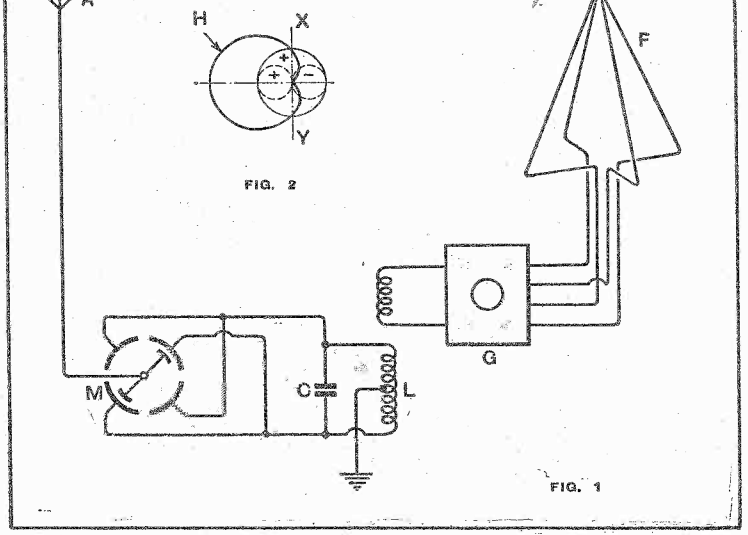
Simultaneously a pair of crossed frame aerials F is fed from the same RF circuit L C through goniometer coils G. The rotating condenser M can also be used to transmit "dash" and "dot" signals on the two opposite sides of the course line XY.

Aga-Baltic Akt. Convention date (Sweden) November 26th, 1936. No. 503428.

o o o o

PREVENTING FREQUENCY "DRIFT"

A PROBLEM in short-wave working is to prevent frequency changes due to the effect of temperature variations on the components of the receiver. Coil and condenser supports are now usually made of ceramic material in order to overcome this difficulty, but when variable condensers or coils are so mounted it is found that the bearings tend to seize or stick owing to the nature of the surfaces.



System of DF using composite radiation from frame and open aerials.

According to the invention, the spindle of a rotating condenser or variometer is made of ceramic material which is formed with conical shoulders at both ends. These run on ball bearings in the ordinary way, except that the balls are also made of ceramic material, suitably ground down.

Telefunken Ges. für Drahtlose Telegraphie m.b.h. Convention date (Germany), October 10th, 1936. No. 503618.

o o o o

ENLARGED TELEVISION PICTURES

A SELECTED part of the transmitted picture is made to occupy the whole of the screen of the television receiver, thus giving the effect of a "close-up." This is done by altering the angular velocity, or the rate at which the scanning stream sweeps over the screen, preferably by varying the value of a resistance in the time-base circuit. A similar kind of adjustment has often been used to effect small adjustments in the size of the picture, but the inventors claim to be the first to employ it for making the complete picture much larger than the screen itself, and enabling them to select one particular part of the enlarged picture, and cause it to occupy the whole of the screen.

The General Electric Co., Ltd., and F. Poperwell. Application date September 6th, 1937. No. 500809.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

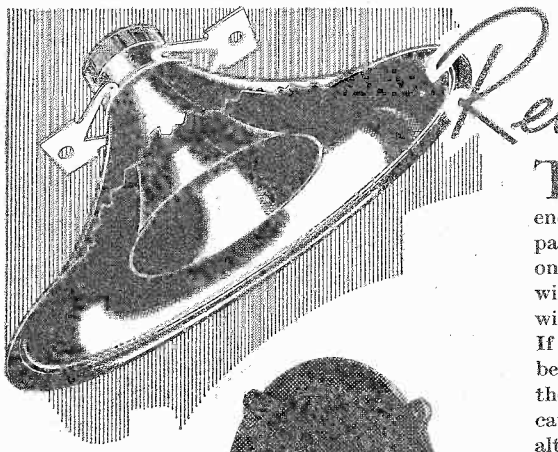
o o o o

SIMPLIFIED WAVEBAND SWITCHING

EPICYCLIC gear associated with the tuning control is so arranged that when the pointer reaches the far end of the scale (as determined by a stop on the condenser spindle) the gearing becomes "locked," and automatically changes the waveband switch, say from "medium" to "short"; at the same time the corresponding indicator scale is exposed to view.

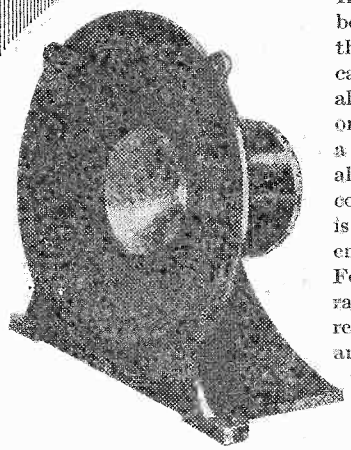
The pointer can then be similarly moved over the new scale until a second change of wavelength is automatically effected, and so on; or, at the end of one traverse, the rotation of the spindle can be reversed to restore the original arrangement of the waveband switch and station indicator. Provision is also made to change a direct drive, such as is used for rapid searching, into an indirect drive for fine tuning.

Pye, Ltd., C. E. M. Butler, and E. V. Root. Application date August 12th, 1937. No. 500873.



Reduces SUB-HARMONICS

THE cause of sub-harmonics can be explained thus:—"If a strip of resilient material is fixed at one end, and pressure applied to the other, in a direction parallel to its longitudinal axis, the strip will bow in one direction. If the pressure is released, the strip will not only return to its normal position but its inertia will cause it to bow slightly in the opposite direction. If pressure is again applied to the end of the strip, before it has had time to return to its original position, the flexing will proceed in an opposite direction to that caused by the first pressure. It will be seen that although two complete cycles have been applied only one vibration of the strip has resulted. By the use of a curved sided or exponential cone this effect can be almost entirely eliminated. It is obvious that if you commence with a strip which in its quiescent condition is already curved, pressure applied intermittently to one end will only tend to increase and decrease the curvature. For the centre cone a curvature of comparatively small radius is necessary, whereas only a slight curvature is required in the main diaphragm, where sub-harmonics are not troublesome . . ." *(Extract from "The Attainment of an Ideal" —GOODMANS Technical Booklet on Loudspeaker construction.)*



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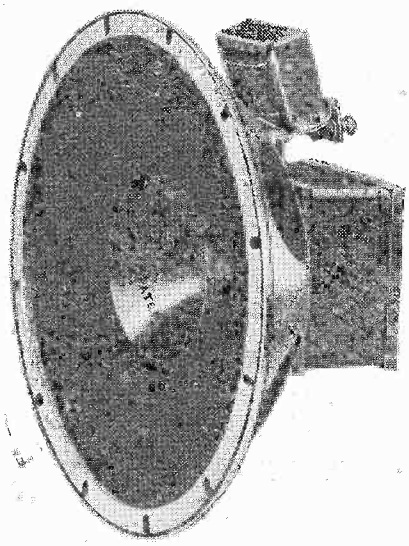

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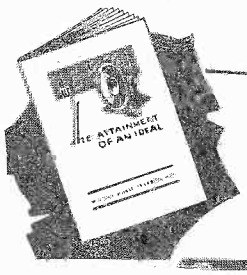

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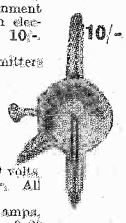

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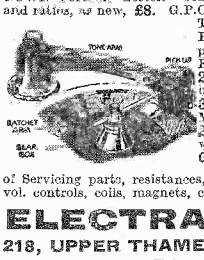

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1939 Car Radios, complete with suppressors and fittings, £4/10; push-button models, long and medium, £5/17/6.

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GOOD Second-hand Car Radio Wanted, 12-volt.—Marples, Harwood Court, Upper Richmond Rd., Putney, S.W.15. [8716

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Printed in England for the Publishers, ILIFFE AND SONS LTD., Dorset House, Stamford Street, London, S.E.1, by The Cornwall Press Ltd., Paris Garden, Stamford Street, London, S.E.1. "The Wireless World" can be obtained abroad from the following: FRANCE: W. H. Smith & Son, 248, Rue Rivoli, Paris; Hachette et Cie, Réaumur, Paris, and branches; Messageries Dawson, 4, Rue de Faubourg, Poissoniere, Paris. BELGIUM: W. H. Smith & Son, 74-75, Boulevard Adolphe Max, Brussels. AUSTRALIA: Gordon & Gotch, Ltd., Melbourne (Victoria), Sydney (N.S.W.), Brisbane (Queensland), Adelaide (S.A.), Perth (W.A.), and Launceston (Tasmania). NEW ZEALAND: Gordon & Gotch, Ltd., Wellington, Auckland, Christchurch and Dunedin. INDIA: A. H. Wheeler & Co., Bombay, Allahabad and Calcutta. CANADA: Imperial News Co., Toronto, Winnipeg and Vancouver; Benjamin News Co., Montreal; Gordon & Gotch, Ltd., Toronto. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd., Cape Town. UNITED STATES: The International News Co., New York.

The
Wireless World
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THE PRACTICAL RADIO & TELEVISION JOURNAL

Thursday, July 27th, 1939

No. 1,039. Vol. XLV. No. 4.

The Wireless World

THE PRACTICAL RADIO JOURNAL

29th Year of Publication

No. 1039. THURSDAY, JULY 27TH, 1939. VOL. XLV. No. 4.

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone : Waterloo 3333 (50 lines).
Telegrams : "Ethaworld, Sedist, London."

COVENTRY : 8-10, Corporation Street.
Telegrams : "Autocar, Coventry." Telephone : 5210 Coventry.

BIRMINGHAM :
Guildhall Buildings, Navigation Street, 2.
Telegrams : "Autopress, Birmingham." Telephone : 2971 Midland (5 lines).

MANCHESTER : 260, Deansgate, 3.
Telegrams : "Iliffe, Manchester." Telephone : Blackfriars 4412 (4 lines).

GLASGOW : 26B, Renfield Street, C.2.
Telegrams : "Iliffe, Glasgow." Telephone : Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home and Canada, £1 10s. 4d. ; other countries, £1 12s. 6d. per annum.

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Plans for Olympia

Technical Meetings

IN last week's issue we expressed satisfaction at the efforts made by the organisers of Radiolympia to widen the appeal of the annual wireless exhibition by the inclusion of features likely to attract visitors whose interest lies mainly in the technicalities of the subject. Since those remarks were written, steps have been taken to organise a "Popular Technical Convention"—a series of meetings at which various technical topics of the moment will be discussed. As reported in our News columns, it is proposed that the Convention, to be held in the Conference Hall at Olympia, should be divided into four sessions, spread over the period August 28th to August 31st.

A Step Forward

The idea of a Convention seems to bring Radiolympia a stage nearer towards the "Exhibition of the future" that was envisaged last week, when we spoke of a Show that should be not merely a market place, but also a forum for discussions and a social rendezvous where those with common interests might get together. We hope that it will receive the fullest support.

For each one of our readers likely to be attracted to Olympia by a mere show of cabinet-work, there are probably a dozen or more who would make an opportunity to go there to hear debates by acknowledged experts on topics that interest them. Indeed, a considerable number would probably themselves wish to take part in the discussions, and it is to be hoped that those who have anything to contribute on the various subjects to be selected will not hesitate to come forward.

By stressing what must, for want of a better word, be described as the technical aspects of Radiolympia, we are not advocating a purely "highbrow" show. What we hope—and expect—to see is an exhibition appealing to everyone capable of taking an intelligent interest in wireless matters in the widest sense.

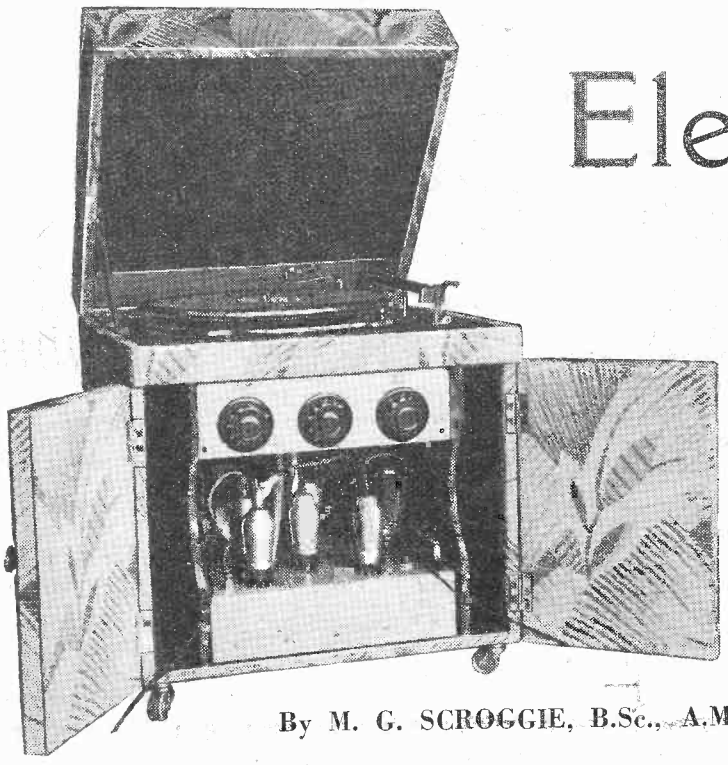
Tuning Scales

Problem for Manufacturers

AS is now well known, the Montreux Plan for the allocation of broadcast wavelengths does not come into force until March 4th, 1940. In consequence, manufacturers of receivers throughout Europe are faced with a minor, though none the less difficult, problem : should their new season's sets bear a station-name dial calibrated for the new plan or for the old ?

If they choose to fit "Montreux" dials, operation of the new sets will be an extremely tricky business for the first few months of their life, and the prospective buyer is provided with an excellent excuse for postponing his purchase—presumably the last thing that the manufacturer wants. On the other hand, if it is decided to fit tuning scales calibrated in accordance with the existing allocation of wavelengths, the maker is laying up for himself a store of trouble next March. Worse still, he runs the risk of incurring a serious loss of goodwill among that section of users of his products that will not trouble to demand a new dial, though saddled with a receiver that is a constant source of annoyance.

What would seem to be one of the best ways out of this impasse is that adopted in Denmark, where each receiver sold between now and March will include a coupon entitling the buyer to a "Montreux" replacement dial, to be fitted free.



More About the Electric Gramophone

NOTES ON THE HIGH-QUALITY EQUIPMENT RECENTLY DESCRIBED

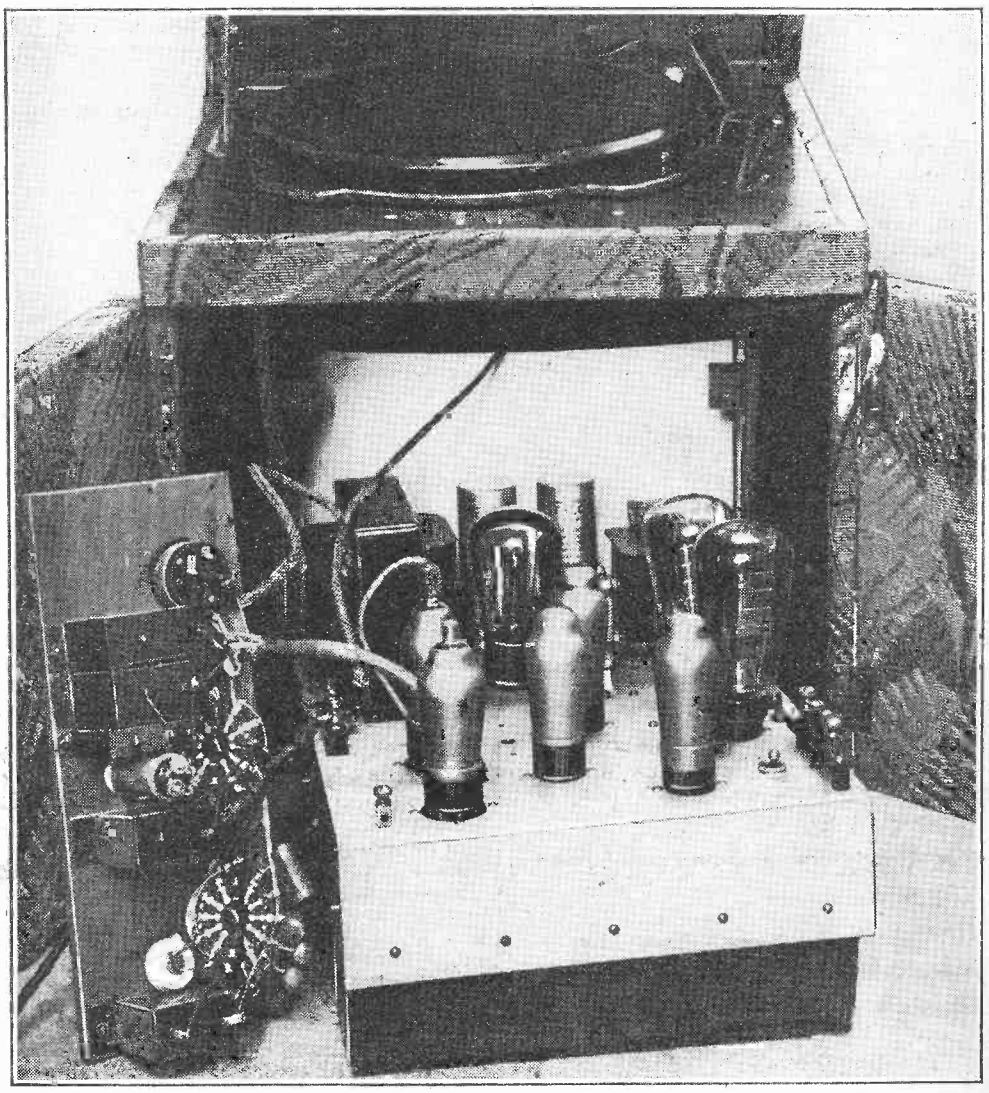
THE article on an electric gramophone in our issue of May 11th last was devoted chiefly to explaining the design; but as a number of readers have shown an interest in the constructional details and have raised other queries concerning the apparatus, the following supplementary notes may be found helpful.

By M. G. SCROGGIE, B.Sc., A.M.I.E.E.

ALTHOUGH tone control has been dealt with fairly often in *The Wireless World* during the last year or so, it still seems to be one of the most popular topics. The theory of most of the system embodied in the gramophone in question has been comprehensively covered by Mr. Cocking's article of June 8th. The treble control is, however, complicated by the tapped choke used for getting optional sharp cut-off characteristics; and seems to have caused some readers a little uncertainty, although it was in fact pointed out that the practical test of listening revealed that such characteristics are no better than gradual ones, and in the writer's judgment at least are actually less satisfactory. There is no doubt, however, that for radio a sharp cut-off is a definite advantage, because such interference as heterodyne whistles is of a definite frequency that can be eliminated, instead of being spread over the whole useful frequency range like record surface noise. So the note inserted in a later issue to the effect that Messrs. Varley can supply the tapped choke in question concerns any who may be thinking of incorporating such a tone control in a radio-gramophone or receiver.

It was suggested that for purely gramophone purposes the two sharp cut-off control positions should be replaced by a wider assortment of the gradual type; and Fig. 1 gives definite circuit information on this. The large amount of simplification will no doubt be noted with pleasure. The only component other than ordinary condensers is the 60-millihenry choke. The Bulgin HF.34 choke is rated at a slightly higher inductance—75 mH—but under the working conditions is only 35 mH, which would give a slight lift. A full 60 mH coil can be made by winding a groove $\frac{7}{32}$in. wide, $\frac{1}{4}$in. inside diameter, and 1in. outside diameter, practically full of 40-gauge enamelled copper wire (approx. 2,400 turns; $\frac{1}{2}$oz.). The characteristics of the revised tone control are shown in Fig. 2.

In the original circuit diagram the tone control switch was reproduced in a way that was rather misleading, as the switch arms were shown connected to studs of different numbers. As the two switch arms in each control (bass and treble) are ganged, this is impossible—or at least it should be if the switches are properly connected. Each control switch is a



Chassis and control panel: connector from pick-up to 1st valve on extreme right. A sheet of paper has been placed behind the chassis to act as a background.

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Yaxley 2-pole 5-way; or the Bulgin S.202, which is a 6-way switch and therefore allows an extra position that can be used (or unused) as fancy dictates. If it is found that local circumstances call for a tone not provided, it is easy enough to judge from Figs. 1 and 2 a suitable value of capacity to try.

Expectations that someone would call attention to the absence of any reference to automatic contrast expansion have not been disappointed. One reason for omitting it is that contrast expansion not only necessitates at least two more valves—probably three to do it distortionlessly—but the whole equipment would have to be on a much larger and heavier scale, because unless the volume can expand upwards as well as downwards there is not much point in the idea. An output of at least 15 watts would be desirable to take care of the peaks. The apparatus would then be very heavy and cumbersome, as well as expensive; and, although it may be a matter of personal taste, the writer has never been greatly impressed with the desirability of contrast expansion. The amount of compression in good recording, as in good broadcasting, is not very large now; and what control is exercised is designed to give the best results *without* automatic expansion at the reproducing end, and does not necessarily follow a law which is the inverse of automatic expansion.

Some readers have enquired about the use of other types of pick-up. The apparatus was designed for a type which gives a substantially level response, without any attempt to boost the bass by tone-arm resonance or otherwise, such attempts being found usually to introduce amplitude distortion. The most important thing, however, is to avoid overloading the first three valves; so most types of pick-up have to be applied through a suitable potential divider to keep the maximum input down to about 0.1 volt peak. For a crystal pick-up the total resistance has to be high, as specified by the makers, but should be the lowest allowable in order to minimise risk of hum. The value of $\frac{R2}{R1+R2}$ in Fig. 3 should be adjusted so that when the volume control is nearly at maximum the output stage is just overloaded on loud records. If the pick-up characteristic has a rise in the bass of 10db. or more, it would probably be best to omit the first stage entirely; in which case 0.3 volt input is allowable. When considering the frequency characteristics shown here

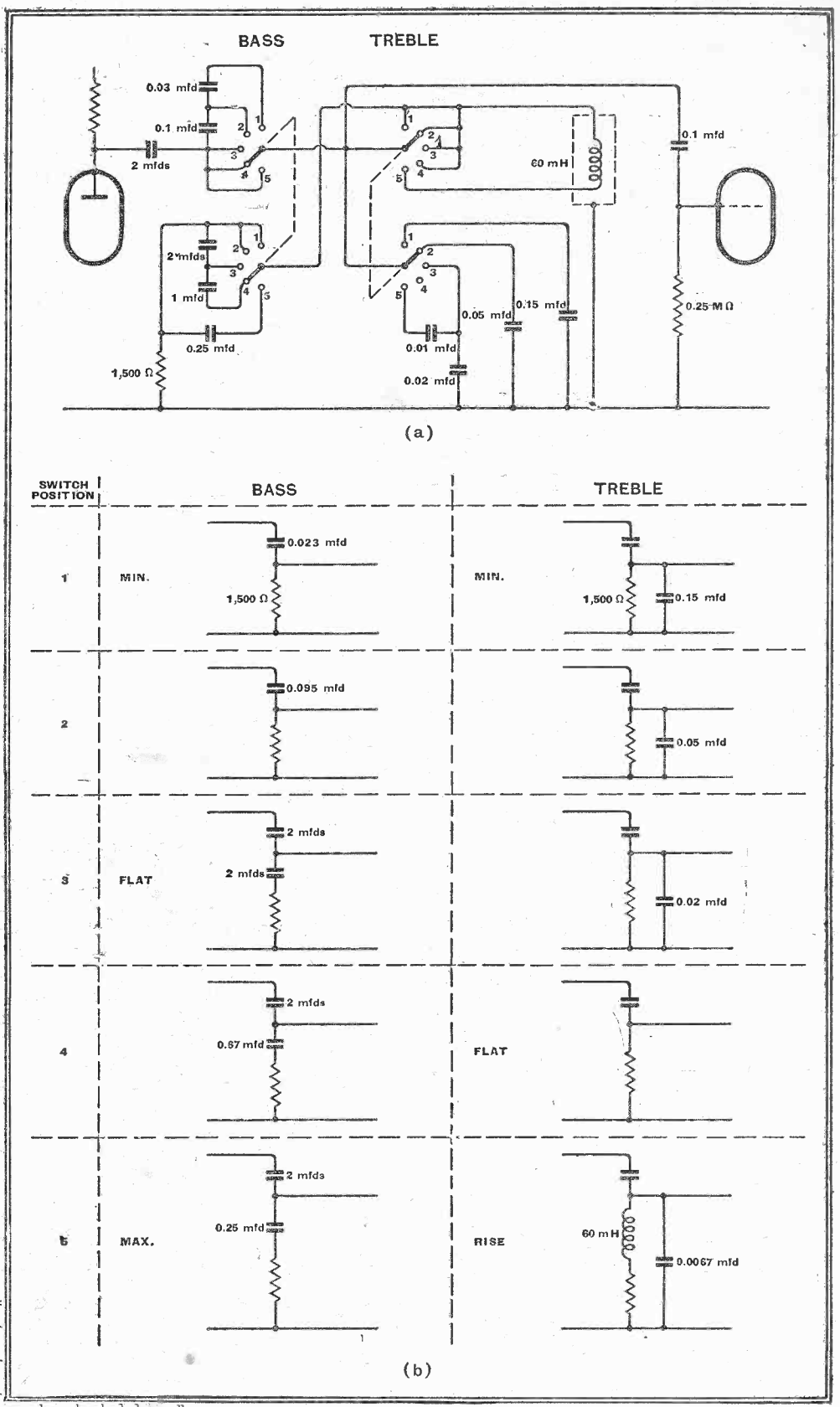

Fig. 1.—Circuit diagram of modified tone-control system. Each of the two controls is operated by a 2-pole 5-way switch. The circuit obtained at each of the five switch positions is shown at (b). The value of the series condenser in the "treble" column depends on the setting of the "bass" control, as indicated in its own column. The same 1,500-ohm coupling resistor is shown in both columns.

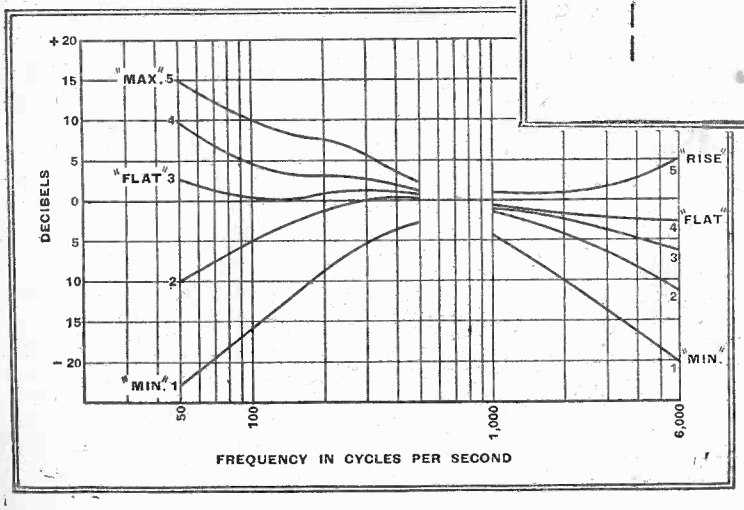

Fig. 2.—Characteristic curves relating to the system of Fig. 1. The five bass curves were obtained with the treble control at "flat," and *vice-versa*.

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and in the previous article, it should not be forgotten that they include the record itself with its bass drop. Characteristics taken from the input terminals of the gramophone, or from a constant-output record, would show much greater bass output.

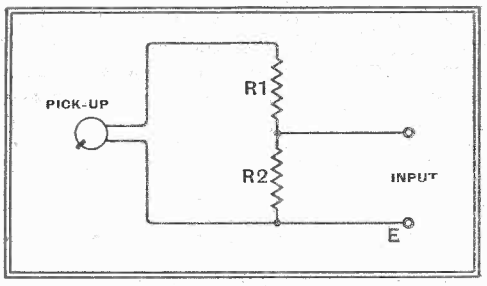


Fig. 3.—A potential divider is essential if a pick-up with a greater output than the Telefunken is used. $R_1 + R_2$ should be made the minimum resistance allowable for the pick-up, and $\frac{R_2}{R_1 + R_2}$ is then adjusted as described.

There would be no sense in employing in high-quality apparatus of this kind a pick-up with such a defect as a serious high-pitch resonance, so it would be out of place to give particulars of a modification in the tone control for counteracting a resonant peak.

In arguing the advantages of push-pull it was stated that it "reduces the unpleasanter components of distortion." In case this might be interpreted to mean that the unpleasanter harmonics (i.e., third and upwards) are reduced, it should be explained that "unpleasanter components" refers to harmonic distortion in general as contrasted with frequency distortion. Actually, it is the second harmonic that is balanced out by push-pull, and the advantage of triodes is that harmonics other than the second are very small indeed. Triodes in push-pull therefore give a very pure output.

Departure from the specified output transformer is not recommended because trouble is liable to be experienced with the negative feed-back circuit from the secondary if excessive phase-shift occurs. The output ratios specified, in conjunction with feed-back, give satisfactory operation with load impedances from $1\frac{1}{2}$ to 15 ohms—a range that includes practically all types of speech coil. In case anybody wants to try an existing output transformer, however, and the ratio is less than the 67 : 1 in the specified transformer so far as the 2-ohm winding used for feed-back is concerned (it is hardly likely to be greater), a resistance should be inserted in series between the transformer and the 250-ohm cathode feed-back resistor to reduce the feed-back voltage (Fig. 4). If the resistance of the load for which the winding used for feed-back is designed is R ohms, the correct series feed-back resistance is $250\left(\frac{R}{2} - 1\right)$ ohms. For example, if the output transformer has only a single output winding, intended for a 15-ohm load, then the required feed-back resistance is 1,625 ohms. As the value is not at all critical, 1,500 would do in this case. If any inductance is required it is likely to be greater than the 1,500 μH found effective in the 2-ohm circuit; it can be decided only by experiment. If the loud speaker leads are not very long it may not be needed at all.

By the way, in the original circuit diagram there was a misprint in the value of the bias resistance for the third valve. It should be 2,500 ohms, not 2.5 MΩ!

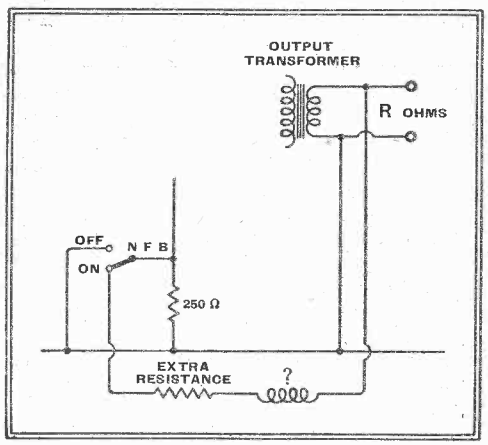


Fig. 4.—If negative feedback is derived from a winding designed for more than 2 ohms, an extra resistance is necessary to reduce the voltage. The value is calculated as described. The series inductance for preventing spurious oscillation may or may not be needed; the value depends on the particular output transformer, so must be found by experiment.

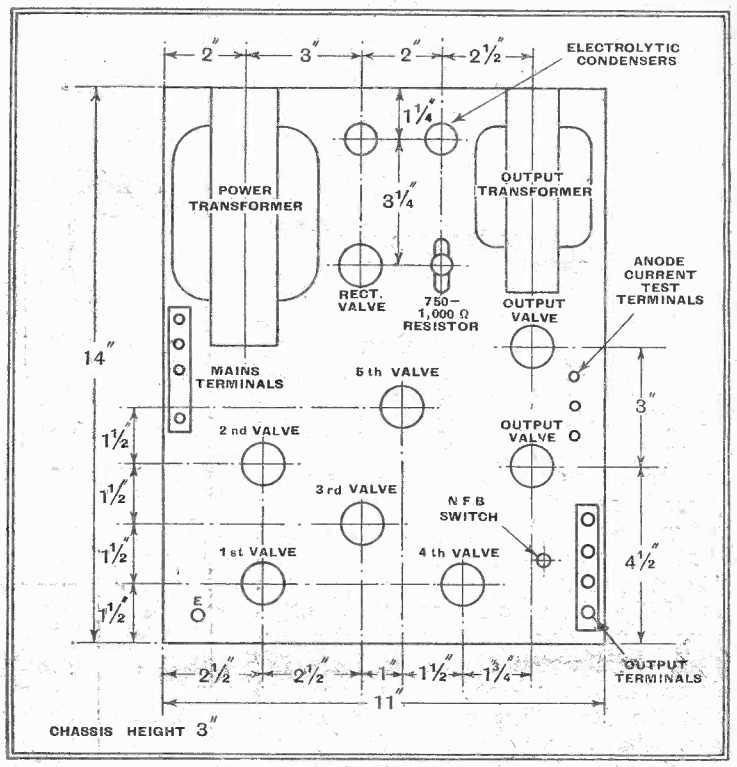


Fig. 5.—Layout of the chassis. The dimensions are included as a guide, but may have to be varied if different components are used.

Now for a few constructional notes. Fig. 5 shows the dimensions of the chassis and the locations of the components above deck; all others go below. The exact positions are, of course, subject to any departures in the components adopted. The smoothing choke should, of course, be mounted at the back, near the power transformer. Most of the 0.1 mH coupling condensers can conveniently be bolted to the inner side of the front of the chassis.

As regards the components, most of the condensers and resistors call for no special comment, and where not mentioned in the accompanying list the usual receiver type may be used, such as ½-watt resistors. The reservoir condenser is 500 volts peak.

The PR4V is a 750-ohm resistor, intended to be adjusted to the required value—approximately 600 ohms—by means of the connection band. Similarly, the PR5V is 1,000 ohms for 750. They are to be adjusted so that the current through the pair of output valves is 75

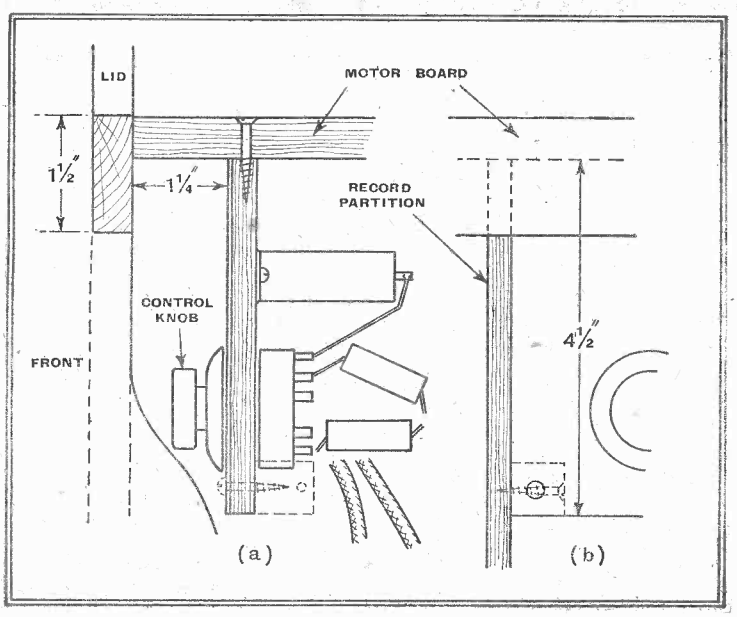


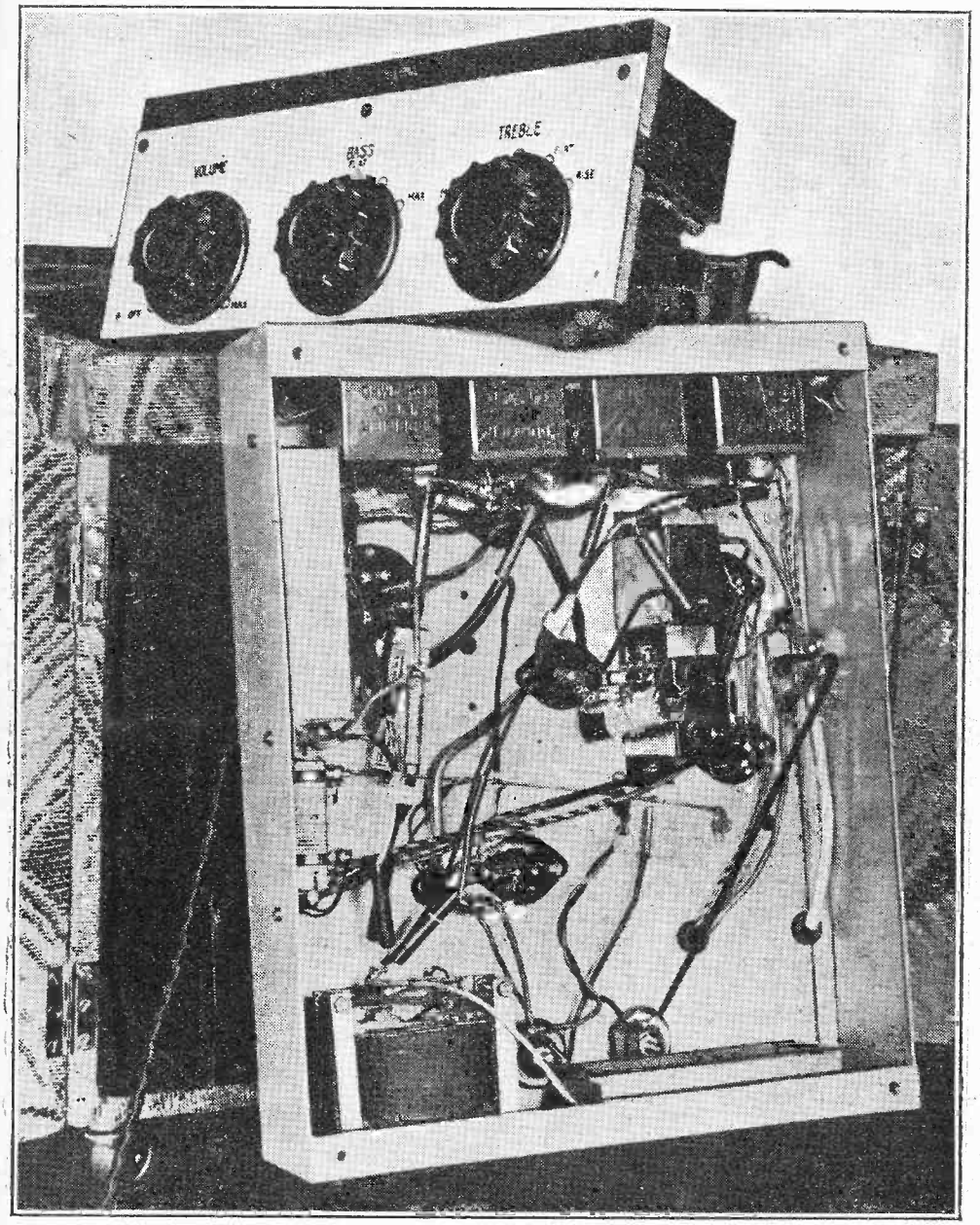
Fig. 6.—Side and front vertical sections to show how the control panel is fixed and arranged. It is connected by several flexible screened leads to the chassis below.

More About the Electric Gramophone—

mA at 385 volts inclusive of bias-resistor drop. The current through the separate valves can be measured by applying a voltmeter (preferably 0-5 range) across the 100-ohm resistors fitted for that purpose, and these resistors should therefore be accurate within about 5 per cent. With perfectly balanced valves the readings would each be $3\frac{3}{4}$ volts. That is static balance, and there is no need to reject valves that differ by no more than about 10 per cent. The more important dynamic balance is ensured by the use of a common bias resistor with no by-pass condenser. When the valves are exactly equal in mutual conductance the signal currents in this resistor cancel out; if not equal, the residual signal current reduces the larger mutual conductance and increases the smaller, by negative and positive feed-back respectively.

Fig. 6 shows how the control panel, containing the two tone controls and the volume control, is supported. As the volume control is of the type incorporating a mains on-off switch, the mains leads should be enclosed in one braided metal sheath, the two volume control leads in another, and the two tone control leads in a third. These screenings can, of course, be used as the earth returns for volume and tone controls. The leads from mains terminals to motor, and from pick-up to first valve, should also be screened.

To allow room for the components at the back of this panel, and to remove them as far as possible from the AC motor, the motor should be mounted as far to the back of the motor board as possible, and also to the left so as to allow plenty of room for the pick-up. It is very important to mount the pick-up accurately according to the instructions enclosed, and especially to adjust the height carefully with the stylus resting on a record of average thickness.



Underside of chassis, with front at the top. Most of the components can readily be identified.

List of Components

Output transformer	Partridge Special
Mains transformer	Partridge T350/120
Smoothing choke, 20H	Partridge C25/60
Bias resistor for output stage	Bulgin PR4V
Smoothing resistor for output stage	Bulgin PR5V
Ivorine control panel facing, $11\frac{1}{2}$in. × $4\frac{1}{2}$in. × $\frac{1}{16}$in. white finished matt	Reliance (Nameplates), Ltd., Richmond Bridge Works, Twickenham
6 condensers, 0.1 mfd., 650 V, working, for coupling valves	Dubilier LEG
Feedback on/off switch	Bulgin S.81T, with on/off plate
Pick-up	Telefunken T.O.1001 (supplied by Pye)
Motor	Garrard AC6
Valves:	2 Tungsram HL4G; 3 Tungsram HL4+; 2 Mazda PP3/250; 1 Brimar R2 or Mazda UU4.

Five-metre DX

WHAT IS THE SKIP DISTANCE?

IF any useful information is to emerge from the activities of amateur experimenters, it seems most desirable that the many reports of reception and transmission that now appear as interesting entries in station log books should be correlated in order that an attempt might be made to formulate a theory to account for some of the unusually long distances covered by the ultra-short waves.

Several amateurs are actually engaged on work of this kind, but in most cases the data available is very meagre and it would seem that far more co-operation is needed between amateurs in all parts of the country. For example, nothing out of the ordinary may be noticed at a station in one part of the country, yet if one ventures to say as much in print it may be flatly contradicted by the operator of a station some two or three hundred miles away.

The position, so far as the writer can gauge it, is that five-metre transmission beyond the optical range takes place either by bending or reflection in the lower strata of the atmosphere. On some occasions it will only produce signals up to 50 to 60 miles, on others the range goes up to 100 to 150 miles, and possibly to 200 miles or so, but the information available covering distances over 150 miles is too inconclusive to be of much help.

When we come to transmission over 800 to 1,000 miles, such as in the case of the Italian signals, for they have been received in the North, vide G6YL's report in last week's issue, we have to assume reflection from a higher altitude. What one wants to know is, were the Italian stations heard by G6YL on June 24th and June 25th last also audible in the South of England. If not, might it be reasonable to suppose that the skip distance was of the order of 500 miles or so?

Another point, G6CW is often received in the southern counties as well as, if not better than, a station only ten miles away. Now, are his signals receivable anywhere between Nottingham and London on these occasions, or is there a skip distance?

Answers to these questions and many more like them would throw much light on the propagation of five-metre waves, and amateurs are in a position to supply the data needed. But co-operation is essential and the writer ventures to suggest that a 56 Mc/s experimental section might be formed to correlate all reports of over 100 miles and examine them in conjunction with meteorological reports for the days concerned.

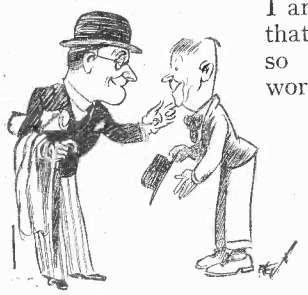
G2MC.

UNBIASED

By FREE GRID

A Revolutionary Invention

ONE of the most gratifying things in my life is the astonishing faith which many readers place in me by asking me from time to time for a frank opinion of certain inventions which they propose to patent. It is exceedingly rare for any of the inventions submitted to me to be covered by a provisional patent. It is quite clear that my readers trust me, and I am happy to say that I have never, so far, found it worth my while to abuse this trust. I have always endeavoured throughout my life to maintain a high standard of integrity in my dealings with other people, this line of conduct being one which was strongly urged upon me by my father when I first announced that I intended to take up wireless, a profession in which, so he informed me, I should be beset by many temptations on the part of unscrupulous persons to induce me to lend the influence of my name to ensnare the public into supporting with their hard-earned money wireless inventions of doubtful practicability.



I must confess that I have more than once found my father's remarks to be only too true, the most notable instance being when I was invited to support a scheme for an inexhaustible LT battery of almost limitless ampere-hour capacity. The idea was to discover an island with large deposits of copper-ore, and a similar one which abounded in zinc. These islands were to form the electrodes of a giant wet primary cell, the intervening sea being the electrolyte.

You will well understand, therefore, that I was particularly suspicious when I was recently approached by a correspondent with a suggestion that I should induce *Wireless World* readers to support financially an invention of his to utilise wireless principles in order to provide aircraft with a reliable and error-free ground speed indicator. As many of you may know, the evolution of such a device is one of the great difficulties which beset the aeronautical world. It is easy enough to devise a speedometer to measure air speed, but it will be appreciated that if there is any wind blowing this will bear no relation to ground speed which, after all, is the only thing which really matters.

The inventor is a member of an amateur flying club, and he said that the invention "suddenly came to him" one day when he was listening to a B.B.C. programme on his aircraft wireless set during a power dive. He noticed that whenever he went at excessive speed the signal strength seemed to fade. At first he put it down to normal fading, and had determined to fit the set with AVC and would in all probability have done so had not the trouble persisted even when he was flying in sight of the aerials of Brookmans Park.

Eventually, he found that a slight adjustment of tuning, when flying at high speed, would put matters right, but his interest was by now thoroughly aroused, and instead of fitting the set with automatic frequency control and forgetting all about the trouble, he made up his mind to probe into the cause of it. As the result of further experimental work he found that when using a knife-edge crystal-controlled receiver the effect was much more pronounced, and by putting a delicate tuning meter in circuit he could detect a change in signal strength, even when flying slowly and slightly accelerating or decelerating. He thus definitely established the fact that the fading was caused by automatic detuning which varied in degree according to the speed of the aircraft.

As the result of further work he has now got a complete cut-and-dried explanation of the phenomenon, and he now only needs your money to make his fortune and yours by floating a company to use his discovery as the actuating principle of a new and revolutionary ground-speed indicator. The explanation of the phenomenon, as he gave it to me, seemed so absurdly simple that I kicked myself for not thinking of it before he did. It is far more simple than elucidating some of Henry Farrad's problems, and I am therefore going to leave it with you for a week or so to think it over. Perhaps Henry Farrad himself might like to have a shot at it.

Realistic Radiovision

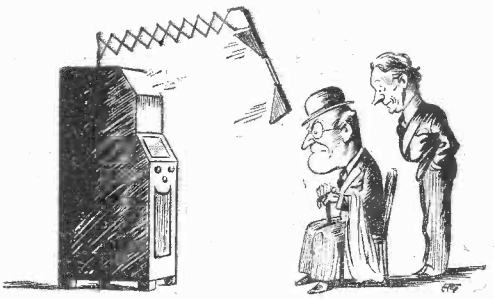
IT is not often that I patronise the cinema nowadays, for I am old fashioned enough to believe that a cinema is a place to which you go to see moving pictures. In any case, to my mind, most of the stuff dished up is sufficiently nauseating to make even a sailor feel seasick. Indeed, I recollect a practical instance of this one Saturday night in Portsmouth, when almost the whole audience, who were mostly sailors, was taken ill, and although the manager assured me that this had nothing to do with the programme, I was not such a fool as to be taken in with that tale.

However, I did find myself in a cinema theatre the other day, the reason for my visit being to see a special television broadcast that was being given, as I was anxious to see how cinema television was progressing. Quite frankly, I was greatly impressed with the performance, and in one important respect I consider cinema television to have an enormous pull over the home variety, and that is in the matter of sound reproduction. It is not that the quality of reproduction is better; indeed, it is not really so good, but the voices do definitely seem to come out of the mouths of the performers, as the loud speakers are, of course, at the back of the picture.

Now in the case of the ordinary home television sets everything, including the sound, is very realistic, but I have always missed that little extra bit of realism which is given when the loud speaker is immediately behind the screen. Curiously enough, I have always found that by wearing headphones the same effect appears to be produced, but this is, of course, not a satisfactory solution of the problem. I was, however, pleasantly surprised the other evening at a demonstration given by a friend of a home-made receiver, in which the loud speaker *was* behind the screen. It was, as you may have guessed, nothing more or less than projection television, in which the picture was thrown on to the screen from the front, thus leaving room for the speaker at the back.

With the usual big-screen type of home televisor, back projection is, of course, employed, but front projection *has* been employed, and so in this respect there is nothing new in my friend's receiver. What was new in his arrangement was that, although front projection was employed, the projector was in the cabinet of the receiver, and there was no apparatus to get in the way of the viewers.

The thing is best explained by a glance at the accompanying sketch, from which



it will be seen that, by tilting the screen slightly upwards, as is done in many ordinary sets, and by using an ingenious arrangement of a couple of mirrors mounted on a long extending arm, there was no difficulty in arranging for front projection without the necessity of using a separate screen, and suspending the receiver-projector from the ceiling to keep it out of the way of the viewers. The point I liked best was that the picture was *not* of the big-screen variety, and so there was no necessity to darken the room. Owing to the use of a projection lens of long focal length, the picture was in fact no bigger than that in the ordinary domestic television receiver, which, as everybody knows, is perfectly satisfactory for an ordinary room.

Regeneration in the Superheterodyne

WHERE AND HOW IT MAY BE APPLIED

By H. C. C. ERSKINE-MACONOCHIE
(Chief Engineer, The British McMurdo Silver Co., Ltd.)

THE judicious application of regeneration in any receiver can generally be relied upon to increase sensitivity and improve selectivity. There are, however, incidental advantages which make it particularly attractive to the designer of high-performance short-wave superheterodynes. The reduction of losses in tuned circuits, particularly when used in conjunction with good dielectrics, results in an increase in signal-to-noise ratio, especially at high frequencies. Further, the increase in overall efficiency enables a reduction in the number of valves to be effected, and a consequent economy of power consumption for a given maximum gain.

Unless carefully handled, however, regeneration may introduce undesirable effects which will offset its advantages. In Fig. 1 are illustrated two conventional methods of regenerating the RF stage of a superheterodyne receiver, both of which suffer from two principal defects.

It is necessary in the interests of signal-to-noise ratio to have a high degree of coupling between the primary and secondary of the aerial coil, and this produces lead spots or nodes at certain points in the tuning range. The length of the aerial will determine the frequencies at which these nodes recur, but the higher the frequency the more pronounced will be the effect. Often the presence of this phenomenon will make it impossible to reach the point of reaction. If, on the other hand, reaction is applied in the control-grid circuit of the mixer stage, and all leads "hot" to RF are kept short, the problem of nodes or anti-nodes does not arise.

The other defect concerns the operation of the controlled valve. In a normal system of electron-coupled regeneration the control of reaction consists of variation of screen voltage, Fig. 1(a), or variation of cathode bias, Fig. 1(b). In practice each system has the disadvantage that the controlled valve, whether RF amplifier or mixer, is rarely working under optimum conditions for its original function, particularly where wide ranges of frequencies are being tuned.

THE principle of employing regeneration to improve the performance of receivers of the "communication" type has many points in its favour. In this article the author discusses the methods which experience has shown to give the best results in practice.

One way of overcoming this difficulty is by the use of a variable capacity to feed back the RF component from screen to reaction coil, Fig. 1(c), but then two further obstacles ensue. First, the condenser, being "hot," should be disposed strictly adjacent to the controlled valve circuit, and this invariably necessitates an extension spindle or Bowden cable; then, where the control is fitted to an all-wave receiver, the value of capacity required at, say, 60 megacycles, is rarely of much use at 1 megacycle. In the low-frequency spectrum the maximum capacity would be incompatible with the very low minimum capacity of, say, 2 to 3 micro-mfd. necessary in the high-frequency spectrum.

Another method of control, that of short-circuiting the reaction coil with a potentiometer, proves to be fierce in operation and tends to mis-align the tuned circuit.

To overcome these and other minor defects a circuit was developed employing a separate triode regenerative valve applied to the control-grid of the mixer (Fig. 2). With this system the constants

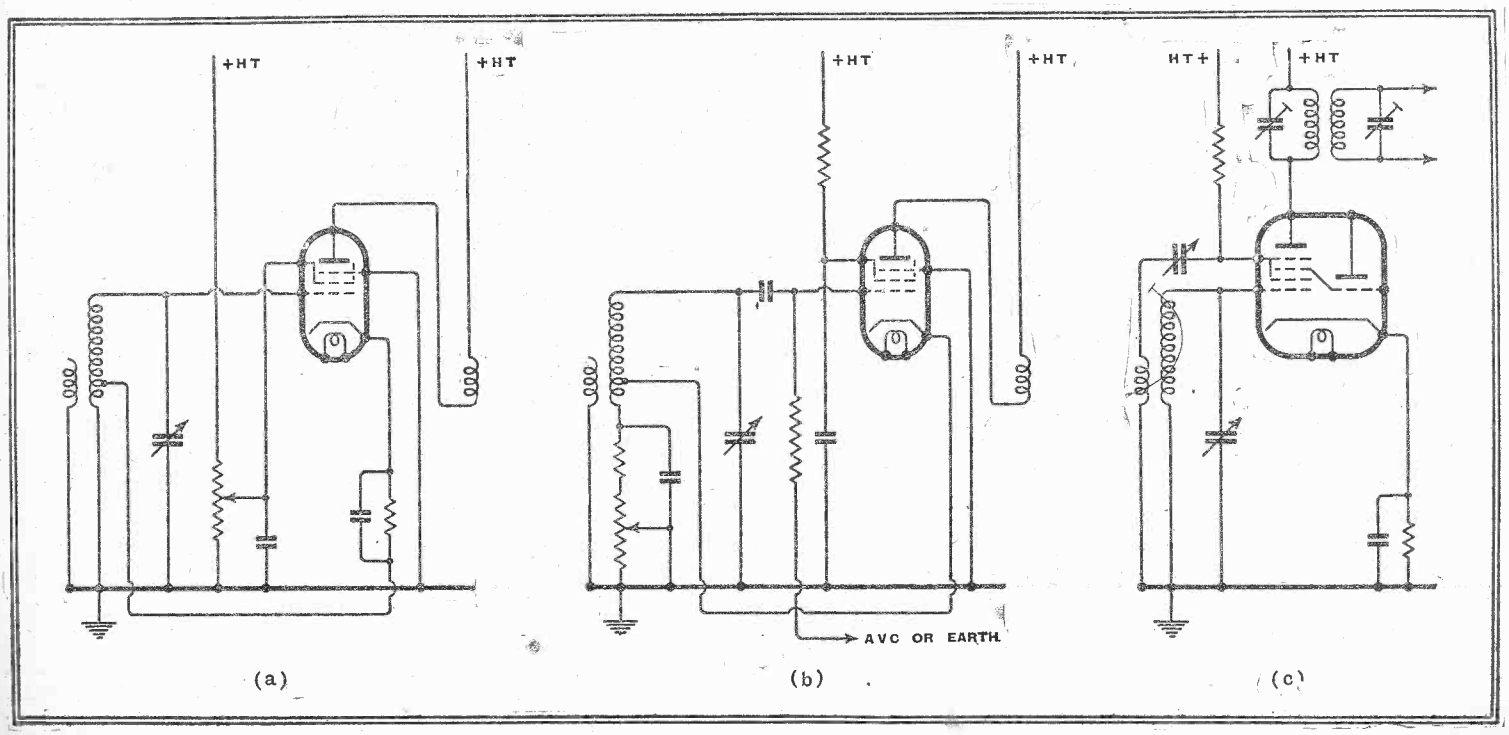


Fig. 1.—Typical methods of controlling regeneration in the RF or mixer stage. (a) variation of screen potential, (b) variation of cathode bias, (c) variable capacity feed-back.

Regeneration in the Superheterodyne—

of voltage on the mixer are unchanged at any degree of reaction, and the valve is therefore always working under optimum conditions. The potentiometer controlling DC voltage on the triode anode is "cold," and can be placed at any convenient point on the front of the chassis, and this, coupled with the high mutual conductance possible in the triode, enables smooth regeneration to be effected at all frequencies. In special cases when it may be necessary to minimise the reflected capacity changes across the tuned circuit caused by large variations of DC potential on the anode, resistances of carefully chosen value can be inserted in the cathode lead to reduce this variation (R1, R2, R3). In our laboratories it was found possible to keep the point of regeneration within plus or minus 10 volts between 10 and 30 megacycles, and the maximum capacity change did not exceed one micro-mfd. For communication or other work requiring extraordinary sensitivity over a wide frequency range it would be advisable to include a supplementary manual trimmer (C1) across this tuned circuit.

Before the fullest advantages of a reactive circuit can be obtained, careful attention must be paid to certain mechanical and electrical details, but, providing these necessary precautions are taken, the circuit shown in Fig. 2 is quite suitable for operation between the frequencies of 150 kilocycles and 70 megacycles.

In this connection we must stress the importance of short "hot" leads and the necessity of returning all earth leads in the circuit to a single point as near as possible to the mixer valve cathode. At the high-frequency end it was found essential to return the low-potential leads from the coils, gang rotor (from wiping contact), and mixer cathode to their chassis earth point via ¼in. double copper braid. The importance of these precautions will be realised when it is remembered that at these high frequencies the inductance of half an inch of wire can be sufficient to cause parasitic oscillation by inductive coupling.

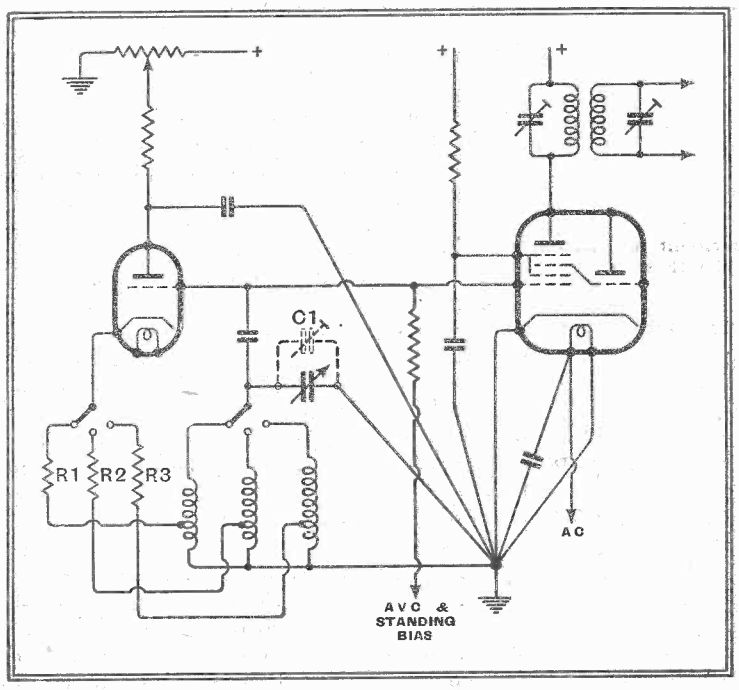


Fig. 2.—Regeneration in the mixer stage by means of a separate triode valve.

It is also essential to employ wherever possible in the RF circuits a good polystyrene or ceramic insulating material, as the electronic bombardment and leakage taking place across poor dielectrics has a most adverse effect on signal-to-noise ratio. The advantage in low noise level to be gained from regeneration can quite quickly be lost through inferior insulation; in fact, it might even increase noise under such circumstances. We emphasise this point, as it would seem often to be overlooked in the type of receiver under discussion.

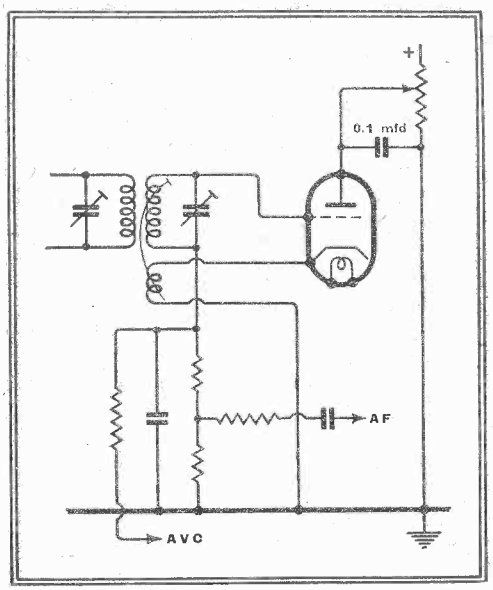


Fig. 4.—Regenerative triode detector for increasing selectivity at the intermediate frequency.

When AC is employed for heater supply, modulation hum may occur unless a 0.005 mfd. condenser is connected between the "live" heater-pin and earth on the signal-frequency valves, the earth being made at each chassis-earth point. The other ends of the heaters are returned to the same respective points.

An RF tuner unit, built on these lines, and incorporating a KTW63 as RF amplifier, X65 as mixer-oscillator, and L63 as regenerator, was fed into a standard laboratory amplifier including two IF stages and having an overall sensitivity of 30 microvolts at 50 milliwatts output. A G.R. Model 605A signal generator was then used to check the sensitivity of the

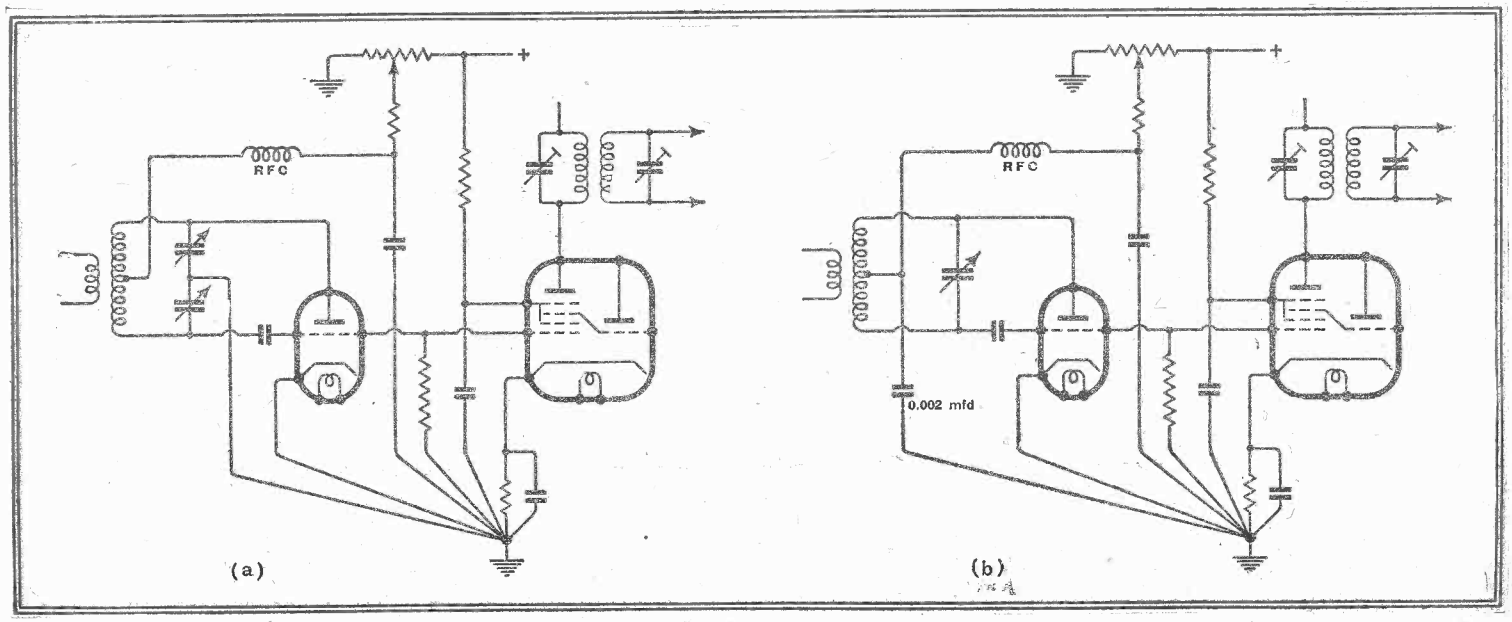


Fig. 3.—Symmetrical regenerative circuits suitable for use at frequencies between 70 and 300 Mc/s.

Regeneration in the Superheterodyne—

receiver as a whole over a range of 150 kilocycles to 35 megacycles. The standard G.R. dummy antennæ were used, except that at high frequencies an additional 0.00005 mfd. condenser was placed in series in order to obtain a conservative figure. However, at all frequencies an output in excess of 50 milliwatts was given with the attenuator at zero and the receiver adjusted to a point below regeneration.

By making connection between the chassis, generator, and earth in thick copper braid, the external field of the generator is reduced to a minimum, but

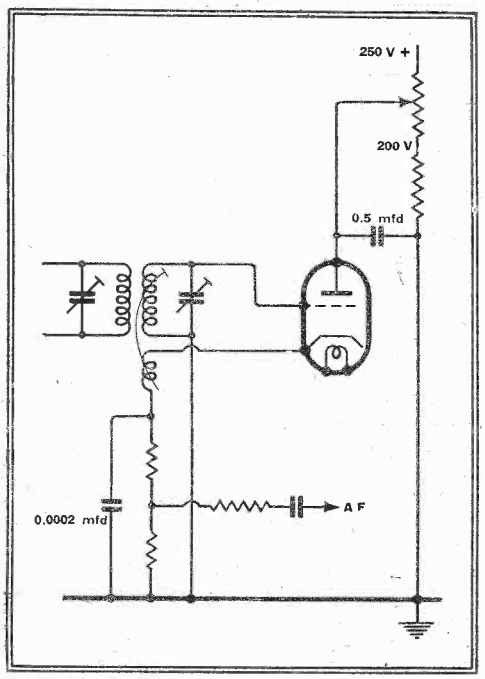


Fig. 5.—RF regeneration can be applied with advantage in the "infinite impedance" detector which employs negative feed-back at audio-frequencies.

the zero figure remains nominal, in view of the slight strays which must still exist.

Without regeneration the sensitivity fell to between 4 and 7 microvolts, at times exceeding this figure in the high-frequency spectrum.

On an aerial test it was possible to obtain intelligible reception of short-wave signals we had previously considered equivalent to ether noise level in the locality.

The improvement in preselection corresponds to the degree of regeneration applied, the intermediate frequency used, the "Q" factor of the first tuned circuit, and the input impedance of the RF valve at the frequency of operation.

An additional feature of the system outlined is that it may be successfully applied at frequencies between 70 and 300 megacycles, so long as symmetrical circuits

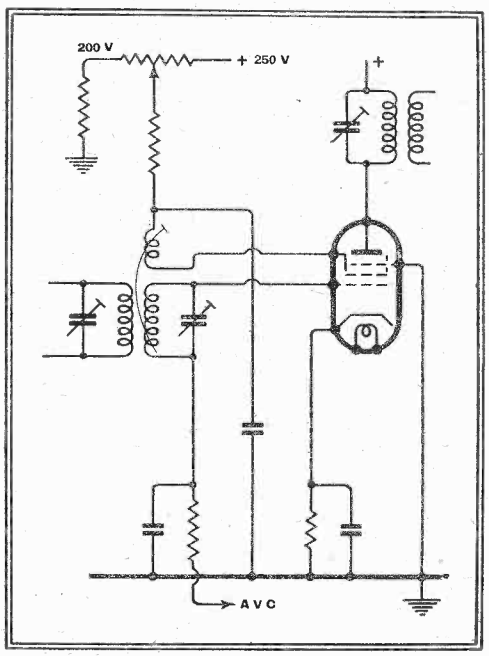


Fig. 6.—Recommended circuit for applying regeneration in the IF stage.

balanced to earth are employed. Though scarcely within the scope of this article, we illustrate in Fig. 3 two circuits which have given very satisfactory results.

In all cases of reaction at these frequencies very good regulation of power supply is needed to prevent motor-boating on the threshold of oscillation. In certain instances it may be necessary to include a neon stabiliser for the DC voltage in the mixer-oscillator circuit.

An intermediate frequency in the neighbourhood of 1,600 Kc/s is advocated, but when a lower and more conventional frequency is used, every care should be taken with screening to prevent "pulling" of the oscillator and RF circuits.

So far in this article we have dealt only with the use of regeneration to improve RF sensitivity and signal-to-noise ratio. But there is another aspect of its application that well merits attention. It has been found possible to achieve a peak selectivity in the IF stages comparable with a crystal gate.

In Fig. 4 is shown a circuit arrangement utilising a triode in place of the more common diode for detection. The control-grid of the triode operates as a diode anode for the purpose of signal rectification, whilst the valve as a whole functions as an electron-coupled regenerator, controlled again by potentiometer in the anode circuit. It will be apparent that the advantage of this is that it not only provides regeneration for peak selectivity at IF, but also it reduces all losses and damping in the diode tuned circuit.

Peak Selectivity

With a variable pitch beat oscillator used in conjunction with two IF stages and the above system of regeneration, a peak selectivity of 500 cycles for CW telegraphy was obtained. It should be mentioned that the IF transformers used for this test were of a normal commercial pattern with an effective "Q" factor of 110 in their cans. It was, however, necessary to reduce the coupling between windings in the output IF transformer to well below optimum.

It was then decided to apply the system to the infinite impedance detector. This form of signal rectification applies negative feed-back at audio frequencies, but, due to the small capacity between cathode and earth, no degeneration takes place at intermediate frequency. The advantage of the infinite impedance detector is that it imposes no load across the input tuned circuit, and furthermore it is capable of handling 100 per cent. depth of modulation without distortion.

By applying regeneration to this circuit, as shown in Fig. 5, we obtained the additional benefit of the peak selectivity previously described.

Of the various methods of regenerating

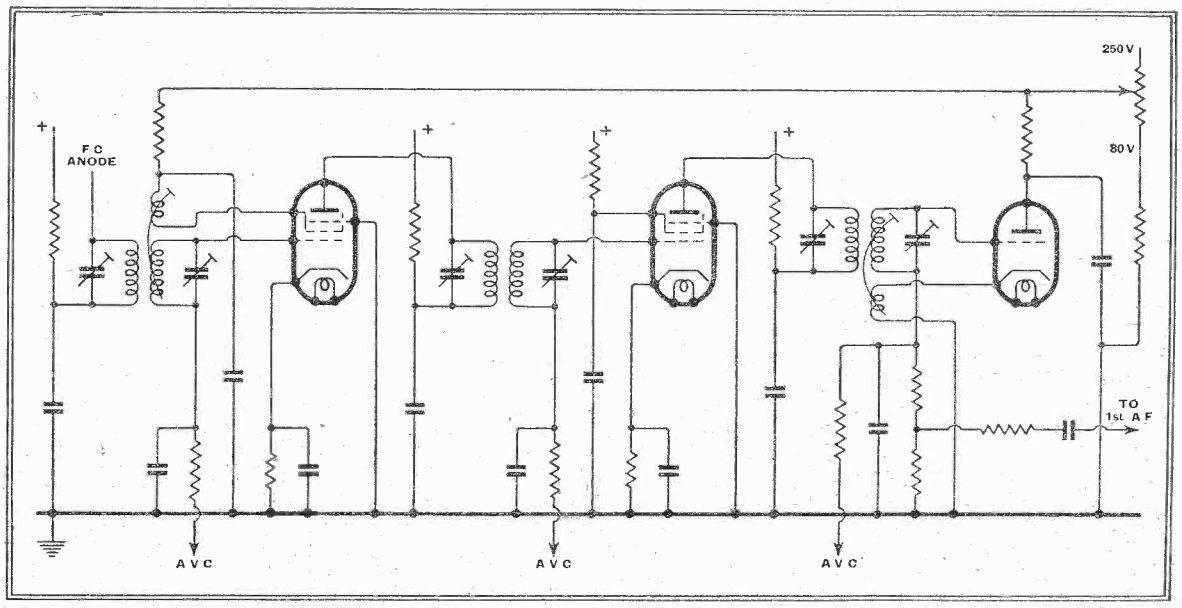


Fig. 7.—Where exceptional selectivity is required, this double reaction circuit may be employed. The reaction coil couplings are each adjusted to the threshold with the screen potentiometer set to give the optimum working voltage for the valve.

Regeneration in the Superheterodyne—

in the IF valve itself, we found that illustrated in Fig. 6 the most satisfactory on the basis of stability and versatility, as, by careful adjustment of the reaction winding, the valve can always be operated at its optimum conditions as a voltage amplifier when on the point of regeneration, and again the control is "cold."

As a final point of interest, tests were made with a view to achieving exceptional peak selectivity of between 250 and 300 cycles from an IF amplifier with double regeneration.

The circuit shown in Fig. 7 was built into a unit having carefully screened compartments with all due precautions taken to prevent stray coupling and maintain stability. The fact that IF regeneration was 180 degrees out of phase with its counterpart in the detector stage enabled both circuits to be taken to the point of reaction without "pulling" each other. Furthermore, control was effected with only one potentiometer by first setting the voltage to the optimum for the IF valve screen and then adjusting the two reactive windings to the threshold of regeneration at this point.

The results obtained from this circuit were extremely satisfactory.

In conclusion, the author would like to acknowledge the assistance of Mr. R. H. C. Foxwell in the preparation of this article.

Henry Farrad's PROBLEM CORNER

No. 30.—Start Point Causes Trouble

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction:—

The Cyders,
Modbury,
South Devon.

Dear Mr. Farrad,

I should like to have your opinion on our wireless. It is a good set, only about two years old. The selectivity ought to be extra special, because not only is it a superhet but it has a "RF stage" which I understand improves the selectivity considerably. And certainly up till a short while ago the results were wonderful. I have a good aerial here, and could receive almost every station you might care to mention, especially when the battery was fresh. But ever since the new station started there has been trouble. There are whistling sounds at several points on the dial; but worse than that, the Regional programme keeps coming in whenever I tune to any station. Do you think I can do anything to improve the selectivity?

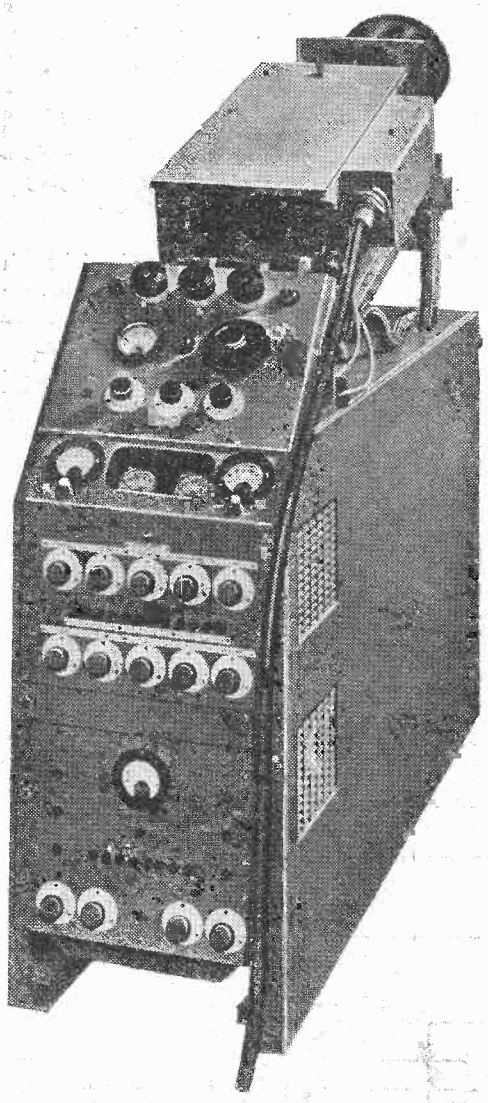
Yours sincerely,
Bramley Orchard.

How would you tackle this problem? Turn to page 90 for Henry Farrad's solution.

Television for Cinemas

E.M.I. PROJECTION APPARATUS

THE number of cinemas in which permanent apparatus is installed for projecting television pictures on to the ordinary screen is increasing very rapidly. It is not surprising that the E.M.I. Company, who are jointly responsible with the Marconi Company for the design and manufacture of the transmitting apparatus at the Alexandra Palace, have now turned their attention to this aspect of television. The installation made by E.M.I. consists of two main parts: the actual projection unit for use in the auditorium, and the subsidiary apparatus which is mounted in some convenient room and is connected by cables to the projector.



Rear view of the E.M.I. projector unit, showing control panels and monitor meters.

It is not possible for a television projector to be used in the ordinary projection room, as the "throw" would be too great to provide a well-illuminated television picture. Back-screen projection is normally ruled out by the fact that the space at the back of the cinema screen is usually occupied by the loud speakers of the ordinary talkie equipment, but there is nothing in the television apparatus itself which vetoes projection on to the back of the screen.

The television projector is intended to be mounted in a small space in the stalls, although it may equally well be put in the circle, provided that it is within fifty feet or so of the cinema screen. At this distance a picture 15ft. by 12ft. 6in. is given by the E.M.I. apparatus, this being large enough for satisfactory viewing in even the largest cinemas. One suggestion for mounting the projector in those cases where it is not desired to have it permanently in position is to place it on a small lift in the floor of the auditorium, so that it can be lowered after the manner of the organ console.

In the projector unit of the E.M.I. installation are scanning and modulation amplifiers, cathode-ray tube and lens system, and also control panels. An interesting point is that the mounting of the cathode-ray tube unit and the lens system is adjustable with regard to its angle of elevation, so that, by suitable inclination of the screen, the best viewing conditions can be obtained. The whole of the "drive" apparatus, including sound and vision receivers and the HT supply, is mounted in another room. Great care is taken in the manufacture of the apparatus to ensure complete safety for the operator. Contrary to what might be thought, the apparatus is not at all difficult to operate, calling for far less skill in this respect than is demanded by the ordinary cinema projector.

The Wireless Engineer

ALTHOUGH the quality of reproduction from output triodes is generally considered to be better than that from output pentodes, the latter are more commonly used. This is undoubtedly due to the fact that pentodes have a higher efficiency and, especially, a much greater sensitivity than output triodes.

In the August issue of *The Wireless Engineer*, which is published on the first of each month, practical cases are discussed which show that the quality of reproduction from pentodes need by no means be inferior to that delivered from triodes.

A cathode-ray oscilloscope for impulse testing developed at the Radio Laboratories of the Netherlands Telegraph Administration is described in the same issue. A feature of the equipment is a new time-base arrangement.

The results of work carried out at the National Physical Laboratory on the improvement in the quality of direction-finding observations by the use of non-linear amplifiers are also discussed.

A monthly feature of *The Wireless Engineer*, which is obtainable from booksellers or from the Publishers, Dorset House, Stamford Street, London, S.E.1, price 2s. 6d., is the Abstracts and References section, compiled by the Radio Research Board. In this section are given abstracts of articles on wireless and allied subjects published in the world's technical Press.

G.E.C. Mains Conversion Unit

A NEW conversion unit designed primarily for use with large receiving sets has been introduced by the General Electric Co., Ltd. It operates from 200-250 volt DC mains, and the maximum AC output is 160 watts.

The unit is of the vibrator type, and includes all the necessary filter circuits. It is contained in a metal screening case 15¼in. × 3¼in. × 2⅞in., and costs 5 guineas.

The Royal Corps of Signals

WIRELESS AT THE CATTERICK TRAINING CENTRE

CONTROVERSY — which has sometimes threatened to become heated—has been proceeding in our correspondence columns as to the amount of technical knowledge desirable for wireless personnel in the fighting Services. This article, written by a member of our staff after visiting the R.C.S. Training Centre at Catterick, will serve to clear up misapprehensions that apparently exist ; it shows that, so far as the Royal Corps of Signals is concerned, the technical standards compare extremely favourably with those existing in civilian wireless circles.

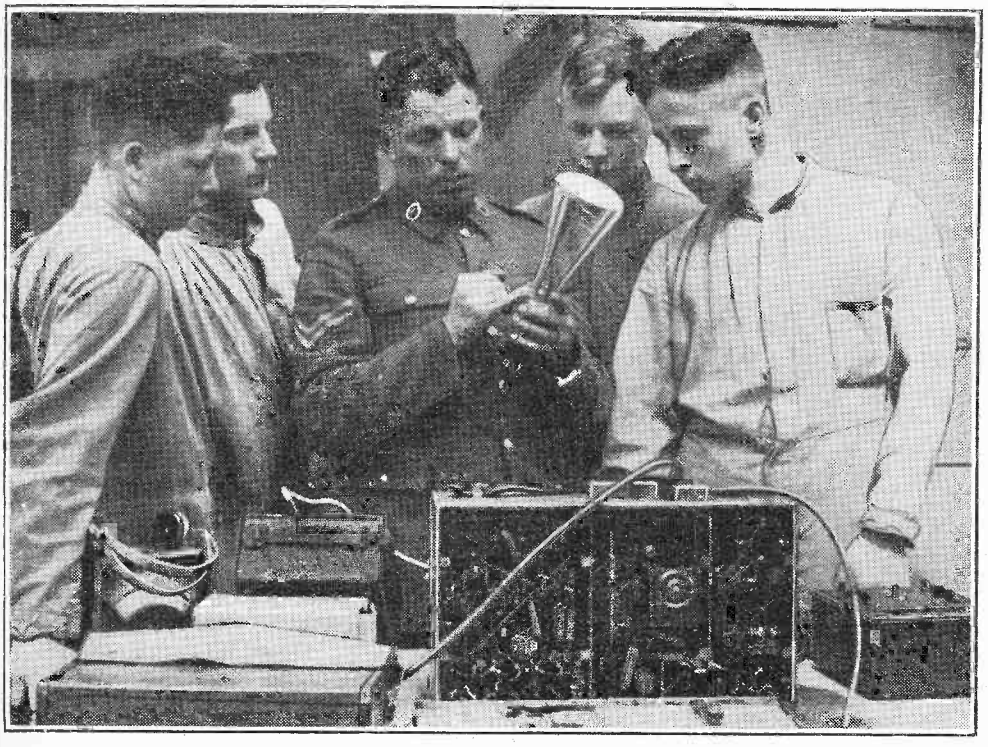
FUNDAMENTALLY, the main function of the signal personnel in all three of the Services, Navy, Army and Air Force, is to operate and maintain all channels of communication between units. As might be expected, each of the Services has its own special problems; a close liaison is, of course, maintained, but human nature being what it is, a little rivalry, perhaps better expressed as *esprit de corps*, exists.

The duties of the personnel entrusted with the important function of communication must necessarily be governed by the special requirements of their respective services, and although wireless is the most important of the systems in use, every other known method of effecting communication has to be considered and arrangements made for its utilisation should the need arise.

In the Army all signalling arrangements are under the control of the Royal Corps of Signals, which is a relatively new corps, formed in 1920. Prior to that date the duties were entrusted to a section of the Royal Engineers. Those who saw military service during 1914-1918 will remember this branch by the familiar designation "R.E. Signals." The Royal Corps of Signals has its headquarters at the Signal Training Centre, Catterick, Yorkshire, where Brigadier R. Chenevix Trench, O.B.E., is in command.

This is the main training unit of the Corps and it consists of a School of Signals where officers undergo an 18-months course, a Training Battalion for technical instruction of non-commissioned officers and men, and a Depot Battalion where new recruits are initiated in Army routine such as drill, musketry, and matters of this kind, before embarking on their course of technical training.

Field work being carried out with portable equipment installed in a light car.



Maintenance of all equipment is carried out in the R.C.S. workshops, where the most modern testing methods are employed.

As the duties of an officer are to command, it is essential that he be conversant with every branch of the particular service in which he serves, and though actual skill in the execution of the multitude of jobs that have to be done is not essential, an officer must be able to advise on the carrying out of all work, and, when necessary, explain how it should be done.

Therefore the course of instruction at the School of Signals is very comprehensive and it covers, in addition to the theory and operation of wireless transmitters and receivers, such matters as line telegraph and telephone practice, including the operation of automatic exchanges, teleprinters, carrier telephony, electric motors, generating plant and the operation of all the instruments employed for these purposes.

The standard of technical knowledge in electrical and wireless theory is based on that required to pass the associate membership examination of the I.E.E.

A considerable amount of practical work is carried out in the laboratories, which are equipped with up-to-date instruments such as standard signal generators, valve-voltmeters, AF oscillators, and cathode ray oscilloscopes, many of the latest double-beam variety being used.

The ultra-short waves are utilised to demonstrate wave propagation, as at frequencies of 300 Mc/s or so the effects of incorrect matching between aerials and

The Royal Corps of Signals—

transmission lines and the transmitter can be investigated with equipment of convenient size either in the laboratories or in the open air.

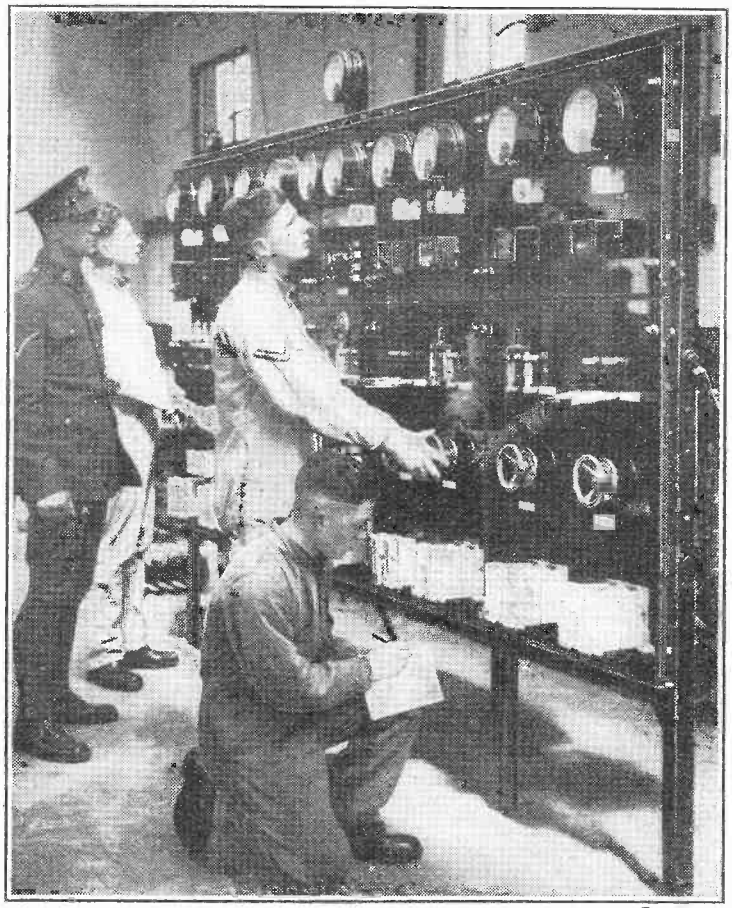
At the end of each course two officers are chosen by their placing in the qualifying examination for further study at Cambridge, after which they may return to Catterick as Instructors or be employed on any special duties that the exigencies of the service may require.

The standards maintained and the technical abilities required of the instructional personnel can quite well be judged from this all too brief résumé of the syllabus of training at the School of Signals.

A certain number of non-commissioned officers who have shown exceptional ability during their course of instruction in the Training Battalion are posted to the School of Signals and on passing out they are promoted to the rank of Company Quartermaster Sergeant. In view of their qualifications both as skilled craftsmen and technicians their services may be called upon for instructional duties in the Training Battalion.

After completing the preliminary general army training in the Depot Battalion, all Royal Signals recruits and other personnel, with the exception of commissioned officers, are posted to the Training Battalion. Here instruction of a more specialised kind is undertaken.

On active service, or when posted to a unit, the personnel of that unit has not only to operate wireless, telegraph and telephone services under all conditions, but the apparatus has to be maintained in working order. This calls for men skilled in the diagnosis of faults and in the repair of damaged equipment, in addition to the operating of these services.



The control panel of the generating plant in the power house.

As it would be impracticable as well as uneconomical to train all non-commissioned officers and men to a sufficiently high standard in *all* branches of the signal service, specialisation in a modified form is adopted.

On entering the Training Battalion one may elect or be chosen for practical work, such as instrument repairing, or take a technical course in the maintenance of telegraph, telephone and wireless equipment, or become wireless, telephone and telegraph operators.

The course of instruction in each branch is approximately the same, its duration being about 30 weeks.

Instrument mechanics must be able to repair or manufacture, and if necessary improvise from any material available a part to replace a broken or faulty component in any piece of apparatus, so that a high degree of skill in the use of tools is of paramount importance.

Instrument Making

Many specimens of parts and instruments constructed by pupils during their course of training were shown to our representative during a recent visit to Catterick. All were made from raw material and with the tools and equipment that would normally be available on a station abroad or on active service.

One, a Post Office type relay, the construction of which demands precision work and a high degree of skill, was an outstanding example. Morse keys, pre-set condensers, fixed condensers, and a host of other small but essential parts of wireless transmitters and receivers were also seen. As it may be necessary first to make tools for the repair or construction of components, tool-making forms part of the course. Instruction is also given in the use of lathes and in screw-cutting.

The technical course for wireless telegraphy electricians includes elementary theory of electricity and magnetism, elementary theory of wireless, then branches out into circuit theory of TRF sets and superheterodynes and finally special instruction on the actual receivers and transmitters used in the R.C.S.

The standard wireless equipment is of advanced design and includes many up-to-date features. They are in the main superheterodynes, but for obvious reasons technical details of them cannot be divulged. They are designed to be used anywhere and under any conditions, which is of course an essential feature of all Service equipment.

Instruction is not restricted to the equipment used by the Royal Signals, and a variety of wireless receivers, including standard broadcast sets, find their way into the workshops for repair and for the diagnosing of faults. Thus the pupils are given a sound groundwork in the maintenance of a wide range of wireless receivers.

Morse instruction, both for wireless operating and line telegraphy, forms an important part of the instruction at the Training Battalion. It is not merely sufficient to be able to send and read the code at the specified speed, but operators must be capable of reading a message accurately through severe interference, so, in order to simulate the conditions that might prevail in the normal course of operation at a wireless post, interfering signals are superimposed on the messages sent over the instructional lines.

This very brief description of the organisation of the Signal Training Centre cannot do more than explain the broad lines on which the instruction at Catterick is based. Mention has not been made of the telegraph line courses, where the laying, jointing, and maintenance of cables are dealt with, nor of the sections devoted to visual systems of signalling, all of which are a very important part of the Signal Corps' work. Mobile stations and their operation, the erection and maintenance of semi-fixed stations, and a dozen or more other activities of the Corps cannot be dealt with now.

The impression gained by the writer during his tour of Catterick is that a very high standard of skill is aimed at and attained, while the technical training is such that it would prove a valuable asset in civilian life.

THE TELEVISION SOCIETY

MAINLY owing to the generosity of Captain Randolph Wilson, the Television Society has at last been able to realise one of its earnest wishes—the provision of an informal meeting room for members. The Council has leased a ground-floor and basement at 17, Featherstone Buildings, High Holborn, London, W.C.1, and the rooms are now being fitted up as a library and viewing room. It is hoped that the President, Sir Ambrose Fleming, will be able to open the rooms formally at the end of August.

Wolsey Television Aerial

The address of the makers of this aerial, which was reviewed on page 40 of the July 13th issue, is, Wolsey Television Limited, 41, Brecknock Road, London, N.7.

Four-Band Transmitter

The concluding instalment of the article under this title will be published next week.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Parasitic Oscillation : A Suggested Cure

IN his description of the television receiver circuit in July 6th issue Mr. Cocking mentions the possibility of parasitic oscillation taking place in the FC valve.

I think his method of keeping this under control is very interesting. During my work I very often have to investigate cases of noisy reception on ordinary broadcast receivers, and not all of it can be put down to mains noise, static, etc.; in fact, quite a large proportion can be traced to parasitic oscillation. I have also found that in nine cases out of ten the offending receiver is fitted with a triode hexode, and in most cases I have been able to improve matters by increasing the value of the oscillator grid leak. This reduces the grid current and also increases bias on the oscillator grid and with it the injector grid. These effects probably account for the stabilising results.

J. W. TAYLOR.

Lower Ince, N. Wigan.

[An article dealing with parasitic oscillation in frequency changers—an extremely troublesome effect in short-wave reception—will appear in an early issue of this journal. —ED.]

Semi-communication Receivers

APROPOS the leading article in *The Wireless World*, of July 6th, on the above subject, we would like to draw your attention to the special Philips Models as we think that these receivers cover the requirements as outlined by you.

The Model 362A is a nine-valve superhet of advanced design using Red "E" valves, has five wave bands covering continuously from $4\frac{1}{2}$ to 580 metres, a sensitivity switch for extreme range if desired or else super high quality, variable selectivity, two-speed tuning, a logging dial and extremely good signal-to-noise ratio. We have logged all districts of the U.S.A. on 10 metres on one of these receivers within five minutes, conditions being, of course, good.

Does this fill your bill?

F. P. BOLTON.
Drury Radio Company, Ltd.

Liverpool.

Distortion in Transformer Cores

NOW that the series of articles by Mr. Partridge on "Distortion in Transformer Cores" is completed, I feel I must add to the letters of commendation that you and he are no doubt receiving. It is a notable contribution to the art of good reproduction. The amount of painstaking research and the data presented must arouse the admiration of all readers. I hope it will help to deflect a proportion of attention from frequency to amplitude characteristics. Incidentally, I agree with Mr. Owen Harries[1] in preferring the term *amplitude distortion* to *harmonic distortion*, because I am unable to accept Mr. Partridge's summary dismissal of intermodulation products—at least until he brings forward evidence more convincing than that of Mr. Harries[2] and "Cathode Ray's" experiment.[3]

This raises the vexed question of how to establish a criterion of amplitude distortion. Mr. Harries has suggested one in the article referred to. Messrs. Callendar and Clarke employ another,[4] based on weighting harmonics according to known physiologico-acoustical data. The R.M.A. has prescribed another, called the *distortion factor*, employing a less scientific but simpler weighting of harmonics, to recognise in some degree the relatively greater offensiveness of those of high order. *Total harmonic distortion* is another term with a definite accepted meaning, being the RMS sum of all the separate harmonics. It is a pity, therefore, that Mr. Partridge should have used this term in quite a different sense, because it is liable to cause confusion in an already complicated subject.

The "Partridge Distortion Index" applies only to output transformers under certain specified conditions, and so is not competitive with various existing standards of amplitude distortion in general. Mr. Partridge, therefore, has a perfect right to define it as it seems to him to serve the purpose best, and in view of his intense experience of transformer design I hesitate to question the reasons underlying his choice, yet I wish he could explain why he departs from the usual practice by adopting an arithmetical sum rather than RMS. And, more particularly, why he should attach no more weight to the 7th harmonic than to the 3rd, seeing that he is fully aware of its much greater offensiveness.

And that leads me to say that although I agree with him in the emphasis given to the relatively greater effect of the higher harmonics, the figures he gives to prove the point are chosen a little unfortunately for the purpose. In the first place, "a loudness level of 20 db" is a contradiction in terms: *intensity* is measured in db; but to avoid hopeless confusion it is absolutely imperative that loudness should be stated in *phons*. The context shows that phons are meant. But 20 phons is an altogether unpractical loudness for sound reproduction, being below the background noise of even quite a quiet room.

Moderately quiet reproduction is around 70 phons, and at that level the 34 db. difference in intensity between 50 and 350 cycles has diminished to 10 db. Moreover, the 50-c/s fundamental is more likely to mask the 350-c/s harmonic than *vice versa*.

These comments on certain details do not in any way intend to distract attention from the value of the series of articles as a whole, which, as I have said, is, in my opinion, outstanding.

M. G. SCROGGIE.

Bromley, Kent.

"In Praise of Television"

I HAVE read "Cathode Ray's" article in *The Wireless World* of July 6th, and like it very much. I agree with all he writes except his opinion that cinema film provides better quality than television. He means, I take it, that cinema film is brighter and clearer (i.e., sharper) than television, but surely the tube is as bright and can be made brighter by the viewer, also the contrast is under his control, and can be altered for any item; film must stay at one mean level of brightness and contrast. Regarding sharpness, I admit if you go close you can see the line building up the picture, but go close to a cinema screen and the picture is not at all sharp owing to grain of the photo film.

As a professional photographer of fourteen years' standing, and also the owner of a Marconiphone television set, I find a lot of interest in comparing cinema and television quality. The picture on a tube (mine is black and white in colour with a blue tinge) seems to stand right out, but a film seems flat and slightly dead.

When a set is left working by a television dealer, he gets the wireless part O.K. as a rule, but the vision (contrast and focus) seems to defeat him, for most of the pictures one sees are not as sharp as the tube can be made to give; also the picture is "soot and whitewash." I enclose a picture I have taken to prove my point.

J. H. JEFFERY.

Marlow, Bucks.

Qualifications of Service Personnel

IN a recent War Office advertisement which appeared in the daily Press, positions were offered as instructors in the Territorial Army, for which certain technical qualifications were specified. Among these were Graduate Membership of the Institution of Electrical Engineers, or Final City and

[1] *The Wireless World*, July 21st, 1938.
[2] *The Wireless Engineer*, February, 1937.
[3] *The Wireless World*, May 19th, 1938.
[4] *The Wireless World*, August 25th, 1938.

Guilds in Radio-Communication. Successful applicants were to be paid at the rate of £4 5s. per week, with increments up to a maximum of £4 15s. in two or three years, and to be offered the rank of Sergeant in the Territorial Army.

Now these qualifications are not what we would expect from beginners. The Graduate I.E.E. Examination requires several years' preparation in electrical engineering, as well as specialised knowledge in radio, or whatever branch the candidate studies for Part II of the examination—its equivalent is the Higher National Certificate, which demands five years at a technical college. The "Final" (Grade III) City and Guilds Examination in Radio-Communication, too, is not for the elementary student, and such qualifications are often stipulated in advertisements offering responsible technical appointments. The I.E.E. examination qualifies a successful candidate for the much-coveted professional distinction "A.M.I.E.E." as far as technical knowledge is concerned. In the Graduate Section of the Institution there are many who hold University degrees like M.Sc., M.A., etc.

It speaks volumes, therefore, for the appreciation technical ability is likely to receive in the Army when we find, set forth alongside the foregoing accomplishments, the statement that candidates will be accepted as instructors who possess an elementary knowledge of valves, AC circuits, etc. The obvious implication is that this is about the standard of knowledge of applicants with the higher qualifications; in fact, incredible as it may seem, the pay and conditions are to be equal for both. Suppose that, instead of advertising for qualified wireless instructors, the War Office required lawyers. Presumably, the advert. would then run something like this: "Solicitors wanted who have passed the examination of the Law Society, or, alternatively, possess an elementary knowledge of conveyancing." What would the Law Society think?

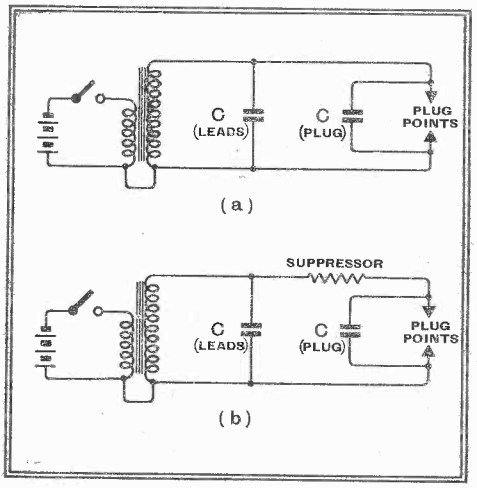
It is to be hoped that the Council of the Institution of Electrical Engineers will take some steps to correct this misapprehension on the part of those whom we expect to have at least some knowledge of technical ability, together with a sense of proportion. What does the War Department take us for? In these days, especially, one would expect real technical qualifications to count for something more than orthodox ideas about "rank" (or the possession of a suitable military personality) in the Services. If we are to compete seriously with the highly organised military machines of the Continent, technical efficiency must be a primary consideration. But, on the other hand, if the standard of technical knowledge required of instructors in the Territorials is a smattering of valves, etc., why on earth specify the higher qualifications? It seems sheer effrontery to offer both the same pay and conditions. "TECHNICIAN."

Interference Suppression on Petrol Engines: Suggestion for Minimising its Effects

WITH reference to letters published in *The Wireless World*, on the subject of ignition suppressors fitted to car engines, many correspondents showed that suppressors have an adverse effect on the engines of their cars, so, seemingly, putting forward a good case against the enforcement of the fitting of these suppressors to all cars by law (on the grounds that the car owner would suffer by loss of mileage per gallon, top speed, etc., with no benefit to himself).

Surely the sole cause of deterioration of engine performance on the plug suppressors being fitted is the alteration of ignition timing due to the angle of lag introduced by the addition of the suppressor resistances in the plug circuits? Admitting this, it would only be necessary to adjust the engine ignition timing to regain the original performance. Actually, it would require that the ignition be progressively advanced as the engine r.p.m. increase.

The accompanying diagrams help to illustrate the principles involved.



Consider diagram (a). To cause a spark to occur at the plug points it is necessary for the plug capacity, and the leads capacity in parallel with it, to become charged up to such an extent that the voltage across the plug points is sufficient to rupture the petrol/air mixture in the gap (this voltage depending on the pressure in the cylinder, temperature, etc.). This, naturally, takes time, which in the present case is very minute, because of the small impedance of the leads, etc., and in any case it is set at nought by the initial ignition-timing operation on the engine.

When a suppressor has been fitted (as in diagram (b) it is obvious that the plug capacity has to obtain its charge, necessarily of the identical magnitude required in the unsuppressed instance, through the suppressor resistance; therefore it cannot "fill up" nearly so quickly. If the suppressor were fitted at the distributor end of the ignition system the effective time lag would be considerably greater, because the capacity to be charged through the suppressor resistance is increased by the addition of the capacity of the leads in parallel. This, I think, was borne out by the experience of one of your correspondents.

This time lag, which has been introduced at the plug points by the addition of the suppressor resistance, would not vary much as the speed of the engine increases (unless in coil-ignition engines it increases because of the reduction of the impulse voltage due to the increased reactance effect of the coil primary winding as the time available for the primary current to build up for each spark decreases). This fairly constant time-lag at the plug points is, however, turned into a varying angle of lag when the effect on the engine is considered, because the angle through which the crankshaft revolves during that time is directly proportional to the r.p.m. of the engine; consequently, the adverse effect on the ignition timing of the engine is much more serious at high speeds than at normal r.p.m. In fact, at very slow r.p.m. it would not be appreciable—i.e., starting would be unaffected.

It is only necessary, then, to arrange for the ignition to be automatically advanced as the engine's r.p.m. increases to regain its original performance. In most cars this would only mean rendering the existing control more effective.

Using arbitrary figures, I find that the effective lag in ignition timing, due to suppressors, is likely to be from three to five degrees at four thousand r.p.m.!

To me it seems that the reduction in intensity and size of the spark due to the introduction of the suppressor resistance is unlikely to have any adverse effect on the engine's performance, as the bulk of the igniting effect of the spark is due to the initial rupture of the insulating mixture in the gap, this because, surely, the ignition must be due to the ionisation of the inflammable mixture assisted by the heat generated by the passage of the electric current, which heat can no longer obtain after the ionisation of the mixture has rendered the spark gap a very low resistance conducting path? C. SINCLAIR (Cpl., R.A.F.).

Worthy Down, Hants.

The Wireless Industry

A FULL range of dry batteries for receivers with 1.4 volt filament valves has been added to the G.E.C. "Blue Label" series. Both English- and American-type sockets are available, and the 1.5 volt LT batteries are made in two capacities.

Technical leaflets relating to the "Phantom" receivers and "Epoch" loud speakers for the 1939-40 season have been received from Halford Radio, 31, George Street, London, W.1.

F.R.I., Limited (formerly Henry Ford Radio, Limited), of 22, Howland Street, London, W.1, inform us that their service department will be closed from August 5th to August 12th.

No goods will be despatched or correspondence dealt with by Salford Electrical Instruments, Limited, Silk Street, Salford, during the annual holiday from August 4th to August 14th.

Lists of "Record" valves for British sets and "Yale" tubes for receivers fitted with American-type valves have been received from Record Radio, Limited, 2 and 3, Eldon Street, London, E.C.2.

A technical bulletin dealing with "Premax" rotary beam aerial arrays is available, priced 3d., from Holiday and Hemmerdinger, Limited, 74-78, Hardman Street, Manchester, 3.

The illustrated folder issued by Frank Turner, Limited, 132-134, Liverpool Road, London, W.1, exhibition stand fitters, should prove of interest to firms showing at Radiolympia.

Ferranti, Ltd., have issued a leaflet giving details of aerials for the Ferranti car radio receiver. The roof aerial has been reduced in price and a running-board type on a rubber mounting has been introduced.

Radio Interference Bulletin No. 63, published by Belling and Lee, Ltd., deals with the origin and suppression of interference arising from television time bases.

NEWS OF THE WEEK

RADIOLYMPIA

Proposed Conventions: Oversea Trade

IF present plans materialise, this year's radio show to be held at Olympia from August 23rd to September 2nd will be of more than usual interest to the technically minded listener. It is proposed that technical conventions should be held during the afternoons and evenings of Monday to Thursday, August 28th - 31st inclusive. These would be held in the Convention Hall which has accommodation for over 1,000.

A "listeners' convention" along the lines of the recent television tea-party organised by the B.B.C. is also proposed. The B.B.C. has been asked to co-operate in organising this, but no definite decision has yet been arrived at.

As last year, a dealers' television convention is to be held on Thursday, August 24th. Details of this, together with invitations to dealers in the television service area, will shortly be issued by the Television Sub-Committee of the Radio Manufacturers' Association.

Export Market

Special attention will be given to the needs of oversea listeners at the show. Every British manufacturer marketing receivers and accessories for use oversea will be represented in the export section, which is an innovation for Radiolympia.

The model of Broadcasting House, which is to be a feature at one end of the main exhibition hall, will contain an exhibition within itself where every phase of B.B.C. activity will be portrayed.

Of particular interest to *Wireless World* readers should be the daily demonstrations, by means of recordings, of good and bad quality in reception.

A new "portable" theatre organ equipped with no fewer than 800 effects will make its début in Great Britain during the shows to be given in the Radiolympia theatre, which will have seating accommodation for two thousand.

Remote Control Room

An interesting technical innovation for the televising of shows from the theatre will be the provision of a separate control cubicle for the producer remote from the televising scanning van. The producer will be seated at the back of the tiered seats and will not only be able to see the stage but will have two monitor tubes, wired to the control van, giving the transmitted picture and a "preview."

DIALS AND THE MONTREUX PLAN

THE association of Danish radio manufacturers, Radio Fabrikant Foreningen, recently concluded a national agreement whereby buyers of 1939-40 receivers are granted a free exchange of the station dial on their new sets when the Montreux Wavelength Plan comes into force next spring.

Each purchaser is to be given a coupon in return for which retailers are to mount a new dial free of charge. This scheme is obviously designed to counteract the possible ill-effects which the impending reallocation of wavelengths might have on receiver sales during the coming season.

DROITWICH BREAKDOWN

An "Act of God"

THE breakdown of the Droitwich aerial last week, when it was struck by lightning, brought the station to a four hours' silence, which would have a startling effect on the year's breakdown figures if they included such incidents. But the B.B.C.'s returns, being confined to "technical hitches," or faults in equipment, ignore untoward happenings of this kind. Breakdowns due to "acts of God" are eliminated from the engineering chapter of misfortunes.

Not So Good

This may be just as well when the full year's tale comes to be told; for already the official record of breakdowns in 1939 exceeds that of the previous year. The last complete figures for six months show a total breakdown period of 1,962.25 minutes, or a percentage of .059 of programme hours, while for the similar period of 1938 breakdowns amounted to 1,136.75 minutes, or .035 per cent. of programme hours. B.B.C. engineers are hoping for a cleaner sheet in the remaining period of the year, in order to preserve their consistent record of immunity from serious interruption to the service.

A Useful Stand-by

The promptness with which the old 30-kW Daventry (5XX) transmitter was put into service has brought to light the fact that this transmitter can be used as a stand-by in case of a prolonged breakdown at Droitwich. Sir Noel Ashbridge stated earlier this year that lightning is now responsible for more interruptions of the B.B.C. service than any other cause.

AMATEURS' CAMP

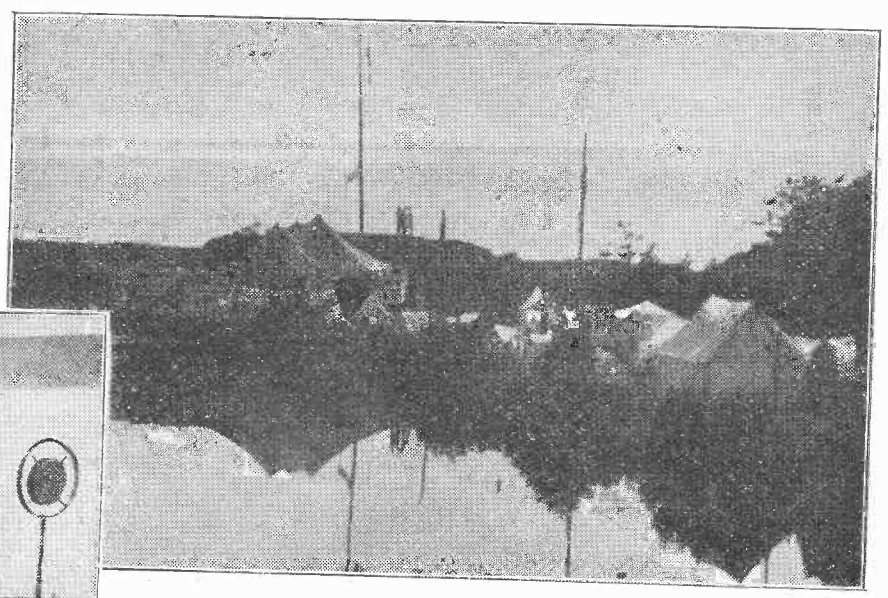
International Comradeship

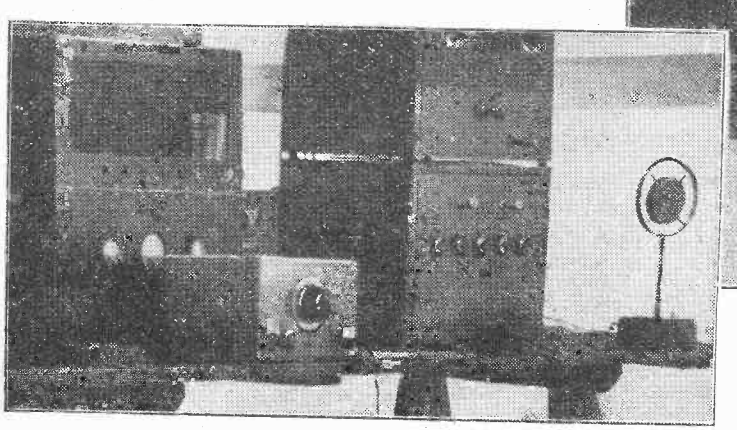
THE amateurs' international summer camp, organised by the Danish organisation, Experimenterende Danske Radioamatorer, opened on Sunday, July 16th. The camp site is near Hasle on the Isle of Bornholm, popularly known as "The Pearl of the Baltic."

When a representative of *The Wireless World* visited the camp on the opening day, nearly one hundred amateurs had arrived or were expected. The total included twelve Germans, seven Swedes, four British, two Dutch and over seventy Danish amateurs.

The central tent, which serves as a dining hall, houses the camp transmitter, to which the Danish authorities have allocated the call sign, OZ7EDR. Official transmissions are being radiated every evening at 6.30 G.M.T. on 3.615 Mc/s, although CW and 'phone tests are being conducted during all hours of the day. A special QSL card has been designed for use during the camp.

This is the seventh international gathering arranged by the E.D.R., and the summer camp has become a popular institution. Its keynote is inter-





THE TENTS at the E.D.R. amateurs' camp are pitched on a narrow strip of land between the blue waters of the Baltic and the greenish splendour of the Smaragdsoen (Emerald Lake). The camp transmitter, OZ7EDR, is shown inset.

News of the Week—

national comradeship, and it is entirely non-political.

TELEVISION LICENCE ?

Mr. Ogilvie's Hint

THE Director-General of the B.B.C., Mr. F. W. Ogilvie, caused a fluttering in the dovecotes of St. Martin's-le-Grand and Broadcasting House when he announced to the B.B.C.'s Summer School at Harlech that the B.B.C. is considering the introduction of a separate licence for televiewers. He did not, of course, mean that the Corporation could or would introduce the innovation ; for such a thing is beyond the powers of his organisation. But he implied that the Post Office, with the concurrence of the B.B.C. and aided and abetted by the Treasury, seemed to see in this the best way out of a financial impasse.

A Modest £100,000

Endorsement for the scheme was given by the Selsdon Committee of 1935, who said that the issue of a special licence had considerable logical justification, but that at the outset an extra licence was undesirable, for if it were placed high enough even to begin to cover the cost it would strangle the growth of the infant service, while if it was placed low enough to encourage growth the resulting revenue would be negligible. Now, however, an estimate can be formed of the costs of extensions, and it is predicted in some quarters that a special licence of twenty shillings might, on the extension of the service to Birmingham and Manchester, bring in at the outset, with an equal contribution from London televiewers, a sum of £100,000.

Mr. Ogilvie said that as there is already a co-axial cable between London and Birmingham the odds were that the extension of the television service would be by cable. It is known that Sir Noel Ashbridge favours the use of the cable as being more reliable, less clumsy, and, above all, occupying no ether space.

EAST AFRICAN RADIO-TELEPHONE SERVICE

A RADIO-TELEPHONE service with Lourenço Marques (Mozambique), on the East Coast of Africa, was opened last week. It will be available for calls from all parts of Great Britain, but in Lourenço Marques will be restricted to certain specially equipped telephones. The service will be available daily except Sundays from 8.45 a.m. to 5 p.m. G.M.T.

The charge for a three-minute call to Lourenço Marques, which has a population of 40,000, will be £4 11s. 6d. or £3 1s. 6d. according to the hour.

9,000,000 AT LAST

THE recent announcement of the approximate number of wireless receiving licences in force in Great Britain at the end of June showed that we have now passed the nine-million mark, the actual figure being 9,009,750. The increase in the number of licence holders in the year was over 371,600. It is noteworthy that it has taken just over two and a half years to add the ninth million.

In reply to a question in the House of Commons the P.M.G. stated that, during the twelve months from July, 1938, to June, 1939, there had been 5,805 prosecutions for using receivers without licences, and that all but twelve were successful.

W3XAL'S TRANSMISSIONS

THE international short-wave station of the N.B.C., W3XAL, is very well received in England, broadcasting on its assigned wavelength of 13.87 metres (21.63 Mc/s) with its beam directed to Latin America. This frequency is now being used daily from 5 to 8.30 p.m. G.M.T., with an English hour from 5 to 6 p.m. The N.B.C. now issue a weekly short-wave news-sheet which gives the programmes in English, Spanish, Italian, German, Portuguese and French. This sheet will be sent gratis to readers of *The Wireless World* on application to the National Broadcasting Company's London office, Electra House, Victoria Embankment, W.C.2.

FROM ALL QUARTERS

Italian Television

ITALY'S regular television transmissions will be inaugurated on Sunday next, July 30th, from the ultra-short-wave transmitter at Monte Mario, near Rome. The programmes, which will be broadcast daily from 8.30 to 10 p.m., G.M.T., will be radiated on 6.8 metres (vision) and 7.4 metres (sound). The aerials are situated at the top of the 150-foot metal tower from which experimental ultra-short-wave transmissions have been radiated for some time.

Broadcasting in Baroda

THE Government of the State of Baroda, India, has placed a contract with the Marconi Company for a 5-kW medium-wave broadcasting transmitter complete with studio equipment.

"Do Unto Others . . ."

WHILST on holiday, amateurs frequently have the opportunity of meeting friends of the ether. Commenting on these informal meetings, *The T. & R. Bulletin* says: "Let us remember that our friends who we visit at the seaside or abroad invariably have jobs of work to attend to during the day and have domestic commitments in the evenings. To avoid embarrassment to your future hosts, and in courtesy to him and to his family, send a postcard before calling."

Miscellaneous Advertisements

THE approach of the August Bank Holiday necessitates slight alterations in our printing arrangements. Miscellaneous advertisements intended for the issue of August 10th must therefore be received not later than first post on Friday, August 4th.

Swiss Wired Wireless

HIGH frequency wired wireless is shortly to be introduced in Switzerland, use being made of the elephone lines. Towards the end of this year tests are to be made at Berne on five frequencies, viz. 172, 208, 248, 270 and 300 kc/s. Early next year the whole of the Swiss telephone network will be adapted for the new service.

Malayan Broadcasting

THE British Malaya Broadcasting Corporation, which at present operates one medium- and one short-wave transmitter at Singapore, is erecting another medium-wave station. The scheme being to provide daily European and Asiatic programmes. Out of a population of over 500,000, Singapore has only 6,000 licensed listeners.

International Exhibition at Liege

AN International Congress of Post, Telegraph and Telephone staffs will be held at the Liége International Exhibition of 1939, on August 24th, 25th and 26th. The Congress is being organised by the National Syndicate of the Staff of the C.P.T. of Belgium, and particulars can be obtained from 9-11, Place Fontaines, Brussels.

Indian Imports

ALTHOUGH the imports of wireless apparatus into India during the year 1938-39 showed a decrease of Rs.673,000 below the previous year's total of Rs. 4,770,000, the contribution from the United Kingdom rose from Rs.1,554,000 to Rs.1,687,000.

Radio Vatican

THE Director of the Vatican broadcasting station announces that there will be no transmissions from the station during the month of August. When they are resumed in September a new schedule will be published.

Television Programmes

Sound 41.5 Mc/s — Vision 45 Mc/s

An hour's special film transmission intended for demonstration purposes will be given from 11 a.m. to 12 noon each weekday. The National or Regional programme will be relayed on 41.5 Mc/s from approximately 7.45 to 9 p.m. daily.

THURSDAY, JULY 27th.

3, O.B. of Croquet at Roehampton Club. **3.15,** British Movietonews. **3.25,** Cartoon Film. **3.30,** "Re-view," songs and scenes from bygone shows.

9, Gaumont-British News. **9.10-10.25,** "The Day is Gone," an eerie play by W. Chetham-Strode.

FRIDAY, JULY 28th.

3, O.B. of Parade of Beachwear at Roehampton Club. **3.15,** Bernard Shaw's "The Man of Destiny." **3.55,** Gaumont-British News.

9, Friends from the Zoo. **9.15,** British Movietonews. **9.25,** Cartoon Film. **9.30-10.40,** "The Parnell Commission," a reconstruction of the famous forgery investigation of 1888-89.

SATURDAY, JULY 29th.

3, O.B. of Aquatic Sports at Roehampton Club. **3.20,** C. H. Middleton "In Our Garden." **3.35,** Cartoon Film. **3.40,** British Movietonews. **3.50,** Roehampton Club O.B. continued.

9-10.25, Nova Pilbeam in "Prison Without Bars," a tragi-comedy of youth by Peggy Barwell.

SUNDAY, JULY 30th.

9.5-10.25, "Fox in the Morning," a comedy of the racing stables by Lionel Brown.

MONDAY, JULY 31st.

3-4.20, Lilli Palmer and Barry Jones in "One Night, One Day. . . ." a comedy by Cecil Madden.

9, Victorian Interlude. **9.10,** Gaumont-British News. **9.20-10.25,** "Table d'Hote," a revue.

TUESDAY, AUGUST 1st.

3, Order to View, No. 4—A Revue. **3.40,** Gaumont-British News. **3.50,** Music Makers: Eunice Gardiner (pianoforte).

9, "Here's looking at them," a revue. **9.30,** British Movietonews. **9.40,** Charles Heslop in "Percy Ponsonby Packs for Bank Holiday." **9.50,** Cartoon Film. **9.55,** "The Open Door," a duologue. **10.15-10.30,** Demonstration by the B.B.C. Bridge Club.

WEDNESDAY, AUGUST 2nd.

3, "Down on the Farm," O.B. from Bulls Cross Farm where A. G. Street and the Farmer will discuss work for August. **3.25,** Cartoon Film. **3.30,** British Movietonews. **3.40,** "Circumstantial Evidence," a "telecrime" by Mileson Horton.

9, Gene Autry, the Singing Cowboy of the Films. **9.10,** Film, "Monkey into Man." **9.30,** Talk on Photography. **10,** Gaumont-British News. **10.10,** Pas Seul.

Simplifying Press-button Tuning

METHOD EMPLOYING A NON-REVERSIBLE MOTOR

PRESENT-DAY tendencies in radio receiver design are in the direction of simplifying control of the receiver. Several systems have appeared in which the ganged tuning condenser is driven by a reversible electric motor to predetermined positions under the control of press buttons; the actuation of one of these buttons causes the motor to be energised through a station-selecting switch, coupled to the tuning condenser, which breaks the circuit of the motor when the tuning condenser has reached the required position. Other operations, such as waveband changing and volume control may also be controlled by press-button systems of this kind, and it is also possible for a whole sequence of adjusting operations to be carried out automatically merely by the actuation of a single press button.

Hitherto such schemes have required the use of a reversible electric motor. In this article is described a control system in which a unidirectional motor is made to drive a number of adjustable components of a radio receiver independantly and in either direction to predetermined positions by the actuation of a single press button.

In the accompanying drawing is shown a tuning unit which may be coupled to a suitable radio receiver for the purpose of selecting six predetermined stations from three wavebands.

Selector switches, marked respectively S1 and S2, are provided for the tuning condenser and waverange switch; these adjustable components may be connected mechanically to a driving shaft by means of electro-magnetically operated reversing clutches A and B. The driving shaft is coupled to a unidirectional motor, and an additional clutch C shown in the drawing may be used to drive a volume control or other adjustable components of the receiver. A bank of press-button switches is provided for actuating the control unit, the moving and stationary switch contacts being clearly shown in the illustration.

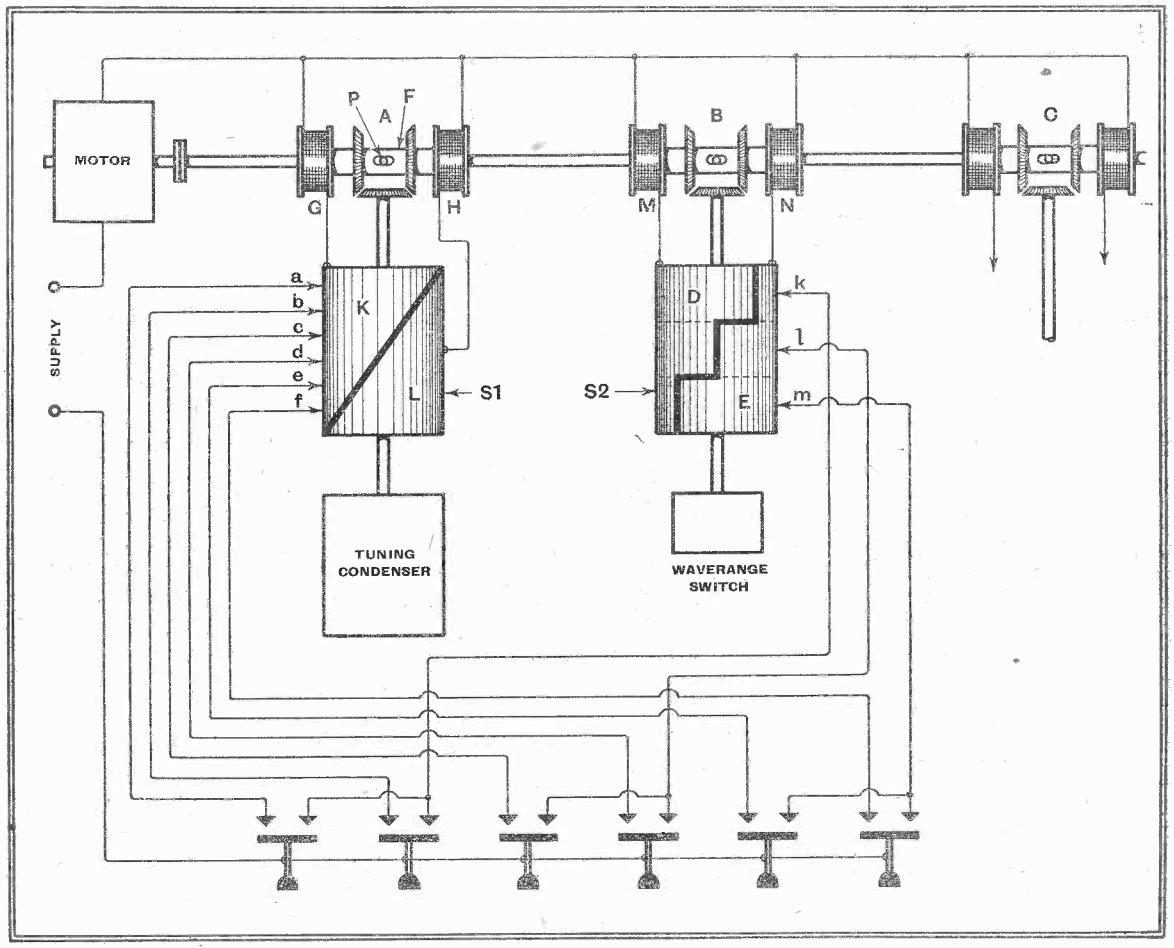
The selector switches may be of any suitable form, and are shown as comprising stator contacts which bear against the surface of a rotor or drum provided with two conducting zones, separated by strips of insulation. In the case of the station-selecting switch, S1, the contacts are indicated by arrowheads *a, b, c, d, e* and *f* and the zone of insulation by a heavy black line.

In the case of the wave-changing selector switch S2, the stator contacts are indicated by *k, l* and *m*. The two conducting zones of the drum D and E and the zone of insulation are represented as in S1.

The clutches may be of any suitable form, and the clutch A for the tuning condenser is shown to consist of a mounted sleeve F slotted to receive a driving pin P and provided with oppositely disposed bevel gear wheels, which are adapted to engage a driven gear wheel coupled to the tuning condenser. The solenoids for operating the clutch are indicated at G and H respectively; solenoid G when actuated moves the clutch in one direction to cause clockwise rotation of the selector switch S1, and solenoid H moves the clutch in the opposite direction to cause the selector switch to rotate in the opposite direction.

The electrical circuit is as shown in the diagram. The station-selecting and waveband-selecting contacts are connected to the fixed contacts of the six press-button switches, the arrangement being such that the right-hand pairs of buttons select short-wave, medium-wave and long-wave stations respectively. One electro-magnet of each clutch is connected to each conducting zone of the corresponding selector switch, so that one or other solenoid of each clutch will be energised when the press button is operated, according to whether the stator contacts lie to right or left of the zone of insulation. In this way each selector switch is rotated in the correct direction to move the zone of insulation into engagement with the selected stator contacts. The motor is connected by one lead to the electro-magnets and by another lead to one pole of the supply; the other pole of the supply is connected to the movable contacts of the press-button switches, as shown in the diagram.

Suppose, for example, that the positions of the selecting switches are as shown and that the left-hand button is actuated. Current flows from the source of supply to the press-button switch and



Motor-driven tuning system employing a non-reversible motor operating in conjunction with magnetically controlled reversing clutches.

Press-button Tuning—
thence in parallel paths through the selector switches S1 and S2, then through the appropriate solenoid of each clutch to the motor and back to the supply; in the case of the station-selector switch S1 current flows from contact *a* through conducting zone K to solenoid G; in this way the selector switch is clutched to the shaft and rotated anti-clockwise until this circuit is broken by the zone of insulation engaging the contact *a*. In the case of the wave-change switch current flows from the right-hand contact to the stator contact *k*, conducting zone E and through solenoid N, whereby the clutch is moved to couple the selector switch S2 to the shaft so that it rotates clockwise until the zone of insulation engages contact *k* and the circuit is broken. It will be apparent that the current passes through the motor as long as a solenoid continues to be energised, and when all the selector switches have been moved to their proper positions and the solenoid consequently disconnected, the motor is then also disconnected and the receiver left in a condition for the reception of the desired station.

Test Report

HIGGS MODEL AW59R

Table Model Superheterodyne (4 Valves + Rectifier)

METHODS of manufacturing wireless sets in quantities have become so standardised in recent years, that on the constructional side it is difficult to find points of dissimilarity between the products of one big factory and another. In the receiver under review, the designers have made a complete break with the accepted conventions of chassis layout, and have produced a refreshingly original design with many points of advantage to the user.

Circuit.—The basic circuit follows standard practice with a triode-hexode frequency changer, variable-mu pentode IF amplifier, double-diode-triode signal rectifier, AVC and first AF amplifier and a pentode output valve. The system of press-button switching which has been adopted makes provision for four medium-wave and two long-wave pre-tuned stations. These are obtained instantly on pressing the appropriate button, and separate operation of a waverange switch is not called for. There are separate buttons for waverange switching when the variable tuner is used, and the circuits are transferred from pre-set to manual tuning automatically when any of the three waverange switches are pressed.

Silvered-mica fixed condensers of high stability are used in the IF tuned circuits, which are adjusted by altering the position of their iron cores. Permeability tuning is also employed in the medium- and long-wave oscillator circuts. The short-wave oscillator and all the aerial circuits are capacity tuned.

The connections of the remainder of the circuit are straightforward. Separate diodes are employed in the second detector stage for signal rectification and AVC bias. The delay voltage is derived from a resistance in the common −HT return lead, and this is used also to bias the triode amplifier section of this stage. The full AVC voltage is applied to both frequency changer and IF amplifier on all three wavebands.

Resistance-capacity coupling is employed between the first AF stage and the output valve. The latter has a variable resistance-capacity tone correction filter across its anode circuit.

The loud speaker field is used for smoothing, and the associated electrolytic condensers are mounted adjacent to it in the lower compartment of the cabinet.

Constructonal Details—All valves are mounted horizontally underneath the chassis, rather after the manner of small battery portable receivers. They are easily removed, as the underside of the set is opened and raised well clear of the base of the cabinet. The space above the chassis is used for the mains transformer, one of the unscreened IF transformers, the two-gang tuning condenser and its associated drum dial.

The latter is 5 inches in diameter and 7 inches long, and gives an exceptionally lucid scale with well-spaced lists of station names on each of the three wavebands. The friction drive has single reduction ratio of 40 : 1 which is convenient for short-wave adjustments but would be too high for medium- and long-wave requirements were it not for the well-designed flywheel attachment, the momentum of which enables the full range of the dial to be covered with one spin of the control knob. The mechanism is very well balanced, and is a pleasure to handle.

As regards workmanship and finish, the set is more obviously an hand-built product than most, but inasmuch as this implies individual attention to each receiver, it may be accounted an advantage. The metalwork, including the loud speaker, is finished in light blue transparent lacquer.

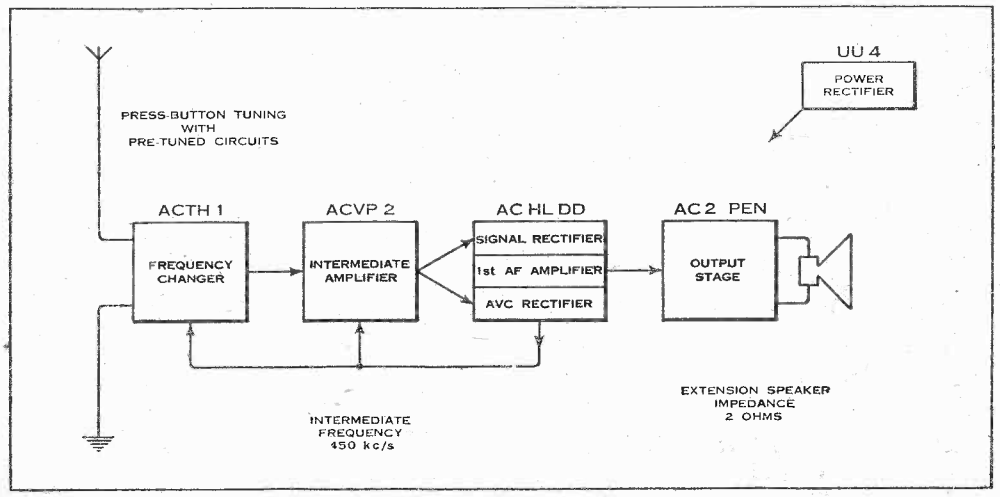
WAVERANGES

Short	*13-51.5 metres*
Medium ..	*200-560 metres*
Long	*870-2,000 metres*

Performance.—There is a confident quality about the performance of this set, which is ascribable partly to the high magnification and good signal to noise ratio on all three waveranges, and partly to the clear-cut reproduction from the loud speaker.

The usable volume is above the average for a table model, yet there is still plenty of amplification in hand when the output valve first shows signs of overloading. With the volume control set at this point AVC looks after the relative signal strengths of the principal B.B.C. and foreign programmes, and it is only necessary to turn the volume up to maximum for long-distance short-wave transmissions when receiving conditions are bad. Normally, American short-wave stations come in well with the manual volume control turned down to the point at which acoustic feed-back makes itself felt on the more powerful local carrier waves. The tuning condenser is mounted on rubber, but possibly vibration is transmitted along the spindle from the large drum dial.

A few self-generated whistles were found in the lower half of the long-wave range, but the strength of stations on this hand is so outstandingly good that the whistles are quite negligible when the volume control is adjusted at its normal working setting.



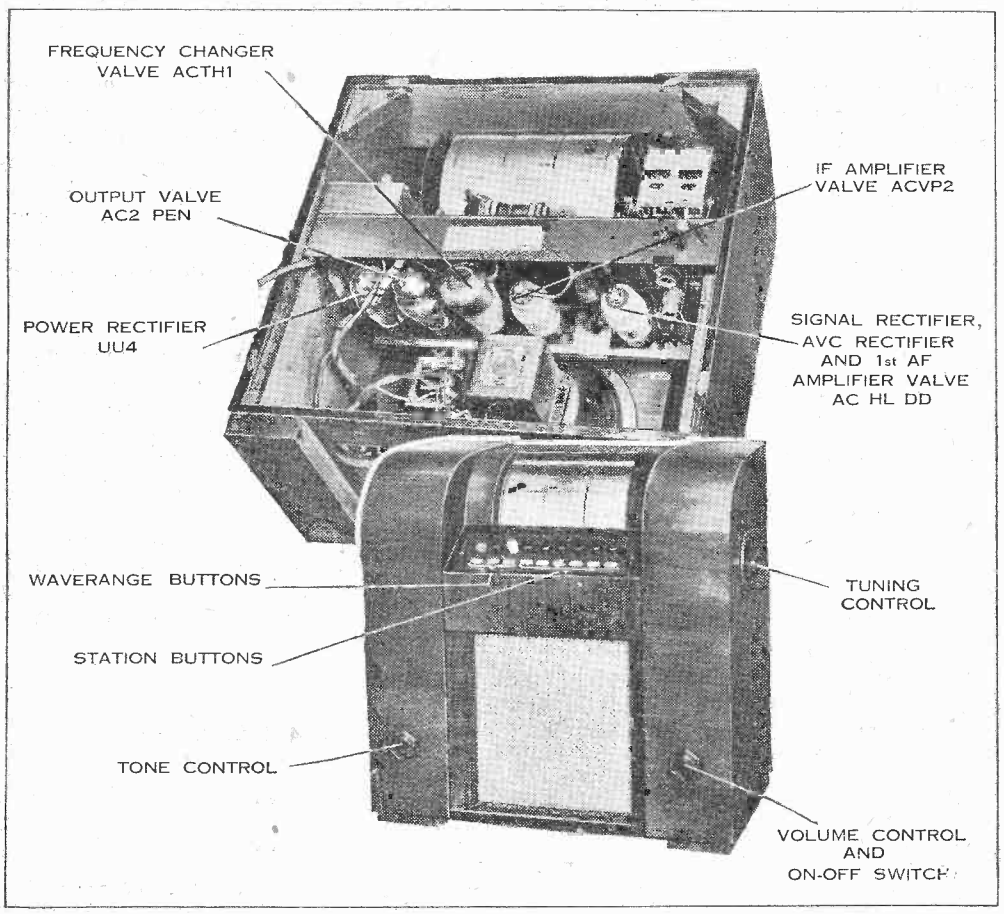
Schematic circuit diagram of the Higgs Model AW59R.

Higgs Model AW59R—

Selectivity on long waves is barely sufficient to clear the Deutschlandsender of interference from Droitwich and Radio Paris. On the medium-wave range the modulation of London Regional could be heard up to three or four channels on either side of its normal setting, when the receiver was working at a distance of 15 miles from Brookmans Park.

Summary.—The outstanding impressions left by this receiver are the smoothness and simplicity of the tuning arrangements, the clarity of reproduction, the excellent range in all three wavebands and the low background noise on long waves. There is room for improvement in selectivity, but the degree provided will be found adequate in most circumstances.

Makers Address: Charlton Higgs (Radio), Limited, Stanley Works, Edward Street, Dudley Hill, Bradford.



Arrangement of valves and controls in the Higgs Model AW59R. The layout of the chassis is somewhat unconventional, but the valves are readily accessible.

Random Radiations

By "DIALLIST"

The Garden Battery

FROM a reader at Kingston-on-Thames come some interesting details of experiments with the Daniell cell as a provider of filament current. He sends me also a highly original suggestion for those who live in out-of-the-way places and have difficulties over their LT supplies. Why not, he asks, use valves with the new low-voltage, low-current filament and run them from a "Garden" battery. Garden is not the name of the inventor, after the manner of Leclanché or Fuller or Edison or Daniell; the garden, back or front, supplies the container, the only other materials required are zinc, crushed coke (or something similar) and a number of carbon plates. Strictly speaking, the contrivance should be called a cell, not a battery, for it is not possible to have two or more in series.

How it is Made

To make the garden cell, start by digging a hole about a foot deep and a yard square. Lay a sheet of zinc with an insulated wire attached to it at the bottom of this and cover with a few inches of earth, which should be well trodden down. Follow with a layer of crushed coke, embedding in this a number of carbon plates and/or rods, taken from old dry cells of large size and connected together by a lead. Fill in the remaining soil, tread well down and your garden cell is ready as soon as you have doused it liberally with salt water.

Worth Trying

The result is, of course a form of Leclanché cell, the difference being that sodium chloride is used instead of ammonium chloride as electrolyte. I've several times used salt for temporarily charging wet Leclanché's when I was out of sal-ammoniac. My correspondent tells me that one of these cells will "blow" 5-amp. fuse wire on short-circuit. Though there's no depolariser, I should think that the large capacity of the cell would enable it to supply steadily the small amount of current needed by a battery set. I'd like to try the garden cell, but my garden is strictly the domain of my better half. If she saw me excavating a hole of the size mentioned there are two undesirable possibilities. The first (a certainty rather than a possibility) is that I should be properly told off for having devastated a flower bed; the second, that, having given proof of my ability and willingness to handle a spade in my own interests, I should thenceforward be pressed to do so in hers. If any reader who is a gardening enthusiast or a bachelor cares to try the garden cell for running a set, I hope he will let me know what results he obtains.

Separate Speakers

THE set manufacturer's passion for building-in the loud speaker as a component of the receiving set is understandable, for the man-in-the-street does like to have his "wireless" all in one box, with no external bits and pieces. But it seems a pity that all sets should now be made with built-in loud speakers. Except for communication receivers, I couldn't name off-hand a set that is not so made. There are two strong objections to the practice from different points of view. The first is that of the man who has invested in a good "separate" loud speaker and wants to retain it. The only thing that he can do is to cut out the internal instrument by means of the switch (if there is one, or have it disconnected if there isn't) and run his loud speaker from the "extension" terminals (if there are any). But he feels, rather naturally, an objection to paying for something that he doesn't want and doesn't use in the shape of the instrument inside the cabinet.

Vibration

A much more pressing objection is that of the man who likes to have everything in his set as nearly as possible "just so." The vibrations set up by a good, hearty loud speaker, attached either to the chassis or to the cabinet, can do all kinds of unpleasant things. Everyone is familiar with their effects on valves that are at all inclined to be microphonic; but there are others less well known. They can, for instance, set the vanes of variable condensers or the turns of former-less coils jigging, with highly undesirable results on the short and ultra-short waves. With any set intended for serious long-distance work I like to have the loud speaker very much a separate unit, and I've no doubt that this feeling is shared by my fellow DX-ers.

No Interference

AT this time of day the old idea that ultra-short-wave signals can't be picked up unless the transmitting aerial is actually or very nearly in view from the receiving aerial is as dead as the deadest of dodos. But it still seems to linger on in the minds of some Americans, for in their papers I find not infrequent expression of surprise that this

signal or that was received at some place outside the quasi-visual range. It's probable that U-S-W vision broadcasts can be received regularly at long ranges if you use sufficient amplification; but the more amplification there is, the greater is the amount of interference, due to the intrusion of unwanted radiations and to receiver "parasites," as the French call them. The problem of obtaining a satisfactory "image-to-interference" ratio (that's the best expression I can think of as the vision counterpart of signal-to-noise) at long ranges is one that has not yet been solved, and may defy solution. It is noteworthy that all the deliberately made attempts at long-distance reception of television that have met with success have been made in places specially chosen for their freedom from man-made interference. The Schenectady reception was conducted at a place high in the Helderberg Mountains.

Appropriate

WALKING the other day over a shoot which I'd been asked to join for the coming season, I observed through a gap in the woods a distant array of lattice masts that looked somehow familiar. "What's that wireless station?" I asked the keeper. He told me that it was Brookmans Park, and I realised why I seemed to have seen those aerials before. I suppose it's appropriate that a wireless man should take his recreation within sight of the aerial masts of the London Regional and National, but I can't help thinking that my shooting days will have something of the busman's holiday about them. I can see my fellow shooters, stimulated by the sight of those masts and the discovery that they belong to Brookmans Park, asking at lunch-time for those simple explanations—"Of course, I don't know a thing about electricity or wireless; but if you *could* just tell me how it all works. . . ." Thank goodness the Alexandra Palace aerials are *not* in view!

Television Prices in the U.S.A.

TELEVISION receivers are now being advertised in the American radio papers, and it is interesting to see at what kind of prices they are offered. One of them is Meissner, with a 5-inch C-R tube, which is sold in kit form. For the chassis alone the price is 139.50 dollars, or about £28. A walnut cabinet costs 20 dollars or £4 more. The larger-vision receivers are not, as a rule, priced in the advertisements, but I hear that the figures for a good many of them are pretty high. Taking the 5-inch receiver as costing about £35 assembled, wired and tested, it would seem that American manufacturers are, at any rate for the moment, in no hurry to offer the public very cheap apparatus. Therein I am sure that they are right. Television is, and should be, something of a luxury in its present state of development. It is far better to give those who want receivers good articles at a reasonable price than to offer them low-priced unreliable apparatus. I've no doubt that prices will come down in the U.S.A. if and when sales are big enough to justify mass-production methods.

The Clicks that Didn't Click

THE company which kindly supplies me with electric current is dying to sell me a refrigerator. So far they haven't succeeded, but they are still after me hot foot. I told them that I'd consider nothing that wasn't absolutely non-radiating from the wireless point of view. They assured me that they had the very thing and sang its praises loudly. Not a sound, they averred, would it cause to issue from any loudspeaker. "You are sure about that?" I asked. No, no, not a sound—except, of course, harmless little clicks when it switched itself on or off. I explained that I didn't want *any* clicks, however small, and that I could see no reason why their radiation shouldn't have been prevented. They are vigorously searching for a clickless refrigerator for me, spurred on by my threat to buy one run by gas if they don't succeed pretty quickly.

Live Mike

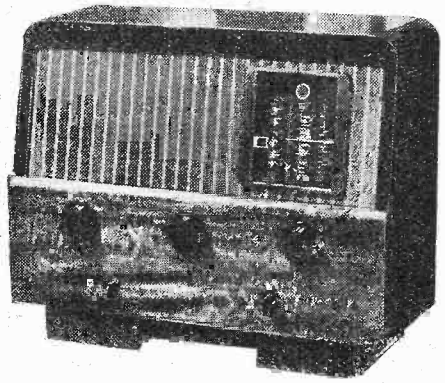
QUITE often the man at the microphone switch isn't quick enough to cope with the speaker who, having finished his talk, nearly asks the same question: "Was that all right?" I don't know how often those words have slipped out before the switch could be opened and have thus been broadcast to the world, but I can think of a good many instances. It's a very natural question after all, particularly from those who are not hardened broadcasters. I'm not sure that the American method of anticipation isn't a better way of dealing with it than lightning work with the switch; in the U.S.A. it's usual, as a speaker finishes his last sentence, for the announcer to set his mind at rest by saying "Thank you, Mr. So and So; that was a fine talk," or something of that kind. The other night, by the way, when a cabinet minister was about to speak, we had just the opposite effect. The microphone switch was closed a second too soon, so that we heard the announcer's final hints about speaking rather slowly and not too loudly.

MURPHY A76

Three Tuned RF Circuits Before the Frequency Changer

A NORMAL four-valve superheterodyne circuit should give the results which the average listener expects on medium and long waves, and the designers' chief consideration has been to invest this receiver with an outstanding short-wave performance. To this end an SP41 television valve is switched in as an RF amplifier on short waves, and with it are associated no fewer than three tuned RF stages. Thus image suppression, gain and signal-to-noise ratio should be much above the average.

Band-spread tuning is obtained by dividing the short-wave range into seven sections, each with its own coil, and tuned by the main gang condenser, with small fixed condensers in series to reduce the capacity charge. The experience gained from the study of circuit stability for press-button tuning has been applied to the short-wave circuits, and both warming-up drift and long-term changes of calibration have been considerably reduced.



Special attention has been given to short-wave performance in the Murphy A76.

The price of the A76, which is for AC mains only, is £16 10s., and provision is made for the addition of the Murphy P80 or RA80 press-button control units.

HENRY FARRAD'S SOLUTION

(See page 80)

ALTHOUGH the set in question is, from the address, practically in the "swamp area" of the powerful Start Point station, and with a good aerial might be expected to generate some whistles due to it, the selectivity of a superhet with RF stage ought to be great enough for no more than perhaps two or three stations each side of Start Point to be subject to adjacent channel interference, assuming that the receiver is properly aligned. The performance apart from Start Point having been so good, it would be rather an unlikely coincidence for it to go out of adjustment for no particular reason just when the new station opened. An RF amplifying valve of the battery-driven type generally has a much more limited "grid base" than its mains-driven counterpart; and, although an exceptionally large interfering signal may be cut out by the subsequent stages, it is likely to exceed the limited range over which the valve characteristic is reasonably straight. It therefore modulates whatever signal may be tuned in—the phenomenon of cross-modulation—so that however selective the subsequent stages may be they cannot eliminate the interference, because it has been impressed on the wanted programme. That this is the nature of the trouble is borne out by the description—"the Regional programme keeps coming in whenever I tune to any station," because unlike ordinary interference it is necessary for another carrier wave to be tuned in before it can be heard, and this forms a test for identifying cross-modulation.

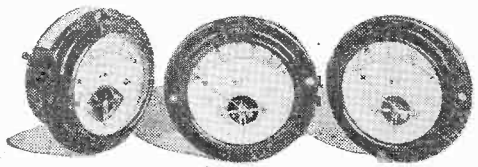
Mr. Orchard might be asked to confirm this; and, assuming it to be the correct diagnosis, there are several ways of tackling it. Improving the selectivity, other than in the aerial tuning circuit, is useless for the reason given. Some battery-driven receivers are provided with an alternative aerial tapping for use near a local station. When the present set was installed, two years ago, there was no local station in view and this tapping, if any, would have been ignored. Alternatively, the aerial can be shortened, or a small condenser connected in series. All these remedies have the disadvantage that general reception is reduced. The preferred method is to employ a sharply tuned wavetrap—usually a simple coil and condenser of low-loss construction, with a proportion of the turns included in series with the aerial—adjusted to Start Point. Reception from that station is thereby brought down more nearly to the level of others, without affecting reception of most of the other stations.

The next best method is to adjust the aerial coupling: the larger and better the aerial, the greater its true selectivity, assuming that the coupling is adjustable. Therefore shortening the aerial itself is the least desirable method.

New Apparatus Reviewed

INEXPENSIVE MOVING-IRON METERS

THE range of small panel-mounting voltmeters and ammeters sold by M.R. Supplies, 68, New Oxford Street, London, W.C.1, are neat and accurate instruments which are very reasonable in price. They require a hole in the panel, approximately 1¾ inches in diameter, and the outside diameter of the flange is 2⅜ inches.



M.R. moving-iron meters for panel-mounting.

The movement is of the spring-controlled moving-iron type, and is lightly damped. As is usual in this class of instrument, the scale is rather crowded at the ends, but is very open in the middle, a fact which should be borne in mind when choosing a suitable range.

Each instrument is hand-calibrated, and when checked against a sub-standard the agreement was as close as the pointer could be read. They should prove useful for monitoring mains voltages and in charging sets.

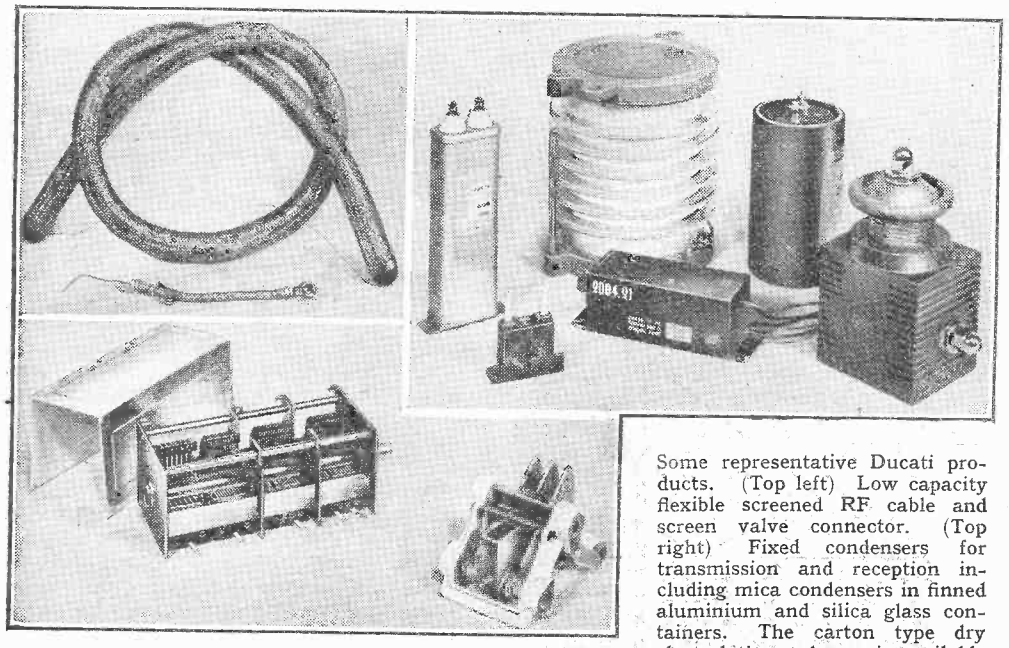
Ammeters are available with full-scale readings up to 1.5, 3.0, 5.0 and 10.0 amps., the price being 5s. 6d. for any reading. There are two voltmeters, one reading up to 10 volts at 6s. 11d., and the other up to 250 volts, priced 7s. 6d.

DUCATI CONDENSERS

WE have recently had an opportunity of examining some of the latest products of the Ducati Societa Scientifica Radio of Bologna. This organisation maintains a large research staff, and many of the dielectric materials used in the condensers shown in the accompanying illustration are the result of recent discoveries.

The range of products is unusually wide and includes low-loss RF cables as well as every conceivable type of fixed and variable condenser for transmission and reception. Close attention to the electrical characteristics has not been given to the exclusion of mechanical workmanship, and from the artistic point of view many of the transmitting condensers present a very pleasing appearance.

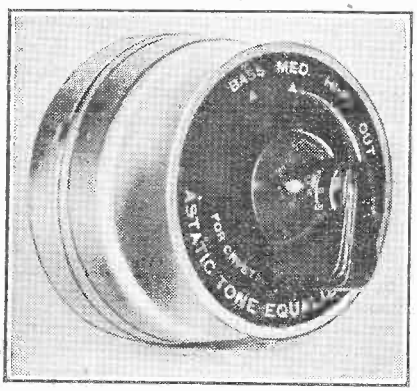
Stocks are carried by Ducati (England), Limited, Imperial House, 80-86, Regent Street, London, W.1, from whom full technical information and prices may be obtained.



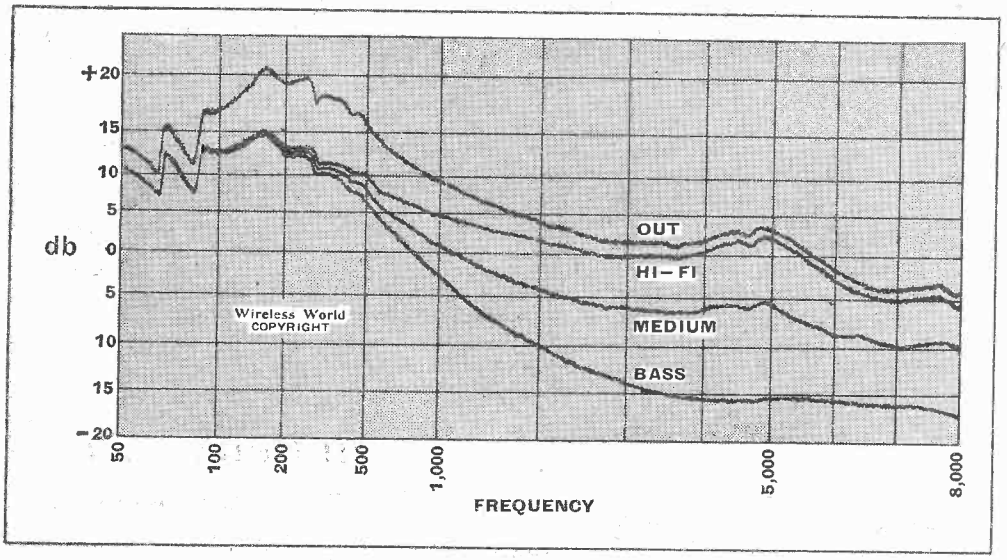
Some representative Ducati products. (Top left) Low capacity flexible screened RF cable and screen valve connector. (Top right) Fixed condensers for transmission and reception including mica condensers in finned aluminium and silica glass containers. The carton type dry electrolytic condenser is available up to 950 volts test, 750 volts working. (Bottom left) Gang condenser with separate S-W vanes in each section and double spaced oscillator section, and precision S-W transmitting condenser with low temperature coefficient and freedom from microphony.

ASTATIC E4P TONE EQUALISER

CRYSTAL pick-ups are justly popular on account of their good high-frequency response and general sensitivity, but too often they show a tendency to over-correct the restriction of amplitude of bass in the record.



Astatic E4P tone equaliser for piezo crystal pick-up.



Frequency response of the Astatic E4P tone equaliser taken with a representative crystal pick-up. The lettering in the curves corresponds with the four positions of the switch.

The Astatic E4P tone equaliser in the "Hi-Fi" position reduced bass relative to the high notes by just the right amount and will give a substantially level response with the majority of crystal pick-ups when used on standard records.

In addition, it has "Medium" and "Bass" positions of the switch, giving reductions in the treble of approximately 6 to 12 db relative to the "Hi-Fi" position; a fourth position cuts out the filter and gives the normal pick-up response.

Our curves, reproduced herewith, are closely in agreement with the makers' figures, and indicate that this component should supply just that degree of finish which will set the performance of the average crystal pick-up above reproach. It will be observed that the correction in the case of the "Hi-Fi" position is obtained without any serious reduction in the general level of output.

The unit is screened and measures 2in. in diameter by ¾in. deep. It is provided with an attractive pointer and scale, and the switch action is positive. Supplies are obtainable from Frank Heaver, Ltd., Bush House, Aldwych, London, W.C.2, and the price is 17s. 6d.

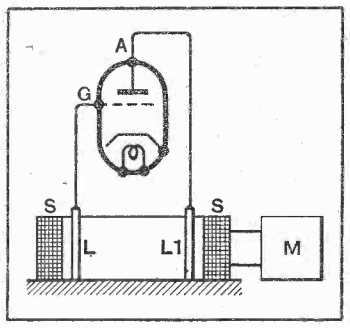
Recent Inventions

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

MAGNETOSTRICTION AND FREQUENCY CONTROL

IT is stated that with wavelengths of the order of a few metres frequency stabilisation is more readily effected with the aid of resonant transmission lines than by using piezo-electric crystal control, with its attendant complications.

According to the invention, a part of the tuned transmission line is made of magnetostrictive material, which alters its length slightly in response to variations in the strength of an applied magnetic field. In this way, either the frequency can be adjusted and stabilised at a fixed value, or the magnetostrictive control can be used for modulation.



Frequency modulation by magnetostriction.

As shown in the figure, the grid G and anode A of a short-wave oscillator are coupled together through a tuned line of which the conductors L and L1 are magnetostrictive. These are located inside a solenoid S which is energised by the current from a modulator M, so that a frequency-modulated signal can be transmitted.

Marconi's Wireless Telegraph Co., Ltd. (*assignees of W. R. Koch*). *Convention date* (*U.S.A.*) *July 28th*, 1937. *No.* 504238.

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CATHODE-RAY TUBES

WHEN a thin coating of metal or colloidal graphite is applied as an electrode to the inside of the glass bulb of a cathode-ray tube, and when high operating voltages are used, a corona discharge is liable to be produced, owing to the extremely high field intensity at the thin edges of the film coating, and this in turn may put a dangerous load on the supply unit.

In order to prevent possible damage due to this cause, a guard-ring with a smooth and round surface is provided near the sharp edges in question, and is electrically connected to the film by one or more light contact springs. Since the guard-ring has a round surface it does not produce any corona discharge.

Radio-Akt. D. S. Lœwe. Convention date (Germany), August 7th, 1936. *No.* 503520.

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LOUD SPEAKER CONES

MANY efforts have been made to improve the response of a loud speaker to the higher frequencies. One method is to use a so-called tweeter in parallel with the main instrument. Another is to make the cone in two parts, each of different materials, the apex, say, of metal, and the base of moulded paper.

As an alternative it is proposed to use a cone made of paper throughout, the upper part being impregnated with a solution of synthetic resin, and then baked. This should make it stiffer than the rest, and therefore more responsive to the high notes.

Murphy Radio, Ltd., and A. K. Webb. Application date, October 22nd, 1937. *No.* 504129.

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POWER-SAVING MODULATING SYSTEM

INSTEAD of maintaining the carrier wave at constant strength during transmission, it is possible to make it "float" or keep in step with the mean strength of the modulation, in order to economise the total output power.

It is now proposed to combine this system of modulation with means whereby the value of the anode voltage applied to the RF power amplifier is also automatically varied as the percentage modulation rises and falls. At the same time, a counter feedback, derived from the anode voltage supply, is applied to the grid of the amplifier, in order to prevent any distortion due to anode voltage fluctuations. Not only does this save power, but it also allows the modulating valve to carry a more efficient load.

C. Lorenz Akt. Convention date (*Germany*) *January 13th*, 1937. *No.* 503443.

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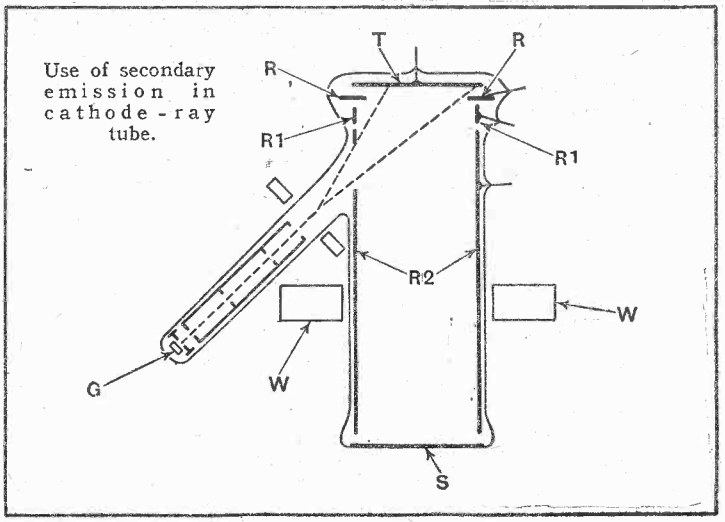
TELEVISION IMPROVEMENT

THE figure shows the arrangement of a cathode-ray tube which is designed to increase the normal brilliancy of a televised picture by means of secondary emission. The scanning stream of electrons from the gun G of the tube is focused on to a target electrode T, which is made of plain metal, and not of a mesh or grid, so that the whole surface is effective in producing a maximum output of secondary electrons.

The reinforced stream of electrons is first accelerated by a pair of rings R, R1 and a cylindrical electrode R2, and is then focused by an external winding W on to a fluorescent screen S mounted at the other end of the tube. The increased density and velocity of impact of the electrons produce a brighter picture, with less chromatic aberration than usual.

O. Klemperer. Application date July 16th, 1937. *No.* 504109.



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VOLUME REGULATION

THE anode voltage applied to a mains-driven set, particularly to the detector and AF valves, is regulated in accordance with the volume of sound required.

For this purpose a series resistance or impedance is connected before the smoothing unit, and is arranged to be short-circuited by a contact on the ordinary tone-control knob when the set is required to give its maximum output. Alternatively the volt-dropping resistance may be continuously varied through the tone-control.

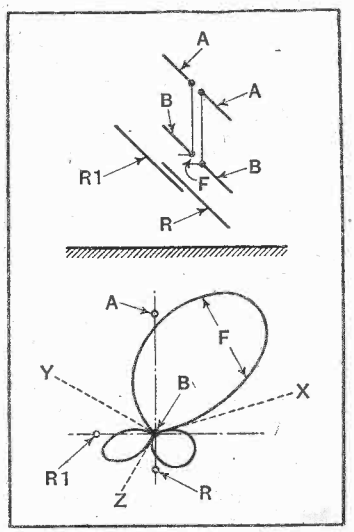
Radiowerk Horny Akt. Convention date (Austria) September 13th, 1937. *No.* 503469.

o o o o

BLIND-LANDING SYSTEMS

A WIRELESS beam, particularly for guiding an aeroplane to ground in foggy weather, is radiated from the aerial arrangement shown in the figure. The two pairs of horizontal dipoles A and B are separated vertically by half the working wavelength, and are energised from a common source of RF energy through the feed line F. One reflector R is placed vertically below the dipole B, and a quarter-wave away from it, whilst a second reflector R1 is also placed a quarter-wave away, but in the same horizontal plane as the dipole B.

The shape of the resulting field is shown at F in vertical section. Its angular position, relative to the three principal axes X, Y, Z, can be adjusted to give a steeper or more gradual "gliding" angle by varying either the phase or the amplitude, or both, of the currents fed to the dipoles A and B. There is no necessity to alter the actual position or elevation of any part of the aerial system. In the same way, the "line of approach" may be narrowed or widened as desired.



Arrangement of dipoles and resultant field for blind landing.

Standard Telephones and Cables, Ltd. (*assignees of Le Materiél Telephonique Soc. Anon*). *Convention date* (*France*) *June 11th*, 1937. *No.* 504507.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

SELECTIVITY WITHOUT RESONANCE

A METHOD of selective reception is based upon the use of a non-ohmic device, such as a diode valve, in place of the usual tuned circuit. If the effective resistance of the device is varied at the same frequency as a given carrier wave, that wave is eliminated, though other waves will pass freely through.

The method is stated to be effective in separating two modulated carrier waves which differ in frequency by only 100 cycles, even though both waves carry sidebands of the order of 2,000 c/s. Ordinary resonance methods would not, of course, effectively separate two signals under these conditions.

L. Gabrilovitch. Convention date (France) September 5th, 1936. *No.* 504455.

CLASSIFIED ADVERTISEMENTS

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

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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 ~~& Co.~~ payable to ILIFFE & SONS Ltd., and crossed ~~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 10th must be closed for press earlier than usual.

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

FIRST POST FRIDAY, AUGUST 4th.

NEW RECEIVERS AND AMPLIFIERS

*

*

CHALLENGER RADIO CORPORATION "Degallier's." Send 2d. stamp for handsome illustrated catalogues telling of our superb range of fully guaranteed receivers; direct to public sales policy saves you 40%; sets to suit every pocket from 65/- to £31/10.—Challenger Radio Corporation, "Degallier s," 31, Craven Terrace, London, W.2. Paddington 6492. Nearest point, Lancaster Gate Tube. [8731

R.
RADIO CLEARANCE, Ltd.
63, High Holborn, W.C.1. 'Phone: Holborn 4631.

GUTHMAN McMurdo Silver Communication Receiver.

WE are Sole Distributors for the United Kingdom of Above Product.

CIRCUIT Superhet., with double regeneration obtained at signal frequency and also at intermediate frequency. As a result, very high sensitivity and selectivity are obtained.

CONTROLS.—R. meter, silencer, tone, aerial trimmer, A.F. gain selectivity, beat oscillator, receiver-send, A.V.C., B.O., on/off; assembled with valves but unwired, £17; wired and aerial tested, £18/18.

BRITISH BELMONT.

RECEIVERS and Chassis Still Available from Stock; as previously supplied.

RECEIVERS, with valves; £7/7.

FOR One Month Only.—Chassis, with valves, £5/7/6.

RADIO CLEARANCE, Ltd., 63, High Holborn, W.C.1. Telephone: Holborn 4631. [8680

AMAZING Offer.—Famous 7-valve push button 1939 models in makers' sealed cartons, listed 13½ gns.; £5/19/6; list free.—Shippers, 18, Corporation St., Manchester. [0639

PREMIER

★ RADIO ★ STOCKTAKING SALE

SPECIAL CLEARANCE OFFERS!

POTENTIOMETERS WITH SWITCH, ¼ meg., ½ meg., 20,000 ohms and 10,000 ohms, **1/3** each.
POTENTIOMETERS WITHOUT SWITCH 2 meg., 1 meg., ½ meg., 400,000 ohms, 25,000 ohms, 20,000 ohms, 10,000 ohms, **1/-** each.
SPECIAL OFFER—CONTINENTAL MAINS VALVES, 4v. AC Types, 5-pin only, AC/HL, AC/L, AC/P, AC/SG AC/VMS, AC/HP, AC/VHP, **2/6** each.
F. W. RECTIFIERS 350v. 120ma., **4/6**; 500v. 120ma., **5/6. 20 v. .18a AC/DC Types,** SG. Var. Mu. SG. Power, HF Pen., **2/-** each.
U.S.A. Types, 24, 30, 41, 39/44, 35/51, 55, 56, 57, 58, 71, 77, 78, 85, 2A5, 2A6, 2A7, 2B7, 6A7, 12Z3, 210, 250, all 2 for **3/-.**
TUBULAR CONDENSERS, .002, .0001, .0003 and .0005 mfd., **1/-** doz. Your choice.
ELECTROLYTIC CONDENSERS. Metal Can. 8 mfd. 320 volts, 2 for **1/6.** 8+8 mf. 475v.+10 mf. 50v., 2 for **2/6.** 8+8 mf. 450v.+8 mf. 250v., 2 for **2/6.**
T.C.C. DRY ELECTROLYTICS. 8+8+4 mf. 500v., **2/-** each.
500v. CARDBOARD ELECTROLYTICS. 4 mf. or 8 mf **1/6.** 8+4 m.f., **2/9.** 8+8 mf., **2/6.** 4+4 mf., **2/4.**
MAINS TRANSFORMERS — MANUFACTURERS' SURPLUS. 250—250 v. 60 ma., 4 v. 2 a., 13 v. 1 a., **3/6.**

Huge Reduction in Prices of TRIAD U.S.A. VALVES

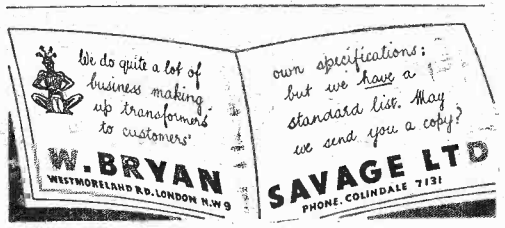
from **2/3** each!

Send for NEW Price List.

PREMIER SHORT-WAVE KITS.
Complete to the last detail including all Valves and coils, as well as theoretical and wiring diagrams and lucid instructions for building and working. Each kit is supplied with a steel Chassis and Panel and uses plug-in coils to tune from 13 to 170 metres.
1 Valve Short-Wave Receiver or Adapter Kit ... **17/6**
1 Valve Short-Wave Superhet Converter Kit ... **20/-**
1 Valve Short-Wave A.C. Superhet Converter Kit **22/6**
2 Valve Short-Wave Receiver Kit **25/-**
3 Valve Short-Wave Screen Grid and Pentode Kit **58/6**
PREMIER U.S.A. QUARTZ TRANSMITTING CRYSTALS 7 mc Band, **10/-** each, with Calibration Certificate. Enclosed holder and base, **3/-.**
MORSE KEYS. Excellent brass movement on bakelite base, **2/9** each.
PREMIER SHORT-WAVE COILS, 4- and 6-pin types. 13-26, 22-47, 41-94, 78-170 metres, **1/9** each, with circuit. Special set of S.W. Coils, 14-150 metres, **4/-** set, with circuit. Premier 3-band S.W. coil, 11-25, 19-43, 38-86 metres. Suitable any type circuit, **2/6.**
UTILITY Micro Cursor Dials, Direct and 100.1 Ratios, **3/9.**
PREMIER Short-Wave Condensers, all-brass construction, with **Trolitul** insulation. 15 mmf., **1/6**; 25 mmf., **1/7**; 40 mmf., **1/9**; 100 mmf., **2/-**; 160 mmf., **2/3**; 250 mmf., **2/6.**
TROLITUL DOUBLE SPACED TRANSMITTING CONDENSERS. 15 mmf., **2/9**; 40 mmf., **3/6**; 100 mmf., **4/-**; 160 mmf., **4/6.**
NEW TROLITUL SPLIT STATOR CONDENSERS, 50×50 mmf., **10/6.**
COIL FORMERS, 4- or 6-pin low-loss, **1/-** each.
Orders 5/- and over sent Post Free. Under 5/- please add 6d. Postage.

Have you had our 1939 Catalogue, Handbook and Valve Manual? 90 pages of Radio Bargains and Interesting Data. Price 6d.

ALL POST ORDERS TO: Jubilee Works, 167, Lower Clapton Road, London, E.5. *Amherst* 4723
CALLERS TO: Jubilee Works, or our NEW PREMISES' 169, FLEET STREET, E.C.4. *Central* 283
or 50, High Street, Clapham, S.W.4. *Macaulay* 2381



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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.

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NEW RECEIVERS AND AMPLIFIERS

ARMSTRONG Co.—After many years at our old premises at Camden Town we have removed to a new building in Warlters Rd., Holloway, N.7 (see displayed advertisement).

ARMSTRONG Amplifier Division Has Removed to New Premises at 94, Camden Rd., N.W.1. In addition to our standard range of 6- and 12-watt push-pull high fidelity amplifiers and local station feeder units, we manufacture equipment for special purposes, pre-stage units, electronic mixers, tone control units, etc.

ARMSTRONG Are Always Pleased to Assist in the Solution of Special Problems; details of standard equipment free on request.

ARMSTRONG Co. (Amplifier Division), 94, Camden Rd., N.W.1. [8752

USED SETS FOR SALE

HALLICRAFTER

HALLICRAFTER Sky Champion, new 1939 model; £13/13.—6, Elizabeth Ave., Christchurch, Hants. [8744

HALLICRAFTER Sky Challenger, SX18, as new; £17/10.—49, High St., Folkestone. [9743

Wanted

WANTED, G.E.C. receiver, BC3880 or 3780; up to £5 offered.—N. D. Hill, 42, East Lane, Wembley. [8736

CAR RADIO

ALL Goods Previously Advertised Still Available.

HENRYS, 72, Wellington Ave., Stamford Hill, N.15. Stamford Hill 2907. [8745

1939 Models from 4½ gns.; 6 new car aerials, from 9/6; trade enquiries solicited; lists free.—Shippers, 18, Corporation St., Manchester. [0622

PUBLIC ADDRESS

"PARTRIDGE P.A. Manual." free to trade, from N. Partridge, B.Sc., A.M.I.E.E., King's Buildings, Dean Stanley St., London, S.W.1. [0631

QUALITY Amplifiers and Microphone Equipments for Hire or Permanent Installation.—Harmony House, 116, Cambridge Rd., Southport. [8505

ALEXANDER BLACK, Ltd.—Consult us on sound installations, temporary or permanent; booklet on request.—55, Eaury St., S.W.1. Sloane 6129. [0597

PUBLIC Address Contractors Can Hire P.A. Vans, loud speakers, microphones and equipments of all types from Hire Dept., Grampian Reproducers, Ltd., Kew Gardens, Surrey. Tel.: Richmond 1175-6-7. [0618

"Radio Data Charts," A Series of Abacs. Post free 4/10.

PUBLIC ADDRESS

V

VORTEXION P.A. Equipment.

IMITATED, but unequalled.

WE Invite You to a Demonstration.

A.C.-D.C. Dance Band Amplifier, 10 watts output, complete in case, with moving coil microphone, speaker and cables, weight 22lb.; 12 gns.

A.C.-20 15-20-watt Amplifier, 38-18,000 cycles, independent mike and gram., inputs and controls, 0.037 volts required to full load, output for 4 7.5, and 15 ohms speakers or to specification inaudible hum level, ready for use; 8½ gns., complete.

C.P. 20 12-volt battery and A.C. Mains Model, as used by R.A.F. output as above; 12 gns.

A.C.-20, in portable case with Collard motor, Piezo pick-up, etc., £14; C.P.20 ditto, £17/17.

50-WATT Output 6L6s, under 60-watt conditions, with negative feed back, separate rectifiers for anode screen and bias, with better than 4% regulation level response, 20-25,000 cycles, excellent driver, driver transformer, and output transformer matching 2-30 ohms impedance electronic mixing for mike and pick-up with tone control, complete with valve and plugs; £15.

COMPLETE in Case, with turntable, B.T.H. Piezo pick-up and shielded microphone transformer; £20.

80-WATT Model, with negative feed back; £25, complete.

120-WATT Model, with negative feed back; £40, complete.

250-VOLT 250 m.a. Full Wave Speaker field supply unit; 25/-, with valve.

ALL P.A. Accessories in Stock, trade supplied.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2814. [8241

NEW MAINS EQUIPMENT

V

VORTEXION Supply G.P.O., B.B.C., L.P.T.B. Why not you?

ALL Models Super Shrouded, primaries screened and tapped, 200-250v., filaments C.T.

ANY Model Fitted 5v. or 6.3v. Filaments if Required.

500-0-500 150 m.a., 4v. 4a., 2.5a., 4v. 2a., 4v. 2a., 4v. 2a., 35/-; 400 or 350v., same price.

500-0-500 120 m.a., 4v. 4a., 4v. 2.5a., 4v. 1-2a., 4v. 1-2a., 28/-; 400v. or 450v., same price.

425-0-425 150 m.a., 4v. 8-10a., 4v. 2.5a., 4v. 1a., 4v. 1a., 32/-.

350-0-350 120 m.a., 4v. 4a., 4v. 2.5a., 4v. 1-2a., 21/-; with extra 4v. 6a., 25/-.

350-0-350 75 m.a., 4v. 2-4a., 4v. 1-2a.; 18/-.

250-0-250 60 m.a., 4v. 2-4a., 4v. 1-2a.; 15/-.

AUTO Transformers, 100-120 to 200-240v., 80 watts, 11/-; 120 watts, 14/6; 200 watts, 21/-; 250 watts, 25/-; 300 watts, 28/-; 500 watts, 47/6.

W.W. Q.A. Output Transformer; 21/-.

MICROPHONE Transformers, in heavy magnetic shielding; 12/6.

CHOKES.—30h. 60 m.a., 7/6; 7-13h., 120 m.a., 12/6; 30h., 150 m.a., 15/-; 25h. 150 m.a., 21/-.

TRANSFORMERS and Chokes to Any Specification.

CAR Battery Charger, 6 and 12v., 1½ to 2 amperes; 30/- complete.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, London, S.W.19. Telephone: Liberty 2814. [8751

NEW LOUD-SPEAKERS

SINCLAIR Speakers for All Types.—Pulteney Terrace, Copenhagen St., N.1. [0603

BAKERS New Corner Horn Speakers, Triple cone conversions; from 29/6, and surplus speaker bargains.—Bakers Selhurst Radio, 75, Sussex Rd., South Croydon. [8728

SAVE Pounds.—1½d. stamp for list British and American P.A. Speakers. Example: P.A. unit with transformer weighing 23lb., incorporating curved cone, 47/-.—Degalier's, 31, Craven Terrace, London, W.2. [8554

LOUD-SPEAKERS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

3,000 Speakers from 5/6 each, P.M. and energised 4in. to 14in., including several Epoch 18in.—Sinclair Speakers, Pulteney Terrace, Copenhagen St., N.1. [0591

VOIGT Corner Horn Speaker in the White, latest laboratory diaphragm and filter, built in 460v. field supply, complete; £25.—Allworth, 20, Purley Bury Close, Purley. [8726

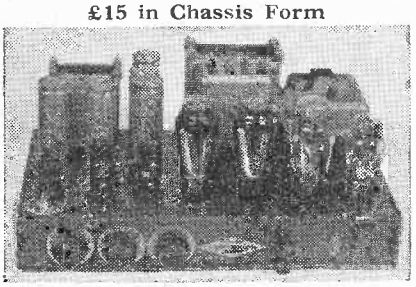
TELEVISION

H.M.V. 29 Gns. All-wave Receiver, as new; £20.

HENRYS, 72, Wellington Ave., Stamford Hill, N.15. Stamford Hill 2907. [8746

VORTEXION 50 W AMPLIFIER

£15 in Chassis Form



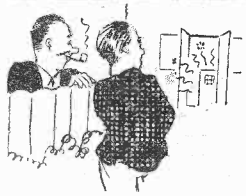
VORTEXION, LTD., are offering their new 50 W amplifier at £15 as a chassis with valves and plugs, or at £20 complete in black leatherette-covered cabinet with Collaro turntable, piezo-electric pick-up and shielded microphone transformer.

A pair of matched 6L6's with 10 per cent. negative feed-back is fitted in the output stage, and the separate HT supplies to the anode and screen have better than 4 per cent. regulation, while a separate rectifier provides bias.

The 6L6's are driven by a 6F6 triode connected through a driver transformer incorporating feed-back. This is preceded by a 6N7, electronic mixing for pick-up and microphone. The additional 6C5 operating as first stage on microphone only is suitable for any microphone. A tone control is fitted, and the large eight-section output transformer is available in three types:—2–8–15–30 ohms; 4–15–30–60 ohms or 15–60–125–250 ohms. These output lines can be matched using all sections of windings and will deliver the full response (20–18,000 c/s) to the loudspeakers with extremely low overall harmonic distortion.

Write for Illustrated Catalogue.

Vortexion, Ltd., 182 *The Broadway, Wimbledon, S.W.*19. *'Phone: LIBerty* 2814.



When a neighbour bemoaned to old White,

"My set crackles all day and all night,"

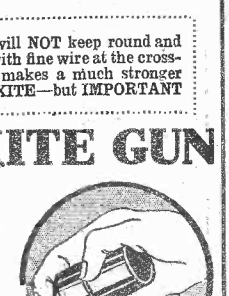
Whitey murmured, "Oh, yes, That's your set's S.O.S., Just to tell you it's needing FLUXITE!"

See that FLUXITE is always by you—in the house—garage—workshop—wherever speedy soldering is needed. Used for 30 years in Government works and by leading engineers and manufacturers. Of Ironmongers—in tins, 4d., 8d., 1/4 and 2/8. Ask to see the FLUXITE SMALL-SPACE SOLDERING SET—compact but substantial—Complete with full instructions, 7/6. Write for Free Book on the art of "SOFT" SOLDERING—and ask for leaflet on CASE-HARDENING STEEL and TEMPERING TOOLS with FLUXITE.

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

THE FLUXITE GUN

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



ALL MECHANICS *WILL* HAVE

FLUXITE

IT SIMPLIFIES *ALL* SOLDERING

FLUXITE LTD., Dept. W.W., DRAGON WORKS, BERMONDSEY ST., S.E.1

TRANSMITTING APPARATUS

A.C.S. RADIO, specialists in short wave apparatus, communication receivers, including Hallicrafters, National and R.M.E. transmitting equipment, valves and components. Send for free catalogue to A.C.S. Radio, 16, Gray's Inn Rd., W.C.1. Holborn 9894-5. G2NK, Technical Manager. [0550

G5N1.—The oldest and largest distributor of amateur equipment transmitting and receiving; short-wave catalogue, 1½d. G5N1 70-page Manual, 7½d., post free; authorised direct distributor for Collins, National, R.M.E., Thordarson, Hammerlund, Bliley, Taylor, Elmac, etc., etc.—44, Holloway Head, Birmingham. [0531

CABINETS

A CABINET for Every Radio Purpose.

CONVERT Your Set into a Radiogram at Minimum Cost; surplus cabinets from noted makers under cost of manufacture (undrilled); 30/- upwards; motors at wholesale prices.

"FIT-A-GRAM" Cabinet, 31×17×15; 21/-.

UNDRILLED Table Console and Loud-Speaker Cabinets from 3/6.

INSPECTION Invited; photos loaned to country customers.

H. L. SMITH and Co., Ltd., 289, Edgware Rd., W.2. Tel.: Pad. 5891. [0485

DEGALLIERS for the Finest Obtainable American Cabinets, Table, Console and Radio Grams; also Record Changers, 5 gns. Send 1½d. stamp for reprints from actual photographs.—Degallier's, 31, Craven Terrace, Lancaster Gate, London, W.2. Paddington 6492. [8553

DYNAMOS, MOTORS, ETC.

ALL Types of Rotary Converters, electric motors, battery chargers, petrol-electric generator sets, etc., in stock, new and second-hand.

A.C.-D.C. Conversion Units for Operating D.C. Receivers from A.C. Mains, 100 watts output, £2/10; 150 watts output, £3/10.

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518

ELECTRADIX Rotary Converters for A.C. Radios on D.C. Mains; alternators 50 to 500 cycles; mains motors and motor generators for 1 to 600 cells; petrol engines and switchgear.—218, Upper Thames St., London, E.C.4. [0619

RECORDING EQUIPMENT

ALL Recording Discs and Materials in Stock, tracker units, £4/7/6; recording motors, £3/17/6.—Write for further details, Will Day, Ltd., 19, Lisle St., W.C.2. [0595

VALVES

ALL Types of American Tubes in Stock of Impex and Arcturus makes at competitive prices.

WE Can Also Supply a Full Range of Guaranteed Replacement Valves for Any British non-ring. American or Continental type at an appreciably lower price.

SEND for Lists of These, and also electrolytic condensers, line cords, resistances, etc.

CHAS. F. WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0452

AMERICAN 2/9; 1,000 non-ring British, from 1/9; bargains galore; lists free.—Shippers, 18, Corporation St., Manchester. [0607

METROPOLITAN RADIO SERVICE.—Special offer. American valves, in makers' cartons, 3/- each. Octals 3/6 each; American valves, first grade, in all types; trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

ELECTRICAL EQUIPMENT

1- and 3-phase Motors, ¼ to 5 h.p., surplus stock, first class condition.—Tel.: Reliance 1693. Easco Electrical Service, 18, Brixton Rd., S.W.9. [0642

TEST EQUIPMENT

ONE Weston Analyser, with English and American circuit selectors, and adaptors; one Philco signal generator; £10; consider exchange for short-wave set.—Box 586, c/o *The Wireless World*. [8741

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Printed in England for the Publishers, ILIFFE AND SONS LTD., Dorset House, Stamford Street, London, S.E.1, by The Cornwall Press Ltd., Paris Garden, Stamford Street, London, S.E.1. "The Wireless World" can be obtained abroad from the following: FRANCE: W. H. Smith & Son, 248, Rue Rivoli, Paris; Hachette et Cie, Rue Réaumur, Paris, and branches; Messageries Dawson, 4, Rue de Faubourg Poissoniere, Paris. BELGIUM: W. H. Smith & Son, 74-75, Boulevard Adolphe Max, Brussels. AUSTRALIA: Gordon & Gotch, Ltd., Melbourne (Victoria), Sydney (N.S.W.), Brisbane (Queensland), Adelaide (S.A.), Perth (W.A.), and Launceston (Tasmania). NEW ZEALAND: Gordon & Gotch, Ltd., Wellington, Auckland, Christchurch and Dunedin. INDIA: A. H. Wheeler & Co., Bombay, Allahabad and Calcutta. CANADA: Imperial News Co., Toronto, Winnipeg and Vancouver; Benjamin News Co., Montreal; Gordon & Gotch, Ltd., Toronto. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd., Cape Town. UNITED STATES: The International News Co., New York.

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The Wireless World

6D.

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Thursday, August 3rd, 1939.

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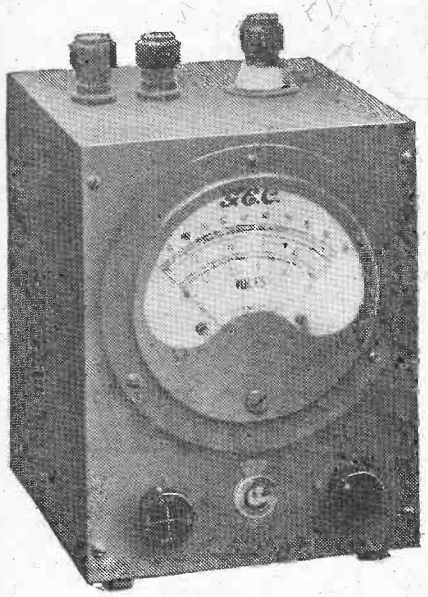

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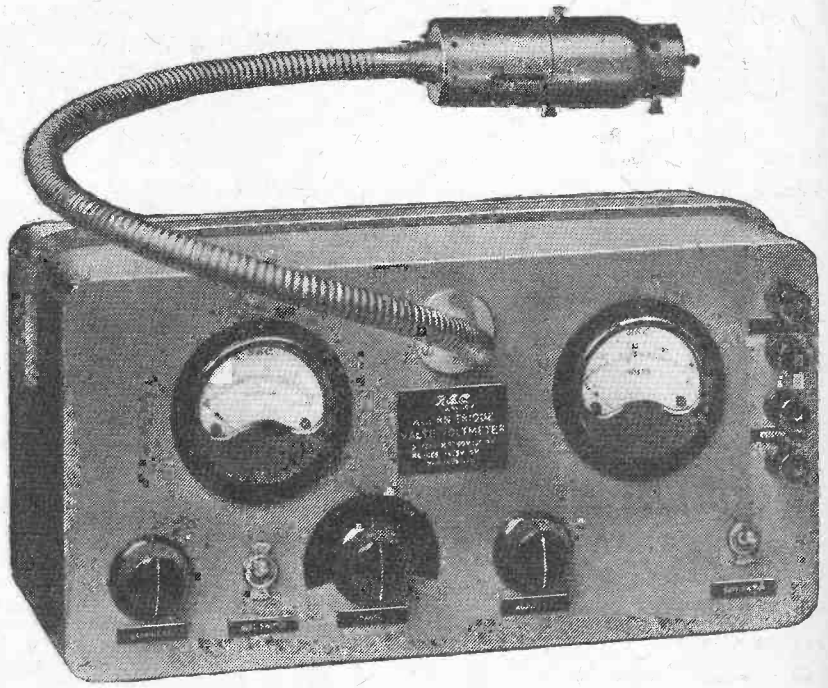

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THE PRACTICAL RADIO JOURNAL

29th Year of Publication

No. 1040. THURSDAY, AUGUST 3RD, 1939 VOL. XLV. No. 5.

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone : Waterloo 3333 (50 lines).
Telegrams : "Ethaworld, Sedist, London."

COVENTRY : 8-10, Corporation Street.
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PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home and Canada, £1 10s. 4d. ; other countries, £1 12s. 6d. per annum.

CONTENTS

EDITORIAL COMMENT

Weather and Wireless

Forecasting U-S-W Conditions

EVERYONE knows that weather is a strictly localised affair, and that, as often as not, the area affected by a given set of conditions is extremely limited. The propagation of wireless signals, on the other hand, is a matter of comparatively enormous distances, covering areas in which a wide diversity of weather conditions are likely to exist. Except in relation to atmospheric interference due to near-by thunderstorms, it seems profitless to attempt to trace any definite connection between the two phenomena.

But ultra-short-wave signals are an obvious exception. The range of these is normally so limited that even at ranges considerably beyond that usually obtained it is quite possible that the path of the signals may lie in an area over which more or less similar weather conditions exist. A study of the relationships between these conditions and ultra-short-wave propagation would therefore seem to be worth while, and, indeed, some connection has already been observed by various investigators.

In an article printed elsewhere in this issue, a contributor traces a distinct relationship between favourable conditions for long-range 5-metre transmission and the existence of a "negative temperature gradient" in the upper atmosphere. In other words, successful transmission by means of the "extended ground wave" may be expected when the temperature of the air at a height of some 3,000 ft. is higher than at ground level. The writer of the article goes on to describe the meteorological conditions likely to give rise to this abnormal temperature effect.

Usually matters of propagation are considered to be of most purely academic interest, at any rate in the early stages of an investigation, and one is often tempted to dismiss the subject, however interesting it may be in itself, as something about which nothing can be done. In the present case, however, there is the obvious difference that, if our contributor's conclusions prove to be justified, anyone with a nodding acquaintance with meteorology stands at least a chance of forecasting the conditions likely to obtain for ultra-short-wave working—or television reception—at ranges beyond those normally expected.

Curbing Interference

Establishing a Principle

ANOTHER session of Parliament is closing without any sign of the anti-interference legislation that is so urgently needed. Installation of radiating appliances is meanwhile proceeding unchecked, and, unless something is done quickly it will become quite impossible to ensure interference-free reception even to a fair proportion of broadcast listeners.

We are told that these protracted delays are due to the difficulty in reconciling conflicting interests and to assessing, on a precise quantitative basis, the nature and amount of permissible interference from various sources. *The Wireless World* has repeatedly urged the need for a stop-gap Bill to establish the general principle that, to borrow an expression from an article in this issue, those who knowingly cause interference "place themselves outside the community of the nation." The article from which we have quoted describes anti-interference methods in Germany; we do not suggest that the practices of that country should be applied here, but the fact that something can be done on quite simple lines surely contains a moral for us.

Distortionless Detection

NEGATIVE FEED-BACK AND THE DIODE

By J. E. VARRELL

IT is well known that distortion occurs in the diode detector because the AC value of the load resistance is lower than the DC value. In this article a method of obtaining equality of the values, and so removing the distortion, by the application of negative feed-back is described.

ONE of the greatest difficulties in the design of high-quality apparatus is the detector circuit. The difficulties are well known. The detector should be linear and, since all known rectifiers act as square law detectors on low input amplitudes, a fairly high input is desirable. An RMS value of some 4 volts is about the best compromise between low output from the RF amplifier and high input to the detector. The detector output has a DC component on which is superimposed the desired AF signal, and if this is applied directly to an AF amplifier, the bias will vary with the signal strength. This is the case with the grid detector, and although, given the correct signal strength, the correct bias can be obtained, the large signal required for linear detection may overload the stage on a fully modulated signal. This circuit, therefore, although capable of giving good results on the correct input signal, is a compromise between high level detection and low input voltage to the triode.

If a separate diode, with a blocking condenser C1, and resistance R1 (Fig. 1), are introduced, the above disadvantages are avoided. However, non-linear distortion is now caused by the low AC load (R1 and R2 in parallel). At all modulation depths above the ratio of AC-to-DC loads, harmonic distortion is produced. For a detector load of 0.25 megohm, and a value for R1 of 2 megohms, this means distortion on all carriers with greater than 89 per cent. modulation. This is a tolerable performance, but the distortion does exist, and harmonic generation is the most unpleasant type of distortion. If an AVC circuit, R3, C2 is introduced in shunt with the diode load, the value of R3 may be as low as 0.5 MΩ, in which case good reproduction is impossible. The AVC voltage may be obtained from a separate diode, and the IF transformer primary, in which case the distortion is greatly reduced, but not eliminated.

Various methods have been introduced to reduce or eliminate distortion. AVC distortion can be eliminated by isolating the AVC circuit entirely.[1] This, however, entails an additional valve or valves, and frequently an additional HT supply. The effect of the low AC load can be largely offset by biasing the diode,[2] but the value of bias is critical and varies with signal strength, thus either a compromise must be made or a complex circuit evolved to give bias proportion to signal strength. The distortion caused by the shunt circuit C1 R1 may be eliminated by using the negative feed-back detector.[3] This has the additional advantage of a very high or even negative input resistance, but since an increase in signal strength results in an increase of rectified DC component in a positive direction, it is unsuitable for AVC purposes.

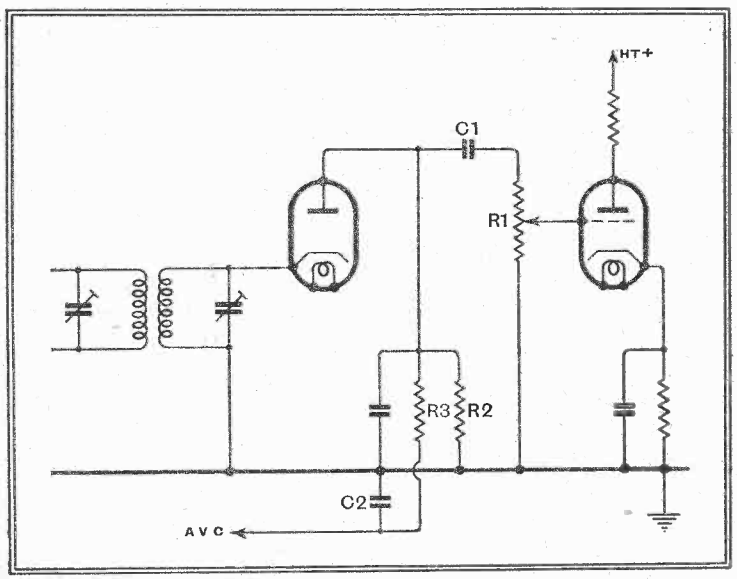

Fig. 1.—This diagram shows the usual arrangement of a diode detector and AF stage.

Two detector circuits will be described which have special applications. The first is intended as a substitute for the leaky grid detector. This is still frequently used with an RF amplifier for local-station reception, and in the USW receiver for television sound, both of which are usually fitted with reaction. The disadvantage of the DC component being applied to the grid remains if a leaky grid detector is used.

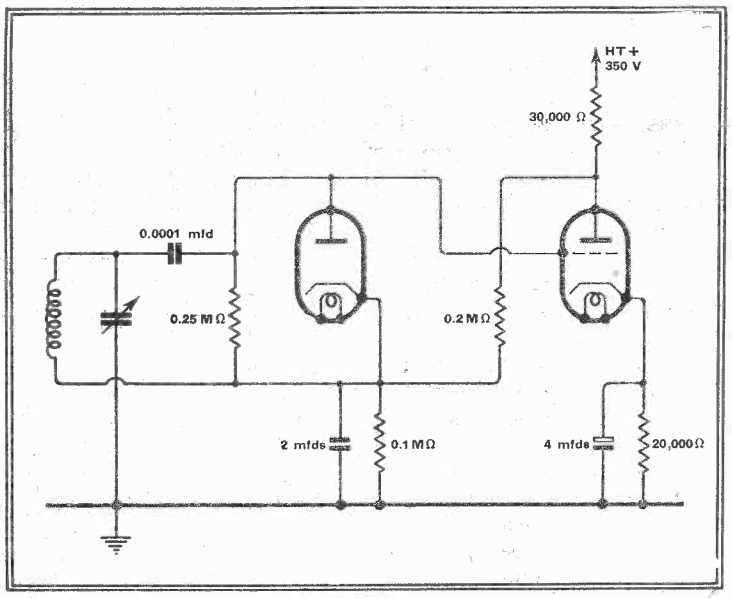

Fig. 2.—Here direct coupling to the AF stage is shown, the DC component of the detector output being compensated by feed-back.

What is required is a DC voltage equal to this DC component, that can be utilised to cancel it. Feed-back provides the solution to many of the problems in radio to-day, and will solve this one. Cathode feed-back reduces the amplification of a stage by producing a voltage across the cathode resistor proportional to the applied grid volts. The effective voltage existing between grid and cathode is thereby reduced, resulting in a decrease in amplification. If a cathode resistor is introduced, and shunted by a condenser, it produces a feed-back to any steady voltage change, but no AC feedback. The effect of a variable DC component in a diode detector output can be largely offset by this means, without affecting its AF amplification.

A practical circuit is shown in Fig. 2. A leaky diode detector is used (this gives a greater RF component for reaction than the normal diode load), and its output is fed in series with a positive voltage to the grid of the amplifier stage. The current

[1] *The Wireless World*, June 12th, 1936.
[2] *The Wireless World*, March 9th, 1939.
[3] *The Wireless World*, Jan. 1st, 1937.

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flowing through the valve gives a potential across the cathode resistance. The operating point of the valve on its characteristic will be a point of equilibrium between current, volts across the valve, and grid-to-cathode voltage. If the grid volts decrease, due to a signal, a very small change in valve current will result in a large change of voltage across the cathode resistance. Thus the operating point of the valve is only slightly altered.

The effect can be increased by obtaining the steady voltage from the valve anode (see Fig. 2). Thus a decreasing grid voltage results in a decrease in current, which gives rise to a decrease in cathode potential and an increase in anode potential, which in turn increases the DC volts in series with the grid. The action is self-compensating, and a large increase in signal strength results in only a small change in grid-to-cathode potential. The resistance values can be calculated from the valve curves for any given operating bias, and the values given are for a medium impedance triode of mutual conductance 3.5 mA/V, and anode AC resistance 11,500Ω, using an HT source of 350 volts.

The curve of Fig. 3 shows the change in steady grid-to-cathode potential for a series of signal strength values. A change of as much as 10 volts in the value of DC component of the rectified output only moves the grid operating point approximately 0.5 volt. Since such a value is larger than ever required, because its AF component would overload the stage, the changes experienced in practice are negligible. If no reaction is required a potentiometer may be used as the diode load to form a volume control. If reaction is desired an RF choke and condenser in the valve anode circuit can be provided.

Equalising the Diode Loads

When the detector output is too large the load can be tapped, since a volume control would affect the reaction. The coil is unearthed, but, since it is at a steady RF potential, the tuning condenser may be earthed (if so, the condenser from diode cathode to earth should be non-inductive).

The applications of this circuit are limited, but it will be found useful in

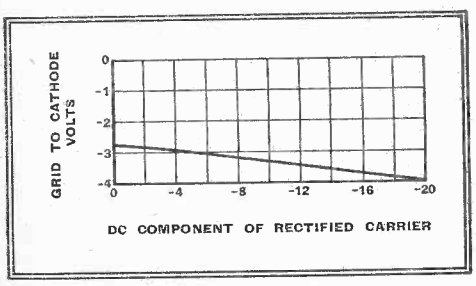


Fig. 3.—This curve shows the amount of compensation obtainable with the circuit of Fig. 2.

certain high-fidelity feeders where AVC is not required. The second circuit to be described is intended to prevent distortion when AVC is taken from the same diode as the signal. As already pointed out, the cause of this distortion is that the AC load to the diode is lower in value than the DC load. The AVC shunt circuit is between

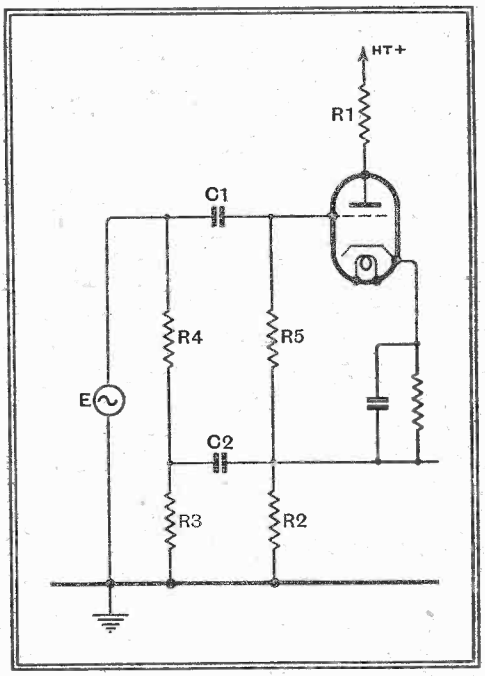
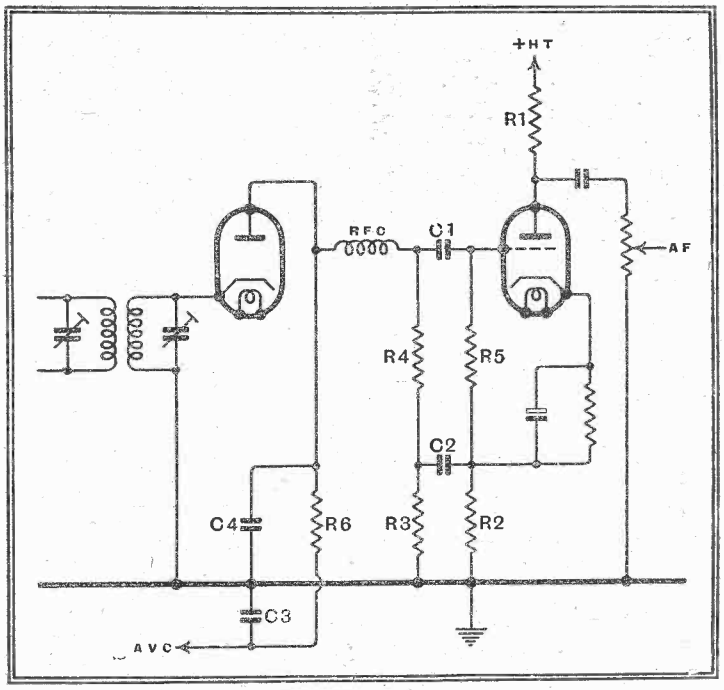


Fig. 4.—This diagram illustrates the basic circuit of the negative feed-back system adopted for equalising the AC and DC load resistances.

the diode anode and earth, and its value is in shunt with the DC load. The only method by which its effect can be nullified is by making the normal AC load to the diode equal to or greater than its DC load.

A choke is the most obvious solution, but a little consideration will show the difficulty of this method. It is in the lower register that full modulation occurs, and if the AC load is to be greater than the DC, the choke impedance must be about 0.5 MΩ at 50 c/s. A choke of about 1,600 H is required. However, feed-back again provides the solution.

Fig. 5.—A practical distortionless diode detector is shown here. The price that must be paid for the equality of AC and DC loads is lower AF stage gain.



Consider the circuit of Fig. 4. An alternating voltage E is applied to the grid of the valve via the blocking condenser C1, and leak R5. The alternating current component through R2 thus caused produces a voltage across R2 in phase with E. This reduces the grid-to-cathode voltage, and thus the amplification of the stage. It also alters the potential across R5, the grid resistance. The effect, as far as the source E is concerned, is equivalent to increasing the value of R5, because the current flowing through it has been reduced.

If a condenser C2 and resistance R3 are shunted across the cathode, the AC component of the cathode voltage is obtained, and the apparent value of R4 will be increased. If R4 and R5 are very much greater than R2, and the value of R2 and R3 in parallel $\left(\frac{R2.R3}{R2+R3}\right)$ be called R_K, the effective values of R4 and R5 are increased by a factor approximately equal to

$$\frac{1}{1-\dfrac{R_K.g_m}{1+R_K.g_m+\dfrac{R_1+R_K}{R_a}}}$$

where R_a and g_m are the valve's anode AC resistance and mutual conductance respectively.

A little consideration will show that a high apparent AC resistance can be obtained, and the DC resistance remains at a value of R3+R4. The practical circuit is given in Fig. 5. If the values given to the resistances are R1=30,000Ω, R2=5,000Ω, R3=10,000Ω, R4=200,000Ω, R5=0.5 MΩ, the value of R_K is 3,333Ω; and a valve of g_m=3 mA/V, and R_a=10,000Ω is used. For the purpose of calculating AC resistance, R4 and R5 may be considered in parallel, i.e., 143,000Ω. The AC value of the diode load, calculated from the formula given, will be $\frac{43}{13}$ times this value, that is, 473,000Ω. The DC load is 210,000Ω, and in spite of the parallel path of C1 and R5, an AC resistance well in excess of the DC value is obtained. Distortion will start when the AC load becomes less than the DC load, and an AVC bias circuit R6, C3 can be introduced in parallel with the existing load such that the AC load is reduced.

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The lowest permissible value of R6 to general distortion is that value required to make the AC load equal to 210,000Ω. This value is 378,000Ω, and hence the AVC circuit should be designed to provide a load on the detector circuit of not less than 378,000Ω. Since there is no disadvantage in an AC load a little higher in value than the DC load, values of 0.5 MΩ for R6 and 0.1 μF for C3 are suggested. Under these conditions the circuit will provide distortionless detection on carriers up to nearly 100 per cent. modulation. The small unavoidable distortion on 100 per cent. modulation which remains is due to the reservoir condenser C4, and the curve at the bottom end of the diode characteristic. This latter distortion is largely reduced if the AC load is greater than the DC (as in the example worked out), because the effect is equivalent to a reduction in modulation depth, and the point of curvature is avoided by the carrier envelope. Two points must be borne in mind when using this circuit. One is the reduction in stage gain. The amplification is reduced to a value of approximately

$$\frac{R_1 g_m}{1 + R_K . g_m + \frac{R_1 + R_K}{R_a}}$$

in the example given, from a gain of 22.5 times to a gain of 6.3. The other is that the volume control, usually inserted after the diode, must be placed in the anode circuit of the AF stage. This is no disadvantage since the cathode feed-back prevents the stage from overloading on the largest fully modulated carrier likely to be received in practice.

If delayed AVC is required, the circuit should be modified to that in Fig. 6. The diode circuit is returned to a point of positive potential instead of to earth. This positive potential, obtained from any convenient cathode circuit and suitably decoupled, should be in magnitude equal to the delay required. The diode D2 then shunts the condenser C3 and maintains the AVC line at earth potential until the detector DC output exceeds the delay. This circuit causes distortion until the diode D2 becomes non-conducting due to the bias produced on the detector diode.[4] This, however, produces a muting action which in some cases is desirable, and for signals on which the AVC becomes effective the circuit is distortionless.

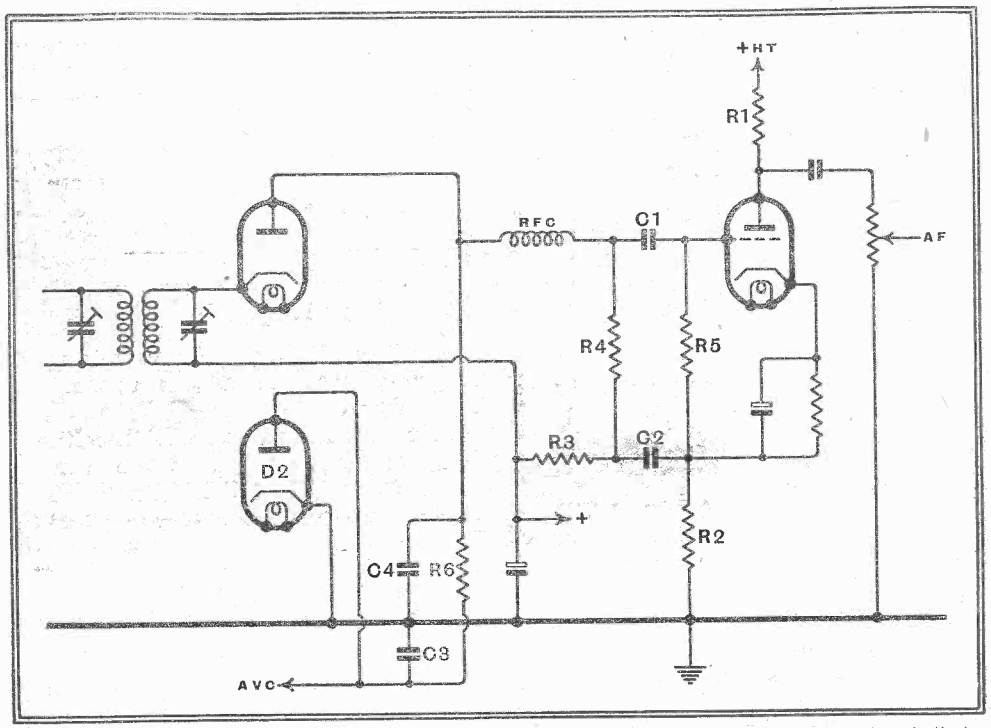


Fig. 6.—This diagram illustrates the method of obtaining delayed AVC. An additional diode D2 is used.

[4] *The Wireless World*, May 13th, 1939.

FIVE-METRE COMPETITION

THIS annual event, organised by the Golders Green and Hendon Radio Scientific Society, will be held on September 17th next, not September 10th, as previously notified.

Eight positions in the country about Watford, Berkhamsted and St. Albans will be selected, and each receiving group visits them in rotation. The transmitter, operating under the call sign G5CDP, will send out eight different code words at suitable times, marks being awarded according to the number of code words correctly received.

The second part of the competition is to locate the transmitter by direction finding.

For particulars of entry a stamped and addressed envelope should be sent to Col. H. Ashley Scarlett, D.S.O., 60, Pattison Road, Hampstead, London, N.W.2.

Henry Farrad's PROBLEM CORNER

No. 31.—Tone Control Causes Distortion

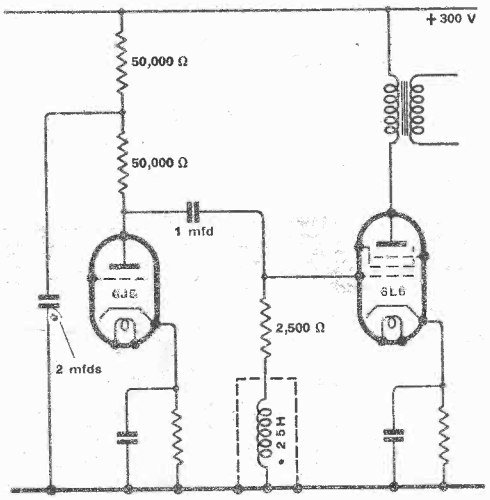
An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction :—

100, Quality Street,
Raisley.

Dear Mr. Farrad,

I have a loud speaker giving very good response up to 8,000 cycles or more ; and to make the most of it I am adopting the principle of tone correction, compensating for the selectvity of the receiver by raising the amplification of the upper frequencies. Fortunately, we are not much troubled by heterodyne whistles here.

The enclosed circuit diagram will show you how I have arranged it. The output valve is of the 6L6 class, which was running quite normally and successfully until tone correction was introduced, which I did by substituting a 0.25-henry coil and 2,500 ohms (including the resistance of the coil) for the grid leak, at the same time increasing the capacity of the coupling condenser. The valve in the tone-control stage is a 6J5. At low frequencies the impedance of the 0.25-henry coil is negligible, so the coupling is practically the resistance only ; but at 8,000 cycles it is about 12,500 ohm., giving approximately a threefold increase in amplification. This seems to be about right to compensate for the loss in the RF tuning circuits, and the balance of tone is quite good ; but the quality is very poor indeed if the volume is turned up.



How Mark Linyer arranged his tone-control circuit.

I have checked the components, connections and the currents and voltages ; and everything seems O.K. Can you help me to trace the cause of the distortion?

Yours sincerely,
Mark Linyer.

Can you? Henry Farrad's solution is on page 104.

Totalitarian Suppression

ANTI-INTERFERENCE METHODS IN GERMANY

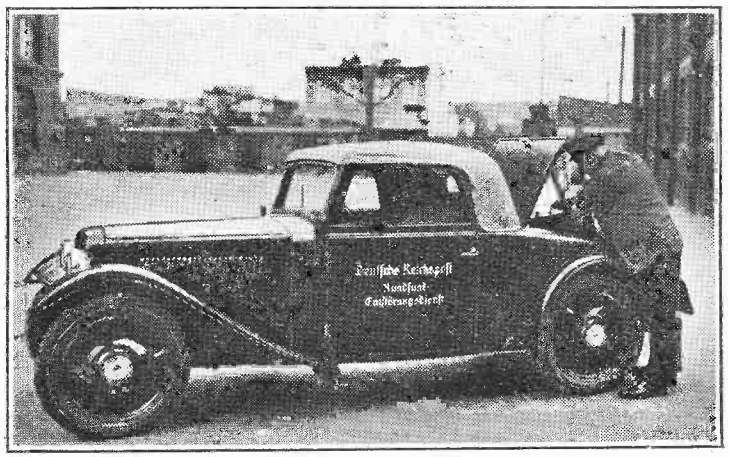
By Our Berlin Correspondent

IN Germany, those who knowingly cause interference with broadcast reception are considered to place themselves "outside the community of the nation." This article describes the working of the anti-interference service conducted by the German Post Office.

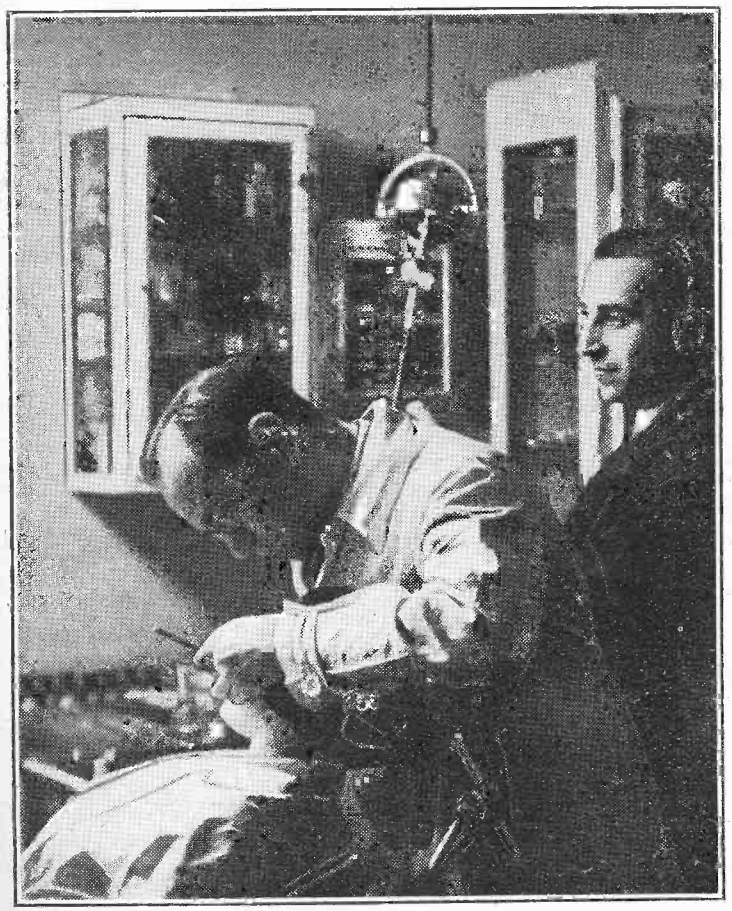
IN spite of the fact that a definite law against man-made interference of radio reception does not, as yet, exist in Germany, there have been few difficulties in dealing with the problem. If a German should interfere with the radio reception of his neighbours by operating apparatus required for his own work or pleasure, and should he refuse to have the interference removed at once and at his own cost, he will be considered as "one who places himself outside the community of the nation," as the saying goes, and will be publicly declared as such.

Broadcasting, of course, occupies a special position in Germany. It is the official mouthpiece of the authorities. A new law comes into force as soon as it has been broadcast. A change of government policy may be announced any moment by a speech in the broadcasting programmes, and will have immediate effect. For that reason the German authorities have decided that every owner of a radio listening licence must have the right of clear reception of his local station. In districts remote from a station he is entitled to the Deutschlandsender programme, and at least one Regional transmission. Apparatus which interferes with this, provided the listener's set is in order and is connected to a reasonably good aerial and earth, must be suppressed.

The process employed is simple. The complaining listener rings up the Post Office and asks for the radio department. He can also write a letter or a postcard. A few days later the Post Office will send a man in uniform to investigate on the spot. This expert first gives the receiver a thorough examination and then investigates the aerial, earth and mains connection. If all seems in order he next enquires about the nature of the interference heard, and then attempts to trace it. He will even come back a second day with special searching apparatus at the reported time of occurrence of the interference which has been observed by the listener. In the event of failure to trace the source of interferences, householders in the vicinity of the complainants' residence are circulated with leaflets explaining the nature of man-made interference. This leaflet also contains a list of possible sources of interference which might be in use in an ordinary household: hair-dryers, thermostatically controlled electric irons, vacuum cleaners, coffee-mills, etc. If one of the neighbouring householders suspects that he may be using interfering apparatus, he can either test it himself or call upon the Post Office service. The Post Office then passes him on to a radio dealer, who does the job of suppressing the appliance.



One of the German Post Office anti-interference cars, of which 250 are at work daily in various parts of the country.



A Post Office engineer investigating the radiation of interference from a Berlin dentist's apparatus.

Electricity supply companies, railways and large factories frequently cause interference with reception in certain districts. Here again the Post Office's anti-interference department is a great help. It energetically organises the immediate suppression of the trouble. Should this prove difficult from a technical point of view, the Post Office Research Institute is called in for consultation. Once the appropriate methods have been decided upon, a specialist firm completes the job. The Post Office consultation service is free of charge.

Growth of the Service

Before this service was taken over by the Post Office the amateur radio clubs and the broadcasting companies used to operate a similar service. But with the growing number of listeners in out-of-the-way places it was found that the investigators spent too much of their time in travelling. The Post Office, on the other hand, already had a complete, nation-wide network covering the whole country, and on October 1st, 1932, it took over the task. In the first five years of operation the total number of complaints received numbered 1,160,000. All of these were dealt with, and 700,000 sources of interference were eliminated.

During the last quarter of 1937 the Post Office investigated 66,170 complaints, and the anti-interference department's records show that these were due to the causes given in the table overleaf.

For purposes of interference suppression Germany is sub-divided into 1,000

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postal districts, each with a central depot fully equipped to deal with even the most difficult cases. A staff of 3,400 specially trained "searchers" is employed, and there is a fleet of cars numbering 250 in daily use.

Hair dryers, widely used in Germany, were responsible for much interference until most of the larger manufacturers began to fit suppressors.

During the past few years it has been possible to reduce the interference by high-frequency medical apparatus quite considerably. In cases where interference elimination would become too costly or would prove to be technically impossible, the doctors and hospitals are asked to work at special times, and especially to refrain from operating at the times of the news broadcasts and of the main evening programme.

Co-operation of the electrical industry has been obtained by the Post Office, and already a number of household apparatus such as have already been mentioned in this article are supplied to the public complete with interference suppressors without extra charge. In other cases an extra charge of 5 per cent. is made for "suppressed" apparatus.

	Per cent.
Faulty receivers	32
Small electric motors for domestic and small-scale industrial purposes	29
Atmospherics and untraced causes	15
Electric supply companies' lines and apparatus	11.5
Electric railways	4
Electrical massage apparatus	3
Improper use of reaction by neighbours	2
Medical apparatus	2
Official institutions	1.5

I have already pointed out that anti-interference is a comparatively easy matter in Germany, due to the official status of broadcasting and the various laws which protect it. Even though no anti-interference law exists, it is already an accepted principle that the owner of the interfering apparatus is liable to pay in full the cost of elimination. At some future time this will, no doubt, become law. The co-operation of the electrical manufacturers is very valuable, and it is hoped that not only the biggest but also the medium and smaller firms will join in the habit of supplying apparatus that does not cause interference with broadcast reception.

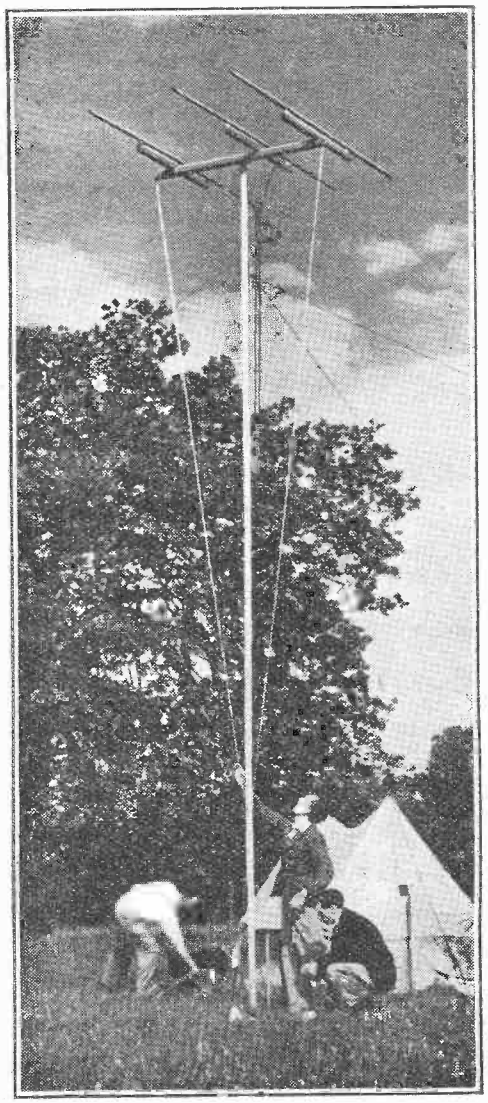
My own practical experience of listening in Germany shows that conditions in Berlin are certainly much better than in London. Of course, London is bigger, but it seems scandalous that its inhabitants cannot all expect to be able to receive the local stations without serious man-made interference.

Five-metre DX

Good Results with Portable Equipment

OWING to a short vacation, the writer has no personal observations to record this week, but several interesting reports are to hand. G6XM, at Farnborough, Hants, submits a list of 41 stations heard and worked on 56 Mc/s from June 14th to July 12th. Included in this list are three Italian stations, I1FA (heard on two occasions), I1SS and I1BE, and one French station, F8AA, in Boulogne. Of the remainder, G2BI, in Colne, Wiltshire, and G6CW, in Nottingham, share honours as DX signals.

G6XM was active during the 56-Mc/s Field Day and made contact with eleven different stations, of which five were portables. An interesting point concerning this report is that all signals were received on a two-valve det.-AF straight set.



Portable station erected by G2QY for the recent 56-Mc/s field day. The aerial is a close-spaced rotary beam with open-wire transmission line to the radiator (centre element).

Using a close-spaced rotary beam consisting of a director, radiator and reflector, G2QY operated a portable station from near Elstree during the 56-Mc/s Field Day, and with 10 watts input contacted G5TX, in the Isle of Wight, at 83 miles. This station was heard also by G6CW, in Nottingham, at 100 miles.

Given a favourable situation it seems that surprisingly good results can be obtained with a low-power transmitter and a well-designed aerial system.

In contrast to this is the unfortunate location of G5MP, in Hythe, Kent, who in a report states that during the early part of June, when the five-metre band was "open" for DX, while harmonics of commercial stations IBE, IRJ and IRX were received at great strength, no amateur stations could be heard on the five-metre band. Despite this, G5MP later received a card from an Italian amateur reporting reception of his signals at strength S9. Two other stations, G6DH and G5MQ, were apparently also heard on this occasion by the same Italian amateur. Apparently hills immediately north of G5MP preclude hearing any five-metre stations but those just along the coast.

Reception from the south is good, as this station reports hearing several Italian amateurs on June 24th and 25th last. These signals were audible only for very short periods and the early afternoon seems to be the best time, for G5MP reports reception at 3 p.m. G.M.T., whilst it will be recalled it was at about the same time that G6YL, in Northumberland, reported reception of Italian stations on June 25th last. Italian signals have, however, been heard and stations contacted at times as late as 8 to 9 p.m. G.M.T.

Incidentally, G6YL is only 38 miles from the Scottish Border and informs us that the distance to I1IRA is about 1,060 miles. Since Italian amateurs are not listed in any call book we could only give the minimum possible distance in these notes in *The Wireless World* of July 20th last.

Another long-distance Continental station heard in this country on five metres recently is CS3VA, in Lisbon, reception being reported via G6YL by both G5AX and G5CM at 1,170 and 980 miles respectively. No time is stated, but the date was July 19th.

CS3VA was again heard on July 24th, calling G6YL, at which station the tone-modulated signals were R5 at 5 p.m. G.M.T. and remained audible until 6 p.m. G6DH reports hearing this station also at exceptional strength.

G2MC.

High-voltage Problems.—I.

By M. G. SCROGGIE, B.Sc., A.M.I.E.E.

Danger—High Voltage!

WHAT LIES BEHIND THIS WARNING

THE exact number of television receivers in use in this country is not known, but 20,000 is perhaps not an excessive estimate. One does not have to be wildly optimistic to foresee 100,000 in the next year or two, and the number may ultimately be much greater still. The voltage required in present-day televisors is 4,000 to 6,000, but already some are being run at 25,000. Although the general public need not know anything about this, those who design and handle television receivers and their components, those who test and service them, and those who make them at home, must sooner or later get used to dealing with voltages at least ten times greater than they have been accustomed to. Then circumstances have caused the authorities to reverse their attitude towards amateur transmitting, and actually encourage people to familiarise themselves with the use of transmitting apparatus, which generally involves fairly high voltages. Even public address gear sometimes comes within this description.

THANKS to increasing interest in television, and, to a lesser extent, in amateur transmission, a greater number of readers than hitherto must sooner or later become acquainted with higher voltages than those existing in normal receiving apparatus. Now high voltage is not merely "the same as before, only more so," and so arrangements have been made to publish a short series of articles dealing with the various phenomena and effects particularly associated with it.

It may be said that this tendency involves only a change in degree, not in kind; just the same thing as before, only more so. But that argument may be difficult to sustain when a person who used to get mere shocks on 500 volts is killed by 5,000. Moreover, there are some effects produced by thousands of volts that are not even slightly present at hundreds—such things as corona, which sets in quite suddenly at a critical voltage. People beginning to deal with high voltages are asking for trouble—apparatus breakdown or personal injury—if they do not allow an ample factor of safety. The death of an American amateur recently was due simply to a failure of the insulation between two windings of a transformer. The question is, what is ample without being extravagant?

Factor of safety, for the information of non-engineering readers, is the number of times the working stress has to be multiplied in order to cause breakdown. For example, it may be found that 10,000 volts is necessary to break down a certain type of condenser. If it is actually used for 10,000 volts, that is to say, with a factor of safety of 1, it is on the very edge of breakdown and is practically certain to fail sooner or later. Bearing in mind that a condenser is liable to deteriorate if worked near the breakdown voltage, that the 10,000 volts may be subject to occasional momentary higher peaks, and that unfavourable climatic conditions may occur, it is prudent to use a condenser requiring two or even three or more times the working voltage to break it down. The factor of safety is then two or three respectively.

It must be remembered that although the voltage applied to a television tube is, say, 5,000, it is not the highest voltage in the receiver. The type of power unit used in most sound receivers is connected as in Fig. 1, and gives an output of 250 volts DC. But 100 volts may be dropped in the smoothing choke (loud speaker field), making 350 across the reservoir condenser, with ripple peak values going up to perhaps 450. This requires 350 volts RMS, and in this full-wave circuit there is a winding each side of the centre tap, making 700 RMS between X and Y, or practically 1,000 volts peak. For cathode-ray tube power this circuit is avoided, and because of the small current to be supplied a simple half-wave circuit with resistance smoothing is adequate (Fig. 2). The voltage across PQ is, say, 6,000 DC, but as the point R is alternating between about +6,000 and −6,000, the voltage between PR alternates between nearly zero and 12,000. To keep such an

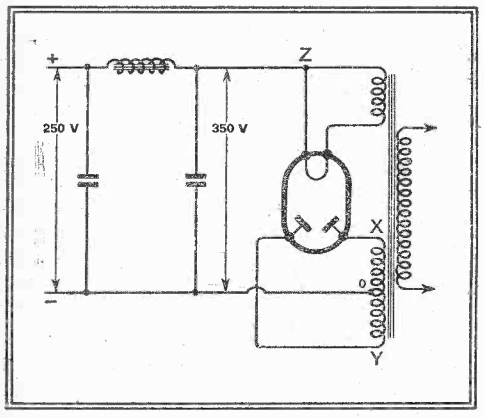


Fig. 1.

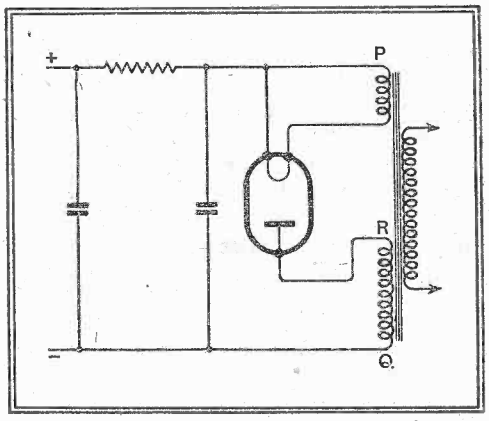


Fig. 2.

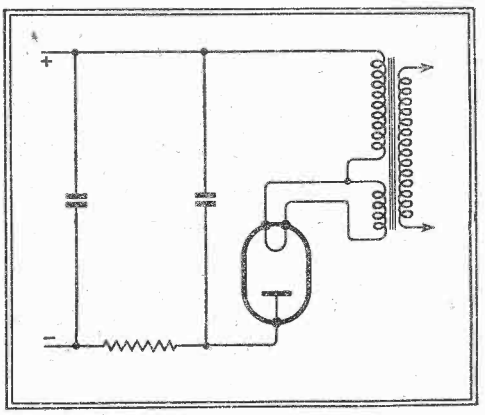


Fig. 3.

The familiar rectifier circuit used for supplying valves involves a peak voltage across the transformer as high as 4 times the DC voltage delivered, so is not favoured for high voltage systems. The half-wave circuit, Fig. 3, is preferable to Fig. 2, which brings the maximum potential inside the transformer. In the voltage doubler circuit, the transformer voltage is still further reduced.

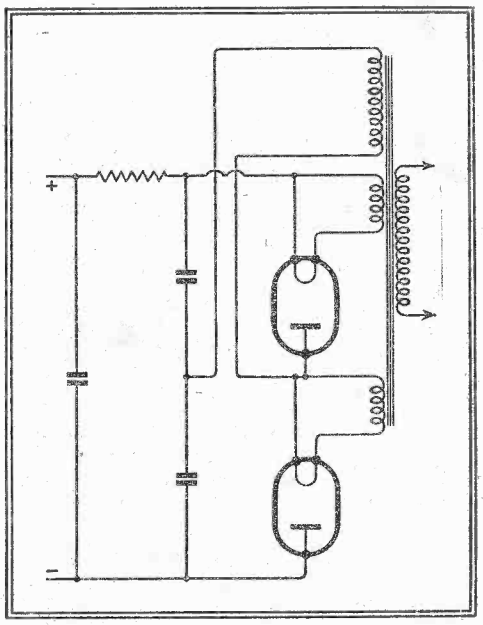


Fig. 4.

Danger—High Voltage!

uncomfortable voltage out of the transformer the rectifier can be reversed (Fig. 3) so that interwinding insulation for 12,000 volts is not needed. Only the rectifier and the leads to it are called upon to stand this tension. The transformer voltage can be almost halved by using a voltage-doubler circuit (Fig. 4); but whatever scheme is used, the peak voltage across the rectifier during the non-conducting half-cycle is approximately double the peak voltage of the transformer winding feeding it, and therefore 2.8 times the RMS voltage of that winding.

Electrical Stresses

What exactly is a breakdown due to voltage? The minute details of what happens in this event still give scientists material for research and discussion; but in general respects the mechanical analogy of applying a stress—tension or compression—to a piece of material till it breaks is quite a fair one. Of course, no engineer loads his structures close to the breaking point. But however small the stress—lb. weight or volts as the case may be—there is a certain amount of strain, which as an engineering term has a different meaning to the common one. It means the resulting sag, bend, stretch, etc. The electrical equivalent is the charge. When a difference of voltage, or potential, is applied between two conducting objects a positive charge is moved on to one and an equal negative charge on the other. The greater the voltage, the greater the charge; and normally these two are proportional to one another, just as is expressed in the mechanical equivalent by Hooke's Law—strain is proportional to stress. But in both cases the law holds good only so far; beyond that there are irregularities which finally lead to breakdown—the point where no stress at all can be maintained. The mechanical piece breaks and lets the weight go; the space between the charged objects breaks down and lets the electricity across the short-circuit between the two.

If you lay a penny on a span of the Forth Bridge, the strain is not noticeable. But if you lay it on a bridge made of a thin steel rule the strain is easily visible. Similarly the charge due to a certain voltage may be too small to be measured in some cases and quite large in others. The amount of charge due to any given voltage is a measure of the *capacity*. Every object—even a speck of dust in space—has some capacity, but the amount is only considerable when the space between it and some other object at a different potential is relatively small, as in a condenser. The capacity of a condenser depends mainly on the dimensions, but also on the nature of the insulating material between the two oppositely charged plates. Just as rubber "gives" more than a piece of steel of the same size and shape, so mica allows a greater electrical displacement than air, other things being equal. The number of times greater is called the dielectric constant.[1] It is interesting to compare electrical and mechanical stress and strain; voltage corresponds to force or weight, which may be steady or vibratory (direct or alternating); charge (measured in coulombs—ampere-seconds) to stretch; current to rate of stretch due to applied load; resistance to friction; capacity to "stretchability."

In diagrams or mental pictures it is helpful to imagine each unit of positive charge to be connected by a "line of force" to its negative partner. The greater the intensity of the electric field, the greater the density of these lines—that is to say, the number of them per square inch or centimetre. If in Fig. 5 (a) we suppose there is a plate 1 sq. cm. in area raised 10 volts, we might agree to represent the resulting electrical strain by 10 lines. Applying only 5 volts to the same plate (b) there are, of course, five lines. If a second similar plate is connected the area is doubled and the total number of lines brought up to 10, but, of course, the number of lines per sq. cm. is as before. Restoring the voltage to 10, and doubling the spacing, the capacity or charge per volt is halved (c). So as the density of the lines is only half what it was in (a), in spite of the voltage being the same, it is clear that what has just been called the "intensity of the electric field" is not just volts. If it is reckoned in volts per cm. spacing, however, it works out all right, because the spacing being doubled one would have to double the volts to keep the density of lines the same as before. This is quite in agreement with our mechanical analogy, because it is not the total load in lb. that must be taken into consideration in deciding what is safe, but the intensity in lb. per sq. in. of the material.

One might jump to the conclusion that the maximum electrical stress can easily be found by dividing the voltage by the closest spacing. Actually that gives the average across the space, which is the same as the maximum only when the field is quite uniform. Theoretically that is only so when the space is between two infinitely large parallel plates. Elsewhere the intensity is not uniform, so the maximum—which is what matters—must be greater than the average. In Fig. 5 we have conveniently ignored "edge effect." Although the spacing between the edges and parts not exactly opposite is greater, so that the intensity is less, it is not zero;

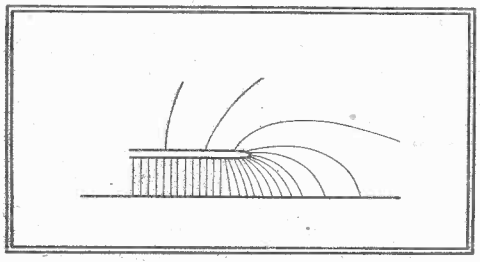


Fig. 7. Owing to the diverging field the electrical stress at sharp angles is much greater than the average.

and, therefore, there are some lines spreading out as in Fig. 6. Even the wiring and the battery itself are not exempt. In fact, if the wire is carelessly allowed to approach closely, the local intensity is very great. At sharp corners or points, as shown enlarged in Fig. 7, the density of lines is enormous actually at the point; so the field strength is very much greater than average here and much less farther along the lines. For instance, 10,000 volts across a gap of 1 cm. is a field of 10,000 V/cm. between infinite parallel plates, but between a point and a plate it may be 100,000 volts per cm., or even more, close to the point.

What may have seemed an irrelevant theoretical discussion is now, literally, coming to the point. Air under normal atmospheric conditions will stand up to about 30,000 volts per cm. If there is a difference of potential of 7,500 volts between two parts in a television receiver, it might be supposed that 0.5 cm. spacing would be allowing a factor of safety of 2, the intensity being only 15,000 volts per cm. But as we have seen, the local intensity might easily be above the breakdown limit.

Why Insulators Fail

We have not yet considered what electrical breakdown actually is. Air is normally a very good insulator, in spite of the fact that largely owing to ultra-violet light and other radiation there is a certain amount of ionisation that causes a slight leakage. As the electrical stress is increased, these ions are attracted or repelled more violently; and at a certain speed they begin to knock electrons out of molecules of the air gases, producing more ions. These in turn are available for producing more, until a strongly ionised—and therefore conducting—path is

Diagrams explaining the meaning of electrical stress or field intensity.

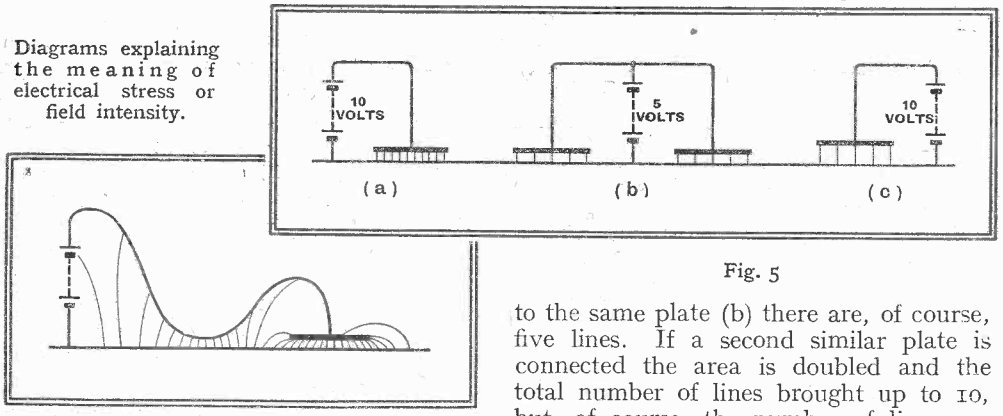


Fig. 5

Fig. 6

[1] More correctly it is with reference to a vacuum: but air is almost the same.

Danger—High Voltage !

forced through the region of greatest stress, narrowing the gap and increasing the stress farther on; until finally a spark jumps across the whole gap, and the heat produced causes the ionisation to be so intense as to constitute a short-circuit. The effects on the other insulating materials will no doubt be discussed in a later article, but the general result is the same, except that it may be permanent instead of self-healing when the stress is removed.

Under some conditions, especially with points or very thin wires, there is an intermediate stage in which the air is not absolutely broken down but there is a considerable discharge, accompanied by a bluish glow, a rustling noise, and a smell of ozone. This is called corona (or brush discharge), and apart from the loss of power is a dangerous condition because it is liable to be the forerunner of a flash-over. The ozone also provokes deterioration of some materials.

Fig. 8, from information given in F. W. Peek's *Dielectric Phenomena in High-Voltage Engineering*, shows the minimum peak voltages that spark across air gaps. It is seen that owing to the more uniform stress a higher voltage is needed to spark across a given gap when small spherical electrodes are used in place of points, and still more for spheres so large as to form almost parallel plates. The graph also shows the experimental fact that very small gaps—1 mm. and less—are abnormally strong in proportion to their length due to the reduced scope for ionisation by collision.

When the pressure of air or other gas is reduced it is electrically weaker; as in neon tubes, where moderately high voltages pass currents through very long spaces.

If the electrodes are wet, or roughened, corona starts at considerably lower voltages. There are other circumstances that tend to increase the risk, so the spacings shown in Fig. 8 should be multiplied several times for safety. Particularly avoid such things as loose strands of flex projecting around terminals.

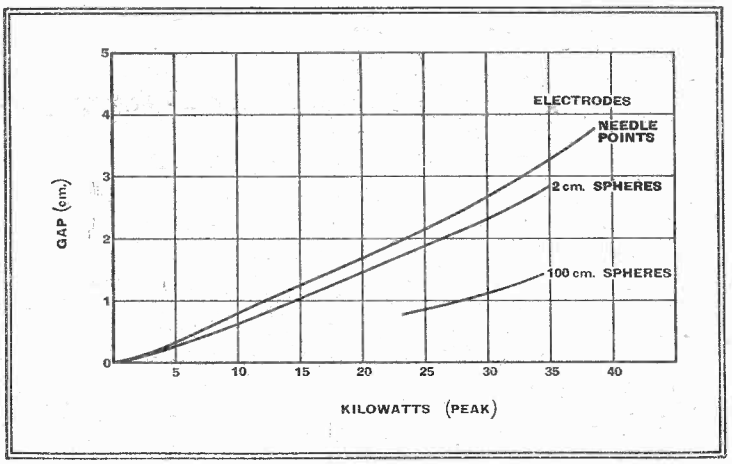


Fig. 8. Maximum sparking distances with different voltages and types of electrode.

Sometimes a space is filled partly with air and partly with some insulating material having a higher dielectric constant. Although this material may itself be stronger electrically than air, the effect of the high dielectric constant is a lower electrical stress across the part of the space occupied by it, throwing the main burden on the air, which may then break down and transfer the entire stress to the solid insulation, breaking it down. Composite insulation is therefore liable to be weak. An exception is the use of high di-electric constant material as the innermost layer round a thin high-voltage cable, to lessen the local electrical intensity. But care should be taken in using condensers in series for high voltages. Suppose a 0.5 mfd. condenser is needed to stand 5,000 volts, and only 2,500-volt condensers are available. It need hardly be said that if two of these are connected in series they must be of equal capacity, 1 mfd. each. Even so, the risk is somewhat greater than with a single 5,000-volt condenser; and, if the circuit permits, it is wise to shunt each condenser by an equal resistance, in order to equalise the stresses imposed.

Cumulative Deterioration

In air, it matters little whether the electrical stress is steady, low frequency, or high frequency, if the peak voltage is the same. The only exception is with momentary surges; if the peak is over within a few microseconds, it is possible for it to rise considerably above the normal breakdown voltage; then if it sparks at all it may do so when the voltage has fallen well below the peak or even below the normal sparking voltage, like a sort of delayed retribution. Solid insulation, as in condensers, is more affected by the time it is subjected to stress. A condenser that stands 5,000 volts for a second or less is liable to be broken down by perhaps 4,000 volts DC continuously, or 2,500 volts peak AC. This is because of cumulative deterioration; and the reason an alternating voltage is so much worse is that the charge continually flowing in and out constitutes an alternating current which tends to heat the condenser, reducing its defensive powers. If the electrodes are not very firmly clamped, they vibrate mechanically due to the alternating electrical attraction; and in time that also tends to cause weakness. The effect of a sudden surge, due perhaps to switching, is then likely to finish it off. An example occurs to mind in which 0.1 mfd. buffer condensers were connected across XZ and YZ in Fig. 1, the transformer voltage being only 250-0-250. Although these condensers all stood "flash" tests at 2,000 volts and therefore appeared to be as safe as could be desired, large numbers broke down in service on this continuously pulsating voltage of about 600 peak, with possibly occasional surges.

Considering personal risks now; one often hears it said that such and such a source is very high voltage "but hasn't much current behind it." This may be rather a puzzling statement in the light of Ohm's Law, according to which the greater the voltage applied to a given resistance the greater the current. Whether everybody who uses the expression has a clear idea of what they mean by it is uncertain, but there are two possible explanations. The voltage produced by a small spark coil may be capable of sparking across half an inch in air so that according to Fig. 8 it is at least 15,000. But it is capable of giving no more than a smart shock if the terminals are touched by the hands, whereas with the same voltage from a television power unit across the first reservoir condenser the odds would be heavily in favour of a fatality. The reason for this is that the internal impedance of the small coil is so large that, when the comparatively low resistance of the human body is connected, the voltage actually across the latter, and hence the current, drops to a harmless level. Similarly one may emerge alive from a shock taken across the cathode-ray tube itself, if there is a high smoothing resistance in series to limit the current.

The explanation that covers other cases depends on the fact that a certain *quantity* of electricity is necessary to inflict death or any other injury. Quantity is current multiplied by time. A current that would infallibly be fatal if prolonged can be tolerated if it is sufficiently brief. It would be safe to discharge through oneself a 0.01 mfd. condenser charged to 20,000 volts, whereas 10 mfds. charged to 10,000 volts certainly would not. As "Free Grid" has complained, the stroking of cats sometimes generates voltages high enough to produce visible sparks without punishing the stroker; the capacity is too small.

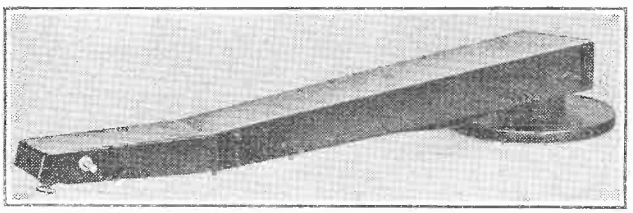
Reservoir condensers charged to several thousands of volts are likely to be dangerous, even long after the power has been switched off; so before working on the apparatus one should discharge them. The method of doing so by short-circuiting the terminals with a stout screwdriver is not the right one, however; because if the voltage is, say, 6,000 and the total resistance less than an ohm, the momentary current is over 6,000 amps, and may be enough to weld the screwdriver to the terminals, and perhaps permanently damage the condenser internally. A resistance of about 10,000 ohms bridging wire prongs held at the end of an insulating rod is a safe method. An interesting comparison is a lightning flash, which can pass such an enormous current as 100,000 amps at many millions of volts, with disastrous effects; yet the same charge could be dissipated with no fuss or noise, at the very non-celestial rate of a few milliamps, if spread over a few minutes.

New Apparatus Reviewed

MILLER TYPE 100-LR PICK-UP

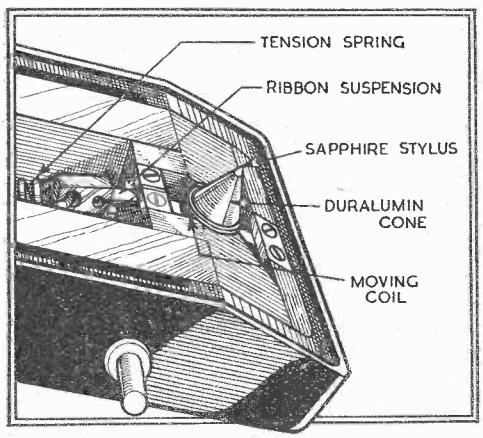
THIS component is a very fine example of the instrument maker's art, and its design and performance are more than equal to the advances of present-day recording technique. It is produced by the Lansing Manufacturing Co., Los Angeles, California, and is obtainable in this country through British Acoustic Films, Ltd., Woodger Road, Shepherd's Bush, London, W.12. The price including royalties is £42.

The principle of operation is similar to that of the d'Arsonval moving coil galvanometer, and since the transverse magnetic field is uniform there is no possibility of amplitude distortion. The sapphire stylus is ground to an angle of 40 degrees, with a radius at the point of 0.002 inch. It is set in the apex of a duralumin conical shell, turned from the solid.



The tone arm of the Miller pick-up is balanced and adjustable for needle pressures between 6 and 30 grams.

The suspension consists of a metal ribbon under a tension of 7 kilograms exerted by a coil spring inside the pick-up head. It is so adjusted that no longitudinal vibration can be excited, and resonances in a lateral direction are quite negligible when the stylus is under the control of the record groove. The needle point impedance is extremely low, and the effective mass at the stylus is only 24 milligrams. The total weight of all the moving parts is 85 milligrams, or about one-quarter the weight of a steel needle.



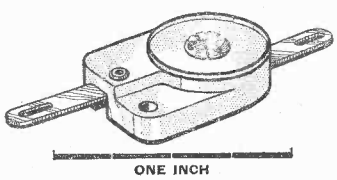
Underside of Miller pick-up head with cover removed.

A very light pressure is required to keep the stylus in contact with the groove wall, and the pick-up is, therefore, well suited for playing back from acetate discs, or even wax masters. The tone arm which is designed for tangential tracking has double pivots, and is fitted with a micrometer weight adjustment with a range of 6 to 30 grams.

The output impedance is 50 ohms, and the EMF developed on an average record is of the order of 0.01 volt RMS. It will be seen from the curve taken in our laboratory, that the frequency response is a close approximation to the characteristic supplied by the makers of the test record. Correction for the drop in amplitude in the bass must be made in the amplifier. This is as it should be, for when compensation is made in the pick-up, harmonic distortion is generally present.

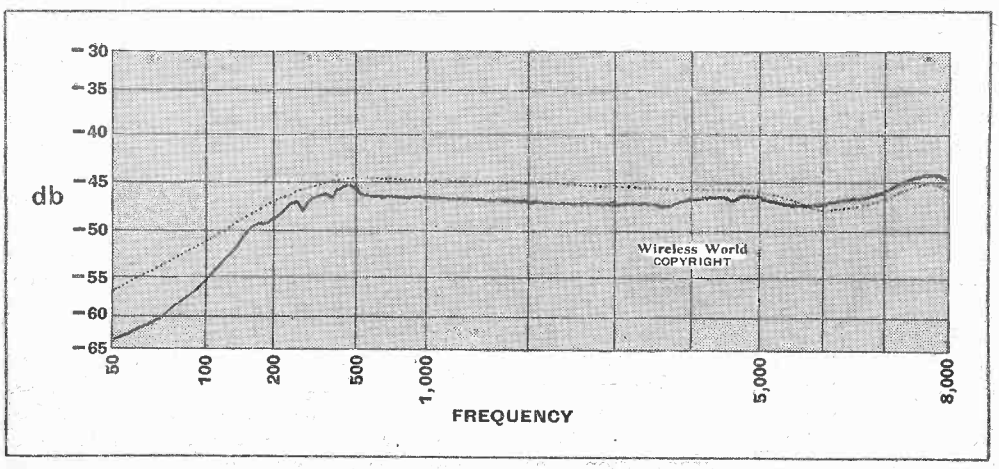
A NEW MIDGET TRIMMER

THE ceramic trimmer condensers made by the United Insulator Co., Ltd., 12-16, Laystall Street, London, E.C.1, are now available in a small size known as the Bijou type. They are of the same design as the standard type and have optically ground stators with a silver electrode fixed directly on the surface. The length of the body is, however, less than ¾in.



United Insulators' Bijou type ceramic trimmer.

The Bijou trimmers are available in single or double types with "Calit" stators and "Tempa S" or "Conda F" rotors. The former are made with capacity ranges of 1.5 to 5.5 and 2.0 to 8.0 micro-mfd., and the latter in three ranges of 3 to 20, 6 to 36 and 15 to 45 micro-mfd.



Output characteristic of the Miller 100-LR pick-up. The dotted curve represents the maker's calibration of the test record. Zero db corresponds to 1 volt R.M.S.

The Wireless Industry

ROTARY converters with AC outputs up to 250 watts are described in a leaflet obtainable from Charles F. Ward, 46, Farringdon Street, London, E.C.4. These machines can be supplied with built-in all-wave filtering and also with an extended shaft for operation as self-excited alternators.

The works of Electrical Sound and Television Patents, Ltd. (Sinclair Speakers), Pulteney Terrace, Copenhagen Street, London, W.1, will be closed for annual holidays from August 5th to 14th. The apparent change of address is the result of an alteration of street name.

The Retail Credit Finance Corporation Ltd. was established in 1929, and not as stated in the advertisement in last week's issue.

Cathode-Ray Tubes, by Manfred von Ardenne. Translated by G. S. McGregor, M.C., and R. C. Walker, B.Sc., A.M.I.E.E., A.M.I.Mech.E. Pp. 530+xiii. Published by Sir Isaac Pitman and Sons, Ltd., London. Price 42s.

THIS book is a translation of the earlier "Die Kathodenstrahlröhre und ihre Anwerdung in der Schwachstromtechnik," by the same author; it is, however, more than a translation, for it has been largely rewritten and much new material has been included. It is virtually a new book, but many of the illustrations are the same.

In spite of its great length, there are only four chapters, headed "The Cathode-ray Tube," "Accessories," "The Cathode-ray Tube and Auxiliary Equipment for Making Measurements," and "The Cathode-ray Tube as an Operating Unit." Each chapter is thus almost a book in itself.

The first chapter deals with the tube itself and is concerned with the production of cathode-rays, focusing, deflection, control, and with tube construction. The second chapter covers associated apparatus such as the voltage-supply equipment, time-bases, amplifiers, and photography.

The remainder of the book is devoted to the use of the tube with the necessary accessories and the applications discussed cover an enormous range from the examination of components to sound-film recording and television. This last section is the least satisfactory, for it is the one part of the book that has not been rewritten "since the author has discussed this subject in considerable detail in the light of present-day experience in his book *Television Reception*, which was published in 1936."

The rest of the book, however, contains an enormous amount of material and there are few problems connected with the CR tube which it will not help to solve. It is well printed and bound and beautifully illustrated. W. T. C.

Five-metre Signals and the Weather

EFFECT OF UPPER AIR TEMPERATURE ON U-H-F PROPAGATION

By D. W. HEIGHTMAN (G6DH)

AFTER discussing the conditions under which long-range transmission may be effected on 5-metre wavelengths, the author traces a direct relationship between these conditions and the temperature of the upper atmosphere relative to that prevailing on the ground.

THOUGH the exact connection was rather obscure, it has been apparent to experimenters on 56 Mc/s that there must be some relation between weather conditions and the propagation of these frequencies, at distances in excess of the optical range. We find that on some days (and nights), even when using transmitting aerials well under 50 feet high, that signals are receivable over distances considerably greater than one hundred miles. The fact that the signals can be received at night, their high frequency, general lack of any pronounced skip and comparative steadiness rules out the possibility of bending in layers ionised by the sun's radiation. We, therefore, conclude that under certain conditions the signals are refracted in the lower atmosphere in a manner similar to light waves.

It should be mentioned that we are not here concerned with the intense E-layer bending, which on some summer days is sufficient to refract signals of over 60 Mc/s at distances betwen 500 and 1,000 miles. Quite probably, however, the lower atmosphere bending here described would contribute to the raising of the apparent E-layer limit by giving the stations an effectively increased height and allowing the signals to just "skim" the ionised layer.

Prior to the following observations it had been noticed that best conditions resulted when there was a sudden drop in

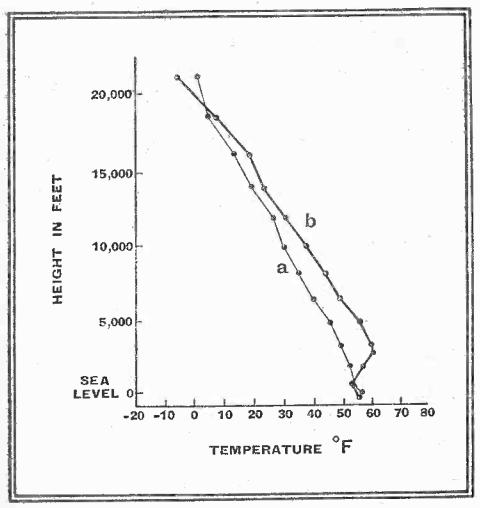


Fig. 1.—General form of upper air temperature curves for normal and "inverted" conditions.

temperature, when the wind was in a northerly to easterly direction and also during foggy weather. Poor conditions prevailed during rain at mid-day, and when the wind was warm from southerly to westerly directions.

The month of June this year provided excellent comparative conditions in weather and 56-Mc/s conditions. For the first ten days there was a wind between east and north, giving warm sunny days and cool to cold evenings. On the 10th to 11th the wind went round to the south-west and rain came. U-H-F conditions were excellent for the first ten days, particularly in the evenings, falling off on the 10th and becoming bad on the 11th. Poor conditions prevailed until the 21st—22nd when the wind again went round to north-north-east. On the 22nd radio conditions were excellent, gradually falling off until the 25th when they became poor again, corresponding with the change of the wind to westerly and southerly directions.

It became obvious to the writer that more detailed information on weather conditions was necessary before any definite conclusions could be drawn. Copies, for the month of June, of the very comprehensive reports issued daily by the Air Ministry were therefore obtained.

From the "Upper Air Section" of these reports, which have charts showing air temperature from ground up to 24,000 feet or so, one thing immediately became apparent, i.e., *that on any day extended ground-wave signals had been observed there was an inverse temperature gradient* somewhere between ground level and 3,000 to 4,000ft. That is to say, whenever the air temperature between 1,000 and 4,000ft. exceeded ground temperature conditions for U-H-F propagation were good. More normally the air temperature drops off at a fairly steady rate with increasing height. Fig. 1 gives the general form of the upper air temperature chart (a) for normal days producing poor conditions and (b) an "inversion" day giving excellent conditions.

From the data on the weather reports and the writer's 56-Mc/s log, Fig. 2 was produced. This shows the *difference* between the upper air temperature (1,000 to 4,000ft.) and ground temperature compared with observed conditions for the whole month. Inspection of this chart leaves little doubt as to the direct relation between air temperature and U-H-F conditions, especially if it is remembered that the weather report figures are for 6 hours GMT, while most of the radio observations were made at around 22 hours the previous night. There is, unfortunately, a lack of consistent activity on the part of 56-Mc/s experimental stations which makes the determining of conditions rather difficult.

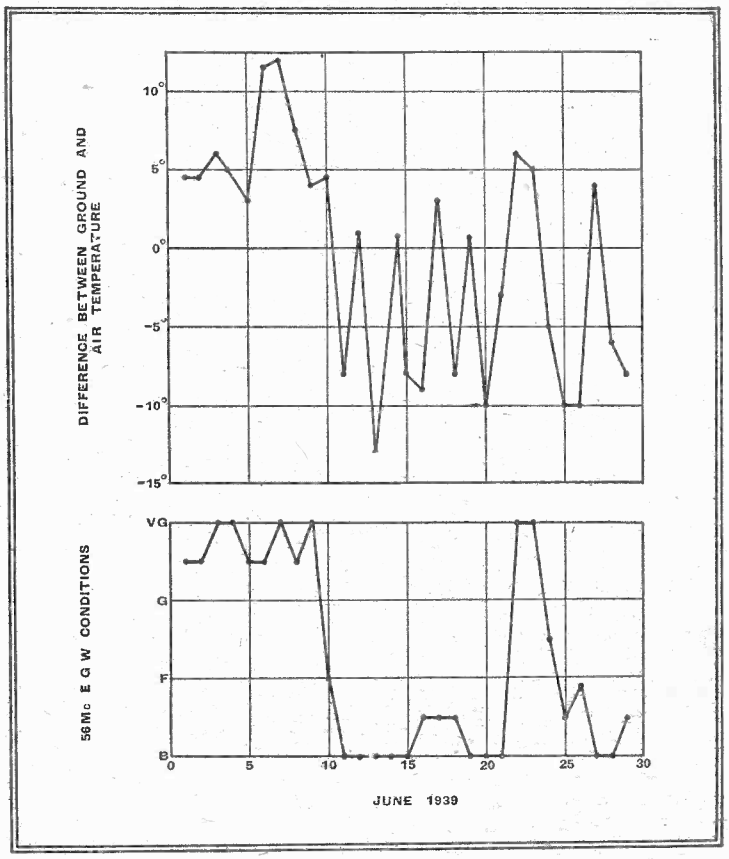


Fig. 2.—The upper curve shows differences above and below ground temperature at heights of 1,000-4,000ft. (Most observations taken at Mildenhall.) Corresponding conditions on the 5-m. band are shown in the lower curve. Abbreviations: VG, very good; G, good: F, fair; B, bad; EGW, extended ground wave.

Unfortunately the writer possesses very little knowledge of meteorology, having been in the past rather inclined to treat it as a subject to be ignored as far as radio conditions were concerned. In view of this fact it is not considered wise to discuss

Five-metre Signals and the Weather—

very fully here the weather conditions required for temperature inversion. During the last few weeks, however, quite a little has been learnt in this respect, and the B.B.C. shipping and general weather reports have taken on a new interest. It is now possible to forecast with reasonable accuracy, by simple weather observations and listening to the radio reports, as to whether or not 56-Mc/s conditions will be good on any particular evening.

Inversion of the temperature gradient, apparently, rarely takes place at mid-day and most frequently occurs in the late evening, during the night (particularly in the summer) and also during early morning. The Air Ministry reports deal with the temperatures at approximately 6 and 12 hours GMT. Taking the first ten days of June, every one of which showed inversion at 6 hours, not one had this effect at mid-day. What takes place is presumably this: During the day the sun's rays heat up the ground and consequently the lower atmosphere, this warm air tending to rise throughout the day. In the evening with a cold north-easterly wind blowing the air at ground level rapidly becomes cool and itself tends to keep low with the warmer air rising upward. This condition persists more or less until the next day when the air at ground level again becomes heated up. Obviously when the warm south-westerly winds blow the cooling effect will not take place and there will be no temperature inversion. It is also understood that during foggy weather (which gives good conditions) a layer of warm air exists over the fog layer.

Morning and Evening Conditions

Most amateur work has been done at night and hence experimental data is lacking for the early morning periods. Some daily tests made by the writer with G2OD, 83 miles distant, at 8 hours have, however, shown that conditions can be quite as good at that time as in the evenings. At the writer's station the television transmissions vary very considerably both from day to day and at different hours during the day, and it is very probable that the weather conditions also affect these signals. Meter tests are at present being made on these transmissions.

In the short time available it has not been possible to go fully into the actual mechanism of the above described propagation, but it is hoped that the matter can be dealt with more fully at a later date. Presumably the signals are refracted in the manner of light, and the condition necessary for downward bending is that they should be propagated from cold to warm air. A query that immediately arises is—what is the effect of this refraction on frequencies lower and higher than the 56 Mc/s amateur band on which observations were chiefly made? If the signals are refracted in the manner of light waves we should expect higher frequency signals to be bent to a greater extent than the 60 Mc/s ones. To obtain more data in this respect it is hoped to make some tests on 112 and 224 Mc/s in the near future. Tests on 28 Mc/s have tended to show that signals of this frequency are not bent to as great a degree as the 56-Mc/s signals, though the tests were not very conclusive.

HENRY FARRAD'S SOLUTION

(See page 96)

THE 6L6 valve, when running normally with 300 volts on the anode, takes a grid bias of −12 volts (as can be ascertained from *The Wireless World* Valve Data Supplement), and it may therefore be assumed that the peak signal voltage for full output is nearly 12. The signal voltage given by the previous stage is equal to the peak current variation multiplied by the coupling resistance. The latter is 2,500 ohms at medium and low frequencies; and, as the resistance between the valve and the 300 volts HT is 100,000 ohms, the former *must* be less than 3 milliamps (0.003 amp.), Irrespective of distortion, the maximum possible voltage available is therefore less than 7.5, and without bottom bend distortion is much less still, and so is quite insufficient for the full volume.

The output can be raised and the distortion reduced by increasing resistance and inductance in equal proportion; but, by the time it is enough, the increase in amplification at high frequencies is not maintained. It is evident that a large amount of amplification is needed between the tone correction and output stages.

Voigt HC Corner Horn

BASS CHAMBER FOR EXTENDING THE LOW-FREQUENCY RESPONSE

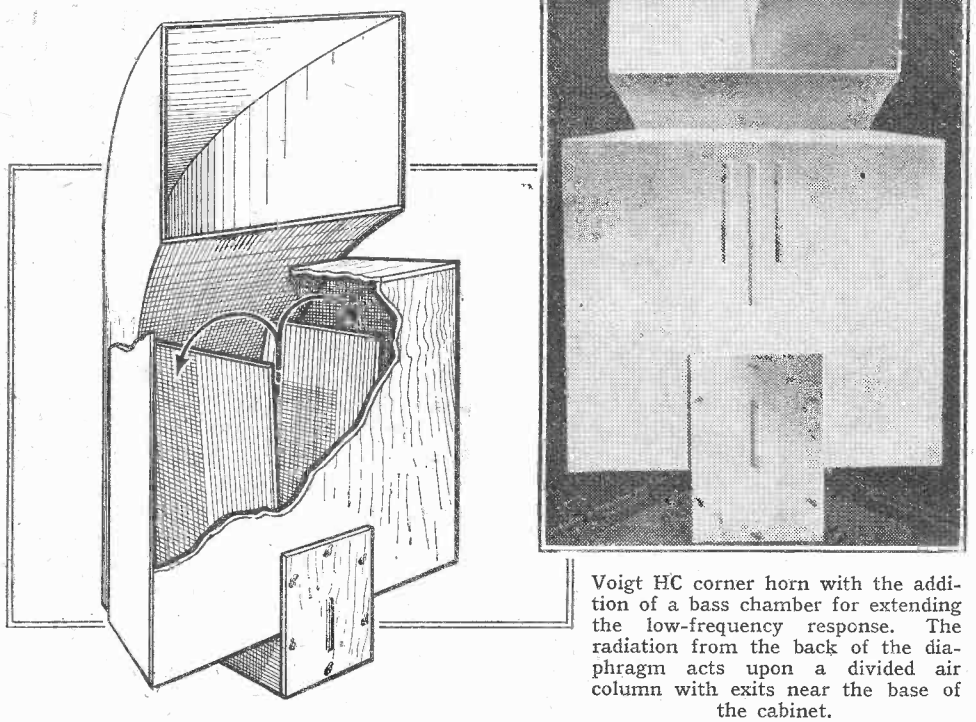
INTRODUCED originally to provide suitable loading for the Voigt loudspeaker unit at a price considerably lower than that of the full-sized corner horn, the HC horn has given excellent results down to 100 c/s, or perhaps a little lower.

To bridge the gap between the performance of these two horns, a bass chamber has now been designed for addition to the HC horn. The principle is similar to that of the big corner horn in that the radiation from the back of the diaphragm is collected and diverted through a branched conduit with outlets near the floor. It is reasonably easy to construct, and blue prints may be obtained, price 7s. 6d., by purchasers of moving coil units.

On test, a very considerable improvement in the bass response was observed, the cut-off having been lowered from 100 to between 45 and 50 cycles. The response in this region is best appreciated on sustained organ pedal notes, though it may be expected to increase also the realism of orchestral performances.

The modified corner horn is supplied complete in birch ply for £7 15s., and the work of adding the bass chamber to existing horns may be carried out at a cost of £5.

The address of the makers is Voigt Patents, Limited, The Courts, Silverdale, London, S.E.26.



Voigt HC corner horn with the addition of a bass chamber for extending the low-frequency response. The radiation from the back of the diaphragm acts upon a divided air column with exits near the base of the cabinet.

Four-Band Transmitter

TUNING ADJUSTMENTS AND OPERATION

(Concluded from page 68 of the July 20th issue).

By S. K. LEWER, B.Sc. (G6LJ)

THE maximum RF power output from a transmitter is only obtained by correct adjustment of all circuits and accurate matching of the final stage to the aerial. These operations are explained in this article.

WHEN making tuning adjustments for the transmitter, it is very helpful to have a lamp-loop (a single loop of stout wire connected across a pocket-lamp bulb) and an absorption-type frequency meter in addition to the milliammeter. The lamp-loop serves as an indicator of RF current in any of the tuning coils when coupled sufficiently closely, and the absorption-type frequency meter is essential when it is desired to determine to which harmonic any particular circuit is tuned. Ordinarily, however, all the tuning adjustments can be made by observing the readings of the milliammeter when it is jacked into each of the circuits in turn.

The selection of the proper coils for operation on the four frequency-bands will be clear from a study of the table showing the circuit frequencies.

The adjustment of the four tuning condensers follows the normal procedure. First, the oscillator is tuned to give steady output as indicated by the fall in the anode current as the tuning control is varied, and by the use of the lamp-loop, and the buffer-doubler stage is tuned to give minimum anode current in the same way. The fall in anode current may not be very great, but it should be remembered that the circuits are already loaded by the capacity coupling, and the current at the tuning "dip" is made higher on account of the power taken out of the circuit in question.

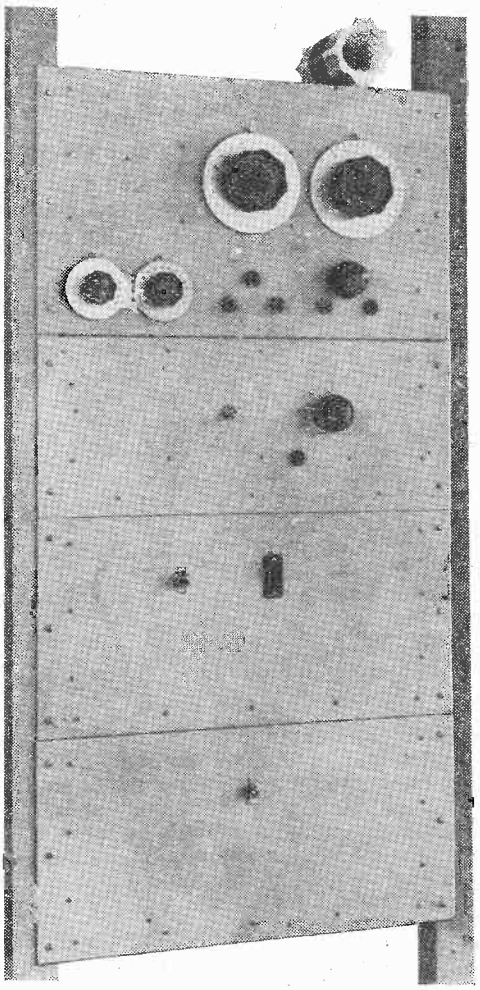
The adjustment for neutralising is not at all critical, and it should be sufficient to vary the neutralising capacity by small successive amounts until no output is obtained from the KT8 stage when the crystal oscillator is detuned so as to cause it to stop oscillating. This test need only be made when 7 Mc/s output is required, since it is only in this case that the second KT66 is working as a straight amplifier. The power should be switched off, of course, each time the neutralising condenser is adjusted, unless a fully insulated type of construction is used.

CIRCUIT FREQUENCIES

Output	Crystal Oscillator		Buffer/ Doubler Anode	P.A. Anode
	Cathode	Anode		
7	—	7	7	7
14	—	7	14	14
28	7	14	28	28
56	7	14	28	56

All frequencies are in Mc/s.

The KT8 anode circuit, when not loaded in any way, will show a very substantial fall in anode current when it is tuned to resonance, and it is important to avoid running the valve more than momentarily in such a manner that the anode current has been depressed to 15 mA or less, since in this condition the screen current is greater than normal and the consequent heating of the screen will give rise to screen emission. As soon as a load is put on the anode circuit, the anode current rises, and the dangerous condition no longer exists.



Complete assembly of transmitter showing RF chassis at the top, followed by the modulator, power supply for RF chassis and power supply for modulator.

The adjustment of the aerial coupler will provide the current load in the ordinary way, although, of course, all preliminary tests should be carried out with an artificial aerial. In this connection, the reader is referred to an article on aerial coupling systems which appeared in *The Wireless World* of March 9th, 1939.

The screen potentiometer R10 for the buffer-doubler will be found to afford sufficient control of the amount of power in its anode circuit, and care should be taken to avoid overdriving the KT8, particularly on the two lower frequency-bands. Overdriving is indicated by a fall in output when the amount of drive is increased.

It is important to keep a watch on the RF current passing through the crystal while adjustments are being made. The small lamp in series with the crystal, which should be of low current rating, such as 60 mA, will serve as an indicator of RF current through the crystal, but it must not be regarded as a fuse. Particularly when adjusting the tritet circuit, care should be taken to tune the oscillator cathode and anode circuits so that the lamp does not glow, or at least does not glow brightly. Heavy crystal current results in serious frequency drift due to the temperature rise, and there is also a danger of cracking the crystal.

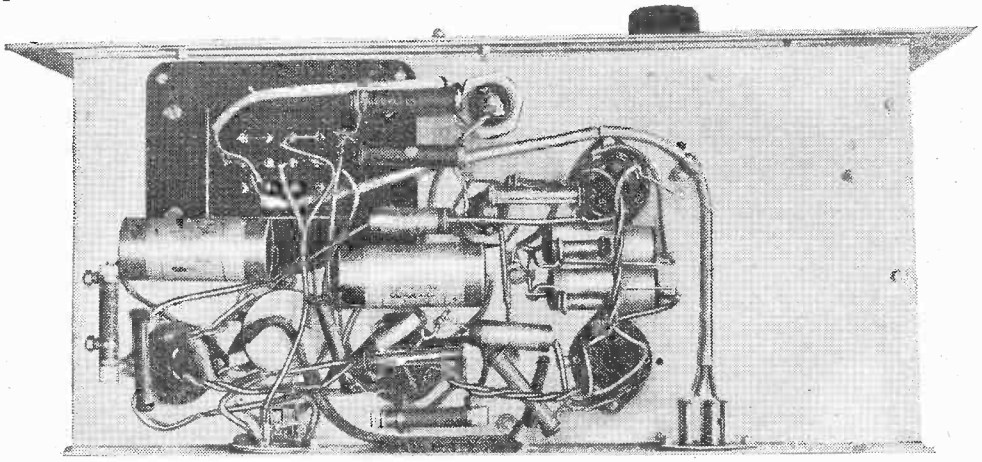
Frequency Restrictions

The choice of crystal frequency is restricted in the case of a one-crystal four-band transmitter to a comparatively narrow part of the bands permitted by the P.M.G., since the harmonics of the 7 Mc/s crystal must lie within the limits of the three higher frequency-bands. Permits which have been granted recently are restricted to frequency limits such that there is no frequency in the 7 Mc/s band which has harmonics in the three higher ones, and in these circumstances two 7 Mc/s crystals are necessary for four-band operation, but those amateurs whose licences are of earlier date and who are permitted to operate within wider frequency limits, will find that one crystal frequency can be selected so as to meet the requirements for the four bands.

For telegraphy operation, the modulator power supply should be switched off and the secondary of the modulation transformer should be short-circuited by means of the switch S1. The keying should give clear cut operation, free from chirp, but if a chirp is found to be present, slight detuning of the buffer-doubler anode circuit to one side of the resonance or the other should overcome the trouble without appreciably reducing the output.

Four-Band Transmitter—

The keying circuit used here actually keys the oscillator besides the buffer and output stages. The transmitter is, therefor, quite silent while the key is up, and no change-over switch is required. The advantage which this affords by permitting "break-in" operation is very great, particularly in these days of severe congestion in the amateur bands, and the writer recommends that every opportunity should be taken to use this feature to the fullest extent.



Under-chassis view of the modulator unit. The socket seen at the right carries the two-wire connection from the modulation transformer to the RF chassis. Ample space is available for fitting a further stage of amplification if it should be required.

For telephony operation, the key should be short-circuited by a switch suitably placed on the operating table, or the key plug may be withdrawn from the jack. The switch S3 on the RF power supply should be opened for telephony working in order to reduce the voltage to a safe value, as previously explained. The modulation transformer secondary switch S1 must be opened, and the gain control adjusted to give the desired depth of modulation.

The adjustment of the potentiometer R24 for giving equal drive to the two KT66 modulator valves can be found with sufficient accuracy by removing each one of the KT66s from its socket in turn and adjusting the potentiometer until the same increment of RF output current in the aerial circuit occurs with either valve working singly. The increment of RF output is best measured by means of a hot-wire ammeter (or one of the thermo-junction type), or more crudely by estimating the increase in brilliancy of a lamp coupled to the output circuit when full modulation is applied. Of course, the gain control R16 must not be altered while this comparison is being made.

Full modulation is obtained when the aerial current increases by about 20 per cent. while a pure tone of sinusoidal waveform is directed into the microphone. For average speech, the increment of aerial current is much smaller than 20 per cent., and care must be taken to avoid over-modulating at the momentary peaks which normally occur in speech, for such incorrect adjustment causes very serious interference with adjacent frequency channels.

Although the transmitter has not been used over a long period of time, the results obtained have been completely satisfactory and the flexibility of the four-band operation has proved to be a very useful feature. The success achieved by any transmitter is, of course, dependent on the aerial systems in use, and proper attention must be given to their design, but these matters are outside the scope of this article. The transmitter described here, used in conjunction with suitable radiating systems for the four frequency-bands, will be found to meet most amateur requirements in this country and may be relied upon to give a lasting and satisfactory performance.

Principles and Practice of Radio Servicing, by H. J. Hicks. Pp. 305+x. Published by McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price 18s.

ALTHOUGH this book deals primarily with wireless servicing, quite a large part of it is devoted to circuit theory. It opens with chapters on the "Fundamentals of Magnetism and Electricity" and "Fundamentals of Radio." Save that the material is not arranged alphabetically, the treatment here is on the lines of an encyclopedia, many paragraphs consisting of definitions. These are followed by a chapter on valves.

The question of test apparatus is then tackled and is much better done, although the treatment of set-analysers is rather sketchy. Multi-range voltmeters and milliammeters are well described, however, as is also the calibration of an RF oscillator.

Chapters on the theory of RF and AF amplification follow, and it is unfortunate that several errors occur here. It is, for instance, stated that chokes are better than resistances for AF decoupling, whereas both theory and practice show that resistances are much better on account of the very low frequencies involved. The author also suggests as a cure for motor-boating the improvement of the regulation of the power supply by the use of a larger mains transformer, a mercury-rectifier, lower resistance smoothing chokes, and a choke input filter. Cases in which these expensive remedies will effect any substantial improvement are rare, however, for the important factor is the output impedance at very low frequencies, but not at zero frequency. This is governed chiefly by the chokes and condensers. In practice, the usual resistance-capacity decoupling circuits are much cheaper and much more effective.

The chapter on power supplies contains over five pages on three-phase supplies, which the average service man encounters quite rarely. The rest of the book is much more satisfactory and consists to a large extent of a description of portions of receiver circuits with a description of the symptoms of likely faults. All the ordinary problems are dealt with and there is a long chapter on Public Address Systems. The book concludes with a useful Appendix, in which are included tables of wire and drill sizes, valve characteristics, and underwriters' regulations. This data is, of course, all referring to American practice. W. T. C.

Television Programmes

Sound 41.5 Mc/s Vision 45 Mc/s

An hour's special film transmission intended for demonstration purposes will be given from 11 a.m. to 12 noon each weekday. The National or Regional programme will be relayed on 41.5 Mc/s from approximately 7.45 to 9 p.m. daily.

THURSDAY, AUGUST 3rd.

3, "Here's Looking at Them," a revue. **3.30,** Gaumont-British News. **3.40,** "The Open Door," a duologue.

9, "Order to View," No. 4—a revue. **9.40,** British Movietonews. **9.50,** Blood Donors, a demonstration of the simple tests and minor operation to which volunteers are subjected. **10.5,** Cartoon Film. **10.10,** Film. **10.20,** Music Makers: Catherine Clark, pianoforte.

FRIDAY, AUGUST 4th.

3-4.15, "The Day is Gone," an eerie play by W. Chetham-Strode.

9-10.30, Film, "Le Patriote."

SATURDAY, AUGUST 5th.

3, Nancy's Puppets. **3.10,** Cartoon Film. **3.15,** Model Trains. **3.25,** British Movietonews. **3.35,** Charles Heslop in "Percy Ponsonby Packs for Bank Holiday." **3.45,** Film.

9, Beatrice Lillie. **9.15,** Cartoon Film. **9.20,** Bee-Keeping. **9.35,** Albert Sammons playing Mozart's violin concerto in G. **10,** "The Tram Conductor," a monologue. **10.10,** British Movietonews. **10.20-10.30,** Cartoons by Oscar Berger.

SUNDAY, AUGUST 6th.

9.5, "Mr Jones Dines Out," one-act comedy by Stuart Ready. **9.35,** Film, "Zoo Babies." **9.45-10.20,** Symposium on Swans.

MONDAY, AUGUST 7th.

3-4, O.B. from the White City of the International Sports Meeting.

9, A Gershwin programme by Eric Wild and his Band. **9.30-10.30,** Western Film, "Galloping Dynamite."

TUESDAY, AUGUST 8th.

3-4.25, Nova Pilbeam in "Prison Without Bars," a tragi-comedy of youth by Peggy Barwell.

9, The Season's New Ballroom Steps. **9.20,** Gaumont-British News. **9.30,** Artificial Eyes—demonstration of the construction of a glass eye. **9.45,** Film. **10,** Cartoon Nonsense by "Nel." **10.15,** Cartoon Film. **10.25-10.35,** Mark and Michal Hambourg.

WEDNESDAY, AUGUST 9th.

3, Cartoon Film. **3.5,** Renée Houston and Donald Stewart in Cabaret. **3.35,** British Movietonews. **3.45,** Pam Norris plays some children's tunes. **3.50-4.10,** Film on Bermuda.

9, "Rule Britannia"—Ballads of Britain and of the Seven Seas. **9.45,** British Movietonews. **9.55-10.25,** A. P. Herbert's play, "Plain Jane."

NEWS OF THE WEEK

PAYING FOR TELEVISION

Sponsored Programmes?

THE possibility of introducing sponsored programmes into the B.B.C. television service has not been widely canvassed, probably because most of the "prophets" have overlooked the fact that such a course was considered permissible by the Television Committee in its report to the Postmaster-General in 1935.

"We see no reason," ran paragraph 65 of the Report, "why the provision concerning sponsored programmes in the existing Licence should not be applied also to the television service, and we think it would be legitimate, especially during the experimental period of the service, were the Corporation to take advantage of the permission to accept such programmes."

It is not unlikely that the Television Advisory Committee has borne this clause in mind in its recent report to the Postmaster-General and that the B.B.C. might, in certain circumstances, be prepared to act upon it.

Direct advertisement would be avoided, but the Corporation might be prepared to admit programmes containing a brief acknowledgment of a sponsor. Whilst the B.B.C., by the terms of its Charter, would not be permitted to accept payment for the inclusion of such programmes, the service would benefit in that the sponsors would presumably pay the artistes.

THE WORLD'S LISTENERS

Denmark Leads Europe

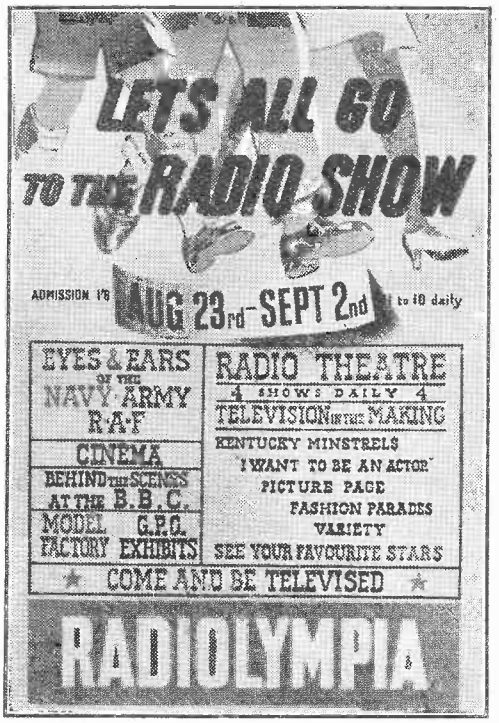
THE annual figures issued by the Union Internationale de Radiodiffusion giving the increase in the number of listeners in the world during the preceding year shows that nearly half the world's receivers are in use in Europe. The approximate figures are: Europe 38,600,000, the rest of the world 39,400,000.

As there is no licensing system in the U.S.A., exact figures for that country are not obtainable. The figures, however, supplied by the Federal Communications Commission, place in U.S.A. as the most radio-minded country in the world with a total of 28,000,000 receivers. This figure gives a proportion of just over 215 sets per thousand inhabitants.

Denmark retains the second place with nearly 206 receivers per thousand. Great Britain has been relegated from the third to the fifth position with nearly 193 per thousand. The third and fourth places being taken by New Zealand and Sweden respectively. Germany is tenth on the list with 133 per thousand.

The approximate total of listeners in the world is given as 312,000,000. In arriving at this total, estimated figures for Russia, Brazil and China have had to be taken into account as no returns have been made by these countries.

CATERING FOR ALL TASTES. This year's Radiolympia poster, which is here reproduced in miniature, shows, in a way which previous posters have failed to do, the diversity of the Exhibition's appeal. This poster is but one way the R.M.A. is endeavouring to make people Radiolympia-conscious.



AMATEURS IN WAR TIME

Government Statement

AS was expected, the Postmaster-General, in reply to a question in the House of Commons, announced that it had been decided, after consultation with the Government Departments concerned, that it would be essential in time of war to close down the wireless transmitting sets used by experimenters. He added that he understood steps had been taken by the Admiralty and the Air Ministry to enrol a number of suitable wireless experimenters in special wireless units in time of emergency. These, of course, are the Royal Naval Wireless Auxiliary Reserve and the Royal Air Force Civilian Wireless Reserve.

During the Great War receivers as well as transmitters had to be surrendered. This procedure would not, of course, be adopted in the event of war now, for broadcasting is counted as a national service, and would most certainly be invaluable to the Government for disseminating news and instructions.

WORLD MORSE CHAMPIONSHIP

75 w.p.m.!

IT is reported from the U.S.A. that, by "taking perfect copy for a period of 15 minutes at 75 words per minute," Mr. T. R. McElroy has retained his world championship for high-speed morse, and also set up a new record. The contest was conducted under the auspices of the Federal radio authorities.

Mr. McElroy acts as resident American buyer in Boston for the British firm of Webb's Radio.

COLOUR TELEVISION

Mr. Baird's Latest Experiment

AS long ago as 1928, Mr. J. L. Baird demonstrated small flickering television pictures in colour at the British Association meeting at Glasgow and again in February last year, he demonstrated a mechanical-scanning system of coloured television to an audience at the Dominion Theatre, London.

Last week, at his laboratories in Sydenham, he used his latest apparatus which utilises a cathode-ray tube with a mechanical scanner to project pictures on to a screen three feet square.

Between the cathode-ray tube and the lens in the receiver a scanning disc with blue-green and orange-red filters revolves so that tinted pictures are thrown in sequence and combine on the screen to form the coloured picture.

The scanner in the transmitter, which was at the Crystal Palace, consists of a mirror-drum with thirty-four facets and a colour disc similar to that used in the receiver.

A complete picture of 102 lines is produced by triple interlacing with a frame frequency of $16\frac{2}{3}$ c/s.

THE LISTENER AND HIS SET

WHILST it is hardly likely that readers of *The Wireless World* need demonstrations to show them whether or not they are getting the best from their receivers, they will doubtless be interested in a forthcoming broadcast entitled "The Ordinary Listener and his Set" to be given by Mr. R. A. Watson Watt.

During this talk, which will be broadcast Nationally on August 17th, recordings will be used to illustrate the effect of the maladjustment of a receiver on its performance. Recordings will also be employed to demonstrate the different methods of overcoming electrical interference.

THE "A" CODE

R.S.G.B. and A.R.R.L. Decision

THE Radio Society of Great Britain has now concluded a very thorough examination of the "A" Code, with a view to ascertaining whether this proposed new signal-code (which was described in *The Wireless World* for May 11th) could be brought into world-wide use to meet the needs of amateur transmitters.

After fully considering the draft code in all its aspects, and having had consultations with the American Radio Relay League on the subject, the R.S.G.B. Council has come to the conclusion that it cannot see its way clear to putting forward the "A" Code for international adoption. Both the R.S.G.B. and the A.R.R.L. incline to the view that new signal abbreviations for amateur use should take the form of additions to or modifications of the existing "Q" Code.

AIR RADIO SERVICE

BY means of a reciprocal arrangement with foreign air lines and ground stations, Imperial Airways has for some years offered facilities to passengers on the Empire routes for the receipt and despatch of radio telegrams in the air. This service was extended from Tuesday, August 1st, to 'planes on the Continental routes, with the

News of the Week—

exception that telegrams cannot be sent from ground stations in the U.K., Ireland and France. The arrangement will, of course, be subject to the exigencies of the radio service in regard to navigation.

RATIONALISING THE GERMAN INDUSTRY

Limiting Receiver Types : Interference Legislation

FULL details of the orders regulating the rationalisation of the German broadcast industry were officially published on July 29th. These regulations, issued by General Fellgiebel, who was recently put in charge of the entire German electrical communications industry, become law under the Four Year's Plan for economic independence.

The radio industry has been organised into twelve groups of manufacturers, the members of which will jointly manufacture receivers which must be for AC or AC/DC operation.

Apart from the People's Receivers, only the following sets may be manufactured by the groups: a high efficiency receiver (probably a small superhet) at a medium price; a large superhet; a car radio receiver and a high-quality set for the reception of the local station and the wired wireless service.

Portables and special purpose receivers may only be manufactured if there is a demand for them in Germany or, alternatively, if they are required for export. Public address amplifiers have been standardised at 20, 120 and 500 watts output.

Components must be chosen from those types which are also suitable for use in apparatus for National defence. Individual or hand-made construction must give place to mass production throughout the industry.

To prevent the selling of last season's sets at reduced prices, the industry has been ordered to continue the production of the new types for a longer period than hitherto.

The number of types of valves has already been reduced from sixty-six to twenty-three and instead of 100 different loud speakers, there are now fourteen.

The number of types of resistances has been drastically reduced; from 1,000 to 17!

The immediate suppression of all sources of man-made interference is to be enforced which, with the introduction of television means that all motor cars must immediately be fitted with anti-interference suppressors.

Commenting on these developments, which seem to put an end to yearly progress, the official German Party newspaper states that a wireless set has now become a common instrument of daily use and therefore it was time to rationalise and standardise production to ensure quality with cheapness. The comment closes with the words, "we will thus have technically the best set in the world, and this set will be purchasable by the widest circle of people."

AFRICANS AND BROADCASTING

A SCHEME for establishing a broadcasting service in Uganda is envisaged in a recent report on the reactions of Africans to broadcasts through public-address equipment. The scheme is essentially educational, for it is pointed out that broadcasting is the only means of reaching the masses.

It is proposed to inaugurate the service either with a 20-kW medium-wave station or a 10-kW short-wave station and a 2-kW medium-wave transmitter. The provision of 300 communal receivers is also proposed.

VILLAGE RECEIVERS

SO far the most formidable obstacle in the path of popularising wireless in India has been the lack of an entirely satisfactory village receiver. Two models now being tested by the Research Department of All-India Radio are based on data gleaned from the use of seven experimental models installed in villages around Delhi by A.I.R. during the past three years.

Both the receivers cover the short and medium wavebands, thereby ensuring good reception throughout the year. The problem of village receivers is essentially that of economically maintaining and running battery-operated sets, for few villages have an electric supply.

AN INTERNATIONAL MEETING

MANY well-known names appear in the list of lecturers at the International Meeting on Physics, which is to be held in Zurich during the Swiss National Exhibition from September 4th to 17th. The second International Television Meeting will be held during this period and the following will be among the speakers: Mr. Blumlein (E.M.I.), Dr. von Okolicsanyi (Scophony), Dr. Strutt (Philips), Dr. Zworykin (R.C.A.), Dr. Lubszynski (E.M.I.) and Dr. D. M. Robinson (Scophony).

During the meeting devoted to high-frequency, Mr. T. L. Eckersley, of Marconi's, and Mr. W. T. Gibson, of Standard Telephones and Cables, will be among the speakers.

FROM ALL QUARTERS

Expedition's Transmissions

THE eighth annual expedition of the Public Schools Exploring Society will be to Newfoundland. The party of forty-six boys under the leadership of Surg. Commander G. Murray Levick, R.N., left for Newfoundland on August 1st. During the period of the exploration, which will be from August 9th to September 6th, the transmitter at the base camp will be transmitting daily between 9 and 11 p.m. G.M.T. on 7.104 and 2.552 Mc/s under the call signs G8XY and G8XZ.

Wireless Beacon at Longstone Lighthouse

AUTOMATIC marine wireless beacons are to be installed at Longstone Lighthouse in the Farne Islands and on the Outer Gabbard Light Vessel, by the Marconi Company. The initials of Grace Darling, who lived in the Longstone Lighthouse, preceded by the distinctive letter M allotted to the beacons around the British Isles, have been used for the beacon's call sign, MGD.

Meteorological Stations

IT has been decided to establish wireless stations on the Islands of Minicoy and Ameni, off the south-west coast of India, which are entirely cut off from the mainland during the south-west monsoon. The islands' transmitters will send meteorological information to the mainland stations at Calicut and Malappuram.

American Enterprise

AN American broadcasting organisation is reported to have approached the Finnish Government with a view to purchasing or hiring a Finnish short-wave station or, alternatively, to constructing its own transmission line from Helsinki to Stockholm in order to meet American requirements for broadcasts from the 1940 Olympic Games. Since the suggestions involve a violation of the Finnish Communications Act, they have been turned down.

Programme Director Retires

WITH the retirement of M. Emile Brémond, Director of Programmes, the French State Broadcasting Service has suffered a big loss, for he has been responsible for the correlation of the programmes. He leaves the broadcasting service to undertake the direction of the French daily newspaper, *Le Progres de Lyon*.

Sponsored Programmes

DURING a recent discussion in the Norwegian Parliament on the State broadcasting organisation's budget for 1939-40, the question of sponsored programmes was raised. It was moved that the Norsk Rikskringkasting be notified that the majority of listeners and members of Parliament would appreciate the abolition of the present daily quarter-of-an-hour transmission of sponsored items. The Parliamentary debate has evoked strong protests from commercial organisations.

Greek Radio Tax

OWNERS of receivers in Greece must comply with a decree which demands that all receivers must be registered for taxation within a month. The tax so far as private houses are concerned, varies from 3s. 9d. to 11s. 3d., according to the value of the receiver; schools will have to pay 7s. 6d. Receivers in cafés, hotels and cars will be taxed at £1 2s. 6d., whilst owners of sets in yachts, trains and aeroplanes will have to pay £1 17s. 6d. per annum.

French Licence Fee

ACCORDING to statements which have appeared in various Parisian daily newspapers, the licence fee in France is likely to be increased from 50 to 70 francs next year.

Italo-German Television

THE German Post Office Television Company, which was formed some months ago, has taken over the complete technical operation of the studio equipment of the Italian television service, which opened on July 22nd, using a frequency of 44 Mc/s for vision and 40.5 Mc/s for sound.

The Berlin Radio Show

IT has been definitely stated that this year's Berlin Radio Exhibition, which opened last Friday, will be the last of the series which have been held annually for the past sixteen years. Next year there will only be a radio section at the International Transport Exhibition in Cologne.

Northants Television Development

LEADING radio dealers in Northants have formed the Northampton and District Television Development Association with a view to impressing upon the Government the necessity of television becoming an immediate national proposition.

Italian "Youth" Set

AT the Rome Fair, a new "popular set" for youth has been introduced to take the place of the former model. It is called Radio-Roma and will be available to the public by September 15th.

Danish Radio Benevolence

To mark the tenth anniversary of the Danish radio benevolence fund (Dansk Radio Hjaelpefond) 500 free receivers are scheduled for distribution in the autumn. By that time the institution will have presented more than 3,200 sets to citizens who would not otherwise have had access to broadcast programmes. Incidentally, about 61,600 registered listeners (8½ per cent. of the total), are for social reasons exempt from payment of the annual licence fee. In this respect Denmark is believed to hold a world record.

Miscellaneous Advertisements

As announced last week, slight alterations in our printing arrangements are necessary with the approach of August Bank Holiday. Miscellaneous advertisements, therefore, intended for the issue of August 10th must be received not later than first post tomorrow, Friday, August 4th.

Mastering Morse

SELF-INSTRUCTION BY AN UNUSUAL METHOD

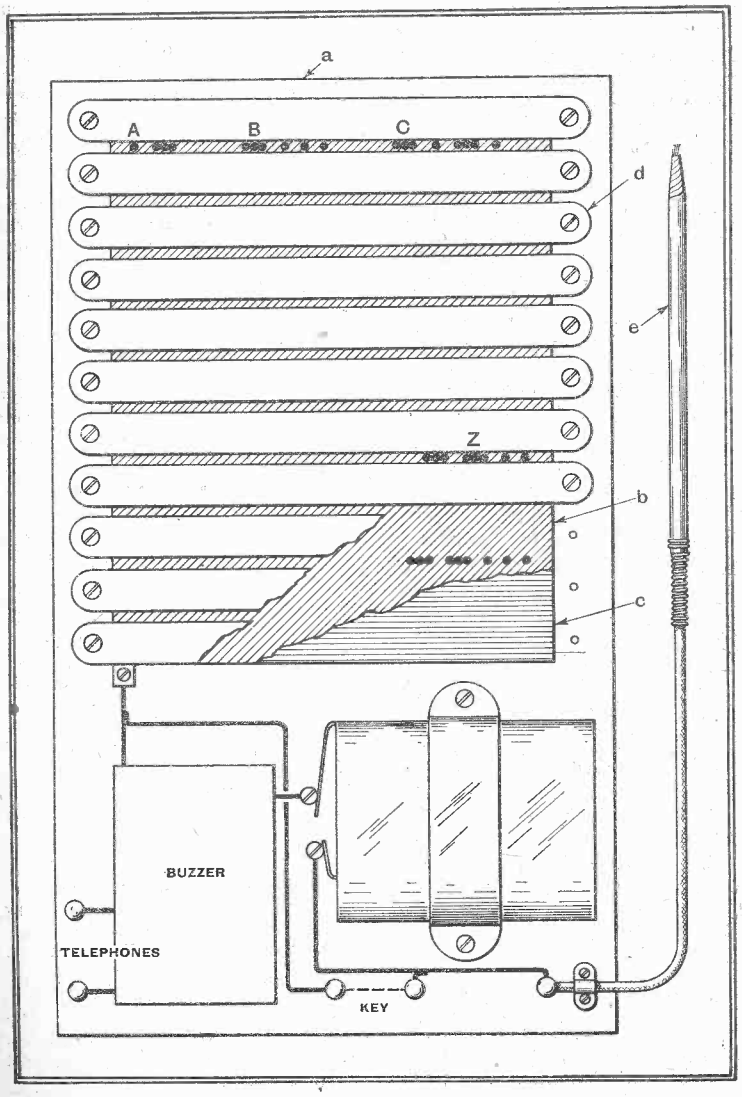
By A. R. KNIPE

THE greatest handicap to the learning of Morse is undoubtedly the lack of a skilled operator to work the key so that proper receiving practice may be obtained. In this article an unusual and easily constructed device is described whereby this disadvantage is, to a certain extent, overcome.

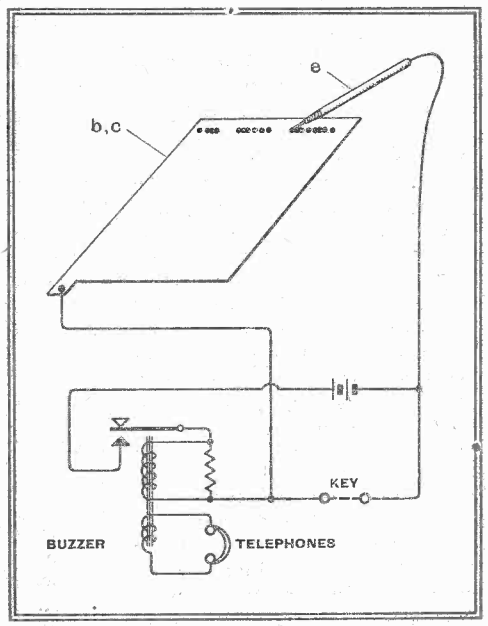
THE principal advantage of the apparatus to be described is that accurate morse symbols, code abbreviations, and even short words can be transmitted with their correct rhythmic sound values at any desired speed, either by the learner himself or by a friend who has no knowledge of the morse code. In addition, the device is simple and cheap to construct. Fig. 1 is a view in plan of the complete instrument, and it will be seen to consist of a baseboard *a* which may be cut from ⅜in. or ½in. thick plywood; a "signal plate" *c* made from a piece of thin flat sheet brass, aluminium or ordinary tinplate; and a stencil *b* which may be formed from a sheet of insulating material such as empire cloth, thin celluloid, or even stout paper. There are also a number of thin wooden strips *d*, slightly wider than the signal plate, each strip being drilled for wood screws at the ends. These strips of wood secure the stencil to the signal plate, and also clamp these two items firmly to the baseboard, in addition to serving as guides for the stylus brush *e*.

This stylus brush is the means whereby the morse signals are transmitted, its exposed end making contact with the signal plate through the stencil, thus closing the buzzer circuit. It may be constructed from a length of insulated wire cable such as one strand of twin lighting flex. It should be stiffened for a distance of about 5in. at one end to enable it to be held like a pencil in the hand. One method of achieving this is to wrap a strip of glued cartridge paper around the cable so as to encase it in a more or less rigid tube, taking care to ensure that the bare copper wires project for a distance of about 3/32in. from the extreme end.

The construction of the stencil sheet, which is the only portion of the whole apparatus on which any real care need be expended, is accomplished in the following manner: A sheet of stout paper of the required size is divided transversely by a series of parallel lines ruled ⅛in. apart. The morse characters to be transmitted are then marked off between these lines, taking care to leave an adequate space between each complete character, and to make the length of the symbols conform to the recognised morse code standards. These lay down that the space between a dot and a dash should be equal to the duration of a dot, and the length of a dash equal to three dots. Actually the spacing between elements should be increased slightly to allow for the thickness of the stylus brush. To illustrate the foregoing it may be mentioned that the morse letter "A" is formed by marking off a distance of ⅛in. on one of the parallel lines to represent the dot. This is followed by a space of 3/16in., and then a distance of ⅜in. is marked off for the dash. The above method may appear rather laborious, but in practice this is not the case, for an ⅛in. diameter hollow punch can be used for piercing the holes, and three holes touching each other (the thin webs being afterwards removed) gives the correct length for a standard dash.



The construction of the unit is quite simple and straightforward.



The electrical connections. The separate headphone winding may consist of a few turns of wire wound over the buzzer bobbins.

Preparing the Stencil

The desired morse characters having been drawn, the paper may be pasted to a sheet of empire cloth, and, when dry, this may be placed on a smooth piece of wood, and all the holes forming the dots and dashes punched through the cloth, using a sharp hollow belt punch for the purpose. The paper is next damped and peeled away leaving an insulated stencil. If the paper used has been tough and of good quality it is quite feasible to employ

Mastering Morse

this as the stencil itself, and thus dispense with empire cloth or other better-class insulator. Finally, the stencil sheet may be cemented to the signal plate with shellac varnish or cellulose cement, or, if desired, it may be merely held in place by the wooden clamping strips.

The assembly of the remainder of the apparatus is quite straightforward, the signal plate and stylus brush being wired in place of an ordinary morse key, as depicted in Fig. 2. It will be noticed that an additional winding has been provided on the buzzer for headphones. A few turns of wire over one of the bobbins of the buzzer is usually all that is necessary. To avoid disturbing other members of the household unnecessarily, the buzzer can be mounted on sponge rubber, and enclosed.

The device is held by the left hand like a writing pad, and the stylus brush inclined at a slight angle to the vertical while being drawn steadily from left to right in the gap between the wooden strips, the point of the brush pressing lightly on the stencil surface. The action is as though the characters were being crossed out as they are transmitted. The speed of passage of the brush may be progressively increased as the rhythmic sounds of the morse symbols are memorised. A buzzer has been employed in place of a valve oscillator, to make the apparatus simple and completely self-contained. The writer would like to stress, however, the importance of obtaining a good quality high-note buzzer.

Random Radiations

By "DIALLIST"

Curses Loud and Deep !

AN hour or two before this note was written I found myself heartily echoing (though in less polite language) the plea made recently in a *Wireless World* editorial for bigger and better instruction books to accompany receiving sets. A smallish communication receiver had proved so strangely insensitive on one of its short-wave ranges that it was clear that the trimming had slipped somewhere. Deciding to tackle the job straight away, I consulted the book of words to ascertain the intermediate frequency. No figure for this was given, so I had to telephone the makers at ninepence per three minutes—and the "pips" went twice before they could tell me what I wanted to know. But I wasn't yet out of the wood; in fact I'm still in it. The book contains a circuit diagram in which each condenser, resistance and so on is numbered; you have only to look up its number in a neat table on the next page to discover the value of any component and the part that it plays. But there is no corresponding layout diagram to enable the padders and trimmers to be located and identified. There are four short-wave ranges, so one needs a little help in this way! As I can't afford any more two-and-threepenny 'phone calls, I've sent an SOS by post, and put off doing the job until the diagram (if one exists) makes its appearance.

Please !

Set manufacturers may possibly defend the sketchy and inadequate instruction book that goes out with so many broadcast receivers on the grounds that they don't want to encourage the uninitiated to mess about with the innards of their sets; hence the less technical information given, the better. That's as may be. But the communication receiver and the short-wave sets are surely in an altogether different category. They are mostly bought, one imagines, by folk who know something about wireless and like to be able to "hot up" their own sets, or to readjust them when the need arises. You can, of course, puzzle out a complicated layout if you've sufficient patience and enough time on your hands. But it's exasperating to have to do so, particularly because you realise that the work you are doing should be completely unnecessary. Will those who make such sets *please* lend an ear! Some books of the words contain everything that one wants to know about the sets with which they go; that should be true of all that concern C.R.s and short-wave sets. May it be so this coming season.

A Queer Decision

JUST why the organisers of Radiolympia have seen fit to put their collective foot down on the proposed A.R.P. exhibit is a little difficult to understand. We are told that it might have the effect of inducing the wrong frame of mind in visitors at the very time when those responsible for the Exhibition want them to feel most happy! What exactly is meant by the wrong frame of mind I don't pretend to know; but I can't for the life of me see why the A.R.P. exhibit that had been planned should have had any very disturbing effect on anyone. Actually, a large proportion of those who go to Radiolympia are likely to be members of one or other of the Defence Services, and to them the A.R.P. sideshow would have been full of interest. I hope he R.M.A. will reconsider this decision. We're not suffering from jumpy nerves, so it's a pity to do anything that suggests that we are.

The Soda Cell

MY best thanks to those readers who have been kind enough to send me suggestions for solving the LT current supply problem in out-of-the-way corners of the Empire, where accumulator charging is impossible. Most of the ideas sent in are ingenious and interesting. One reader mentions a primary cell that is new to me, but seems to have distinct possibilities for filament heating. This is the Edison Soda Cell, which is now used by the signal and telegraph departments of some railways for track circuit working. In such a circuit the cell is under a continuous small load, with frequent brief periods in which it is almost on dead short circuit. In these conditions it lasts for six to nine months, needing no attention until a renewal is called for. The electrodes are in one block, and the chemicals for the electrolyte are packed dry in a tin. It can thus be sent by parcel post. My correspondent describes it as the cleanest of all primary cells. The only snag is that the EMF is but 0.9 V per cell. Some nominal 2-volt valves will work with a filament battery voltage as low as 1.8, but others won't; anyhow, with two 0.9-volt cells in series there's absolutely nothing to play with.

Running Costs

No one has described any experiences with the bichromate cell. This gives a full 2 volts, and I know that it will supply a heavy current, for a time at any rate. If the zinc is well amalgamated and made so that it can be lifted clear of the electrolyte when the cell is not in use, can a cell of suitable size supply, say, 0.6 ampere for two or three hours a day without running costs being too ruinous? The big difficulty with primary cells seems to be that the non-messy ones that have the necessary volts won't supply the amperes required, and vice versa.

A Quaint Plug

DO you remember my mentioning some weeks ago that I'd read in an American paper that numerous fatal accidents were caused each year on the other side of the Atlantic by the reprehensible habit of yanking wall plugs out of their sockets by the leads? I wondered then whether the plugs had no kind of finger-grip, and whether there was no achorage for the leads. A British Columbian reader has just sent me what he assures me is a fair sample of the plugs used in Canada and the U.S.A. Having examined it, I'm not surprised that untoward things are apt to happen with it! Imagine a very small mushroom provided with twin flat stalks, and you have a fair picture of it. The "stalks," which form the prongs, are simply brass strips $\frac{1}{4}$-inch wide and less than $\frac{1}{16}$-inch thick. The wires go in through a hole in the mushroom top, and the only anchorage is that provided by the terminal screws. These screws, by the way, are exposed, for there is no cover to the underside of the mushroom. Uncle Sam might do worse than take a look at our plugs! The standard mains voltage in the U.S.A. is, of course, only 110; shocks may be common, but I should think that fatalities are much rarer than was suggested by the journal from which I quoted.

Twisted Joints

Not everyone agrees with my condemnation of the twisted-up joint made in flex wire as being unreliable unless it is subsequently soldered. A reader points out that the G.P.O. telephone people use thousands of them in their underground cables running through conduits, and have little trouble with them. Others write of similar joints in flex HT battery leads that have been in use for years, and still seem to be as good as ever. You may or may not remember that my uncomplimentary remarks about twisted joints were inspired by a fault that had developed in the *LT* leads of a portable, which had been lengthened some time previously. A service engineer writes that he deals each week with about a dozen sets whose HT and LT leads have been extended by means of twisted joints to enable batteries supplied by a hire service to be used. "I find," he says, "that, whilst the HT leads give very little trouble, about one in twelve of the LT leads requires attention." Am I right in surmising that the twisted joint will stand up to a current of a few milliamps, but becomes unreliable when called upon to carry half an ampere or more?

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Valve Prices : Official Statement

IN connection with the references in your issue of July 20th, 1939, to the prices charged to the public for valves, it is desired to advise you that no reductions in their prices are contemplated at the present time.

It should be borne in mind that experience has amply demonstrated that the valves maufactured by the members of this Association give an exceptionally long life, and it is the fact that the sales of valves for the maintenance of existing receivers is very small in relation to the sales of valves for new sets.

The foregoing, taken in conjunction with the guarantee and generous service offered by the English valve manufacturer, results in the average cost of new valves to listeners being of the order of only a shilling or two per receiver per annum. Since this small sum attaches to the use of perhaps five valves, for some thousands of hours per annum, it may be accepted that its incidence upon the public is extraordinarily low and does not constitute any hardship.

D. P. WHEELDON,
Secretary, British Radio Valve Manufacturers' Association.

"Distortion in Transformer Cores"

BEFORE replying to the technical points raised by Mr. Scroggie in his letter of last week, I should like to express my appreciation of the exceedingly nice things he said about my articles on "Distorton in Transformer Cores." And at the same time may I be allowed the space to thank the many other readers who have written to me privately about the same matter?

Mr. Scroggie's first point relates to amplitude distortion and intermodulation products. The reason for my "summary dismissal" of this matter is that it did not seem quite so important in the case of a transformer as in that of a valve (for example) because of frequency discrimination in the former. Only spurious frequencies of a low order can find their way to the external load. However, it is quite possible that I have under-estimated this evil.

The next item, which deals with my use of the *arithmetical* sum of the harmonics, is very important. The "Partridge Distortion Index" is intended to fulfil two purposes: (1) to provide a simple means whereby professional engineers and amateurs alike can make reliable comparisons between transformers, and (2) to provide the transformer designer (as distinct from the circuit designer or transformer user) with a convenient means of dealing with distortion calculations. As Mr. Scroggie states in his letter, it is purely an index number associated with output transformers, and therefore does not in any way come into conflict with existing standards.

It is well known that the offensiveness of harmonics varies considerably with their order. We are particularly concerned with the 3rd, 5th and 7th harmonics, and of these the 3rd is the least harmful, while the 5th and 7th are suspected of being vastly more sinister. An exact measure of the relative "nastiness" is not possible, and therefore the only really sound method expressing the total distortion is by a statement of the percentages of each separate harmonic. This requires three numbers and three calculations to obtain them. Clearly a single index number would be preferable if one can be found that is easy to derive and that is not too misleading in its indications. But there is no point at all in going to any trouble to obtain a figure that is of academic interest alone.

Consider two possible examples of distortion. One consisting of 6 per cent. 3rd harmonic alone, and the others of 2 per cent. 3rd, plus 2 per cent. 5th, plus 2 per cent. 7th harmonic. There are reasons for believing that the former will be the more pleasing. But the RMS sum of the harmonics gives 6 per cent. for the former (least harmful) and 3.5 per cent. for the latter. To what purpose have we squared three numbers, added the results together, and then taken the square root of the answer? The straightforward arithmetical sum is every bit as good as a guide to effective distortion (better in the example given), requires no aptitude for mathematics and saves a lot of time. In addition to this, there is another thing that adds to the usefulness of the "Partridge Distortion Index." A glance at the transformer distortion curves given in the articles will show that *very approximately* the 3rd harmonic is generally about 50 per cent. of the arithmetical total, while the 5th and 7th harmonics are each around 25 per cent. Thus one always has a very fair idea of the whole story. In brief, the RMS summation involves more work and produces a less convenient "Index" than the arithmetical sum.

Lastly, there is the affair of the 20 phons. I fear that my imagination was so fired by the discovery that 2 per cent. 7th harmonic *could* sound like 100 per cent. that I told the world about it without stopping to consider the subdued nature of the experiment. However, we agree about the principle of the thing, so perhaps I may be forgiven for this unintentional exaggeration. But I am not so sure about the masking effect. The fundamental might mask the harmonic *as such*, but would it cover beats against a near-by frequency? N. PARTRIDGE.

London, S.W.1.

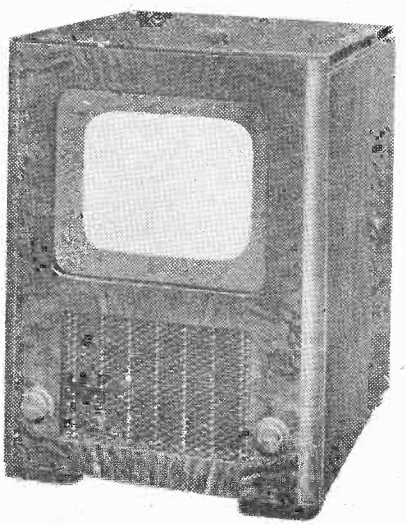
New H.M.V. Television Sets

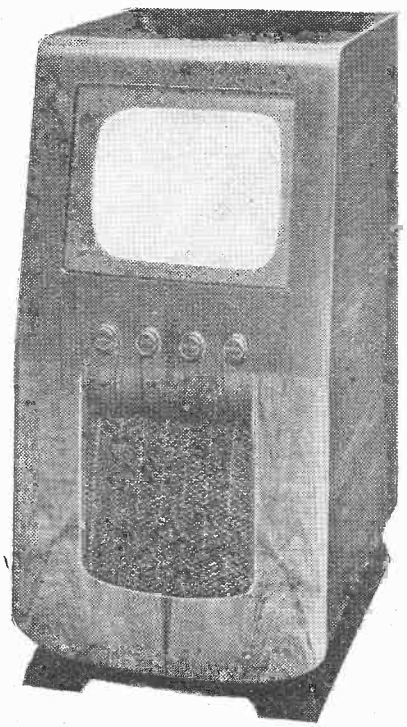
DETAILS of the new models which will be added to the H.M.V. range of television receivers on August 29th are now available. The new instruments all incorporate the same chassis, which is a superheterodyne with a new high-slope valve of compact design (the Z62) in its RF stage. The frequency changer is followed by two IF stages common to sound and vision, and these are followed by additional separate stages for sound and vision. The sound channel includes a "hiss limiter" circuit which takes a portion of the output and feeds it out of phase through a diode into an earlier point in the circuit. This feature has been introduced primarily to combat motor car interference.

On the vision side, the output from the third IF stage is passed to a D43 valve for demodulation, and thence through a KTZ41 to the cathode ray tube. Separate diodes in conjunction with KTZ63 valves act as sync. separators.

Separate power supply units are provided for the sound and vision circuits, so that the receivers may be used for high-quality reception of programmes relayed through Alexandra Palace, without working the vision side of the receiver.

In two of the new receivers, the picture size is 6⅝in. x 8⅜in. They are the table Model 1800 at 31 guineas, and the console Model 1801 at 36 guineas. A 14-inch tube giving a picture 9⅜in. x 11⅝in. is used in the Model 1802 console at 44 guineas, and the Model 1850 at 57 guineas.





H.M.V. table Model 1800 with 10-inch tube and console Model 1802 with 14-inch tube. Provision is made for using the sound side separately for high-quality reception.

The latter includes an all-wave push-button receiver with AFC.

The existing Models 905, 907 and 900 are being continued.

UNBIASED

By FREE GRID

"Cathode Ray" Solves a Mystery

I WAS exceptionally interested in the recent article by "Cathode Ray" in which he expounded the mysteries of the transatlantic telephone, as it clears up another mystery existing in my own household, which has worried me for many years past, almost, in fact, since the day when the transatlantic telephone was inaugurated.

It so happens that Mrs. Free Grid has a sister living in America, not because her family is American, but because many years ago she—the sister I mean—entrapped some unfortunate citizen of the U.S.A. into a promise of marriage at a time when he was just recovering from the effects of a very bad crossing, and was probably feeling like death warmed up, and hadn't a kick left in him.

At any rate, whatever be the reason for this strange lapse on the part of a member of a nation of people who pride themselves on their mental alertness, she has for many years past been installed in the U.S.A., and is doubtless responsible for a good deal of the strange ideas which the Americans have concerning our mode of life over here. The point is that about once a week Mrs. Free Grid rings her up on the phone, and what I have never hitherto been able to understand is that the conversation simply develops into a long, unbroken monologue on the part of Mrs. Free Grid, her sister, apparently, not being able to get a word in edgeways. Now my sister-in-law is only slightly less well endowed with conversational powers than my wife, and I failed to see why the weekly contests should have developed into such one-sided affairs.

Mrs. Free Grid and —

The whole thing is, of course, quite clear now, after Cathode Ray's explanation. The power used in the transatlantic phone is so great that if something were not done a vicious feed-back circle would be established between transmitter and receiver on the same side of the Atlantic, and continuous howling would occur. This is prevented by making each speaker's voice operate a relay which breaks the circle by opening the neighbouring receiver circuit. In effect, therefore, as long as a person continues to speak, the transatlantic telephone is a one-way affair, and the unfortunate wretch at the other end has no chance to butt in.

This, of course, is precisely what happens in the case of Mrs. Free Grid and her sister. Mrs. Free Grid certainly has no flies on her, as her American brother-in-law once told me, and what she does after she has rung up is to get her spoke in first, and since she scarcely pauses for breath once she has started, her unfortunate sister can't get a word in edgeways. I have sent a marked copy of the *Wireless World* containing Cathode Ray's article across the Atlantic, together with a few anonymous explanatory notes, and am now awaiting developments.

Is Remote Control Wanted?

I HAVE just been having an interesting correspondence with a reader on the subject of remote control. He was roused to write to me in the first place because of what he claimed to be my obvious ignorance of the goings-on in that strange underworld in which wireless manufacturers live and have their being. His claim to special knowledge lies in the fact that he is acquainted with a girl who winds coils in one of our big wireless factories, and she, so he claims, is in a position to be in the know. This may not seem a very reliable source of knowledge to you, but, all the same, it is surprising what some factory girls do know, and I am not at all sure that there may not be something in what this particular correspondent tells me.

In the first place, he takes me to task for prophesying that manufacturers will be bringing out remote control receivers galore because there is a strong public demand for them. He argues that there is no more a public demand for them than there was for broadcasting itself in the days before it started. It was, he states, the manufacturers who created the demand for broadcasting by forming the old British Broadcasting Company in 1922, and starting to broadcast programmes. Coming to more recent times, my correspondent alleges that there was never any outcry or demand among listeners to be given the advantages of push buttons. It was only after they had been given them that they realised their advantages, and took to them.

As a truthful man, I must admit that my correspondent is right in the above statement, and quite frankly, told him so, but I ventured to disagree with him when he said that even if there were a public demand for anything, manufacturers would ignore it. Much as it went against the grain, I felt compelled to rush to the defence of the manufacturers, and in a somewhat heated reply, pointed out that they would most certainly market anything for which there was a public demand, as it would be in their interests to supply goods to a market which was already waiting for them. My correspondent, however, countered by citing numerous instances in which the manufacturers had failed to satisfy a very strong public demand, and, in addition, he stated that everybody in the manufacturing world knew that public demand was fickle and unreliable. Being a technical man, I promptly refused to argue with him on non-technical subjects, and so closed the correspondence.

Personally speaking, I am all in favour of remote control, my only objection to it being that it *is*, after all, still necessary to push a button bearing the name of the

—her sister.

station you want to listen to. I should have thought that as a result of all the experimental work which must have been put into the development of the voice-operated relays in the transatlantic telephone, about which I have just been talking in connection with Mrs. Free Grid and her sister, radio engineers would have found it easy to produce some sort of voice-operated system of tuning. I personally cannot see any fundamental difficulty in the way; it is merely a question of perfecting details; and, after all, difficulties are only sent into the world to be overcome. None of you can deny that it would be exceedingly pleasant to sit back in your armchair and tune in by bawling out the name of the station you want to receive.

I dare say, however, that the scheme would be abused, and some of you idle rich would take to having a footman standing at your chairside to do the bawling. However, probably some of you of a more technical turn of mind than the average have your own ideas on the subject and could probably devise some method whereby we poorer folk could dispense with the necessity of shouting without having to go to the expense of a footman.

Recent Inventions

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

DIRECTION AND ELEVATION FINDER

IF two dipole aerials, spaced apart by a distance greater than the working wavelength are rotated about a common centre, the arrangement will give more than two minimum readings when directed on to a transmitter carried by an aeroplane.

The signals picked up on each dipole may either be added together or subtracted, and the incidence of each minima is automatically recorded, during each rotation, on a circular scale in combination with timing marks.

From the record so formed it is possible to determine the elevation of the aeroplane as well as its direction in azimuth.

H. A. Thomas. Application date October 22nd, 1937. No. 504293.

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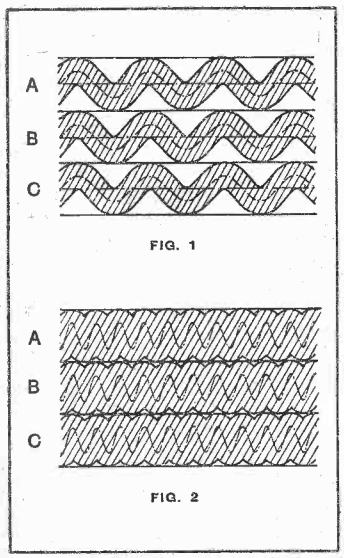
IMPROVED SCANNING SYSTEM

ONE obvious way to improve the detail of a televised picture is to increase the number of scanning lines at the transmitting end. But in most cases this would mean considerable alteration to the standard type of receiving set. The scheme now proposed secures better definition without increasing the number of scanning lines, by reducing the size of the scanning spot to less than the width of the scanning line, and making the spot move in a curved instead of a straight path.

Fig. 1 shows the spacing of successive lines, A, B, C in a "straight" scanning system, the shaded curve being the track covered by a spot of half the usual diameter moving along a curved path as already mentioned. Fig. 2 shows the result of increasing the frequency at which the spot



Oscillating scanning spot to increase definition.

of light is oscillated as it moves forward. It will be seen that the whole width of each scanning line is now substantially covered, whilst the resolving power of the spot, say, on a sharp edge separating black from white, has been increased. A similar oscillating movement is given to the scanning spot at the receiving end by transmitting suitable synchronising impulses. Pictures so transmitted can be received on a standard type of set without loss of definition, though to secure the full benefit of the invention a special receiver should be used.

A. D. Blumlein. Application date 14th October, 1937. No. 503555.

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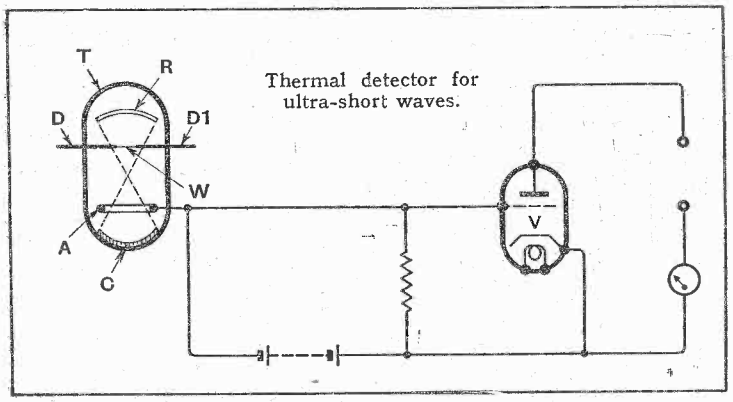
DETECTING ULTRA-SHORT WAVES

THE figure shows a highly-sensitive circuit for receiving ultra-short waves. The signals are picked up by two dipoles D, D1, which are mounted partly inside and partly outside an evacuated tube T. The dipoles are joined together by a fine baretter wire W, which is heated by the received energy. This baretter wire may be pre-heated by an auxiliary battery in order to increase its resistivity to the received signal current. The heat so produced is projected on to a photo-sensitive cathode C, a reflector R being mounted on the other side of the wire to assist this process.



Thermal detector for ultra-short waves.

The resulting emission from the cathode C is collected by a positively charged anode A which is made in the form of a wide-meshed grid in order not to screen the cathode from the heat radiated by the baretter wire. The photo-electric current so collected is finally amplified by a valve V.

Telefunken ges. fur drahtlose Telegraphie m.b.h. Convention date (Germany), 3rd November, 1936. No. 504836.

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TELEVISION SYSTEMS

THE object of the invention is to allow a higher degree of amplification to be applied to the picture signals in a television transmitter without increasing the difficulty of separating them out from the synchronising impulses at the receiving end. The improvement is based on the fact that it does not matter, so far as the subsequent separation of the signals is concerned, if the amplitude of the picture signals is increased during the first part of each scanning line, provided that, at the end of the line, the relative amplitude of the picture and synchronising signals is brought back to a fixed level.

Accordingly, by increasing the amplitude of the picture signals during the first part of each scanning line and then bringing it back to a fixed level towards the end of the line, the "overall" picture amplification can be considerably increased without causing trouble when the signals come subsequently to be separated. The desired result is secured by using a form of automatic volume control which is kept out of action during the first part of each scanning line, but is made operative, by applying a periodic voltage impulse, towards the end of that line.

Cie pour la Fabrication des Compteurs et Materiel d'Usines à Gaz. Convention date (France) February 8th, 1937. No. 505057.

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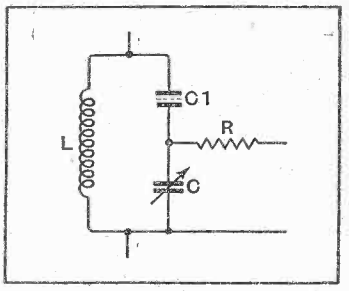
TUNING CONTROL

THE tuning of a set is varied by the direct application of a control voltage to a special type of condenser, without using any other intermediary. The arrangement may be applied to systems in which an initial error is automatically corrected, or for tuning by remote control.

The type of condenser used is one in which the dielectric between the two outer plates includes a "blocking" layer of badly-conducting material, the action being similar to that of an electrolytic condenser—or an electrolytic rectifier—where the effective capacity is known to vary with the value of the applied voltage. The layer may be made of copper or zinc oxide, or it may consist of an electrode covered with a coating of selenium.

The figure shows a typical



Circuit arranged for tuning control by voltage variations.

arrangement in which the "blocking-layer" condenser C1 is inserted in series with a tuned circuit L, C. The effective tuning of the circuit will then depend upon a control voltage, which is applied through a resistance R and may be derived either from the ATC stage of the set, or from a distant point. Suitable precautions are taken to prevent the "blocking-layer" condenser from damping the tuned circuit, or from acting as a short-circuit.

N. V. Philips Gloeilampenfabrieken. Convention date (Switzerland), 1st May, 1937. No. 501238.

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CUTTING OUT INTERFERENCE

IN order to minimise local interference it is usual to erect the aerial as high above ground as possible, and couple it to the receiver by a screened downlead or a pair of "crossed" feed-lines. In practice, however, owing to imperfect shielding and lack of symmetry, some of the interference generally gets into the set via the downlead. Also, since it is difficult to place the aerial at a sufficient height to be outside the field of interference, a certain amount of disturbance will enter the receiving set in this way.

According to the invention, the downlead or transmission line is deliberately "unbalanced" in such a way that any disturbance picked up by the line is made to oppose and balance that picked up by the aerial. In practice the two feed-lines are shunted by a potentiometer, one end of which is connected to earth through a variable capacity, whilst a second earth connection is made through a variable tap on the potentiometer.

Marconi's Wireless Telegraph Co., Ltd. (assignees of V. D. Landon). Convention date (U.S.A) October 31st, 1936. No. 504752.

The Wireless World

CLASSIFIED ADVERTISEMENTS

NOTICES

THE CHARGE FOR ADVERTISEMENTS in these columns is

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 & Co. payable to ILIFFE & SONS Ltd., and crossed 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 10th must be closed for press earlier than usual.

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

FIRST POST FRIDAY, AUGUST 4th.

NEW RECEIVERS AND AMPLIFIERS

*

*

CHALLENGER RADIO CORPORATION "Degallier's." Send 2d. stamp for handsome illustrated catalogues telling of our superb range of fully guaranteed receivers; direct to public sales policy saves you 40%; sets to suit every pocket from 65/- to £31/10. Sale list also available upon request.—Challenger Radio Corporation, "Degallier's," 31, Craven Terrace, London, W.2. Paddington 6492. Nearest point, Lancaster Gate Tube. [8731

R

RADIO CLEARANCE, Ltd.

ALL Lines Previously Advertised Still Available.

ALL Orders Over 5/- Carriage Free; under this amount sufficient postage must be included with order.

ALL Enquiries Must Enclose 1½d. Stamp.

RADIO CLEARANCE, Ltd., 63, High Holborn, W.C.1. Holborn 4631. [8774

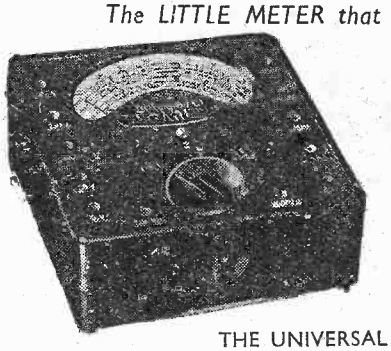
ARMSTRONG Co.—After many years at our old premises at Camden Town we have removed to a new building in Warlters Rd., Holloway, N.7 (see displayed advertisement).

ARMSTRONG Amplifier Division Has Removed to New Premises at 94, Camden Rd., N.W.1. In addition to our standard range of 6- and 12-watt push-pull high fidelity amplifiers and local station feeder units, we manufacture equipment for special purposes, pre-stage units, electronic mixers, tone control units, etc.

ARMSTRONG Are Always Pleased to Assist in the Solution of Special Problems; details of standard equipment free on request.

ARMSTRONG Co. (Amplifier Division), 94, Camden Rd., N.W.1. [8752

The LITTLE METER that does the



BIG JOBS

THE UNIVERSAL

AVOMINOR

Regd. Trade Mark BRITISH MADE.

ELECTRICAL MEASURING INSTRUMENT

D.C. VOLTAGE	
0-75 mv.	0-100 v.
0- 5 v.	0-250 v.
0-25 v.	0-500 v.
A.C. VOLTAGE	
0- 5 v.	0-100 v.
0-25 v.	0-250 v.
	0-500 v.
D.C. CURRENT	
0-2.5 ma.	0- 25 ma.
0-5 "	0 100 "
	0-500 "
RESISTANCE	
0- 20,000	ohms
0-100,000	"
0-500,000	"
0- 2	megohms
0- 5	"
0-10	"

Weighing only 18oz. and measuring but $4\frac{3}{4}'' \times 3\frac{3}{4}'' \times 1\frac{3}{4}''$, this is a really portable meter of high accuracy for measuring A.C. & D.C. volts, D.C. milliamps and ohms. An accurate moving-coil movement gives a 3" full scale deflection. Total resistance is 200,000 ohms. Complete with instruction booklet, leads, interchangeable testing prods and crocodile clips.

£5.10. *(leather case 10/-)*

DEFERRED TERMS IF DESIRED

Write for descriptive pamphlet

Sole Proprietors & Manufacturers:—
The Automatic Coil Winder & Electrical Equipment Co., Ltd.,
Winder House, Douglas Street, London, S.W.1. *'Phone: Victoria 3404/7*

GET 2 YEARS FREEDOM FROM NEEDLE CHANGING with the

Walco GENUINE *Sapphire*

GRAMOPHONE NEEDLES

More than 2,000 playings from one needle, a minimum of record wear, and greatly improved reproduction are obtained from the new Walco Needle—price **12/-**. Order now or write for FREE BOOKLET **"SOUND REPRODUCTION"** from

R. A. Rothermel LTD

(Dept. G)

Canterbury Road, High Road, Kilburn, N.W.5

For details of the NEW 1940 RANGE of

ARMSTRONG CHASSIS

See AUGUST 17th "Wireless World"

SOMETHING REALLY GOOD

Look out for it!

ARMSTRONG MANUFACTURING CO.
Warlters Road, Holloway, London, N.7.
'Phone: NORth 3213

NUMBERED ADDRESSES

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

DEPOSIT SYSTEM

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

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

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

NEW RECEIVERS AND AMPLIFIERS

AMAZING Offer.—Famous 7-valve push button 1939 models in makers sealed cartons, issued 13½ gns.; £5/19/6; list free.—Shippers, 18, Corporation St., Manchester. [0639

USED SETS FOR SALE

HALLICRAFTER

HALLICRAFTERS "Sky Chief" Communication Receiver, condition new, guaranteed; first offer over £6/10.—H. Barnett, 2, Church St., Evesham. [8759

Wanted

WANTED.—W.W.S.S., or Q.A. super receiver.—Heal, 21, Wall Lane Terrace, Cheddleton, Staffs. [8768

CAR RADIO

ALL Goods Previously Advertised Still Available.

HENRYS, 72, Wellington Ave., Stamford Hill, N.15. Stamford Hill 2907. [8745

1939 Models from 4½ gns.; 6 new car aerials, from 9/6; trade enquiries solicited; lists free.—Shippers, 18, Corporation St., Manchester. [0622

PUBLIC ADDRESS

V

VORTEXION P.A. Equipment.

IMITATED, but unequalled.

WE Invite You to a Demonstration.

A.C.-D.C. Dance Band Amplifier, 10 watts output, complete in case, with moving coil microphone, speaker and cables, weight 22lb.; 12 gns.

A.C.-20 15-20-watt Amplifier, 38-18,000 cycles, independent mike and gram., inputs and controls, 0.037 volts required to full load, output for 4 7.5, and 15 ohms speakers or to specification inaudible hum level, ready for use; 8½ gns., complete.

C.P. 20 12-volt battery and A.C. Mains Model, as used by R.A.F. output as above; 12 gns.

A.C.-20, in portable case with Collard motor, Piezo pick-up, etc., £14; C.P.20 ditto, £17/17.

50-WATT Output 6L6s, under 60-watt conditions, with negative feed back, separate rectifiers for anode screen and bias, with better than 4% regulation level response, 20-25,000 cycles, excellent driver, driver transformer, and output transformer matching 2-30 ohms impedance electronic mixing for mike and pick-up with tone control, complete with valve and plugs; £15.

(This advertisement continued on next page.)

"Radio Data Charts," A Series of Abacs. Post free 4/10.

PUBLIC ADDRESS

(This advertisement continued from previous page.)

COMPLETE in Case, with turntable, B.T.H. Piezo pick-up and shielded microphone transformer; £20.

80-WATT Model, with negative feed back; £25, complete.

120-WATT Model, with negative feed back; £40, complete.

250-VOLT 250 m.a. Full Wave Speaker field supply unit; 25/-, with valve.

ALL P.A. Accessories in Stock, trade supplied.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2814. [8241

"PARTRIDGE P.A. Manual," standard handbook on electro-acoustics, amplifiers, and audio circuits; price 2/6 (free to trade).

"PARTRIDGE Amplifier Circuits," describes many modern constructional amplifiers, 2w. to 45w. output, battery, A.C.-D.C., etc.; price 2/- (no free copies).

PARTRIDGE, N., B.Sc., A.M.I.E.E., King's Buildings, Dean Stanley St., London, S.W.1. [0630

ALEXANDER BLACK, Ltd., pioneers of hiring microphone amplifying equipment since 1928. Booklet on request.—55, Ebury St., S.W.1. Sloane 6129. [0598

PUBLIC Address Contractors Can Hire P.A. Vans, loud speakers, microphones and equipments of all types from Hire Dept., Grampian Reproducers, Ltd., Kew Gardens, Surrey. Tel.: Richmond 1175-6-7. [0618

Wanted

WEBSTER Battery Amplifier Model MV-410, new or second hand, without microphone or speaker.—EIGJ, Cavan, Eire. [8767

15-WATT Amplifier for Speaking, clarity essential, microphone to suit, four permanent magnet moving-coil speakers.—Johncock, 35, Headfort Place, S.W.1. [8757

NEW MAINS EQUIPMENT

VORTEXION Mains Transformers, chokes, etc., are supplied to G.P.O., B.B.C., L.P.T.B. Why not you?

VORTEXION, Ltd., 182, The Broadway, Wimbledon, London, S.W.19. Telephone: Liberty 2814. [8772

NEW LOUD-SPEAKERS

SINCLAIR Speakers for All Types.—Pulteney Terrace, Copenhagen St., N.1. [0603

BAKERS New Corner Horn Speakers, Triple cone conversions; from 29/6, and surplus speaker bargains.—Bakers Selhurst Radio, 75, Sussex Rd., South Croydon. [8728

LOUD-SPEAKERS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

VOIGT Twin Diaphragm Unit with Whitewood Corner Horn and Field Supply Rectifier; £20.—Dixon, Honiton House, Hamilton Rd., Reading. [8755

3,000 Speakers from 5/6 each, P.M. and energised 4in. to 14in., including several Epoch 18in.—Sinclair Speakers, Pulteney Terrace, Copenhagen St., N.1. [0591

VOIGT Corner Horn Speaker in the White, latest laboratory diaphragm and filter, built in 460v. field supply, complete; £25.—Allworth, 20, Purley Bury Close, Purley. [8726

Wanted

WANTED.—Haynes Senior Standard Speaker, fields 2,500 and 7,500 ohms, and output transformer type OPP 15; also duophrase balanced coupler.—Smith, Highlands, Windmill Lane, Wightwick, Wolverhampton. [8756

TELEVISION

H.M.V. 29 Gns. All-wave Receiver, as new; £20.

HENRYS, 72, Wellington Ave., Stamford Hill, N.15. Stamford Hill 2907. [8746

"MURPHY" Television, as new, under guarantee; £26.—Box 653, c/o *The Wireless World*. [8769

TRANSMITTING APPARATUS

A.C.S. RADIO, specialists in short wave apparatus, communication receivers, including Hallicrafters, National and R.M.E. transmitting equipment, valves and components. Send for free catalogue to A.C.S. Radio, 16, Gray's Inn Rd., W.C.1. Holborn 9894-5. G2NK, Technical Manager. [0550

G5N1.—The oldest and largest distributor of amateur equipment transmitting and receiving; short-wave catalogue, 1½d. G5N1 70-page Manual, 7½d., post free; authorised direct distributor for Collins, National, R.M.E., Thordarson, Hammerlund, Bliley, Taylor, Elmac, etc., etc.—44, Holloway Head, Birmingham. [0531

CABINETS

A CABINET for Every Radio Purpose.

CONVERT Your Set into a Radiogram at Minimum Cost; surplus cabinets from noted makers under cost of manufacture (undrilled); 30/- upwards; motors at wholesale prices.

"FIT-A-GRAM" Cabinet, 31×17×15; 21/-.

UNDRILLED Table Console and Loud-Speaker Cabinets from 3/6.

INSPECTION Invited; photos loaned to country customers.

H. L. SMITH and Co., Ltd., 289, Edgware Rd., W.2. Tel.: Pad. 5891. [0485

PREMIER

★ RADIO ★

STOCKTAKING SALE

FINAL SALE OFFERS!

BATTERY CHARGERS for A.C. Mains, 2 volts, ½ amp. Metal Rectification, **10/-.**
POTENTIOMETERS WITH SWITCH, ½ meg., ¼ meg., 20,000 ohms and 10,000 ohms, **1/3** each.
POTENTIOMETERS WITHOUT SWITCH, 2 meg., 1 meg., ½ meg., 400,000 ohms, 25,000 ohms, 20,000 ohms, 10,000 ohms, **1/-** each.
SPECIAL OFFER—CONTINENTAL MAINS VALVES, 4 v. AC Types, 5-pin only, AC/HL, AC/L, AC/P, AC/SG, AC/VMS, AC/HP, AC/VHP, **2/6** each.
F.W. RECTIFIERS. 350v. 120ma., **4/6**; 500v. 120 ma. **5/6.**
20 v. 18a AC/DC Types, SG. Var. Mu., SG. Power, HF Pen., **2/-** each.
U.S.A. Types, 24, 30, 41, 39/44, 35/51, 55, 56, 57, 58, 71, 77, 78, 85, 2A5, 2A6, 2A7, 2B7, 6A7, 12Z3, 210, 250, all 2 for **3/-.**
TUBULAR CONDENSERS, .002, .0001, .0003 and .0005 mfd., **1/-** doz. Your choice.
ELECTROLYTIC CONDENSERS. Metal Can. 8 mfd. 320 volts, 2 for **1/6.** 8+8 mf. 475 v.+10 mf. 50 v., 2 for **2/6.** 8+8 mf. 450 v.+8 mf. 250 v., 2 for **2/6.**
T.C.C. DRY ELECTROLYTICS. 8+8+4 mf. 500 v., **2/-** each.
500 v. CARDBOARD ELECTROLYTICS. 4 mf. or 8 mf., **1/6.** 8+4 mf., **2/9.** 8+8 mf., **2/6.** 4+4 mf., **2/4.**
MAINS TRANSFORMERS — MANUFACTURERS' SURPLUS. 250—250 v. 60 ma., 4 v. 2 a., 13 v. 1 a., **3/6.**
GARRARD AUTO CHANGERS, Model RC.4 for A.C. Mains, 250-250 v., plays eight 10" or 12" Records. Limited quantity only to clear at **£5.5.0.**

Huge Reduction in Prices of TRIAD U.S.A. VALVES
from **2/3** each!
Send for NEW Price List.

PREMIER SHORT-WAVE KITS.
Complete to the last detail including all Valves and coils, as well as theoretical and wiring diagrams and lucid instructions for building and working. Each kit is supplied with a steel Chassis and Panel and uses plug-in coils to tune from 13 to 170 metres.
1 Valve Short-Wave Receiver or Adapter Kit ... **17/6**
1 Valve Short-Wave Superhet Converter Kit ... **20/-**
1 Valve Short-Wave A.C. Superhet Converter Kit **22/6**
2 Valve Short-Wave Receiver Kit **25/-**
3 Valve Short-Wave Screen Grid and Pentode Kit **58/6**
PREMIER U.S.A. QUARTZ TRANSMITTING CRYSTALS 7 mc Band, **10/-** each, with Calibration Certificate. Enclosed holder and base, **3/-.**
MORSE KEYS. Excellent brass movement on bakelite base, **2/9** each.
PREMIER SHORT-WAVE COILS, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, **1/9** each, with circuit. Special set of S.W. Coils, 14-150 metres, **4/-** set, with circuit. Premier 3-band S.W. coil, 11-25, 19-43, 38-86 metres. Suitable any type circuit, **2/6.**
UTILITY Micro Cursor Dials, Direct and 100:1 Ratios, **3/9.**
PREMIER Short-Wave Condensers, all-brass construction, with **Trolitul** insulation. 15 mmf., **1/6**; 25 mmf., **1/7**; 40 mmf., **1/9**; 100 mmf., **2/-**; 160 mmf., **2/3**; 250 mmf., **2/6.**
TROLITUL DOUBLE SPACED TRANSMITTING CONDENSERS. 15 mmf., **2/9**; 40 mmf., **3/6**; 100 mmf., **4/-**; 160 mmf., **4/6.**
COIL FORMERS, 4- or 6-pin low-loss, **1/-** each.
Orders 5/- and over sent Post Free. Under 5/- please add 6d. Postage.
NOW READY. PREMIER 1940 CATALOGUE. 112 illustrated pages. Over 20 pages of British and American Valve Data. Bigger and Better than Ever! 6d. per copy.
"CLASS B" KITS, comprising driver transformer, 2 volt Class B Valve and holder, with circuit. **10/-** complete.
MAGNAVOX 8" P.M. MOVING COIL SPEAKERS, with Output Transformer, **10/6** each.

ALL POST ORDERS TO: Jubilee Works, 167, Lower Clapton Road, London, E.5. *Amherst* 4723.
CALLERS TO: Jubilee Works, or our NEW PREMISES, 169, FLEET STREET, E.C.4. *Central* 2833.
or 50, High Street, Clapham, S.W.4. *Macaulay* 2381

McJL TRADE SERVICE

Get in touch with us for

Steel or Aluminium chassis, Oxy. welding, Spot welding, Stove enamelling, Chokes, Transformers, Tuning Units, R.F. Coil Winding in matched sets, Receiver and Amplifier chassis, Quartz Crystals, etc., etc.

We invite your enquiries for general lathe work and any form of light engineering.

JOHN McCLURE LTD. (66 JM)
ERSKINE ROAD, LONDON, N.W.3. PRImrose 5435

DYNAMOS, MOTORS, ETC.

ALL Types of Rotary Converters, electric motors, battery chargers, petrol-electric generator sets, etc., in stock, new and second-hand.

A.C.-D.C. Conversion Units for Operating D.C. Receivers from A.C. Mains, 100 watts output, £2/10; 150 watts output, £3/10.

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518

RECORDING EQUIPMENT

PHONO-DISC Recording Gramophone with Microphone; bargain, £17.—Millar, 7, Park Lane, W.1. [8754

ALL Recording Discs and Materials in Stock, tracker units, £4/7/6; recording motors, £3/17/6.—Write for further details, Will Day, Ltd., 19, Lisle St., W.C.2. [0595

FEIGH Recording Sets are Within Reach of All; ball bearing gear box, worm drive traverse; records on any disc, Morse, speech or music; diamond cutter-pickup on tone arm, the set 37/6; 6in. blanks, 3/3 doz.; 10in. discs, 7/- doz.—Electradix, 218, Upper Thames St., London, E.C.4. [0620

VALVES

ALL Types of American Tubes in Stock of Impex and Arcturus makes at competitive prices.

WE Can Also Supply a Full Range of Guaranteed Replacement Valves for Any British non-ring. American or Continental type at an appreciably lower price.

SEND for Lists of These, and also electrolytic condensers, line cords, resistances, etc.

CHAS. F. WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0452

AMERICAN, 2/9; 1,000 non-ring British from 1/9; bargains galore; lists free.—Shippers, 18, Corporation St., Manchester. [0607

METROPOLITAN RADIO SERVICE.—Special offer, American valves, in makers' cartons, 3/- each, Octals, 3/6 each; American valves, first grade, in all types; trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

ELECTRICAL EQUIPMENT

1- and 3-phase Motors, ¼ to 5 h.p., surplus stock, first class condition.—Tel.: Reliance 1693. Easco Electrical Service, 18, Brixton Rd., S.W.9. [0642

COMPONENTS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

RADIO CLEARANCE, Ltd.

ALL Lines Previously Advertised Still Available.

ALL Orders Over 5/- Carriage Free; under this amount sufficient postage must be included with order.

ALL Enquiries Must Enclose 1½d. Stamp.

RADIO CLEARANCE, Ltd., 63, High Holborn, W.C.1. Holborn 4631. [8773

PREMIER SUPPLY STORES.

PLEASE See Our Displayed Advertisement on this page. [0488

GOODS Previously Advertised Still Available.—Ryall's Radio, 280, High Holborn, London, W.C.1. [8709

VAUXHALL.—All goods as previously advertised still available; write for free list.—Vauxhall Utilities, 163a, Strand, W.C.2. [8727

SOUTHERN RADIO, 46, Lisle St., London, W.C. Gerrard 6653.—Stocks of receivers and replacement components, as previously advertised. [8548

MAINS RADIO DEVELOPMENT Co. Offer all Exclusive Bargains as last week; stamp for list 228.—4 and 6, Muswell Hill Rd., London, N.6. [8759

REPAIRS AND SERVICE

"SERVICE with a Smile."

AMERICAN Valves, spares, linecords, rewinds, repairers of all types of American and British receivers.—F.R.I., Ltd., 22, Howland St., W.1. Museum 5675. [0434

LOUD-SPEAKER Repairs, British, American, any make, 24-hours' service; moderate prices.—Sinclair Speakers, Pulteney Terrace, Copenhagen St., N.1. [0590

GUARANTEED Repairs, Any Transformers, choke, motor armature, converter, dynamo, etc., keenest prices, immediate quotation, prompt, dependable service.—See below.

L.T.P. (LONDON TRANSFORMER PRODUCTS, Ltd.), Willesden, N.W.10. Willesden 6486 (3 lines). [6892

MAINS Transformer Service, Repairs, rewinds, or construction to specification of any type, competitive prices and prompt service.—Sturdy Electric Co., Dipton, Newcastle-on-Tyne. [0516

REPAIRS AND SERVICE

METROPOLITAN RADIO SERVICE.—Guaranteed repairs to American and British receivers; American valves, service parts and rewinds; trade supplied.—1021, Finchley Rd., N.W.1. Speedwell 3000. [0435

REPAIRS to Moving Coil Speakers a Speciality; cones and coils fitted, fields altered; prices, including eliminators quoted; loud speakers, 4/-; L.F. and output transformers, 4/-, post free, guaranteed satisfaction; trade invited, estimates free; prompt service.—Loud-Speaker Repair Works, 5, Balham Grove, London. Battersea 1321. [0394

SITUATIONS VACANT

WIRELESS Technicians.

FOR H.M. Forces.

SPECIAL Enlistment of Staff Sergeants.

VACANCIES Exist in the Armament Artificer (Wireless) Section of the Royal Army Ordnance Corps for Technicians to Undertake Testing and Overhaul of Military Wireless Apparatus.

APPLICANTS Must Have Sound Theoretical Knowledge of Wireless, and be able to carry out tests of a laboratory nature on wireless sets.

"ASSEMBLY Line" Testers and "Radio Service" Engineers Will Not be Accepted Unless They Can Produce Evidence of a High Standard of Theoretical Knowledge.

AGE.—Over 22 and under 30, except in special circumstances.

MAXIMUM Rates of Pay and Allowances.

SINGLE Men Living Out; £5/0/5.

MARRIED Men Who Have Attained 20 Years of Age and Who Fulfil the Conditions Governing the Issue of Family Allowance; £5/8/3.

MARRIED Men With 1 Child; £5/13/3.

MARRIED Men With 2 Children; £5/16/3.

WHERE Public Quarters are Allotted, the rates for married men will be reduced by 19/6 per week.

CANDIDATES May Live Out During the Course.

UNIFORM and Kit Issued Free on Enlistment.

PROMOTION for Qualified Men, and, subject, to satisfactory conduct, increases in pay after 8 and 13 years' service.

PENSION.

PENSION From 32/- Per Week After 21 years' Colour Service, according to ranks held.

SELECTED Applicants Must be Medically Fit, and pass a test in Radio Technology and the practical use of modern testing equipment. These tests are carried out at Woolwich and last about three days, the journey and stay being made at the applicant's own expense.

APPLICATIONS Should be Made by Letter Marked "A.A. Wireless," to the Commandant, Military College of Science, Woolwich, S.E.18, giving details as follows:—

1. Firms worked for, period and actual work undertaken.
2. General education. Technical education, subjects, periods and certificates.
3. Date of birth, if married, number of children. [8748

AIR MINISTRY.

AERONAUTICAL INSPECTION DIRECTORATE.

VACANCIES Exist for Unestablished Appointments as Examiners in the W/T and Instrument Branches.

QUALIFICATIONS.

APPLICANTS for Vacancies in Instrument Branch Must Have Good General Education, theoretical knowledge of physics and training in light engineering or instrument making. Candidates should be able to read drawings, understand specifications and use micrometers and other types of measuring instruments. If necessary, preference will be given to candidates having a good knowledge of thermometry and optical and pressure measuring instruments.

APPLICANTS for Vacancies in W/T Branch Having the Following Qualifications will Receive Preference: good general education, sound technical knowledge of high frequency engineering equal to City and Guilds final examination in Radio Communications, practical knowledge of modern W/T and electrical equipment. Candidates should be able to read drawings, understand specifications and use micrometers and other measuring instruments.

APPLICATIONS from Candidates Previously Declared Unsuccessful will be Considered, provided the necessary additional experience has been gained.

SUCCESSFUL Candidates will be Given a Period of Training in Inspection as Applied to These Subjects, not exceeding three months.

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Printed in England for the Publishers, ILIFFE AND SONS LTD., Dorset House, Stamford Street, London, S.E.1, by The Cornwall Press Ltd., Paris Garden, Stamford Street, London, S.E.1.
"The Wireless World" can be obtained abroad from the following: FRANCE: W. H. Smith & Son, 248, Rue Rivoli, Paris; Hachette et Cie, Rue Réaumur, Paris, and branches; Messageries Dawson, 4, Rue de Faubourg Poissoniere, Paris. BELGIUM: W. H. Smith & Son, 74-75, Boulevard Adolphe Max, Brussels. AUSTRALIA: Gordon & Gotch, Ltd., Melbourne (Victoria), Sydney (N.S.W.), Brisbane (Queensland), Adelaide (S.A.), Perth (W.A.), and Launceston (Tasmania). NEW ZEALAND: Gordon & Gotch, Ltd., Wellington, Auckland, Christchurch and Dunedin. INDIA: A. H. Wheeler & Co., Bombay, Allahabad and Calcutta. CANADA: Imperial News Co., Toronto, Winnipeg and Vancouver; Benjamin News Co., Montreal; Gordon & Gotch, Ltd., Toronto. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd., Cape Town. UNITED STATES: The International News Co., New York.

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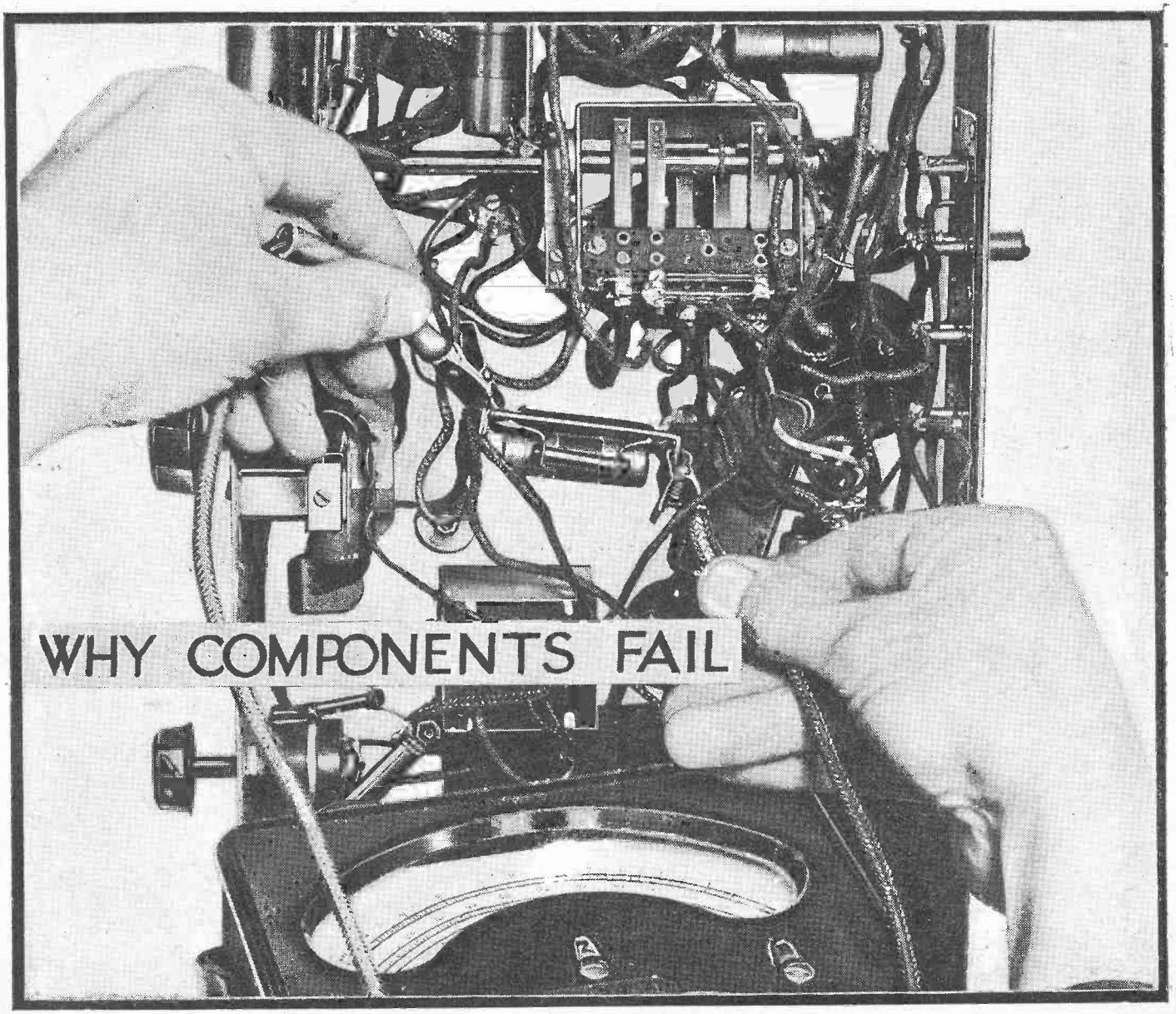
The Wireless World

THE PRACTICAL RADIO & TELEVISION JOURNAL

Thursday, September 7th, 1939



No. 1,045. Vol. XLV. No. 10.

The Wireless World

THE PRACTICAL RADIO JOURNAL

29th Year of Publication

No. 1045 THURSDAY, SEPTEMBER 7TH, 1939 VOL. XLV No. 10

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1.

Telephone : Waterloo 3333 (50 lines).
Telegrams : "Ethaworld, Sedist, London."

COVENTRY : 8-10, Corporation Street.
Telegrams : "Autocar, Coventry." Telephone : 5210 Coventry.

BIRMINGHAM :
Guildhall Buildings, Navigation Street, 2.
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Telegrams : "Iliffe, Manchester." Telephone : Blackfriars 4412 (4 lines).

GLASGOW : 26B, Renfield Street, C.2.
Telegrams : "Iliffe, Glasgow." Telephone : Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home and Canada, £1 10s. 4d. ; other countries, £1 12s. 6d. per annum.

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EDITORIAL COMMENT

Wireless and War

Services to the Nation

THOSE of us who have spent our working lives in the service of wireless must often have taken encouragement from the thought that the part we have played, humble though it may be, has contributed something towards the good of humanity. The record of wireless is indeed nothing to be ashamed of : we think of the thousands of lives saved from the perils of the sea by wireless telegraphy and of the interest and widening of outlook brought to millions by broadcasting. But it has long been a cause for regret to many of us that the self-evident potentialities of broadcasting in the cause of peace have been exploited with such poor success.

"Nation shall speak peace unto nation" was an inspiring motto for those responsible for British broadcasting, and it was one which they conscientiously strove to justify. That it has so far failed to achieve results does not imply that any blame is to be apportioned, and, even if it were, this is no time for recriminations.

International Broadcasting

Although wireless may not have succeeded in this respect, it has performed a wonderful service to everyone during the dark days of suspense. Anxiety and uncertainty has been relieved, and the extraordinary calmness of the British nation must surely be due in no small measure to the thoroughness of the B.B.C.'s news service. Other organisations that deserve the thanks of the world are the great American broadcasting networks. Considering their position as neutrals and making allowance for the Transatlantic tendency towards dramatisation of news, the crisis has been handled with admirable restraint. So far as broadcasts that we ourselves have heard or seen reported are concerned, nothing has been done to exacerbate the European situation ; on the contrary, obviously genuine efforts have been made to play the part of peacemaker. The broadcasting of news bulletins from America in the languages of all potential belligerents has probably done good. Coming from a neutral country, such messages probably carry more weight than if they emanated from a more directly interested and inspired source.

We must not delude ourselves into thinking that the kind of international short-wave broadcast to which we have just referred reaches a very wide audience. The number of efficient short-wave sets in use is still small, though the better types are now more readily available than hitherto. We can foresee a wide market for them when more normal conditions return. As a contributor says elsewhere in this issue, there is nothing like a good wireless set for collecting news ; it gives its owner the feeling of being in intimate touch with things as they happen, and he becomes something more than a mere spectator, remote and aloof from actualities.

Whatever the days ahead may have in store for us, there is one thing that we can face with the most serene confidence. The wireless service, though young in years, has already established a tradition of steadfast devotion to duty on the part of its personnel of which we are all justifiably proud. Maintenance at extreme efficiency of all forms of wireless communication is now vital to the successful prosecution of the war ; the various branches of the service may meet with difficulties that none of us can yet foresee, but, whatever these difficulties may be, communication will be maintained.

Why Components Fail

RELATIVE SUSCEPTIBILITY TO BREAKDOWN

By W. H. CAZALY, Grad.I.W.T.

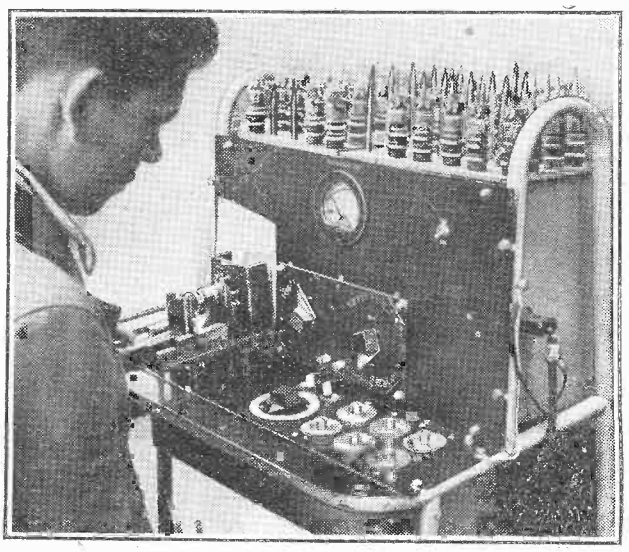
THERE is no substitute for the close inductive reasoning of which every serious radio man must be capable—especially if he has much to do with the tracing of faults in modern receivers. But out of experience comes an intuitive knowledge of where common troubles are likely to lie, and this enables the skilled man to short-circuit some of the laborious fundamental testing and go straight to the component that is the probable cause of the trouble. A knowledge of the primary causes of breakdown in generally used components is a useful aid to such speedy diagnosis.

Speaking very generally, it may be said that those components combining mechanical movement with electrical function are, on the whole, liable to develop unsatisfactory behaviour, if not complete failure, before the rest. It is probable, as a matter of fact, that such components only seem to develop faults before the rest because their physical movement reveals impending defects. In other components the process of deterioration is difficult to detect before the stage of complete failure is reached. Placing them roughly in order of liability to give trouble, then, volume controls of the high-resistance potentiometer type are notoriously liable to give rise to noises; switches seem to come next, then loud-speaker speech coils. In the class of fixed components, condensers seem to fail before resistors, and coils, including the windings of chokes and transformers, last of all. Valves are in a class by themselves. The nature of the defects to which these various components are liable will now be discussed.

A KNOWLEDGE of the liability to breakdown of the various components of a receiver often saves waste of time in searching for a fault; the present article discusses this matter and also describes the usual causes of failure.

In these days of AVC for preventing excessive amplification of signals in the RF stages, output level is usually controlled by high-resistance potentiometers connected across two points of AF difference of potential, such as the secondaries of transformers or the load circuits of diode dectectors. In these positions they seldom handle much power and the causes of their failure lie more in the inherent shortcomings of their materials and construction than in the functions they have to perform.

Potentiometers usually consist of a thin layer of composition resistive element fixed to an insulating base, and the moving contact is made by a squash-plate. The expansion with heat of the element itself may not be the same as that of the base to which it is fixed, and the frequent and considerable temperature changes that occur in a mains-driven receiver cause the element to crack. This may happen at some part of the element that is not normally used, either the extreme loud or low volume ends, and until the crack is complete it may pass unnoticed. Although the squash-plate is a far better method of making moving contact than a rubbing slider (which is liable to break up the smooth, hard surface of the element) it does not entirely overcome a very common difficulty which is known as "hop-off resistance." As the contact passes from the end contact to the body of the element, a sudden change of resistance in that arm of the potentiometer from almost zero to, perhaps, many thousands of ohms, takes place, and the volume, instead of decreasing gradually, does so abruptly. Again, since contact at the ends of the element is often made by painting with colloidal copper—finely divided copper or bronze particles suspended in liquid—this thin layer of copper paint may crack away from the element, and when the squash plate impinges on this cracked contact the resultant noises are only too familiar.



Courtesy Pye, Ltd.

Prevention is better than cure: testing and matching of components is an important part of factory routine.

Switches suffer from the effects of either dirt or oxidation. Rubbing contacts usually avoid these effects, but if the insulating material over which the rubbing contacts pass between the fixed contacts is soft, or itself likely to deteriorate with age through surface oxidation—ebonite is a frequent offender in this respect—it forms a layer on the rubbing contact. This can be removed with *very* fine abrasive paper. Pressure contacts in the better class switches are coated with some non-oxidising metal, and, as this is usually very thin, it should not be cleaned with abrasive; petrol, or even "penetrating oil," if afterwards removed, is best. The on-off switches in mains-driven receivers should, if of good quality, stand up to some 20,000 operations on full load of about 2 amps at 250 volts. Their failure is usually mechanical—the speed of opening the contacts falls and gives rise to arcing.

Speech Coil Defects

Considering the hard work they do, speech coils show a reliability that does credit to the immense amount of trial and research preceding their manufacture. Apart from obvious troubles due to incorrect centring and the like, they are liable to a loosening of the wire on the former, owing to the unequal expansion with heat of wire and former. This causes a shrill buzz, often only on certain frequencies, and the defect is usually not discernible when the coil is inspected cold. Coating the ends of the speech coil with cellulose or bakelite cement is always a wise precaution if nothing else is obviously wrong.

Electrolytic condensers are essentially electro-chemical devices, and their behaviour can therefore be upset both during the forming process in manufacture and in subsequent use by minute chemical impurities in either the electrolyte or the metal of the electrodes, especially the positive element, which is usually aluminium. The action of chemical impurity is cumulative, so that even if a film of oxide formed during manufacture on the positive aluminium is sufficiently continuous and thick to enable the condenser to pass ordinary tests, in subsequent use further electrolytic action will take place due to the impurity and result in corrosion of the electrode and the destruction of the oxide layer. Once a leakage path is set up by this process, heat generated at that

spot by the passage of current makes matters worse.

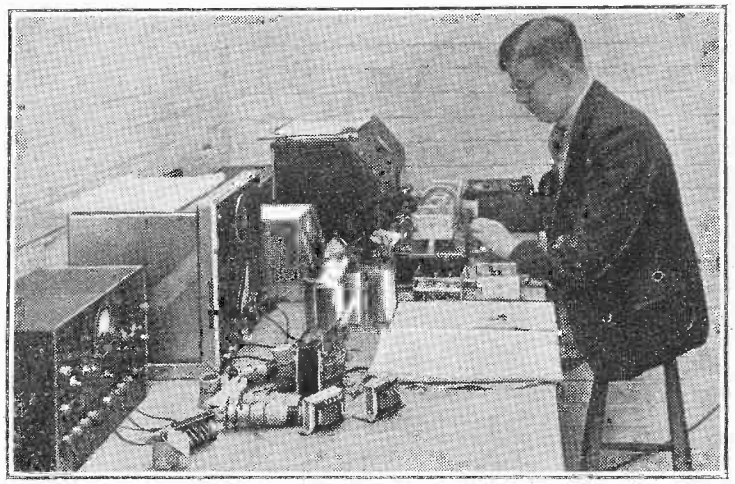
An electrolytic condenser has a limited "shelf-life": if not used, the oxide film slowly dissolves, and if, on again putting the condenser into use, the full rated voltage is applied, so much current passes that heat is generated and the oxide layer cannot re-form. Hence, a long disused electrolytic condenser should be gradually reformed by the application of low initial voltage which can be steadily increased until the rated value is reached. Loss of capacity is due either to drying up of the electrolyte or to the oxidisation of the aluminium where it is attached to the external lead—at which point soldering is almost impossible. Loss of capacity also occurs as a natural result of the passage of the small leakage current that is inevitable with electrolytic condensers: this current tends to exhaust the active chemicals of the electrolyte by continued electrolysis, or even to build up the oxide layer faster than it is dissolved by the electrolyte, making it a thicker dielectric.

Superimposed on the steady DC voltage, at which the condenser is designed to operate, there is very often an AC component—such as the ripple that electrolytic condensers are required to eliminate in smoothing circuits. This ripple voltage drives a current through the condenser which may be concentrated at spots where the oxide film is thinner and so give rise to localised heat. For this reason the breakdown of some component in another part of the circuit which tends to increase the ripple voltage—for example, a partial short-circuit of the HT supply so that excessive current passes through the smoothing choke, reducing its inductance—may cause an electrolytic condenser to break down. Although normally the temperatures reached in a mains driven receiver keeps the atmosphere round the electrolytic condensers dry, cases may arise in which the condenser can absorb moisture, which may cause internal sparking, with consequent charring of the impregnated cotton spacing between the electrodes.

Paper—dielectric Condensers

The larger solid dielectric condensers usually have aluminium foil plates, and the impossibility of attaching these to external leads by soldering gives rise to poor contact at these points and apparent loss of capacity. Short-circuits in such condensers, without the application of excessive voltage or the passage of AC, seem usually to be due to impurities in the paper or the wax used as the dielectric; leakage currents initiated by such defects give rise to localised heat and charring of the wax and paper.

Fixed resistors deserve a book to themselves. They are, as a matter of fact, a makeshift forced on us by the failure of Nature to provide us with a good choice of substances having specific resistance between that of the fairly good conductors and that of the insulators. Those that have such intermediate resistivity, such as germanium, are either rare and expensive or chemically and physically unsuitable. Moreover, it seems to be impossible to predict from its chemical or physical structure what the electrical behaviour of any compound is going to be, and knowledge in this direction is largely empirical. Hence, in order to obtain high resistivity with reasonable bulk and cost, resort is had to mixtures of a good conductor, such as powdered graphite, with insulating binders such as resins and clays, the mixture being subjected to various processes to render it durable. This is the modern method, and, fortunately, the day of the simple graphitic rubbing or painting on a stick of pipe-clay has gone: good modern resistors do not now give much trouble if they are not overloaded.



Courtesy Murphy Radio, Ltd.

At work in the Reject Analysis Department of a receiver factory. Here defects are investigated with a view to preventing their recurrence.

But certain shortcomings in composition resistors remain. For one thing, such mixtures are not very successful as elements in variable resistances, as has been indicated when discussing potentiometer volume controls, for which the element must be thin in order that the moving member can make some approach to contact with the main body of the element instead of merely with its surface. Moreover, certain heat and pressure treatments become difficult when the element must be annular in shape and fixed to an insulating base; thus something in the nature of a mixture of graphite with a gummy self-drying binder must be used. Since the high resistivity of the element is in this case obtained merely by the attenuation of the conducting paths through the body of the resistor, it is difficult for internally generated heat to reach the surface and be dissipated by radiation. Hence composition resistors cannot handle much power without the heat causing changes in the nature of the binder.

Then there is the difficulty of making effective contact with the element at the ends: usually this is done by a metal cap or wrapping of wire, and the application of a hot soldering iron may cause the contact to separate from the element or become loose. Finally, there is a curious electrostatic effect in composition resistors used in high voltage circuits. "Like charges repel . . ." and particles of graphite in the element similarly charged at high voltage may repel each other unless they are very firmly embedded in the binder. This causes the resistance to "go high," and was one of the difficulties that high-voltage television experimenters encountered. With a steep potential gradient through the resistor, too, internal sparking may occur, giving rise to crackles and intense local heat.

LF Transformers and Chokes

Now let us consider coils. Multi-turn windings are not used in modern receivers nearly as much as in early types, and to-day are found only in the form of mains and output transformers. Hence they are not prominent trouble-makers: for that matter, well-constructed transformers and chokes never did give much trouble unless grossly overrun.

Litz wire RF coils can still give rise to loss of amplification if soldered connections are made to their ends, but by fusing the strands together in a small hot gas flame and so welding them to a thicker lead, even this difficulty has been largely overcome.

Failures in iron-cored RF coils can be traced to either the penetration of moisture or to bad winding processes, and the latter is a negligible factor in the products of reputable firms charging economic prices for their goods. Mass-production winding machines are extremely expensive, and this must be taken into consideration when considering the prices of multi-turn coils: they cannot be efficiently produced at very low cost. Moisture in the windings causes corrosion by electrolysis and the generation of localised heat by leakage currents. Bad construction has the following effects:—

Overrun turns: superimposed layers press hard on the overrun turns to cause the wire to bite through enamel insulation and give rise to a short-circuited turn which, by induction, has excessive current generated in it, causing heat and further deterioration of insulation.

Loose winding: in circuits carrying power, insecure windings may vibrate just as the speech coil of a speaker, and this vibration, though of small amplitude, may rub off the insulating varnish, causing short-circuited turns. This is a very common cause of failure in mains input transformers.

Cheap and nasty varnish: this may contain acid impurities that corrode the copper, absorb moisture, and becomes

Why Components Fail—

brittle and easily cracked after a comparatively short period of use. The varnish will also have been put on unevenly, so that some parts of the wire are insufficiently insulated.

Poor quality flux for soldering fine wire to thicker leads is another common cause of breakdown. The traces of acid left give rise to corrosive electrolysis in use.

The cause of failure in valves depend essentially on construction. Of the purely electrical causes of failure, probably the commonest is the underheating of the filament or cathode. In mains values, the cathode heats unevenly, so that the full voltages are applied to the HT electrodes while parts of the cathode are still comparatively cool. This gives rise to loss of emission at these parts, since the emissive material on the surface is stripped by the high voltages. Moreover, the high voltages impart such velocity to the electrons that if there is the slightest trace of residual gas, such as occluded gas or that entering by an ultra-microscopic crack at the sealing of the leads into the glass, ionisation takes place and the cathode surface is disintegrated by bombardment with positive ions. The changes of temperature undergone by the cathodes of mains valves causes the insulation to crack sooner or later, when leakage occurs between the heater and the cathode surface. In battery valves, especially the output valve with its thick filament and high anode voltage, the filament is destroyed by ionic bombardment. In fact, it may be said that the strain put on valve cathodes at the times of switching receivers on and off is responsible for their deterioration more than many hours of steady and continuous use.

On the Short Waves

PREVAILING CONDITIONS ON THE VARIOUS BANDS

AFTER a spell of poor conditions around August 22nd, short-wave conditions improved considerably and at the moment of writing are up to the best sunspot maximum standards. Early on the evening of August 30th, the presumably rather low-angled radiation from the American stations W2XE and WNBI in the 17 Mc/s band was on rather *too low* a frequency for the conditions then prevailing. At 10 p.m. G.M.T. on August 29th, the Rio telegraph transmitter PPX on 20 Mc/s approx. was still an R9 signal.

These good conditions are undoubtedly connected with the presence on the sun's surface of a sunspot covering 800 millionths of its disc during the period August 26th-September 7th. Associated with it was a bright chromosphere eruption of magnitude 3 and August 29th from 08.51 to 10.10 G.M.T.

One effect of these excellent propagation conditions during the "war of nerves" period must not be overlooked, and this is that the B.B.C.'s Daventry transmitters GSE on 11.86 Mc/s and GRX on 9.60 Mc/s during the daytime and GRX and GSA on 6.05 Mc/s during the evening must have been particularly well received in Europe, if not throughout the world. Judging by the signal strength of GSA in London recently, special aerials are probably being employed in connection with the two transmitters regularly employed on this European Service.

To revert to the performance of W2XE and WNBI, one notes that W2XE's new channel is quite clear of interference, and is a big improvement on the old shared channel with DJE, both W2XE and WNBI have been excellent, and have "covered the European crisis" from many angles—especially W2XE.

W2XE's programme during the late evening and early morning of August 29th-30th gives a good idea of how thoroughly European events were handled.

(1) Talk by C.B.S. representative in Paris.

(2) Talk by H. G. Wells and the C.B.S. representative in London.

(3) Talk by C.B.S. representative in Berlin.

(4) Talk by Mr. Douglas Reed, late of London *Times*.

(5) Talk by Dr. Kaltenborn, of C.B.S., from London.

(6) Talk by Y. Masyryk—Dr. Masyryk's son—from London.

(7) Final summing up by Dr. Kaltenborn.

It should be stated that W2XE closes down at 10.00 p.m. G.M.T. on 17 Mc/s and reopens at 10.30 p.m. G.M.T. on 11.83 Mc/s. This latter frequency is also well received, especially after midnight.

Although the American short-wave bands have been dominated completely by W2XE and WNBI, good signals have also been intercepted from WGEA on 15.33 Mc/s (19.56 m. formerly W2XAD) and news from W1XAL on 11.79 Mc/s has also been readable round 11 p.m. in spite of a high level of atmospherics on occasions.

Although the notes above indicate that there has been during the past week at least a temporary return to almost sunspot maximum conditions, it should be borne in mind that the tendency from now onwards will be for the optimum frequencies to get lower and lower and working waves to be longer for any given path and time.

The following quotation is taken from a paper read by D. R. Goddard, of R.C.A. recently, "The British afternoon (television transmissions on 41.5 and 45 Mc/s) programmes between 9.30 a.m. and 11.30 a.m. New York time, could be received at times during certain winter months with some clarity. In the past few years, the latest date for which reception is possible has been steadily receding from March through February to January, and it seems probable that next winter (as the sunspot approaches) no reception at Riverhead of these signals will be possible after December 31st."

With this disappearance of the 7-metre signals we may also expect to see the complete disappearance of amateur 5-metre signals across the Atlantic since all the recorded cases of transatlantic transmission appear to have been via the normal F-layer mechanism, as distinct from the U.S. lower atmosphere transcontinental phenomena of last year. Amateur communication on 10 metres (28 Mc/s) will also suffer to some extent, but 28 Mc/s conditions during the last sunspot minimum showed a peculiar habit of becoming quite good when the sun's face was completely devoid of spots. The reason for this anomaly is not clearly understood and will probably be the subject of further investigation in 1944 or thereabouts. It is just possible that the somewhat higher frequency television transmissions may behave in a similar way, but more erratically.

In conclusion, one notes that W2XE on 17 Mc/s is at the moment giving the latest news summaries in German, Polish, French and Italian, at 9 p.m. G.M.T. The inclusion of Polish is noteworthy and constitutes a precedent.

"ETHACOMBER."

Henry Farrad's PROBLEM CORNER

No. 36.—Mysterious Disappearing Trick

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction :—

Rose Cottage,
Nitting Sockbury,
Worcs.

My Dear Henry,

You will be interested to know I have gone in for a new wireless! Well, it *was* getting a bit *passé*, if I may say so; and then when that interesting man spoke some time ago—Mr. Voltson Volt, wasn't it?—and made such queer noises, he quite convinced me that it was time to get a new one. One thing I particularly remembered that he said was if you wanted to get the best results from *all* stations you had to get a set with *Variable Selectivity*, so I made a special point of this when I went to buy mine.

It was a bit rash, I suppose, getting one without asking your advice first, Henry; but it does bring in a wonderful lot of stations when you turn the knob only quite a little way round. I cannot understand what they all say, except that some of them seem very angry. Most of them come in only one at a time, which I am afraid they *never* did on the old wireless! But there is one thing that seems rather queer, and I wonder if you can explain it. The book says that if you want to get the best tone you should have the variable selectivity knob fully to the right; then if you get other stations interfering you turn it to the left until they disappear. Well, I have tried this; and instead of the interfering station disappearing it was the one I wanted that disappeared! Wasn't that a strange thing?

Yours very sincerely,
Jane Stoughton.

Why does the variable selectivity behave in this way, and how can it be put right? *Solution on p. 232.*

Impressions of Olympia

"DIALLIST" LOOKS BACK AT THE SHOW

HAVING read that there was to be an Export Section at Radiolympia, I saw in my mind's eye a cluster of smallish stands—small because they would display only selected products—presided over by bronzed men well versed in what is needed in the way of radio receivers in the far countries of the Empire, and surrounded by other bronzed men, eager to see the receivers designed for their special requirements. The Export Section, I decided, would contain things of special interest to readers of *The Wireless World*: for the set that will receive Daventry in Canada or Australia or India or South Africa should also be just the thing for receiving Canada or Australia or India or South Africa if used in this country.

Hence, when I had made the first rather rapid preliminary tour that is my wont, I asked a commissionaire if he could direct me to the Export Section, which I hadn't so far observed.

"Couldn't say, sir," he replied; "perhaps this other commissionaire knows. George, where's the Export Section?" But George didn't know. Nor did Charlie when hailed by George, or Bill when Charlie applied to him.

However, I espied the stand of the Department of Overseas Trade and felt sure that they would put me right. They did. If I would but turn about in their doorway where I was standing, there would be the Export Section before my eyes.

It was rather a blow to find that it consisted of a single large stand, at the back of which were a number of show cases. In these were receivers and components; and notices referred one to the main stands of the firms that produced them. I suppose that really it wasn't a bad idea, for you'd only to jot down the numbers of these stands to know where the oversea goods were. But I would have liked to see my cluster of stands, my bronzed men demonstrating and buying . . .

And there was plenty at Radiolympia to have made a full-dress Export Section, or a Long-distance Section—or both. You found that when you came to go round the stands and to examine their wares in detail. I don't know how many sets there were, for instance, in which there were two or more short-wave ranges instead of one, but there were certainly a good few.

Short-wave Sets

Some time ago I wrote that the tuning of the "all-wave" receiver with a single short-wave range and no kind of band-spreading arrangements was apt to demand more patience than its owner might care to devote to searches for stations on wave-bands such as the 16-metre, the 19-metre and the 25-metre. There are welcome signs that designers have realised that if they want short-wave reception to be popular they must make it as easy as the price of the set will allow.

One receiver has gone the whole hog. It covers only the 13-, 16-, 19-, 25-, 31- and 49-metre bands and none of the intervening wavelengths. But it devotes a full-scale sweep to each of these six bands; and what is more it bears the actual names of over 100 short-wave stations, whose exact setting are marked on the scales.

In a word, it aims at making the reception, not only of WGEA, WCAI, XGOY and other strongly received short-wave stations, but also of dozens of the smaller fry as easy as that of European medium-wave stations. That is indeed a laudable effort, and I look forward very much to trying one of these sets a little later on.

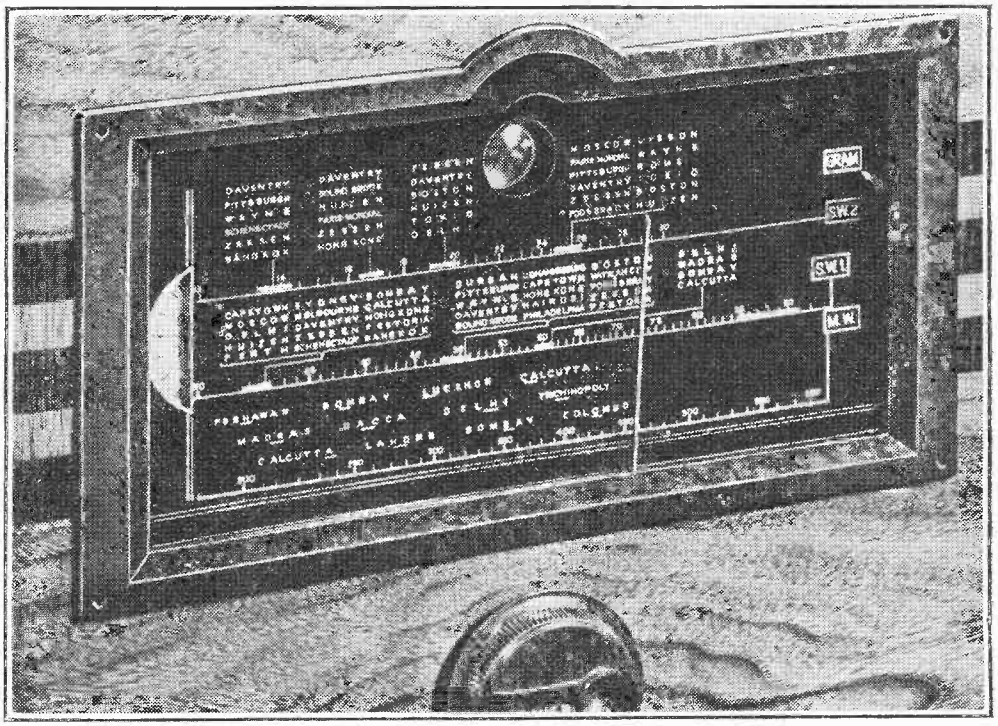
I was much attracted by the ingenious methods used by other designers. Some employed band-spreading of one kind or another; others pinned their faith to bigger and more clearly marked dials with finer pointers than in the models of yester-year; others, again, were waging war against second-channel "images" and whistles by the use of signal-frequency stages.

All of the "all-wave" models shown by one firm had a range of from 50-150 metres. These, I take it, are made with an eye to the markets of India and other countries, where wavelengths of that order are authorised for the internal broadcasting services. In this country such a range has its uses, for it takes in two amateur bands and yacht telephony.

Some time ago numerous readers corresponded with me on the subject of really universal sets: sets that would work equally happily on AC mains, DC mains or batteries. There was a most ingenious portable on these lines at the show. The "working" valves are of the battery low-voltage low-current filament type. Their filaments are arranged in parallel when the batteries are in use, but in series for mains heating. The dry batteries used are contained in one and the same cardboard case, and both LT and HT connections to them are made by means of a 4-pin plug and socket. Grid biasing is automatic.

One striking demonstration given to me by the designer was to insert the mains plug into its socket and switch on. The set came to life instantly, the batteries doing duty until the rectifier had warmed up to a certain temperature. When that was reached, there was a slight click: by means of a relay the batteries had been cut out and current from the mains cut in. If the mains current was switched off, the relay immediately brought the batteries into action again.

I'm not sure that that principle isn't worth adapting to sets other than portables. Is there anything more annoying than when you suddenly realise that some item you specially want has just begun, switch on and have to wait what seems hours for the heaters to warm up?



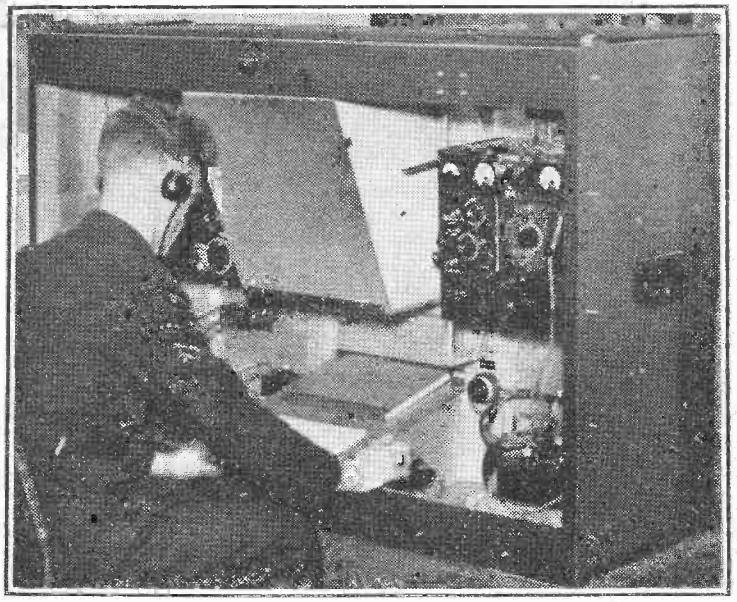
An Export Section exhibit. The tuning scale on the Marconiphone Model 808 universal six-valve superheterodyne is calibrated with the names of 12 Indian stations on the medium-wave band which covers 200-580 metres. The shorter wavelengths are covered in two ranges 13-30 and 30-90 metres. It is adjustable for any mains voltage between 105-255. Tuning is made easy by the incorporation of the Thaumoscope visual tuning indicator.

Impressions of Olympia—

I don't know if I was specially lucky, but I seldom had any difficulty in finding at the stands I visited someone who would deal with technical questions. In past years one has too often found, on returning hopefully at intervals to a stand where there was something of particular interest, that the only technical man provided appeared to start on tea as soon as he had finished his lunch and on dinner the instant his teacup was empty.

Makers have realised that what the great public is yearning for above all things in their receivers is reliability. At stand after stand I was told of the steps that had been taken to ensure it, and of the amazingly complex tests to which sets are subjected before they leave the factory. The lessons of the past have been taken to heart, and I do think from what I saw of the insides of sets and of the components therein that real progress has been made in this respect.

Another thing that impressed me was the stress laid by many firms on the quality of the reproduction given by their better models. And, listening to the questions asked by Mr. and Mrs. Everylistener, I found something of a change there also. The first enquiry always used to be: "Will it bring in every station in Europe?" or "Will it get America?" This year I heard many lead off with questions about the reproduction of the local 'stations' programmes, absence of hiss, hum, other hateful background noises, and so on.



"The Services' stands were of considerable interest." This portable ground station, which was among the interesting apparatus to be seen on the R.A.F. stand, consists of the transmitter and receiver as used in a 'plane. Complete with message pad, key and 'phones, they are fitted into a metal cabinet the front of which is covered by a drop sheet.

Radiolympia 1939 was certainly the most stunt-free exhibition that I can remember. And that, I feel, is a very good sign. Manufacturers had come down to brass tacks and were showing the public what the public had come to see.

No Longer a Marvel

They had come to see television receivers as well as wireless sets. There wasn't much doubt about that. And my impression, from what I saw and heard here and there, was that the period of mere marvelling at television was over: the enquirers were fully alive to the entertainment value of television, and most of them were seriously considering the installation of receivers in their homes, if they hadn't already made up their minds to do so.

The Services' stands were of considerable interest, though the organisers of each were naturally much handicapped by not being able to display devices that would indeed have produced thrills! But what they gave us was enough to show that they aren't exactly behind the times. Something more than a word of thanks is due to the able and most willing demonstrators on all these stands.

There are those, and I am one of them, who lament that the fun-fair side of the Exhibition was so strongly stressed in the advertisements of Radiolympia. These urged you to come and be televised, to visit Miss Radiolympia's boudoir, to see the stars in the theatre; they also mentioned that there were wireless sets and television receivers on view. It was the worst of bad luck that the Exhibition should coincide with the crisis. But for that, I feel that it could well have stood on its own feet as a radio show, without the help of the boudoir or the great bowl theatre. The purely technical "sideshows" always seemed to be well patronised, and it was noticeable that many of the visitors were professional wireless people.

HENRY FARRAD'S SOLUTION

(See page 230)

IF the instruction book is correctly quoted by the correspondent, it is not a very good one. Stations should be tuned in first with the *greatest* selectivity, and the response then broadened out if conditions permit. If a station is tuned with least selectivity, it is difficult or even impossible to do so accurately. Especially is this so if the variable selectivity is not much more perfect than is often the case. A common fault is that the response curves at the extremes of the selectivity control are something like those shown here. When tuned at the least selective setting it is natural to bring the wanted station, W, in line with the peak. If the frequency separation of an unwanted station is represented by that between W and U, it is likely that some interference from U will be heard. If the selectivity is increased to get rid of U, it can be seen that W will be cut out and U remain almost unaffected.

Although this asymmetrical broad response curve is not ideal, the system could at least be made to serve its purpose by tuning with maximum selectivity. W would then come where U is shown, and U would be excluded. Conditions permitting, the best would also be obtained from the wide response adjustment.

Theory and Design of Valve Oscillators, by H. A. Thomas, D.Sc., M.I.E.E. Pp. 270+xvi. Published by Chapman and Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price 18s.

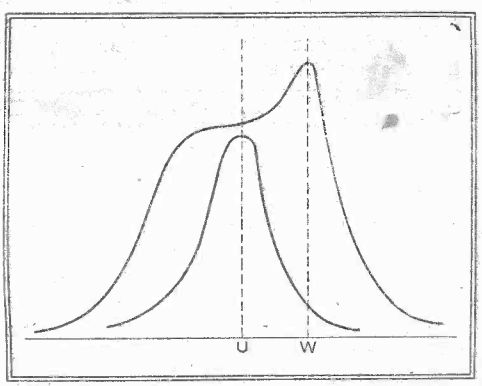
THIS book is Volume VII of a series of monographs on electrical engineering and deals very thoroughly with the problems associated with valve oscillators. Fundamental principles are treated in the first chapter and types of oscillators and the conditions for oscillation in the second. Here the close relationship which exists between many apparently dissimilar circuits is well brought out by their derivation from a single prototype. The dynatron and multi-vibrator are not omitted, and in Chapter III the efficiency of oscillators is dealt with in some detail.

This occupies 76 of the 270 pages, and apart from the bibliography and index the rest of the book is devoted to the problems of frequency stability in one form or another. There are chapters on frequency drift due to the valve, to the effect of temperature on the coils, the effect of temperature on condensers, as well as the stabilisation of the maintaining system, the inductance, and the capacity. The book concludes with a chapter on methods of obtaining automatic frequency stabilisation.

Crystal-controlled oscillators are not treated, the discussion being confined to uncontrolled oscillators. Among the methods of stabilising the valve circuit, it is shown that much can be done by the choice of suitable circuit values. The author gives a list of seven principles, which are not mutually exclusive, by the observance of which a considerable improvement can be obtained. Special circuits, such as the Franklin oscillator, the phase-compensated oscillator, the line-stabilised oscillator, the Kolster high-Q circuit, and the Dow circuit, are dealt with.

It is often believed that frequency variations are due chiefly to the valve and the voltage supplies. The author shows that while they undoubtedly affect the frequency appreciably, the effect of temperature on the coils and condensers is often much greater. The chapters dealing with the stabilising of inductance and capacity are thus especially important.

The book is admirable for its lucidity and accuracy. The treatment is often mathematical, but it is rarely necessary to follow the equations in order to obtain a qualitative understanding of the subject. The book is consequently of considerable value to the non-mathematical, and can confidently be recommended to all interested in this important subject. W. T. C.



Typical resonance curves for alternative settings of a selectivity control.