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EDITORIAL COMMENT

Talk of Saturation

What Effect Will It Have ?

THERE has been a distinct falling off in the rate of increase in broadcast licences. This has led to more talk about saturation having been reached, and brings us face to face with the necessity for looking to the future supply of wireless sets to the public as mainly a replacement market.

The arrival of saturation must have a pronounced effect upon the trend of development of broadcast receivers, the attitude of the public buying them, and the problems of the salesman. There is a very great difference in the attitude of a buyer who says "I want to buy a wireless set" and one who says "I want to buy a *new* wireless set." Sales to those who have not previously owned a set have been comparatively easy, but the owner who contemplates buying a new set approaches the question very differently. He has had experience of wireless reception, his existing set probably still works well enough for the purchase of a new set not to be a matter of urgency, and he will want to know exactly what are the advantages to be obtained from the new model before he commits himself to a purchase. He will in all probability examine the claims of respective makers very carefully before he makes his final choice.

More Discrimination

This leads us to the logical conclusion that the successful manufacturers of the future will be those who produce sets with features of superiority and who do not merely manufacture, at a lower price, sets having a performance only equivalent to those already in the hands of the public. The manufacturer, too, will find it essential to talk intelligently, both in his literature and publicity matter, to prospective buyers who are already knowledgeable and experienced in the use of a set, and who will want to know far more about the next set they buy than they did in the case of their first purchase.

What is a Valve ?

Need for a Simple Definition

WILL some learned judge kindly oblige by asking the simple question "What is a valve ?" or better still, "What is a five-valve receiver ?"

In a County Court case reported recently the judge decided that the description "all-mains set" entitled the purchaser of an instrument so described to believe that it would work on any type of mains supply. This is an obviously sensible interpretation of the description but one which does not coincide with the meaning generally accepted by wireless people, who have for long described as an all-mains set any receiver which was independent of batteries.

In last week's issue an article discussed the position which has arisen as a result of the production of multi-valve types, rectifiers and other non-amplifying devices which are often included in the description of the number of valves in a receiver. It was shown that to-day it is hard to arrive at an idea of the performance of a set from a general description which states the number of valves without discrimination.

It may be that some naïve enquiry by a learned judge will provide in the same way the answer to enable us to distinguish between valves and valve stages and all those gadgets classified collectively as valves but which are in fact something else.

Synchronising in Television

WHEN THE AMPLITUDE FILTER CAN BE OMITTED

By CHRISTOPHER TIBBS
(Ultra Television Research Dept.)

IT is the usual practice to employ a special sync separation circuit to ensure that the sync pulses fed to the time-bases are unaffected by the vision signal. It is shown in this article, however, that when gas-triode saw-tooth oscillators are used a sync-separator is unnecessary if the proper precautions are taken.

THE designing of modern commercial television receivers might be called Economic Engineering, consisting as it does of a continual fight to reduce their cost. Upon examination of the cost of a television receiver one item stands out above all others, that of the valves, which may amount to as much as 25 per cent. of the total cost.

Most receivers on the market to-day use from one to three valves, serving no other useful purpose but that of separating the synchronising pulses from the picture intelligence and applying them to the time bases. If these valves, complete with all their associated components, could be removed lock, stock and barrel from the receiver and good synchronisation still be maintained, this would be a stride in the right direction.

The Ultra television receiver incorporates a unique circuit arrangement which supersedes the need for any separate valves or components to synchronise the receiver time-bases. In this circuit the gas-triode discharge valves in addition to generating the sweep voltages, separate the synchronising pulses from the picture intelligence. It is the purpose of this article to describe the circuit used and its action.

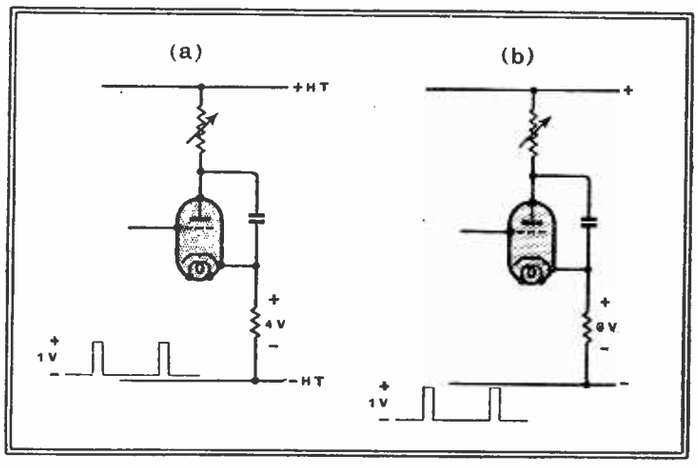

Fig. 1.—In (a) there is 4 volts standing bias derived from the cathode resistance and one volt positive synchronising pulse, but in (b) there is 3 volts bias derived from the cathode resistance and one volt extra bias which collapses during a synchronising pause. As far as the gas-triode is concerned the two conditions are the same.

We will first consider the normal method used to synchronise a gas-triode time-base. The gas-triode will have a standing bias of, say, 4 volts, which is usually derived from the voltage drop across a resistance inserted in its cathode circuit, as shown in Fig. 1. A synchronising pulse is manifest on its grid as a positive kick, which has an amplitude of the order of 1 volt. Considered in another way the grid bias on the valve is 4 volts during the transmission of picture intelligence and 3 volts during a synchronising pulse.

With the new method the gas-triode has the normal cathode resistance, across which the standing bias voltage is developed, but in this case the resistance is lower in value, only 3 volts being developed across it; Fig. 1 (b). The result of this is that at all times, other than that occupied by synchronising pulses, 1 volt extra negative bias must be maintained on the valve grid if the conditions are to simulate those of the normal synchronising circuit.

It will readily be seen that if a point can be found anywhere in the receiver which is at least 1 volt negative with respect to the −HT rail during picture intelligence and is at the same potential as the −HT rail during a synchronising pulse, the normal conditions will be simulated if the gas-triode control grids are connected to this point.

We are lucky in that we have not far to look in order to find such a point; it is the live end of the diode load. In order that the exact arrangement of this section of the circuit may be understood, we will look at Fig. 2 for a minute. The most important point to be noticed is that a VF amplifier is used after the diode detector. The importance of this valve is that, in addition to amplifying the vision signal, it inverts the signal waveform.

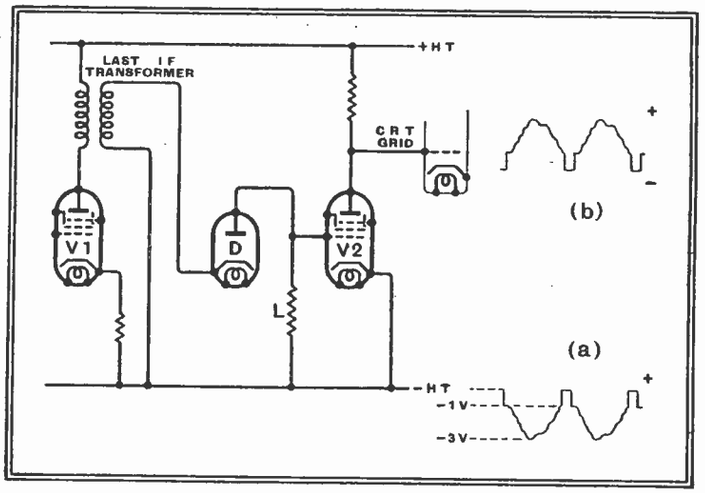

Fig. 2.—This diagram shows the vision output circuit used with the new system of synchronising. The waveform (a) is that across the diode load L and (b) is the waveform on the grid of the cathode-ray tube.

Operating Conditions

As a positive signal (i.e., white corresponding to a positive voltage excursion) is required on the control grid of the cathode-ray tube, the signal must be negative on the diode load (i.e., white corresponding to a negative voltage excursion) in order to compensate for the phase reversal of the VF valve. One end of the diode load is connected to the −HT rail, and therefore the other, the live end, must be negative with respect to −HT during the transmission of picture intelligence. If we assume that 3 volts are developed across the diode load for a peak white, then a black will be represented by 30 per cent. of this voltage, or approximately 1 volt. A synchronising pulse is transmitted as a complete cession of carrier, and therefore during both line and picture pulses there will be zero voltage

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across the diode load. This results in the live end of the diode load being, at all times other than those occupied by synchronising pulses, from one to three volts below the −HT rail. The exact amount negative will depend upon the brilliance of that part of the image which is being transmitted.

Glancing back at the requirements of the gas-triode as regards synchronising, it will be found that they line up with the conditions existing on the live end of the diode load. Let us therefore connect its grid to this point, as shown in Fig. 3, and consider the voltage conditions existing between its grid and cathode. An initial bias of 3 volts is provided by the cathode resistance of the gas-triode. During a synchronising pulse this will be its only negative bias, whilst during the transmission of a black the total bias will be increased to 4 volts. The extra volt will be that generated across the diode load. As pointed out earlier, if the brilliance of the image is raised above that of a black, the voltage across the diode load increases. Taking, for instance, a white, we will have 3 volts developed across the diode load and another 3 volts due to the gas-triode cathode resistance, giving a total bias of 6 volts. The valve will remain in a cut-off condition so long as the bias does not drop below 4 volts, any increase in the bias merely tending to make doubly sure that it will remain in a cut-off condition.

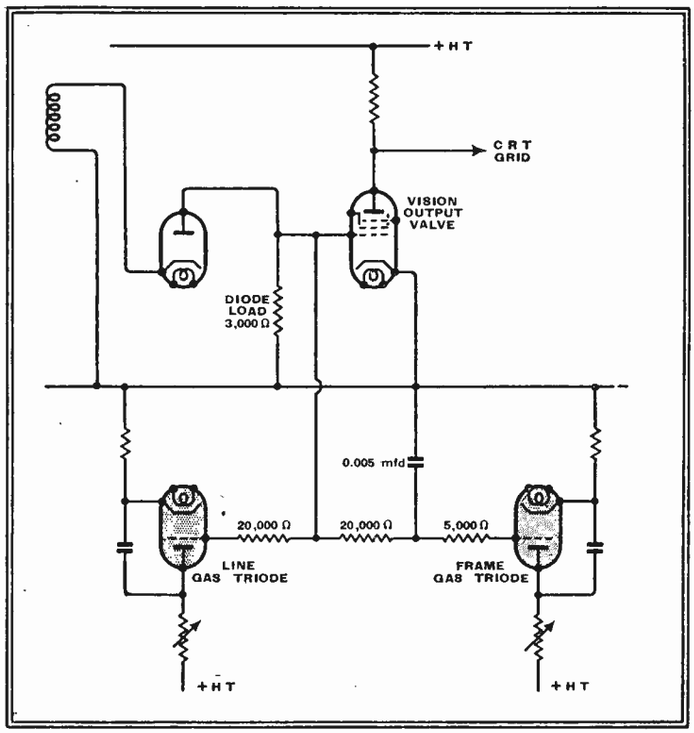
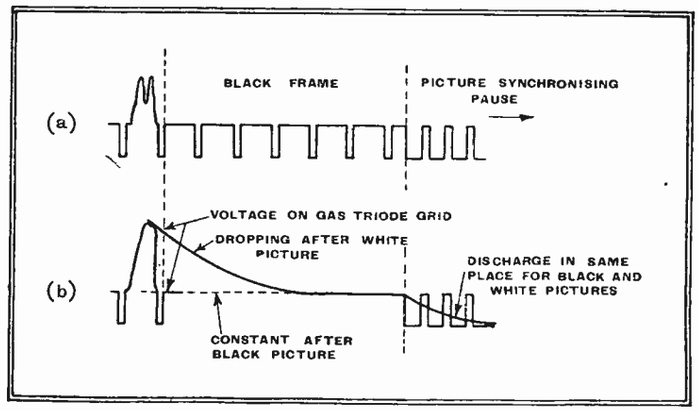


Fig. 3.—The complete synchronising circuit is given here together with the values of components.

A chart of the conditions existing in the gas-triode cathode-grid district is shown in Fig. 4. This chart makes the source of all the component sections of bias quite clear.

Having dealt with the theory of this method of synchronising we will pass on to the individual time-bases and deal with the practical difficulties encountered. It is most important, if the faults described later are to be avoided, that the line gas-triode grid-cathode capacity is kept to a minimum.

Fig. 5. — Provided that the grid time constant is shorter than the time occupied by the black frame, the picture discharge will be independent of the mean brilliance of the image, as indicated in this diagram.



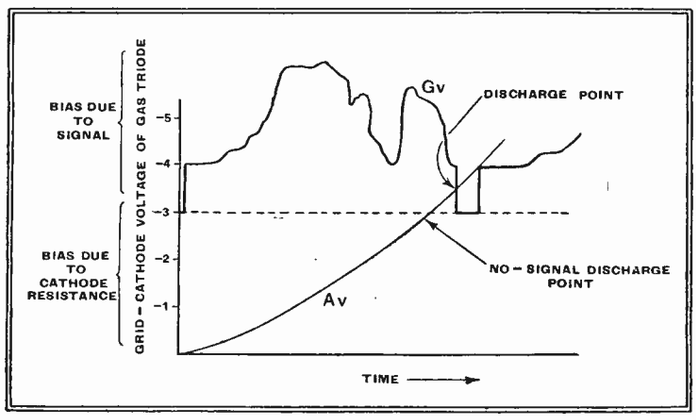


Fig. 4.—This chart shows the source of the component sections of bias. Gv is the actual voltage between the gas-triode grid and cathode, and the curve Av is the voltage to which the bias must drop at any time for a discharge to take place.

Due to causes which will be dealt with later it is necessary to insert a resistance of approximately 20,000 ohms between the grid and the diode load. This resistance and any capacity across the input of the gas-triode will form a circuit having a time constant which will temporarily maintain the bias on the grid after it has fallen to zero on the diode load. The first effect of this will be that the time-base will fire late, which will call for an excessively rapid fly-back for the spot to be at the beginning of the next line upon the commencement of the picture intelligence. The second, and by far the more objectionable, effect will be that of "pulling on blacks." If one line ends with white and the next with black, the grid input-capacity will take longer to discharge on the first line than on the second. This will result in the time base firing later on the first line than the second. These irregular time-base discharges, or the phase displacement of lines by picture intelligence, are commonly known as "pulling on blacks."

Interlacing

The point which requires most attention in synchronising the frame time-base is that of the interlacing. In the waveform transmitted from the Alexander Palace there are about six lines occupied by an unmodulated black frame which precedes every picture-synchronising pulse. Fig. 5 (a) shows the waveform before a picture-synchronising pulse.

It is necessary to connect a condenser across the frame gas-triode grid-cathode circuit in order to maintain the voltage across it during the line pauses, so ensuring that it will not be triggered by them. If the time constant formed by this condenser and the grid series resistance is less than six lines it is immaterial whether the preceding picture has been black or white. In each case the voltage on the grid will have settled down to the same value before the commencement of the frame-synchronising pause. As the voltage on the frame gas-triode grid is substantially the same before every picture pause, and always collapses at the same rate upon the commencement of a pause, it follows that the discharge will take place at a given time after the commencement of each picture pause. As the transmitted picture pauses are displaced from each other by half a line, it follows that the picture discharges will take place at intervals also displaced from one another by half a line, resulting in a reliable interlace.

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Should the value of the grid condenser be made too large, the frame synchronising will be influenced by the mean brilliance of the transmitted image. The result of too small a grid condenser is insufficient attenuation of the line synchronising pulses and consequent destruction of the interlace.

Upon a discharge taking place through a gas-discharge triode the grid will be in an atmosphere of ionised gas, and will therefore tend to assume a voltage somewhere between that of the anode and the cathode. If, for example, there are 3 volts bias derived from a cathode resistance, the end of which is connected to −HT, then during a discharge the grid will be at least 3 volts positive with respect to the −HT rail. The practical result of this is a positive kick of some few volts (the amplitude will depend upon the value of the grid resistance employed) on the gas-triode grid every time a discharge takes place.

Let us assume for the minute that in order to synchronise the two time-bases we connected the line and frame gas-triode grids together on the live end of the diode load. As pointed out above, each grid, in addition to the signals received from the diode, would be contributing a pulse every time a line or frame discharge took place. The frame time-base would, under these conditions, be fired some few lines too early, due to the spurious signals generated by the line oscillator. In a similar way the line oscillator would have the bias on its grid reduced during a frame discharge, with the result that it will fire before it has received its correct synchronising pulse. The result in each case would be that the interlace is destroyed.

Gas-Triode Input Circuit

If, as shown in Fig. 3, a resistance is placed in series with the load to each gas-triode grid, the kicks generated there will have their amplitude appearing across the diode load reduced by the ratio of the series resistance to that of the diode load. In practice a ratio of 8 or 10 to 1 is found quite satisfactory and the faults described above are avoided. This arrangement results in each valve receiving the full voltage developed across the diode load, but at the same time contributing a minimum signal itself.

The resistance shown in Fig. 3 between the frame gas-triode grid and the 0.005 μF. condenser is to safeguard the valve from the excessive grid current which would otherwise flow as the result of the low AC grid return path formed by the condenser.

The synchronising system outlined above is extremely useful in conditions of severe interference. When correctly adjusted it is literally impossible to distinguish major objects in the image before a single line is tripped by the interference. The reason for this remarkably solid synchronising lies in the fact that it is necessary, in order to upset the time-base, to do one of two things. Either the carrier must be cancelled out long enough to trigger the gas-triode or the synchronising pause must be completely filled up with interference. The chances of either condition arising are very remote. The very simplicity of the system renders failure to synchronise in a correctly adjusted circuit virtually impossible.

In conclusion, it may be added that the system, which is the subject of a provisional patent, has proved eminently satisfactory in every one of the hundreds of television receivers to leave the Ultra factory.

In America Today

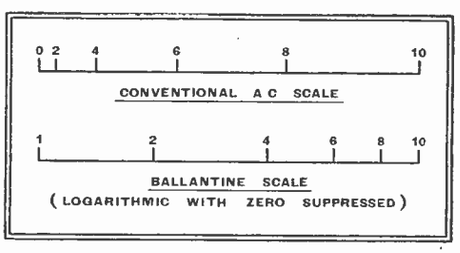
By Our Special Correspondent

THE BALLANTINE SENSITIVE AC VOLTMETER

AT the annual convention of the Institute of Radio Engineers at New York City there was shown the new Model 300 Ballantine Sensitive Voltmeter, due to the Ballantine Laboratories of Boonton, N.J. This device consists of a DC meter preceded by a rectifier and a multi-stage high-quality amplifier having fine and coarse gain controls. The possibilities of such a combination have been utilised skilfully by the designer, Mr. Stuart Ballantine.

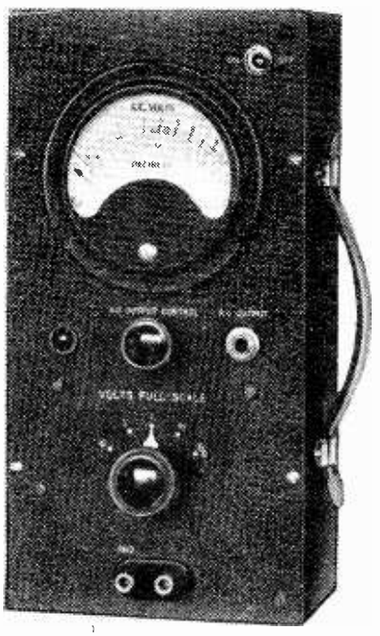
The meter and the circuit conditions are so chosen that the meter-scale is linear if considered in decibels; therefore, if calibrated in voltage the crowding takes place at the upper end, while the lower end is more open than that of a DC meter. The result is a very considerable increase in the ease of reading, a point better appreciated after a glance at the accompanying sketch of the Ballantine scale and that of a conventional AC meter. The zero does not appear on the Ballantine meter since a logarithmic scale has no zero point. When at rest the meter needle is somewhat to the left of the scale. A decibel scale is also provided as a matter of convenience. Its zero has arbitrarily been placed opposite 1 of the voltage scale, whereupon the 20-decibel mark necessarily lies opposite 10 on the voltage scale.

To secure proportionality between AC input to the amplifier and DC output from the rectifier to the meter it was essential



The scale of the Ballantine meter is shown here in comparison with an AC scale of ordinary type.

to cause the rectifier to act in a nearly ideal manner, which is to say its rectification characteristic must show a form approximating to two straight lines joined at an angle—not by a curve. Furthermore, it is necessary to make the entire system rather obtuse to changes in the amplifier tubes, due to either ageing or replacement. These two aims were accomplished by introducing amplifier feedback, which involves the rectifier. Fairly obviously, the effect of line-voltage changes is also reduced by such a circuit. A less obvious advantage is that the device is less influenced by harmonics than if the rectification were improved by resistance-ballasting. This is an advantage if one desires to measure the RMS value of the fundamental frequency, which is normally the case. The Ballantine meter is accordingly calibrated in terms of RMS values for a sinusoidal wave, but the user will



A view of the Ballantine meter as produced commercially.

do well to know what he is feeding into the meter, for its operating range extends from 10 c/s to 10,000 c/s, and readings are obtainable at much higher frequencies though with a larger error.

The voltage ranges are: 0.0001-0.01, 0.01-0.1, 0.1-1, 1-10 and 10-100, but the meter requires only a single voltage-scale which is multiplied by the factor opposite the pointer of the range-switch, just as in a DC instrument. The effect of the range-switch is to change the amplifier-gain; the maximum value is 70 db (3,100 times in voltage) with a variation of about 1 db from 10 to 10,000 cycles and with low harmonic distortion at outputs below 30 volts. The usefulness of such an amplifier for general laboratory work has induced the makers to provide an output jack. Insertion of a plug into this jack

disconnects the meter and rectifier, replacing them with a high-resistance output voltage-divider for fine control, coarse control being provided by the range-switch, which has steps of 10-1, as already mentioned.

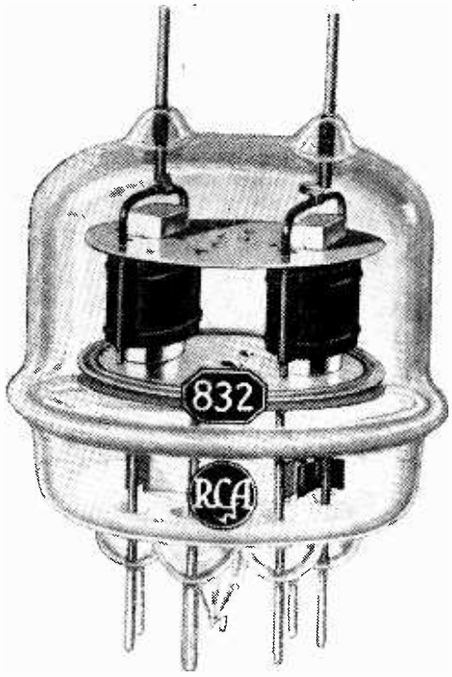
The utility of such a meter depends to a considerable extent upon minimisation of any loading effects upon the circuit under measurement. The input of the Model 300 "looks like" 500,000 ohms shunted by 25 micro-microfarads. This, and the wide voltage-range, make possible many direct measurements of output-over-input at any point in the audio range. These capabilities have been provided with a weight of somewhat less than 10 pounds and in a space of 4½in. by 6in. by 11in. The error is stated to be less than 2 per cent. over most of the range, at no point over 3 per cent., temperature effects negligible, and other causes of error (line voltage changes and tube changes) to be at or below 1 per cent.

ULTRA-HIGH FREQUENCY "DOORKNOB" TUBE

A FURTHER piece of apparatus described at the I.R.E. convention was another member of the growing family of UHF doorknob tubes. The earlier members of the tribe have been due to the Western Electric Company, and have been of both triode and pentode form, some with a single unit, others push-pull in the same bulb, and in a few instances the same element has been brought out at both ends of the bulb.

However, the latest variety, which is due to Radio Corporation of America, differs from all of these in that the twin pentodes are of the beam variety and especially because the screen-bypass condenser is at last placed inside the tube, where it has long belonged. These features permit the full amplifier-output of 22 watts (telegraphy) or 12 watts (telephone carrier) to be obtained at wavelengths as short as 2 metres, after which the output drops rather rapidly, falling off 50 per cent. at 1 metre, which is the shortest wavelength for which the tube is rated, though self-oscillation is possible somewhat beyond.

The plate voltage is 400 or 325 for telegraph and telephone outputs as above, and the screens may be supplied from the same source through a 7,500-ohm resistor which serves both screens. The grid bias of −60 volts (telegraphy) or −50 volts (telephony) may be obtained in the usual manner. In the foregoing it is assumed that plate-modulation is to be used. However, for UHF work it is sometimes convenient to employ grid-modulation and to accept a lower percentage of modulation, and a reduced carrier power. Here the RCA-832 gives an exceptionally good performance. With plate and screen voltages of 400 and 250 respectively there can be obtained a carrier power of somewhat more than 7 watts capable of acceptable 70 per cent. grid-bias modulation. In this case the screen voltage must be fixed, but bias may be taken from a 1,000-ohm cathode resistor.



The general arrangement of the RCA-832 is clearly shown in this photograph.

In all of the applications mentioned the driving requirements are modest, falling below 0.2 watt in all cases. In the demonstration before the Institute an 832 doorknob drove a 10-watt Mazda lamp well above normal brilliancy when its own grid was driven by a receiving "acorn" tube operating on quite low voltages. The output ceased when the acorn was switched off, showing that proper amplification was occurring.

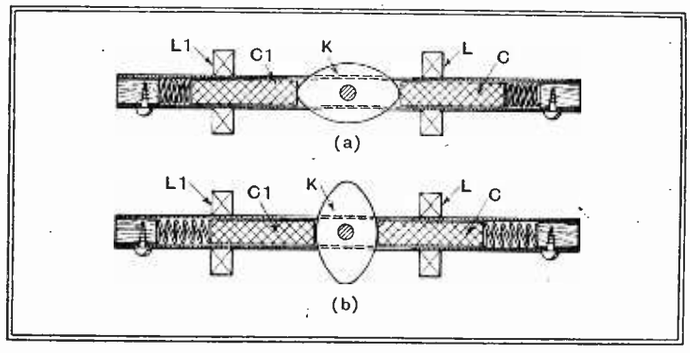
The glass doorknob body measures about 2in. each way, but the plate pins at one end and the other terminals at the opposite end raise the overall length to about 3½in. Incidentally, this terminal arrangement is very convenient when the tube is to be used with one pair of parallel rods connected to the plates and another pair to the grids, the plate supply and grid return being connected to the corresponding short-circuiting bridges of these rod-pairs. The driver may be coupled magnetically to the resulting grid loop and the load either coupled to the plate loop magnetically or tapped to the plate rods through stopping condensers in the conventional way.

The construction of the RCA-832 is best described by the accompanying photograph, which is due to the manufacturers, RCA Radiotron Division, RCA Manufacturing Co.

Variable Selectivity

SELECTIVITY can conveniently be adjusted to meet different conditions in the ether by varying the effective "width" either of the RF input or of the intermediate-frequency stages of a super-het. set. In both cases the band pass or filter effect of the circuits depends upon their tuning and mutual coupling.

The figure shows a neat arrangement (Patent No. 480755) for controlling the selectivity of a set by moving powdered-iron cores in and out of inductance coils. The coils L and L1 form part of a band-pass circuit, and are fixed in position on a supporting tube of insulating material.



Method of varying the coupling, and hence the band width of coupled coils, forming a band-pass RF or IF circuit.

Inside the tube slide two powdered-iron cores C, C1, which are spring-pressed from each end of the tube against an oval cam K mounted on the control shaft.

In the first position of the cam K the cores C and C1 are at their maximum distance apart, so that the coupling between the circuits is a minimum, and selectivity is high. It will be noticed that the cam K is not mounted midway between the two coils, but is placed somewhat nearer to L than to L1. At the same time, each of the cores extends well past both ends of the two coils, so that the self-inductance of both coils is approximately the same, and the tuning is not affected.

In the second position of the control cam K, shown in the lower drawing, the two iron cores have been brought close together, so that the coupling between the two circuits is tight, and selectivity is low. In this position it will be seen that the core C is symmetrical about the coil L, so that the self-inductance of the latter is a maximum. The core C1, on the other hand, is barely flush with one end of the coil L1, so that the self-inductance of this coil is near its minimum. This alteration in the self-inductance of the two coils varies the tuning of the two coupled circuits in opposite directions, and so helps to improve the quality of reception when the "control" is set for low selectivity.

Home Recording

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

Part II.—The Recording Machine and Tracking Mechanism

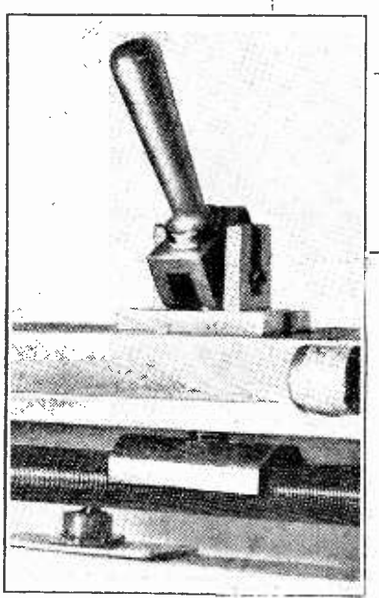
IN this article the author deals with the recording machine and the mechanism that imparts the lateral movement to the cutting head. The various methods adopted are discussed, together with the points to which particular attention should be given in order to obtain a satisfactory spiral groove on the record.

(Continued from page 26 of last week's issue)

IN the first article of this series consideration was given to the general theory of lateral recording and the size and shape of the groove cut in a directly recorded gramophone record. We next come to the recording machine by means of which this groove is cut. In the first place, the disc must be rotated at a perfectly uniform speed, and as a groove is being cut in the disc more power is required than when the finished record is replayed and the needle merely follows the groove. Secondly, the cutting stylus, which is mounted in the recording head, must be made to traverse the disc at a uniform speed in order that a spiral of the correct pitch may be produced.

At first sight this may all sound quite simple and, of course, in actual practice the mechanism required to perform the above functions is not really complicated. Unfortunately, however, small variations both in the speed of the recording table which rotates the disc and in the speed of the tracking mechanism, as it is called, which moves the recording head and stylus, are often very apparent to the human ear when the resulting record is replayed. It is usually the absence of such small variations that constitutes the difference between a good and a bad recording machine.

There is also one other important requirement in the recording machine mechanism. Owing to the fact that for obvious practical reasons neither the turntable of the recording machine nor the disc which is being cut can never be perfectly flat, the recording head must be mounted on the tracking mechanism in such a manner that the cutting stylus is free to move up and down so as to allow for the variations in flatness referred to.



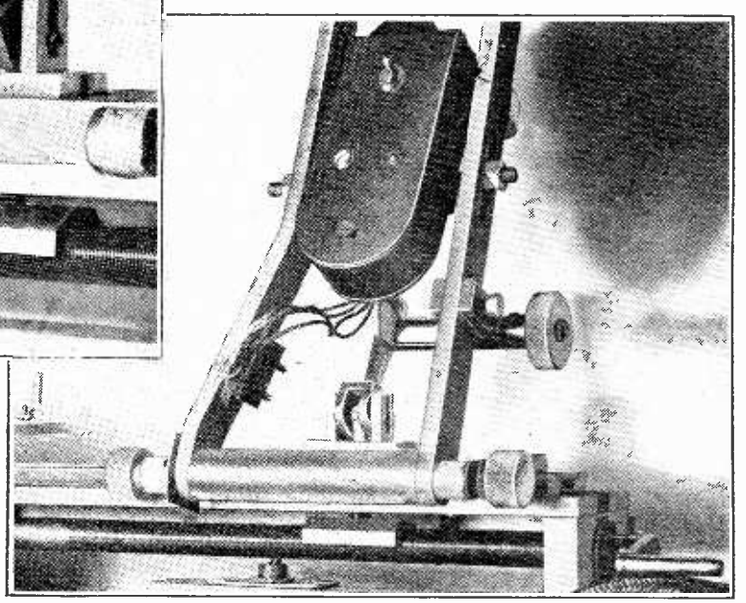


Fig. 2. — Two views of another type of tracking mechanism showing the method of disengaging the half-nut and recording head mounting.

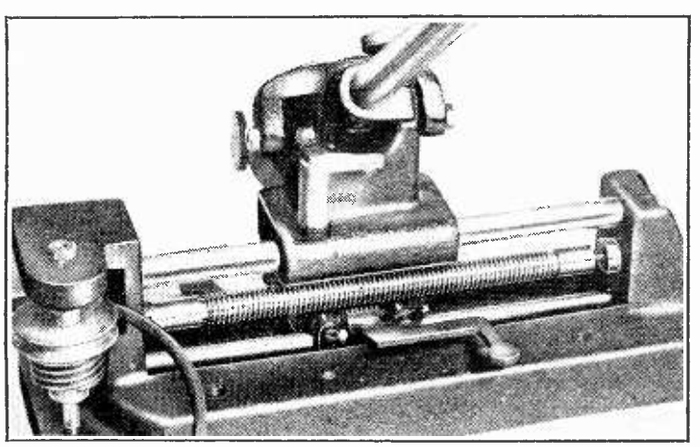


Fig. 1.—Tracking mechanism driven by belt from turntable spindle.

This movement is, of course, only small as the depth of the groove and the angle of the cutting stylus to the disc must not vary appreciably. This last requirement is very important as for satisfactory recording it is absolutely essential that the cutter head should be perfectly free to move in the vertical plane while being rigidly held in the horizontal plane by the tracking mechanism. This point will be referred to again in dealing with the subject of the recording blanks and their faults.

It is interesting to note, before coming to a consideration of the actual types of tracking mechanisms commonly used in direct recording machines, that whereas in such machines the tracking mechanism causes the recording head to move laterally across the recording table, in many of the wax recording machines used to-day the opposite action is used, that is to say, the recording head is fixed with regard to the base plate of the machine and the turntable moves laterally across it. Such an arrangement, while it has advantages, is perhaps more complicated and expensive to construct and is therefore not employed in the direct recording machines used by the amateur.

Tracking Mechanisms

An examination of the catalogues of the makers of the numerous machines at present on the market will show that there are several different ways in which the recording head may be made to traverse the turntable. Naturally, price plays an important part in the satisfactory operation of such apparatus, although some of the simpler and less expensive mechanisms can be made to function reasonably well if they are adjusted intelligently. It is not proposed here to review the various different machines available to the experimenter but rather to illustrate the various general types of tracking mechanisms and explain some of the faults which may

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arise and the methods to be adopted in dealing with them.

In practically all types of tracking mechanism the recording head is mounted on an arm, called the tracking arm, which moves on slides sideways in a similar manner to the slide-rest of a lathe. This arm is driven by a half-nut engaging with a rod on which is cut a screwthread. The half-nut is movable so that the mechanism may be engaged and disengaged at will at the beginning and the end of each recording.

Driving Systems

A view of such an arrangement is shown in Fig. 1. Another mechanism of a similar type is shown in Fig. 2. The tracking screw in this type of mechanism is driven from the recording turntable spindle usually by means of a leather or rubber belt. The pitch of the spiral groove cut in the record depends, of course, on the pitch of the tracking screwthread and the speed of rotation of the screw. In the more elaborate types the pitch of the recorded groove may be made variable by altering the speed of rotation of the tracking screw, either by a variable-speed gear driving the screw or by changing the size of the pulleys driving the mechanism. The belt which drives the mechanism is sometimes taken to a pulley on the centre clamp which holds the disc on the recording table, or alternatively to a pulley mounted on the turntable spindle and on the underside of the base plate. This latter method is more satisfactory as a general rule, as with the former it is necessary for the belt to be put on every time the disc is changed and the centre clamp removed, also there is a tendency for the swarf from the disc to get mixed up with the tracking belt and cause tracking faults.

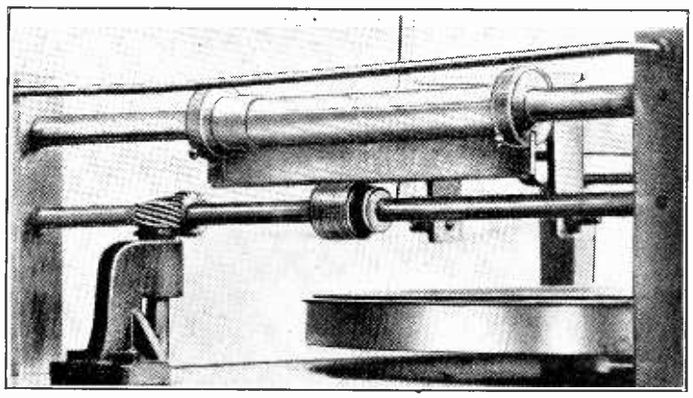

Fig. 3.—Tracking mechanism in which a worm driven by bevel gears drives a rack mounted on the tracking arm.

Another form of tracking drive is shown in Fig. 3. In this case instead of a tracking screw there is a worm wheel driving a toothed rack which is engaged and disengaged by raising and lowering the tracking arm. There are, of course, many other variations of this scheme and it is not proposed to give details of all the different mechanisms on the market, but rather to explain some of the faults which may occur.

It must be realised at the outset that the function of the tracking mechanism is to move the cutter head across the disc at a steady uniform speed, and any unevenness or variation in speed will be immediately apparent in the resulting spiral groove on the disc. It can cause variations in the pitch of the spiral and may even lead to one groove running into the next. To obtain good tracking, a tracking screw having a well-cut thread and of reasonably large diameter is required, and it should be free and run easily in its bearings. A leather belt is usually found better for the drive than a rubber one, as there is often a tendency for a "period" to be set up in a rubber belt giving a jerky drive to the tracking screw.

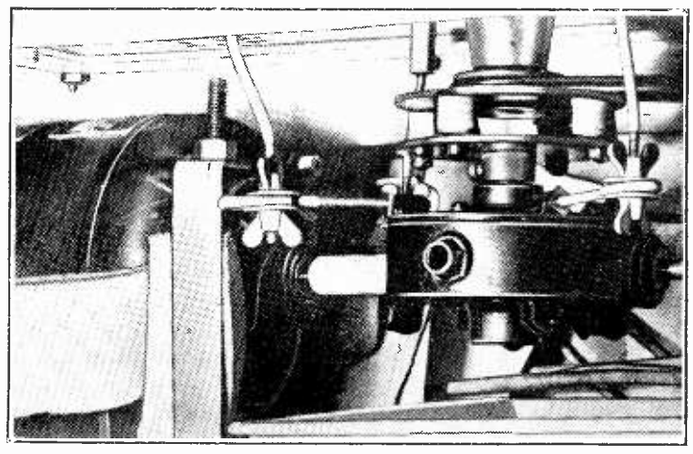

Fig. 4.—Underneath view of a recording machine in which the motor is coupled to the turntable spindle through a reduction gear box. Note the rubber motor coupling and mounting.

This last fault is often not obvious at first sight as tracking faults may appear in the recorded disc, although the tracking screw and half-nut may be perfect, but a close examination of the motion of the pulley driving the tracking screw while it is working will soon reveal the defect. Either a jointless belt should be used or care be taken with the joint to see it does not give rise to a variation in speed of one of the pulleys as it goes round. Metal fasteners should be avoided.

A periodic fault will occur in the pitch of the spiral corresponding to the speed of the pulley if the joint is too stiff or too big. If a small round leather belt is used, a good butt joint may be made by using catgut (the author has found that an old violin E string is excellent for this purpose). In most machines it is arranged so that a certain amount of slip can take place in the tracking mechanism drive so that no serious damage will be done to the tracking gears should the mechanism be allowed to overrun accidentally. In a more elaborate arrangement a small lever is arranged to operate a switch at the end of the travel of the tracking arm so that the motor is automatically switched off if the tracking arm overruns. Backlash in the half-nut or mounting of the tracking arm can play an important part in the satisfactory operation of any mechanism, and although it should be kept small it need not cause any trouble if care is taken to see that all the backlash is taken up before the cutter head is lowered when commencing a recording. All the above remarks may lead the reader to suppose that tracking faults are common and difficult to cure, but it should be emphasised that, provided a reasonably well-made but not necessarily expensive mechanism is used, quite good tracking may be obtained if the mechanism is looked after and kept clean and well oiled.

Before leaving the subject of tracking mechanisms it might be well to mention again the question of cutting from the inside to the outside of the disc instead of the reverse or normal procedure. The advantages of the former method have already been discussed in the first article of the series, and it is again suggested that for many experimental purposes, or when one is getting used to a new machine, the in-out cut avoids a number of difficulties, and it is, of course, only necessary to reverse the belt on one of the pulleys driving the racking mechanism in order to alter the direction of drive.

Motors

We come now to the consideration of methods of driving the recording turntable. This drive may be electrical, clockwork or by gravity, using a heavy-weight motor. The first is perhaps more usual in direct recording machines, although for small portable recorders the clockwork motor can be used very effectively. Where the space occupied by the recording gear is not important, the gravity motor, so often used in wax recording, has many advantages to recommend it; but, as recording engineers in the past have found, it is important to use a really strong cable to support the driving weight.

Where absolute constancy of speed is essential, either three-phase or single-phase synchronous motors are used, but for normal purposes this is rather an unnecessary elaboration. For alternating current

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supplies small induction motors are now available at very reasonable prices, and, for direct current, motors having very good constant-speed characteristics have been developed by a number of well-known firms. Low-voltage motors operated from a bank of car-starter type accumulators can also be obtained, and even with such motors a steady speed over a number of hours' run can be obtained with only small variations of the field resistance.

Power ratings vary considerably with different machines, and although some are rated as high as a quarter of a horse-power, one-eight horse-power is normally sufficient. This power is, however, more than can be obtained from the ordinary gramophone motor, and it is for this reason among others that the early home recorders were never entirely satisfactory. Special recording turntables have, however, now been introduced with the motor running at 78 revolutions per minute, but these cannot be classified with the ordinary gramophone motor. For details with regard to these the reader is referred to an article in *The Wireless World* for March 19th, 1937, and also the various catalogues issued by manufacturers.

Vibration

At whatever speed the motor runs, certain general principles are involved and certain precautions must be observed. For satisfactory operation of a recording machine all types of vibration, either on the recording turntable or tracking arm, must be avoided. A large number of different methods are adopted for mounting the motor, and it is usually essential to insulate the motor from the base plate on which the turntable is mounted either by means of springs or by rubber mountings. As a rule, most motors vibrate when they are running to a greater or less extent, and this vibration is transmitted to the turntable either direct, if the two are mounted on the same baseplate, or through the coupling between the motor and the turntable or reduction-gear box if a high-speed motor is used. This vibration, which must be eliminated by suitable mountings and resilient couplings, produces various different patterns on the disc, depending on the frequency of the vibration and the speed of the turntable. If the turntable speed is 78 r.p.m. and the motor vibration 50 cycles, a common case, the usual pattern is similar to a stroboscope disc, but in the form of radial lines like the spokes of a wheel.

Careful examination of a disc cut under such conditions shows that lines are produced by an alternate light and heavy cut due to a periodic vertical movement of the cutter head. This patterning of the disc is also sometimes called "watermark." One method of insulating the motor and gear box to avoid such vibration troubles is shown in Fig. 4. This is, of course, only one of many types, and in this case the speed of the motor (induction type 50-cycle) was 1,500 r.p.m. and the turntable speed 78 r.p.m. Fig. 5 illustrates one type of direct motor drive without reduction-gear box. Apart from motor vibration, pattern can be introduced by the gear box, either by tooth ripple or due to bad bearings, etc., but the motor is generally the cause of most of the trouble.

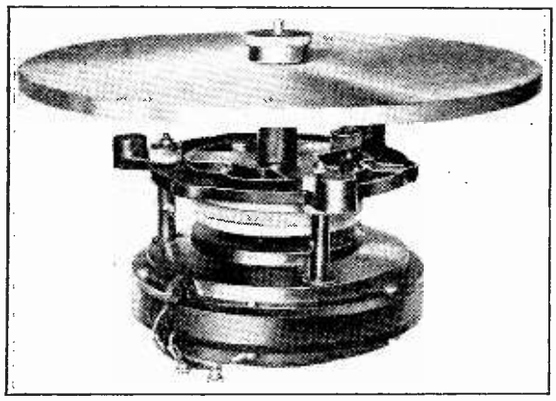

Fig. 5.—A direct coupled recording motor. A rubber washer insulates the turntable from the motor vibration.

One other very important point must be considered before leaving the subject of the motor drive, and that is "Wow." "Wow" may be defined as a regular periodic fluctuation in the speed of the turntable of either the recording or reproducing machine. It may be normally produced in two ways. First, by the fact that the hole in the centre of the disc is not, as a matter of fact, exactly in the centre, so that the distance of the replay needle from the spindle of the motor varies appreciably during one revolution of the disc. This type of "Wow" occurs mostly with shellac pressings, and gives the familiar 78 per minute variation with which the reader is probably familiar, and is, of course, not connected with the constancy of speed either of the reproducing motor or recording motor. It does not strictly come within the definition given above, as it is due to periodic variations of the speed of the point of the replay needle. Also, it does not worry the direct-recording experimenter as a rule, as, unless the centre hole of the disc becomes enlarged, no such variation in distance referred to above can occur. Variations in the speed of the recording turntable can, however, occur, and these are usually due to the misalignment of either the motor and turntable, in the case of the directly coupled machine, or of the motor and gear box, or of the gear box and turntable in the case of the other type of drive.

The complete removal of any periodic variation of speed is practically impossible, but with a little practice it is fairly easy to determine the amount which can be allowed in practice before it is noticeable in recorded music. Naturally, it should be the aim of the experimenter to get the amount of "Wow" in his recording machine down to the absolute minimum, but it is a curious fact that certain musical instruments when recorded on a gramophone record or, for that matter, on film, show up any variations in turntable speed far more than others. Any piece of music containing a series of long-sustained chords will serve as an excellent test of the steadiness of the recording turntable, but if these chords are played on a piano, as a general rule any variations will be much more noticeable. The piano tone seems to be particularly susceptible to "Wow." On the other hand, any instrument which is normally played with some "vibrato" is not so susceptible, except perhaps to the expert ear. In testing equipment for "Wow," using a constant-frequency disc, a frequency of about 500 cycles is generally used at 78 r.p.m. or 156 r.p.m., for "Wow" is most easily detected at about this frequency. Secondly, it is important to distinguish between genuine variation in frequency and periodic variations in intensity. If the record or the turntable is at all seriously out of truth, it is possible to get variations in the intensity of the 500-cycle note which have the same frequency as the variations in frequency of the note.

This sounds perhaps a little involved, but the two types of variation in the sound can be readily distinguished with a little practice provided that it is known that they both exist. Anyone who has had much experience with the adjustment of recording equipment and the removal of "Wow" will also know that it is only possible to carry out observations for a certain length of time, as the human ear tires when listening critically to one frequency, and after a time it is impossible to tell whether it is present or not unless the ear is given a rest. The subject is a most interesting one, and it is only possible to touch upon it in this series of articles. The frequency of the "Wow" may vary considerably with different recording machines and discs, and it may be of a frequency corresponding to one cycle per revolution of the recording table or take the form of a high-pitched flutter.

Turntable

We turn finally in our brief survey of the general action of the recording machine to the turntable itself. This should be massive in construction and reasonably heavy in weight, as it then acts as a flywheel and helps to smooth out both "Wow" and gear box and tooth ripples. On some machines the turntable alone weighs as much as 10 lb. to 15 lb. Some manufacturers dish the surface of the turntable—that is to say, turn it so that the centre of the turntable is an eighth of an inch or more thinner at the centre than at the edge. This is done so that when a metal-base disc is used the centre clamp pushes the centre of the disc down, and it is gripped on the edges as well as the centre, and slipping of the disc becomes practically impossible. This method also allows for variations in the flatness of the discs, and makes it possible for a reasonably good cut to be obtained on a disc which on a flat turntable might be too uneven or undulating on the surface.

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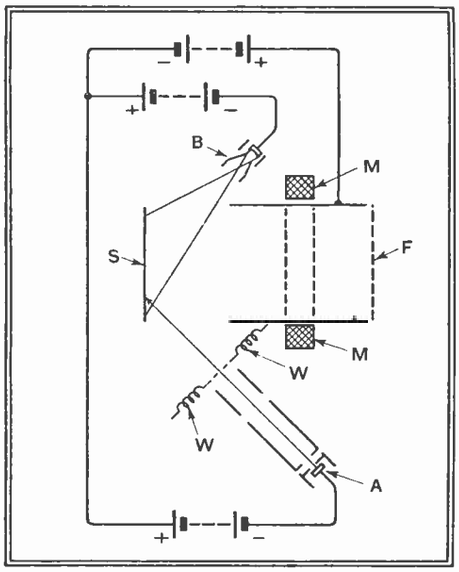
Before closing this particular portion of the subject, the author would like to point out that the details and illustrations given above are intended not to illustrate particular machines but particular principles, and that it is obviously impossible to illustrate and describe all the different ingenious mechanisms on the market at the present time, but only to describe and illustrate the principles on which they work.

Secondary-Emission Screens for Television

WHEN a sensitised surface is struck by primary electrons, the resulting secondary emission is determined partly by the material used for the screen, and partly by the velocity of the incident electrons. It appears, however, that a plate of nickel, when treated with uranyl nitrate (Patent No. 481563), is capable of emitting a more copious supply of secondary emissions after it has been subjected to a preliminary bombardment by electrons travelling at comparatively low speed.



Increasing the emission of secondary electrons from a treated nickel screen by a preliminary bombardment.

The Figure shows how this effect is utilised to increase the brilliance of a picture in television. The incoming signals are applied to modulate the electron stream from a cathode-ray "gun" A in the ordinary way, the stream being deflected by coils W so that it scans the specially prepared nickel screen S. This preliminary bombardment merely serves to prepare or modify the emissivity of the screen S from point to point in the manner mentioned above.

During the "flyback" interval, which follows the completion of each picture frame, the whole surface of the screen is simultaneously bombarded by a wide-sectioned beam which is projected at high velocity from a second gun or cathode B. This serves to release a copious supply of electrons from all points on the screen, so that it forms, in effect, an electron image of the original picture. The intensified stream is then focused by an external magnetic winding M on to a fluorescent screen F, at the other end of the tube, where the picture is viewed.

New American Valves

RANGE FOR DRY BATTERY OPERATION

FOR many years battery valves have been available with filaments rated for operation at 2 volts, this figure being chosen because it is the output of a single accumulator cell. There are many cases, however, where a dry battery is much more convenient than an accumulator. The output of such a battery is a variable quantity and depends upon its condition and the load upon it. In general, however, it is in the neighbourhood of 1.3—1.5 volts over a large portion of its useful life.

In a new series of valves recently introduced in America the filament rating is 1.4 volts and with one exception all specimens consume a current of 0.05 ampere. The valves are, in fact, designed for operation from a single dry cell without any filament circuit resistance.

The range includes a heptode frequency-changer 1A7G, which is rated for operation at 90 volts for anode and oscillator anode, and zero control-grid bias. The screen should be fed from 90 volts through a 70,000-ohm resistance. The currents for anode, screen, and oscillator anode are respectively 0.6, 0.65, and 1.1 mA. The anode AC resistance is 0.6 MΩ and the conversion conductance 0.125 mA/V.

The RF pentode is the 1N5G and is rated for 90 volts on the anode and screen and zero control-grid bias. Its anode current is 1.2 mA with a screen current of 0.3 mA, and it has a mutual conductance of 0.75 mA/V. It is a variable-mu valve of the short-base type.

There is a single-diode-triode in the range; this is the 1H5G. The anode rating is again 90 volts, and the valve has an AC resistance of 0.24 MΩ with an amplification factor of 65. It is, of course, intended for use with RC coupling. No grid bias is needed.

There are two output pentodes, the 1A5G and the 1C5G, the latter taking 0.1 ampere filament current instead of the usual 0.05 ampere. Automatic grid bias is recommended; the 1A5G needs −4.5 volts and the 1C5G −7 volts. Assuming a battery of 90 volts, the constants of the valves are consequently given for 85 volts and 83 volts anode and screen supply respectively.

The 1A5G consumes 3.5 mA and 0.7 mA anode and screen currents and has an output of 100 milliwatts at 10 per cent. distortion with a load of 25,000 ohms. The 1C5G, however, gives an output of 200 milliwatts for 10 per cent. distortion into a load of 9,000 ohms. It takes 7 mA anode current, however, with 1.6 mA for the screen.

The valves are fitted with the octal base and are of small dimensions, the overall diameter being only 1-3/16in. The longest valves are the top-grid types, which measure 4-5/16in. over all. In all types the length from the bottom of the base to the top of the bulb is 3-7/16in.

For details of these new Sylvania valves we are indebted to Messrs. Claude Lyons, Ltd., of 40, Buckingham Gate, London, S.W.1, from whom supplies may be obtained.

The Wireless Industry

Marconiphone will carry out the arrangement for sound amplification on the occasion of the unveiling by H.M. The King of the Australian War Memorial at Villers-Bretonneux. As electric supply mains will not be available, a large battery of Exide accumulators is being transported from England to feed the set of amplifiers, which incidentally have been specially constructed for the occasion. Marconiphone is also to be responsible for sound amplification during Navy Week at Devonport.

Exide batteries were used on Howard Hughes' record-breaking world flight.

Dubilier announces that the Acton works will be closed down for the annual holiday from Friday evening, July 29th to Monday morning, August 8th. During this period no goods will be despatched, and so the firm's customers are asked to anticipate their requirements.

Ediswan Loudspeakerphones have been successfully installed under many diverse conditions—in shops, catering establishments, on piers, in dentists' surgeries, hospitals, auctioneers' premises, and even as an aid to the detection of crime.

BRITISH TELEVISION SETS FOR U.S.A.—A consignment of Cossor television apparatus leaving the London works on the first stage of its journey to America.

UNBIASED

By FREE GRID

Medical Advice Wanted

I TRUST that you will forgive any slight falling-off you may have noticed in the past few weeks in the technical standard of these columns, but, as a matter of fact, I have not been able to give that care and attention to my scientific work which I like to do. This has been due, I am sorry to say, to certain domestic worries, and, although I hate bothering you with my personal affairs, I feel that I am compelled to do so to find out if any of you technical men have had any experience of the sort of thing that has been troubling me of late.

To come to the point, I have been worried in recent weeks about certain strange behaviour on the part of Mrs. Free Grid. Although I know it seems hardly credible, and some of the less charitable among you will, I fear, not believe me, she has started to take an avid and altogether unaccountable interest in wireless, and has bluntly announced her intention of applying for a transmitting licence. She spends most of the day surrounded by text-books, and has already rigged up the drawing-room as a very passable home-laboratory, following out the instructions now appearing on these matters in this journal.

Not only has she commenced to find fault with my own writings, but has been picking holes in the technical pronouncements of other writers in this journal, and has even extended her criticisms to the sacrosanct pages of *The Wireless Engineer*. I narrowly averted trouble only last week by short-circuiting a letter

Advice from Harley Street.

addressed by her to a person very eminent indeed in wireless engineering circles in which she flatly contradicted certain of his statements.

I am, in fact, only able to write these few words by reason of the fact that she is at the moment out of the country attending a technical congress in Berlin, whither I am arranging to send her a specially printed copy of this journal, with my article omitted.

Needless to say, I have taken the very best medical advice on the matter, and have consulted a well-known Harley Street psychologist, who tells me that she is suffering from an "obsessional neurosis resulting in an extravasation of her alter ego." He tells me that if there is to be any hope of a cure I must on no account thwart her in any way, and that she must be entirely "unrepressed." I ventured to point out to the medico that if this were the treatment it might be said with truth that she had been taking it more or less all our married life. His only reply to this, however, was a polite intimation that the three-guinea time limit was up.

I am, therefore, no better off than before consulting him, and am faced with a very grave problem indeed, as I expect that if the malady is allowed to go on she will probably be starting a wireless journal herself, or even setting up as a wireless manufacturer, and things would then become very difficult for me. If, therefore, any of you with specialised knowledge of these ills to which the human psyche is heir can help me, I shall be more than grateful.

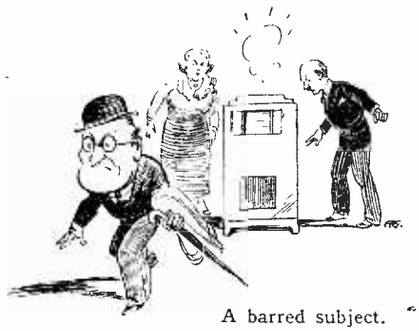
Teleolfaction

IT is, I think, astonishing how much non-scientific people take the wonders of this age for granted, and dismiss engineering feats of the greatest magnitude with a disdainful sniff. One of the most wonderful pieces of engineering, in my opinion, is the Forth Bridge, and only the other week when Mrs. Free Grid and I were crossing it in the train on a circuitous return from a visit to the Glasgow Exhibition I called her attention to it, and her only comment was that it was a pity that the engineers responsible had not sufficient common sense to make it wide enough to take a road as well as a railway track.

However, it is more in connection with wireless matters than with general engineering that this sort of thing has been brought home to me. Not so very long ago I was at a friend's house watching a television programme, the main feature of which was a cookery demonstration. The whole business was very well done indeed, so much so that I began to imagine that I could detect the smell of the cooking. My friend's wife, who was with us, merely gave a disdainful sniff and said that it was a pity that the B.B.C.'s demonstrator could not do better than that as he was obviously burning the dish.

I must confess that the picture was so vivid that even I got the impression that the dish was well done, but I was amazed when it turned out in the course of conversation that my friend's wife actually thought that the B.B.C. were transmitting smell along with the sound and vision. When I said this was not so, she bluntly demanded to know why, just as though the problem of transmitting smell by wireless was a minor one which could be left to some of the B.B.C. office boys to solve.

I am fairly well acquainted with modern psychology, and I immediately went into a long dissertation on the effects of hetero-suggestion, and explained that it was a high tribute to the B.B.C.'s technical skill that they could make the cookery scene so vivid that we had actually thought that we could detect the smell of cooking and even of burning. My friends were very interested in my little lecture, and more so since we were having such a striking demonstration of what I was talking about.



A barred subject.

We were, in fact, just about to telephone the B.B.C. and congratulate them on the remarkable vividness of their programme when the main fuse blew with a loud report, and on examining the back of the receiver we discovered a badly charred mains transformer. Psychology and hetero-suggestion is rather a barred subject with me at present.

Incidentally, I should like to say that I think it exceedingly bad policy for an all-electric concern like the B.B.C. to use a gas-stove for their television cooking demonstrations.

In 1938!

I THOUGHT that the hoary old "technical hint," which used to appear regularly in the "Wireless Corner" of certain journals, about using a jam-jar full of earth as a wireless "earth" was dead years ago. Apparently this is not so, as a reader has sent me a cutting from a woman's journal in which this advice (?) is once more given, together with an illustration and instructions to keep the soil moist. It is really very hard to believe that this sort of thing could be accepted for publication and good money paid for it in 1938, even in a woman's journal. It looks as though the gates of Eldorado were open to anybody who cared to send in a regular series of this sort of wireless hint; in fact, I am sorely tempted to do it myself. Before any of you commit yourselves to paper, do not forget that you must sign yourself Gladys, or something like that, and remember also to present your subject matter in a proper feminine manner; by this I mean do not attempt to do it in any scientific or even logical manner or you are liable to bring suspicion on yourself.

Neon Stabiliser

AN INEXPENSIVE "CONSTANT VOLTAGE" DEVICE

By D. H. THOMAS, M.Sc. Tech.

THERE is one very useful application of the neon gas-discharge lamp which is not widely appreciated, and that is its use as a voltage stabiliser, or steadying device, on direct current. This article describes the fundamental application of an ordinary neon lamp, such as one used as a "night-light" as a device to keep the voltage on a piece of apparatus constant within close limits, independent of large fluctuations of the supply. Such a device is often useful for oscillators, or for calibrated amplifiers, where a constant anode or screen-grid voltage is necessary for constancy.

THE author shows how a single neon "night-light," plus a resistor, may be used to minimise voltage fluctuations in the HT supply to oscillators, etc.

The curves of Fig. 1 show the current-voltage characteristic of an ordinary neon night-light. The one tested was a G.E.C. "Osglim" lamp, but is typical of them all. Curve A applies when the circular electrode is positive, and the spiral or "beehive" negative, and curve B when the connection is reversed. We will confine our attention to A, and it is seen that from about 6 to 24 mA of current a very small change in applied voltage brings about a very large change in current.

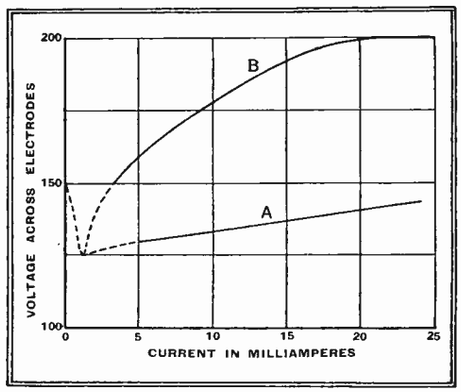


Fig. 1.—Characteristic curve of a G.E.C. "Osglim" neon lamp. Curve A, disc positive; curve B, spiral positive.

This region is of present interest to us, but we need not concern ourselves with the dotted part of curve A nor with curve B, as this polarity of electrodes is not important for our purposes.

Round about 16 mA on curve A, a voltage change of 10 volts produces a current change of 14 mA. We term the ratio of "voltage change/current change" the "differential resistance" of the device, designated by R*a*. Its value here is 10 ÷ 0.014 ohms, or 700 ohms. This differential resistance must be distinguished from the normal resistance of the lamp, for here 137 volts causes 16 mA to flow. The normal resistance R*n* is, therefore, 8,500 ohms.

Consider the action of this lamp in the circuit of Fig. 2. The mains, at voltage V_1, supply the load and the lamp through a ballast resistance R*b*. Suppose the voltage of the load R has to remain at a value of V_2, in accordance with Ohm's law, and the current it takes.

Let us suppose that matters are so arranged that V_2 lies in the region of the straight part of the lamp characteristic (or V_2 is round about 137 volts), and assume that V_1 increases. Due to the character of the lamp, a disproportionate increase of the current will be shunted off by the lamp. This will lead to increased volt drop in R*b*, this drop tending to neutralise the increase of V_1, and to leave V_2 as before. If V_1 drops in value, the lamp current decreases very rapidly. There is thus a tendency for the lamp to maintain a constant voltage at its terminals, any voltage change in the supply leading to large variations in the current taken by the lamp.

Practical Consideration

The size of the ballast resistance R*b* must be just sufficient to bring about a volt drop from the mains voltage V_1 to the voltage at which the lamp is to work. When the mains voltage is known it is an easy matter to calculate R*b*, knowing the current taken by the lamp, together with that needed in the load itself. In order to produce the maximum stabilising effect, R*b* should be as large as possible. This means that the current needed in the load should be small.

Another factor influencing the effectiveness of the device is the ratio of the two resistances rn and ra. For maximum stabilisation rn should be many times ra. In the lamp tested this was 21 to 1, and lamps specially designed for smoothing have this ratio much increased.

It will be seen that such a lamp can be used to stabilise voltages of the order of 140, and with suitable circuit conditions, the fluctuations in the mains are reduced to 1/5th by the time they reach the lamp. If smaller voltages than 140 are needed, a potentiometer arrangement or series dropping resistance can usually be applied. If higher stabilised voltages are needed it is always possible to use two lamps in series, with ballast resistance, across the supply which is to be smoothed.

Lamps intended for night-lights are provided with a resistance in the cap, this must be removed if the lamp is to be used as a stabiliser. It has been found convenient to cement the lamp into a valve

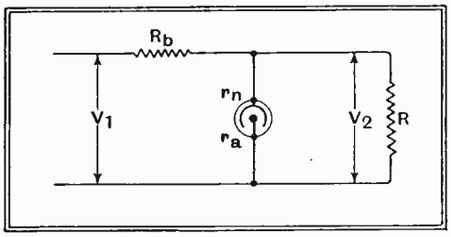


Fig. 2.—Circuit of the neon stabiliser.

socket, connecting the disc (which is to be positive) to the anode pin and the spiral to the cathode pin.

In order to produce stability it is desirable to "age" the lamps by burning them, at their rated consumption, for about 8 hours on AC. If DC is used, reverse the connections during the "ageing" period, which normalises the gas conditions in the lamp.

As the lamp forms a shunt load the method is rather a wasteful one, but a few milliamperes wasted in the lamp is of no great moment if increased stability in testing gear is obtained. The use of a normal night-light, as here indicated, can produce a very useful amount of stabilisation.

This method of voltage stabilisation has been applied, with satisfactory results, to a radio-frequency oscillator using a circuit of the Collpitts type, which derives its high-tension supply from DC mains which are none too steady. The complete circuit, including stabiliser, is shown in Fig. 3

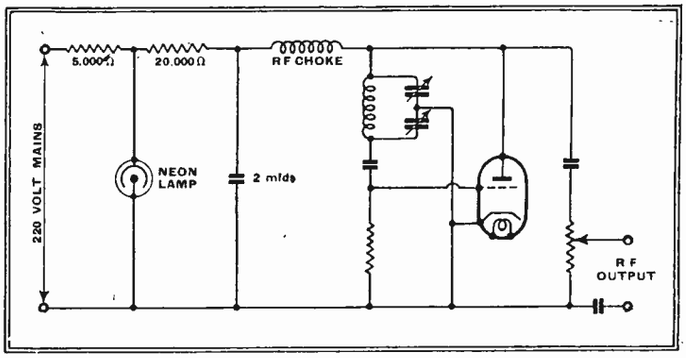


Fig. 3. — Illustrating the practical application of an "Osglim" neon lamp for stabilising the power supply of an RF oscillator.

Neon Stabiliser—

The HT input needed by the oscillator was 80 volts, and it took 3 mA. This supply voltage needed some reduction, as the stabilised voltage available, as explained above, is 135 volts. Hence the series resistance of 20,000 ohms in Fig. 3, and the 2 μF condenser. The ballast resistance needed is 5,000 ohms, as it drops 85 volts (being the difference between 135 volts and the mains voltage of 220), and passes a total of 17 mA for the lamp and oscillator together.

Calculations show that only 20 per cent. of the mains voltage fluctuations appear on the valve anode, and this contributes considerably to the stability of the oscillator.

APPENDIX.

Calculation of the degree of stabilisation.

If r_a is the differential resistance of the neon lamp, and r_n its DC resistance, and R_b and R are the resistances of the ballast and of the load respectively, it can be shown that the changes of the mains voltage V1 will appear as changes in the smoothed voltage V2 of :

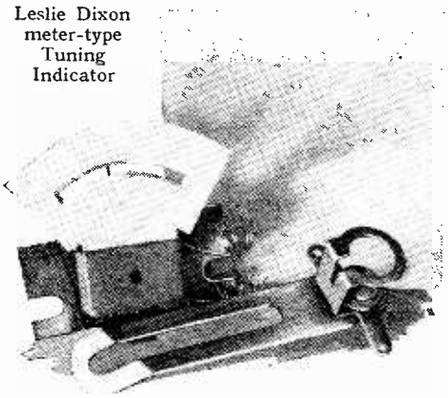
$$\frac{r_a}{r_n} \times \frac{Rr_n + R_b r_n + R_b R}{Rr_a + R_b r_a + R_b R} \times (\text{percentage change of V1})$$

From this it is at once apparent that for this ratio to be as small as possible, and for the smoothed voltage to experience only a small fraction of the changes in V1, we must have $r_n > r_a$ and also R_b and R as large as possible.

TUNING INDICATOR

A TUNING indicator of the milliammeter type is now marketed by Leslie Dixon and Co., of Electradix House, 218, Upper Thames Street, London, E.C.4. It is a moving-iron meter, and at rest the pointer is at the right-hand end of the scale. It must be included in the anode circuit of a valve controlled from the AVC system, and preferably one taking about 8 mA. The meter needle then moves to the left of the scale, and the decrease of current consequent upon tuning in a signal causes the needle to move to the right.

Leslie Dixon meter-type Tuning Indicator



The DC resistance is some 970 ohms, and the full-scale current is 8 mA. The meter is uncased but fitted with a plain card scale, and it is supplied with a sheet of mica to cover the panel opening and a bracket for a back-lamp. Complete it is priced at 3s. 9d. post free.

Television Programmes

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

Vision	Sound
45 Mc/s.	41.5 Mc/s.

THURSDAY, JULY 21st.

3, A Revue: "Life Goes On." **3.30,** British Movietonews. **3.40,** 165th edition of Picture Page. **9,** Repetition of 3 p.m. programme. **9.30,** Gaumont-British News. **9.40,** 166th edition of Picture Page. **10.10,** News Bulletin.

FRIDAY, JULY 22nd.

3, West-End Cabaret. **3.30,** Gaumont-British News. **3.40,** Cartoon Film. **3.45,** Catch-as-catch-can wrestling.

9, West-End Cabaret. **9.30,** British Movietonews. **9.40,** Speaking Personally: Vernon Bartlett. **9.50,** Cartoon Film. **9.55,** Music-makers. **10.5,** News Bulletin.

SATURDAY, JULY 23rd.

3, Cartoons by Ernest Mills. **3.10,** British Movietonews. **3.20,** A Revue: "And Now Another." **4,** Cartoon Film.

9, Three-Four: A Waltz Programme. **9.30,** Gaumont-British News. **9.40,** Starlight. **9.50,** Cartoon Film. **10,** Bridge Demonstration. **10.15,** News Bulletin.

SUNDAY, JULY 24th.

8.50, News Bulletin. **9.5,** Starlight. **9.10,** Cartoon Film. **9.15,** "The Danger of Tobacco," monologue by Anton Tchekov. **9.25,** Film. **9.40,** "The End of the Beginning," one-act comedy by Sean O'Casey.

MONDAY, JULY 25th.

3, Eric Wild and his Band. **3.20,** British Movietonews. **3.30,** Cartoon Film. **3.35,** "Order to View," a revue.

9, Cabaret. **9.35,** Gaumont-British News. **9.45,** Cricket Demonstration. **10,** Cartoon Film. **10.5,** Music-makers: Mildred Dilling (harp). **10.15,** News Bulletin.

TUESDAY, JULY 26th.

3, Forecast of Fashion. **3.15,** Gaumont-British News. **3.25,** Cabaret.

9, Forecast of Fashion. **9.15,** Cartoon Film. **9.20,** In Our Garden, C. H. Middleton. **9.30,** British Movietonews. **9.40,** "Ann and Harold": Episode 4. **10,** News Bulletin.

WEDNESDAY, JULY 27th.

3, A Little Show. **3.30,** British Movietonews. **3.40,** Cartoon Film. **3.45,** Repetition of Sunday's 9.40 p.m. programme.

9, Golf Demonstration. **9.15,** Gaumont-British News. **9.25,** "Nocturne in Palermo," by Clifford Bax. **10,** News Bulletin.

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, JULY 21st.

Nat., 7, Shows from the Seaside, from the Winter Garden, Eastbourne. 8, Revival of Bernard Shaw's "The Dark Lady of the Sonnets." 8.30, Helen Perkin (pianoforte) and the B.C.C. Orchestra (C).

Reg., 6, Continental romance, "Sweet Dreams." 7, Walks in London—III. 8, "Meet the Stars," from the New Hippodrome Theatre, Coventry. 8.45, Dialect Spelling Bee.

Abroad.

Hilversum I, 7.55, AVRO Symphony Orchestra, with members of the Italian Opera Company.

Paris PTT, 8.30, Charles Dickens' "David Copperfield," relayed from the Odéon.

FRIDAY, JULY 22nd.

Nat., 1.30, His Majesty unveils the Australian War Memorial at Villers-Bretonneux. 6.25, Test Match Commentary. 7.30, Radio Travel Bureau.

Reg., 6.45, The Colwyn Follies of 1938 from the Pier Pavilion, Colwyn Bay. 9, Reflections, a musical reminiscence.

Abroad.

Paris PTT, 8.30, Soulima Stravinsky (pianoforte) and the National Orchestra.

Brussels I, 9, Charpentier conducts excerpts from his opera, "Louise," at the Casino, Knocke.

SATURDAY, JULY 23rd.

Nat., 6.40, A Falla Concert—B.C.C. Orchestra (C). 7.30, "Foort-Issimo," Reginald Foort at the Theatre Organ. 8, Variety, including Rudy Starita and Wee Georgie Wood.

Reg., 6.40, Peter Yorke and his Orchestra. 8.35, Jan Stewer in his original part of George Growsell in his own Devonshire comedy, "Barnet's Folly." 9.40, The Return of Walford Hyden and his Café Colette Orchestra.

Abroad.

Strasbourg, 8.45, Wagner Opera Music from the Orangerie.

Rome I, 9, Wagner's "Lohengrin" from the Teatro delle Terme Caracalla.

SUNDAY, JULY 24th.

Nat., 11.15 a.m., The London Palladium Orchestra. 4, Pianoforte recital: Solomon. 6.30, Intermission—B.B.C. Variety Orchestra. 7.15, Recital: Peter Dawson. 9.5, Joint concert by the Band of the Garde Républicane and the B.B.C. Military Band.

Reg., 5, The Grand Hotel, Eastbourne, Orchestra, and Olive Groves. 9.5, "Semi-detached," radio comedy, adapted from P. G. Wodehouse's novel "Sam the Sudden."

Abroad.

Kalundborg, 4, Municipal Concert from the People's Park, Copenhagen.

Brussels II, 9, Concert from the Kursaal, Ostende, with Jo Vincent (soprano).

MONDAY, JULY 25th.

Nat., 6.25, Test Match Commentary. 7, The Bungalow Club. 8.10, "Press-Gang," the story of the British Navy of the 18th century. 8.50, Handel's opera "Perseus and Andromeda."

Reg., 4.15, Band of His Majesty's Royal Marines (Chatham). 7, Local Dishes with a West Country Flavour. 9.40, Fifth Speedway Test Match at Wimbledon. 10, George Gershwin: a commemorative programme.

Abroad.

Brussels I, 8.30, Concert from the Casino, Spa.

TUESDAY, JULY 26th.

Nat., 5, Royal Naval Singers. 6.25, Test Match Commentary. 7.30, "On Trek," programme devised by Josef Marais. 8.30, "Bournemouth Nights," fourth relay in series from seaside resorts.

Reg., 8.15, "Down on the Farm," a review of country life throughout the year. 9, "The Death of Phryne," one-act opera by L. Rocca, from the Turin studios.

Abroad.

Berlin (Funkstunde), 8.10, Bizet's "Carmen," with Helge Roswaenge in the cast.

Breslau, 8.30, Beethoven's Ninth Symphony, relayed from the Jahrhunderthalle.

WEDNESDAY, JULY 27th.

Nat., 7.20, Selections from "Rhythm Express." 8, "Dear Love," a musical comedy. 10.25, Meredith Willson, Music Director, N.B.C. Western Division, conducts the Variety Orchestra.

Reg., 8.15, "The Elephant," an anthology from the writings of the past 2,000 years. 9, Dance Cabaret from the Royal Bath Hotel Ballroom, Bournemouth.

Abroad.

Vienna, 8.10, Festival Concert relayed from Salzburg.

Bordeaux-Lafayette, 8.30, Jerome K. Jerome's play "The Passing of the Third-Floor Back."

Developing a High-Quality Communication Receiver

How a Receiver is Designed—XIX

THE RF AMPLIFIER AND FREQUENCY-CHANGER

WHAT may be termed the "fixed-tuned" parts of the equipment have been dealt with in the previous articles in this series. These include the AF amplifier and output stage, the detector and AVC system, the IF amplifier, and the variable-selectivity circuits. The method of tuning remains to be treated, and in this article the essentials of the RF stage and frequency-changer are discussed.

NOW that the essentials of the receiver circuits from the IF amplifier onwards have been dealt with, we must turn to the earlier stages. The IF amplifier operates at a fixed frequency and the signals we wish to receive are on many widely different frequencies; the amplifier, therefore, must be preceded by apparatus which will change the frequency of the wanted signal to that of the amplifier. This apparatus is called the frequency-changer. This name, however, is something of a misnomer, for, strictly speaking, the frequency-changer does not change the frequency of the incoming signal to the intermediate frequency. Instead, the incoming signal causes the frequency-changer to produce an output at intermediate frequency; the signal appears also in the output circuit at its original frequency.

The process of frequency-changing can be carried out in many different ways. One method is to use two valves, one as an anode-bend rectifier and the other as an oscillator. These are arranged as shown in Fig. 19, where LC is tuned to the incoming signal. The oscillator frequency is determined mainly by L1C1, the reaction coil being L3. A coupling coil L2 is provided in the cathode circuit of V1, whereby a voltage at oscillator frequency is injected into the grid-cathode circuit of V1. Between grid and cathode of this valve there is thus applied a total voltage which comprises the sum of the signal and oscillator voltages, the latter of which is normally considerably the greater.

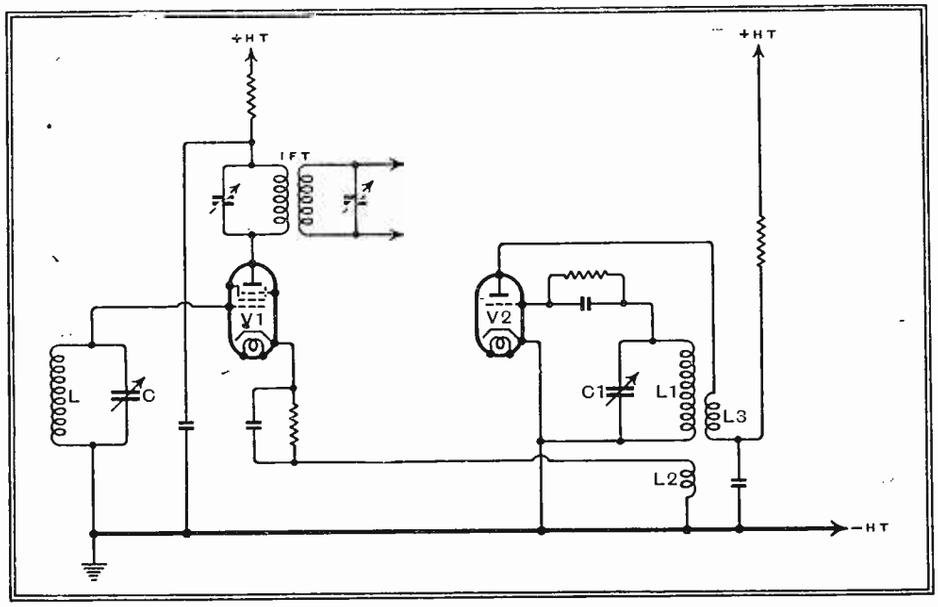


Fig. 19.—This diagram shows the now old-fashioned two-valve frequency-changer with cathode injection.

As V1 is functioning as a rectifier, beats are produced in the anode circuit between the two input frequencies. If the signal input is fs and the oscillator frequency is fo, there will be currents in the anode circuit at frequencies fs and fo and also at fo − fs (or fs − fo, depending on which is the greater) and fo + fs. There will also be harmonics of all frequencies; *i.e.*, 2fs, 2fo, 2(fo − fs), 2(fo + fs), 3fs, 3fo, 3(fo − fs), 3(fo + fs), and so on. There are also likely to be more complex components, such as 2fo − fs, 3fo − fs, 3fo − 2fs, and so on.

Of all these currents at differing frequencies fo is the strongest, and in general fs is probably the next strongest. We are not interested in these, however, for we want to use the strongest of the beat frequencies; these are fo − fs (or fs − fo) and fo + fs. Normally we always use fo − fs, and the harmonic components of the anode current are very much weaker. In some circumstances these harmonic components can cause trouble, but they do not do so under normal conditions when the proper precautions are taken. It will be clear that to receive a given station of frequency fs the signal circuit LC must be tuned to the frequency, and it is then only necessary to adjust L1C1, so that the oscillator frequency fo is such that fo − fs = fi, the intermediate frequency. The selective circuits of the IF amplifier pick out this frequency to the exclusion of the other output frequencies of the frequency-changer. It should be noted that the oscillator circuit L1C1, must always be tuned to a frequency different from that of the signal circuit LC by the intermediate frequency; in practice, it is almost invariably tuned to the higher of the two possible frequencies.

Electron Coupling

It is quite possible to use a single double-valve of the triode-pentode type in a slightly modified arrangement of Fig. 19, and entirely satisfactory results are obtained on the medium and long wavebands. On short waves, however, difficulties occur through the grid-cathode capacity of V1; this acts in conjunction with L2 to couple the signal and oscillator tuned circuits, with the result that the tuning of one affects the tuning of the other. This effect becomes increasingly great as the operating frequency rises, and is very serious on short waves.

The remedy is to adopt a form of electron coupling, just as we did in the case of the beat-frequency oscillator. The matter is complicated by the higher operating frequencies, however, and by the fairly large oscillator voltage needed on the mixing valve. Many special frequency-changing valves have appeared in the last few years, and it seems to be

High-Quality Communication Receiver—

generally agreed that the triode-hexode is the most satisfactory for short-wave work.

The circuit arrangement is shown in Fig. 20, and again LC and L1C1 are the signal and oscillator circuits respectively. The triode-hexode is really two valves in the same envelope. The triode section V2 is used as an oscillator, and the hexode section V1 functions as a mixing valve. The signal is applied to the innermost grid, and there are then two screen-grids, between which there is an injector grid which is connected internally to the triode grid. The full oscillator voltage is thus applied to the injector grid.

With this type of frequency-changer the formation of beats between the applied frequencies does not depend upon rectification. The beats are produced because the anode current which flows as a result of applying a signal voltage to to grid 1 depends upon the oscillator voltage applied to grid 3. The effect has been called multiplicative mixing.

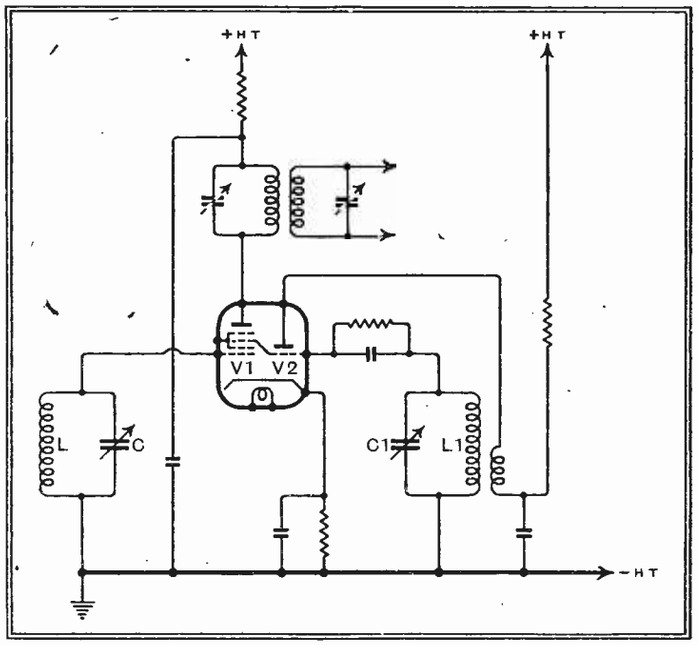


Fig. 20.—Modern frequency-changers are usually of the triode-hexode type, for the electronic mixing greatly reduces interaction between the tuned circuits.

Owing to the screening grids, inter-electrode capacities are low and the oscillator circuit is substantially isolated from the signal circuit. The isolation is not complete, for there is still some coupling left, but it seems to be better than with alternative arrangements.

The frequency-changer acts also as an amplifier, by which is meant that the IF output voltage on the IF transformer secondary is greater than the signal input voltage to the grid. The efficiency of the valve in this respect is expressed in terms of the conversion conductance, which is analogous to the mutual conductance of an ordinary valve. Instead of a valve of 1–3 mA/V, which is found for an RF pentode, the conversion conductance is of the order of 0.25–0.75 mA/V.

At first sight it would appear best to pick the valve with the highest value of conversion conductance, and if we were concerned only with the medium and long wavebands this might be the right course to adopt. On very short waves, however, there is another effect which comes into play. So far we have treated the input resistance of a valve as infinite. Apart from feed-back effects this does not lead to serious error at audio frequencies and moderate radio frequencies.

At very high radio frequencies, however, the time taken by an electron to pass through the valve is an appreciable fraction of the time occupied by one cycle of the input signal. This makes the valve absorb power from the input circuit, and the effect is most conveniently expressed as a fictitious resistance which, if connected between grid and cathode of a perfect valve, will have the same effect on the performance. In general, the input resistance increases with a decrease of conversion conductance (or mutual conductance in a triode, tetrode or pentode) and with a decrease of operating frequency. It also depends on the physical dimensions of the electrode system, increasing with a reduction in valve size.

A valve of high conversion conductance gives high gain, but its input resistance is low, so that the input circuit is heavily damped and only a small signal is actually applied to the valve. With a valve of low conversion conductance the gain is low, but the input resistance is high and the input circuit is much less heavily damped, with the result that a larger signal is applied to the valve.

Signal-Noise Ratio

The precise results depend upon the operating frequency and upon the efficiency of the signal circuit. In general, however, the frequency-changer of low conversion conductance gives a higher overall efficiency on short waves than the one of high conductance. Furthermore, as the tuned circuit is less heavily damped its selectivity is higher. This valve, then, is the better type in this case. In the Marconi and Osram range the valve is the X65.

Since we can easily obtain all the amplification we need at intermediate frequency there would seem little point in using a radio-frequency amplifier before the frequency-changer. This would be true if it were not for the noise introduced by valves. Any valve introduces a certain amount of noise, but provided that the stage gain is not below a certain figure it is only the noise of the first valve that has any appreciable effect. Now a frequency-changer invariably introduces more noise than a plain amplifier, usually about three or four times as much. Consequently, for minimum noise it is necessary to use an RF stage before the frequency-changer.

Valves are not the only cause of noise in a receiver, however, for the tuned circuits contribute some. When an RF amplifier is used it is usually possible to make the noise in the first tuned circuit the major factor in determining the signal-noise ratio. This is only on the medium and long wavebands, however, and on short waves circuit noise is usually negligible. It is, therefore, necessary to pick the first valve carefully for minimum noise.

Valve noise depends on the general design of the valve and upon the excellence or otherwise of its construction. The latter need hardly concern us nowadays, since it is only in defective specimens that constructional faults are likely to be a cause of noise. There are certain general valve characteristics which can help us in choosing a valve; in general, other things being equal, the valve with the lowest ratio of anode current to the square of mutual conductance will give the least noise. Other things are not always equal, however, and it is also found that the noise is proportional to the ratio of screen current to cathode current.

Problems in Radio Engineering. By E. T. A. Rapson. (Third edition.) Pp. 117. Published by Sir Isaac Pitman and Sons, Ltd., 39, Parker Street, London, W.C.2. Price 3s. 6d.

THIS book consists primarily of a collection of examination questions representative of papers set by the City and Guilds, I.E.E., and London University; in the present (third) edition questions set as recently as 1937 are included. Answers are given at the end of the book, with occasional hints for solution, for those question which demand a numerical result; a feature especially useful to students working privately, provided, of course, that there are no errors in the answers given. A check of half a dozen of the questions appearing in this edition for the first time, and a comparison of the answers in this edition with those of the last having failed to reveal any discrepancies or amendments, we can feel some confidence in the accuracy of the answers as a whole. (But some of us may remember that once upon a time there was an official Government publication, the author or authors of which would have stood in great danger of being failed in any examination, since about 50 per cent. of the answers had to be "amended" in the next edition!)

Not the least valuable part of this book is the list of references and summary of formulæ and definitions set at the head of each group of examples; these might with advantage be expanded in future editions, even if such expansion rendered necessary the judicious weeding out of some of the earlier examples, and a section on AC bridges might perhaps be added. C. R. C.

NEWS OF THE WEEK

LISTENER RESEARCH: A Technical Questionnaire?

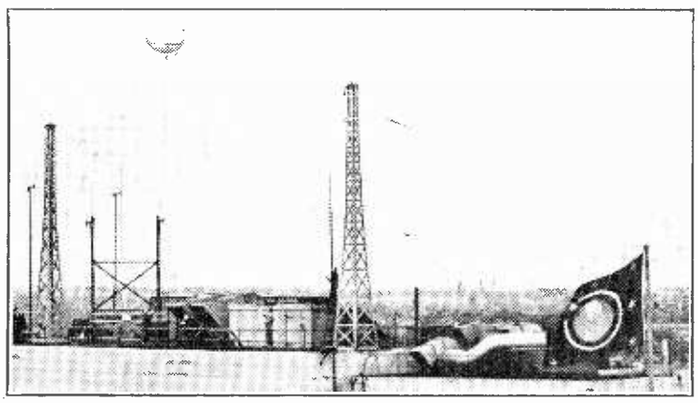
Intimate Knowledge of Reception Conditions

THE success of the Listener Research Campaign has been so great that the B.B.C. is understood to be considering an extension of the scope of these enquiries. Among the subjects to be enquired into may be that of radio reception generally, with particular reference to signal strength and quality of stations most favourably received.

The B.B.C. could with advantage obtain information from listeners on such points as the incidence of fading, the districts in which it is most noticeable, and the times of day when it is most in evidence. Interference might also provide a question on the enquiry form, though as this bugbear is properly the province of the Post Office, the Corporation would merely pass on the answers to the official quarter.

Much of the information gained would be of indirect value, but it would all supply the B.B.C. with that intimate knowledge of reception conditions and the problems of the listening public without which it is impossible to assess their real needs.

As evidence of the popularity of the questionnaires it may be mentioned that a few hours after the announcement was broadcast concerning the latest questionnaire, a fortnight ago, 5,600 applications for forms were received at Broadcasting House. Simultaneously the Post Office sent out the questionnaire to 4,700 families picked at random from telephone directories, and some 20 per cent. replied.



A CAPTIVE BALLOON riding gently over Broadcasting House was the subject of considerable speculation in London last week. Actually it was being used by B.B.C. engineers for reception tests of the transmissions from Daventry, as it permitted the use of various lengths of aerial.

ACTIVELY PURSUED!

Welcomed Words from the Post Office

THE Assistant Postmaster-General, Sir W. Womersley, in reply to a question in the House as to how many complaints approximately his department received annually of wireless interference by neon-sign installations and whether any action was contemplated in this connection, said that approximately 2,000 complaints were received each year. He went on to say that most of the owners of the offending signs agreed to fit suppressors, although there was no legal power to compel them to do so.

The closing words of his reply will be welcomed by all sufferers from man-made static, for he said: "The necessary enquiries regarding the possible scope and operation of a new Wireless Telegraphy Bill to deal, *inter alia*, with the question of electrical interference with wireless reception are being actively pursued."

Jerusalem Worries Manchester

THE B.B.C. is receiving a crop of complaints regarding the clashing of stations. Midland Regional listeners are complaining of high-pitched whistles, attributed to Bratislava, on 298.8 metres, and Mancunians are positive that North Regional is being heterodyned by Jerusalem, which is reported to be straying from the 449.1-metre wavelength which it shares with Slaithwaite.

COMFORTABLY ENSCONCED IN AN ARMCHAIR before the television-telephone apparatus in Munich which has just been linked with Berlin. In this official photograph the image on the cathode-ray tube shows much more than in actual practice when the head is larger and the image is cut off just below the collar. Note the loud-speaking telephone in front of the speaker.

TELEVISAPHONE

Latest Developments in German Television-Telephone

GERMANY has extended its television-telephone service which has for some time been in operation, linking Berlin with Leipzig and Nürnberg to Munich, which adds approximately 100 miles to the existing 300-mile link. It is, however, possible for only one person at a time to put through a call for although the four towns are now linked they are on one circuit. It is officially announced that Hamburg, Cologne, Frankfurt-on-Main, and probably Vienna, are to be brought into the system in the near future.

The extension was formally opened on Tuesday, July 12th, when German Press representatives were allowed free calls. On the following day the service was opened to the public, and the Berlin correspondent of *The Wireless World* was the first member of the public to use the new link. The cost of his three-minute call was Rm.4.80, plus 0.80 for the person called to be brought to the booth in Munich (about 9s. in all). He states that illumination was vastly superior to that when he used the Berlin-Nürnberg line. The person in Munich who, owing to the use of infra-red rays, appeared to be unshaven, was able to read the headlines of a newspaper held up in Berlin.

The use of a loud-speaking telephone has greatly improved the system. This employs a lond speaker of the moving-coil type which is used as microphone and loud speaker. A simple circuit arrangement renders the microphone dead whilst being used as a loud speaker.

Mechanical spot-light scanning is employed in the transmitter, which transmits 180 lines and 25 frames per second. Repeaters are used every 35 kilometres on the new extension, although for television broadcasting, when the German Post Office will use 441 lines and 50 frames interlaced, repeaters will be placed every 17.5 kilometres.

The picture frequency for the television-telephone is of the order of 500,000 c/s. This is imposed on a carrier of 1.3 Mc/s, the upper sideband being suppressed so that only the lower sideband is used.

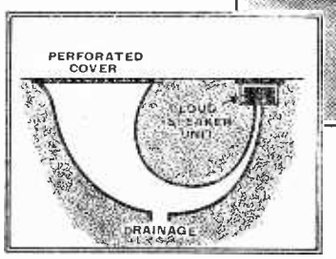
FORECASTING FADE-OUTS

Results of Listeners' Co-operation with Greenwich Observatory

AS a result of the co-operation of Empire listeners with the B.B.C. and Greenwich Observatory, it may in the future be

MR. A. J. GILL, B.Sc., M.I.E.E., M.Inst.R.E., who is Chairman of the Wireless Section of the I.E.E., has been appointed Assistant Engineer-in-Chief of the G.P.O. Mr. Gill entered the Engineering Department of the G.P.O. as assistant engineer in 1913 and was attached to the Radio Section. He was appointed executive engineer in charge of the Radio Experimental Section at Dollis Hill in 1925, assistant staff engineer in 1929, and three years later staff engineer of the Radio Branch.

ACOUSTICAL PROBLEMS were successfully overcome, at the recent meeting of the Sokols (Falcons) in Prague by the use of twenty-four 25-watt ground loud speakers, one of which is illustrated above. As will be seen from the diagrammatic inset, the horn is built in the earth.



possible to warn listeners to Daventry of the approach of long-term fade-outs. Investigations show that complete fade-outs are preceded some thirty-six hours by a bright hydrogen eruption from an active sunspot crossing the sun's meridian. This delayed effect is apparently due to the emission of numerous charged particles from the vicinity of the sunspot. These travel at a much slower speed than light, and as they enter the ionised layers reduce the ionisation levels by contact with the electrons giving rise to poor conditions for propagation and the resultant failure of signals.

Many overseas listeners cable reports of fade-outs to the B.B.C., which information, together with the observations of B.B.C. engineers, is correlated with the accurate solar information supplied by the Greenwich Observatory.

TELEVISION AT OLYMPIA SHOW

Visitors to See Behind the Scenes

EXTENSIVE facilities for the public to see television programmes in production will be available at Radiolympia this year when, from August 24th to September 3rd, six hours of television programmes will be transmitted daily. The Radio Manufacturers' Association is erecting in the National Hall a large television studio with glass walls which will enable visitors to see artistes at work. The two principal programmes will be "Cabaret Cruise" and "Queue for Song"; Fashion Parades will be included daily.

For the first time two mobile television units will be in use during the Exhibition period. One will be installed at Olympia to relay the programmes to Alexandra Palace for retransmission, and the other will be operating first at the Kennington Oval for the final Test match, and, later, at the Zoo.

Each morning visitors to Radiolympia will be invited to face the television cameras so that their friends can see them on demonstration receivers which will be constantly working in different parts of the exhibition.

BOOK ON SCOTTISH BROADCASTING

ONE of the last occasions on which Sir John Reith put pen to paper as Director-General of the B.B.C. was to write a 140-word foreword to "Scotland on the Air," an exhilarating book compressing into 160 vigorous and vivid pages the history of Scottish broadcasting since that "Black Hole of Calcutta," 202, Bath Street, Glasgow, became the first Scottish broadcasting studio on March 6th, 1923. Compiled by George Burnett, the indefatigable B.B.C. Public Relations Officer for Scotland, this lively book will see the light towards the end of this month. Chapters on the first transmitter at Port Dundas power station, and photographs of this and the antiquated control room, should be of exceptional interest to *Wireless World* readers.

NEW I.W.T. REGULATIONS

AT a meeting of the Institute of Wireless Technology held on July 15th, the members unanimously approved the recommendations placed before them by the Council for revising the syllabus of examinations. The adoption of a new grade of membership, that of Graduateship, was also approved. In the opinion of the Council, the new grade will be appreciated by many who hitherto have not been eligible for admission to the Institute.

Copies of the Revised Syllabus and Membership Regulations, with appropriate application forms are now available and may be obtained from the Secretary at 4, Vernon Place, Southampton Row, London, W.C.1.

FROM ALL QUARTERS

"Tatsfield" for South Africa

THE South African Broadcasting Corporation is reported to have purchased a 96-acre site near Johannesburg on which to erect a powerful receiving station for relaying the world's short-wave stations to listeners throughout South Africa.

Hospital Wireless

THE position of the hospitals regarding the payment of wireless licences was clarified by the Assistant Postmaster-General when, in reply to a question in the House last week, he stated that a single wireless licence taken out by a hospital authority covered the installation of any number of receiving sets for use by patients in the hospital.

Inter-Communication in the Army

THE Royal Corps of Signals, which is responsible for intercommunication in the Army, will, from August 1st to 13th, display its equipment and demonstrate its skill in the Services Pavilion of the Empire Exhibition, Glasgow. Visitors will see W/T stations working, repairs in the workshop, and demonstrations of alternative methods of communication, namely, wireless, wire, visual, and despatch riding.

"Aircraft Production": A new Journal

OUR publishers, Iliffe and Sons Ltd., are shortly to issue a new journal, to be entitled *Aircraft Production*. The aim of the publication, which will appear monthly, is to promote efficiency in the aircraft industry by co-ordinating design and production and by disseminating modern ideas on the manufacture of airframes, engines, and accessories.

More Power for Sweden

ALTHOUGH it is less than two years since the 100-kW Hörby transmitter was put into service, the Swedish Administration of Posts and Telegraphs has given the contract to Telefunken for another 100-kW transmitter to be erected at Falun. This will replace the present 2-kW station, which works on 276.2 metres.

Calling All Cars!

POLICE loud speaker cars were put to a new use during Her Majesty Queen Mary's visit to the Tower of London last week. Owing to the limited space in the vicinity, the cars of those attending the garden party were parked a quarter of a mile away, and when wanted their numbers were announced by a police patrol car which was receiving wirelessed instructions from a transmitter at the Tower entrance.

Duplex Radio for Gliders

SUCCESSFUL experiments were recently conducted by the Yorkshire Gliding Club in duplex radio-telephone communication between a glider and a ground station.

Wired Wireless for A.R.P.

A FEATURE of the Wimbledon (London) A.R.P. scheme is the method of communication to be used if the telephone system is put out of action. The apparatus is plugged into the electricity supply, the cables of which then become the medium for carrying the transmissions to a receiver plugged into the same power supply. Even though the current were cut off, the apparatus is still usable, for it does not rely on the mains for power.

Empire Trophy Comes to Britain

THE 1938 British Empire Radio Union Reception Contest has been won by Mr. M. G. Bourke, of Jersey. At his SW station 2AOU, he was successful in receiving and working stations in twenty-two divisions of the Empire; his achievement brings back the trophy, which has been in Australia for the past two years.

New Osram Battery Valve

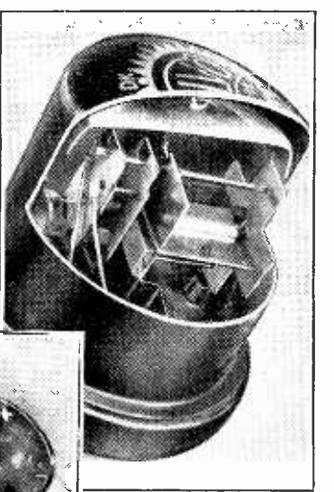
THE General Electric Company announces a new 2-volt double-diode-triode 5-pin battery valve with a top cap for the control grid. Considerable stage gain is obtainable by reason of its high amplification factor (40) whilst its low filament consumption (0.15 amp) provides economical operation. It will be known as Type HD23 and is priced at 9s.

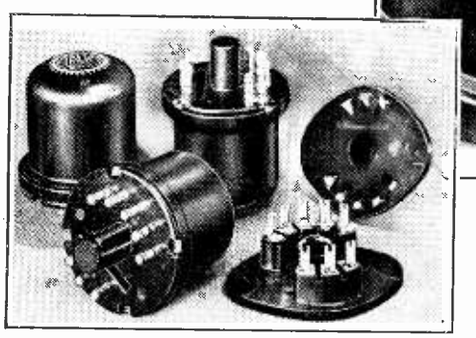
PA to the Rescue

IN Finland many of the large bathing beaches have been equipped with PA apparatus, which, as well as relaying music, are used at intervals throughout the day to give instruction on rescue work.

Is This a Record?

IT is understood that the broadcast of the Louis-Schmeling fight cost the Buick Motor Company, the sponsors, over $47,000 for the limited period of fifteen minutes. This sum was paid to the N.B.C. for the commentaries to be radiated over 146 stations.





NEW GERMAN METAL VALVES which have an entirely new style of base, and as can be seen from the cut-away photograph, have the electrodes mounted horizontally. The diminutive size of these Philips valves can be judged by comparison with the holders shown.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Educating the Public ?

I THINK "Diallist," in *The Wireless World* of June 23rd, rather missed the point of Mr. Eric Cundell's accusation that the B.B.C. has missed a golden opportunity of educating the people's taste for good music. The performance of good music does not in itself "educate" taste—education must come before appreciation. To give an analogy, the broadcasting of, say, Molière's works would not educate the public's taste in the French language if they had not previously learnt the grammar and vocabulary. A listener receives music in the form of a complex wave, and he cannot analyse it unless he has been trained to recognise the timbre of the various instruments. It is not sufficiently recognised that a symphony or a string quartet sounds to the untrained listener as a mere noise.

Formerly, the youngster went to concerts, saw the different instruments played, listened to his elders discuss the qualities and the form of the music, and so learnt how to listen. What chance has a youngster to learn to appreciate music when it comes to him in the form of crooning, jazz, or sugary tunes by somebody's sextet "drooling" away all the time as a background to the conversation, quarrels and other noises incidental to domestic life? His elders, so far from helping him, do not even listen, or occasionally say "How nice!" or "Turn it off and try somewhere else."

Those who understand music appreciate the B.B.C.'s work, but it is doubtful if anyone's taste is educated by it.

The B.B.C. might help by broadcasting items by individual orchestral instruments, then music combining a few instruments, such as Bach's Brandenburg Concertos, Mozart's Serenades, etc., then introduce the complete orchestra by way of the earlier symphonies, such as those of Haydn and Mozart. Analysis of the structure could be given in *The Radio Times* (instead of the present unhelpful notes). Television, when it becomes general, would be a great help.

London, W.4. H. W. LEE.

Debunking Harmonic Distortion

I HAVE just read with much interest the article entitled "Debunking Harmonic Distortion," written by "Cathode Ray," appearing in your May 19th, 1938, issue.

The condition which the author describes as "inter-modulation distortion" has been recognised in the United States for some time past. The first printed reference thereto which I at the moment recall was contained in an engineering bulletin issued early in 1936 by the Ken-Rad Corporation, of Owensboro, Kentucky.

While I cannot state absolutely definitely, I believe from my own engineering acquaintance and experience that attention was first focused upon what we in the United States term "modulation product distortion" some two years ago. At that time Class B amplifiers were still popular in radio receiver and public address amplifier design. A few enquiring souls sought to determine why a Class B amplifier, which under conventional measurement technique exhibited not over 5 per cent. total harmonic distortion, sounded so unutterably "sour" when employed for musical reproduction.

Someone—I don't know exactly who did it first—suspected the generation of sum and difference frequencies such as might be anticipated as arising in any circuits containing rectifying elements, and so measured a Class B amplifier using not one but two signal sources. Suspicion of the generation and presence of sum and difference frequencies as soon as two different frequencies were applied to the amplifier was immediately confirmed. Ever since that time this phenomenon has been known as "modulation product distortion." This seems a good descriptive term, and in the interests of uniform terminology in England and America may be worth being made known to your readers.

Fundamentally, "modulation product distortion" may arise in any circuit containing a rectifying element. This may be an overloaded tube, and may particularly easily be a tube or tubes operated with positive grid excursions, and it is best avoided by guarding against overloading and eschewing positive grid operation in audio-frequency amplifying valves.

Turning to "Cathode Ray's" suspicions that harmonic distortion may be tolerated in reasonable amount, may I say that in the United States I believe that it is the general opinion that up to 10 per cent. even harmonic distortion may not prove excessively objectionable, while 3 per cent. of odd harmonic distortion is distinctly annoying. In my own laboratories where we are engaged in designing radio receivers and amplifiers for presumably extremely critical musicians, we have learned to believe that much over 1 per cent. total harmonic distortion is disagreeably perceptible at ordinary home entertainment volume levels of up to 5 watts electrical amplifier output. Modulation product distortion is definitely more annoying even than a few per cent. of odd harmonic distortion, but this fact does not justify the designer in "white-washing" harmonic distortion. It is unfortunate that most sales departments, if not most engineers themselves, the world over consider the public to be afflicted with "tin ears," and, as the human ear relatively easily "conditions" itself to distortion in regularly repeated doses, the radio industry can take little credit for improving the general public's taste in tone quality.

To turn to another, but associated, subject, in the United States "high-fidelity" receivers have been offered capable of good reproduction up to 9,000 cycles. Upon the presumption of good transmitter modulation, such is of distinct tone benefit. Commercial considerations result in "deep" modulation by practically all American broadcast stations for commercial and economic reasons, with the result that for critical listeners such increased tone range is an annoyance rather than a benefit. I have observed over several years a condition which leads me to believe that this annoyance is traceable to harmonic distortion resulting from intermittent but regularly transmitted over-modulation. This is because, if reproduction be cut off sharply at 6,000 cycles, such distortion is not noticeably apparent, but becomes increasingly so above what might be termed the "threshold" of 6,000 cycles.

As a corollary I seriously question the importance of any frequencies in musical reproduction above 6,000 cycles as a result of tests conducted with skilled musicians of wide hearing range, as well as because of the tendency with increasing age of adult hearing progressively to reject higher tones.

Until such time as auditory perspective, binaurality, depth or third dimensional effects can be had in radio reproduction, I am inclined to feel that discreet amounts of both odd and even harmonic distortion may profitably be included in electrical sound reproducers as a means of simulating in some slight measure the three dimensional aspects of music so sadly lacking in radio reproduction. McMURDO SILVER.

Chicago, U.S.A.

Relays

MAY I apologise to your correspondent "C. G. J."?—I seem to have misled him. Relay companies, to the best of my knowledge, are not losing 90 per cent. of their subscribers. I meant to convey that 90 per cent. of those subscribers they did lose were well satisfied with the service they received. "PRAXIS."

"Amplitude Distortion"

I HAVE been very interested in "Cathode Ray's" article entitled "Debunking Harmonic Distortion" in your issue for May 19th, 1938, and in the correspondence between this gentleman and Mr. Benham and Messrs. Callendar and Clarke. The latter gentlemen entitle their contribution "Debunking Intermodulation." I have followed their example in summing up, in the title of this letter, what I feel about the matter.

Fundamentally, any system of measuring amplitude distortion must:—

(a) Measure the shape of the working input/output characteristic of the apparatus under test.

(b) Establish by experiment the relative "unnaturalness" (or, as Messrs. Callendar and Clarke call it, the "unpleasantness") of telephony transmitted through the apparatus in question.

(c) Establish by experiment the relation between "unnaturalness" of reproduction and a number of shapes of the input/output characteristic.

This is the process used in the work described in my *Wireless Engineer* paper. As a result a proposed standard of distortion was set up.

Referring to items (b) and (c) above, a large number of experiments must be made to cover many different types of telephony; for instance, (1) speech, (2) music and speech, (3) violin and piano, (4) orchestra and recitation, (5) organ and voice, etc., etc. These tests must be done on "high-quality" apparatus, in which a known degree of distortion can be introduced and switched in and out instantaneously, and which at any given time may be readily expressed in terms of the shape of the output/input characteristic. (I refuse to court misunderstanding by saying either harmonics or intermodulation products!) If this is done, particularly on such items as Nos. 1, 2, 3, and 4, it will readily be found that the greatest infidelity of reproduction exists when the input/output characteristic is such as to produce certain higher-order intermodulation products *when a certain test signal is fed into the apparatus.* Note

that these are side tones produced from the test signal; *they have nothing whatever to do with whether such side tones occur (or do not occur) in the telephony on which the experiment is made.* The experiment will also show that, whereas infidelity is more or less proportional to the behaviour of certain measured side tones, it is by no means proportional to the ordinarily measured harmonics of a sine wave. This is because the phase angles of the harmonics are not measured. Therefore in my *Wireless Engineer* article I suggested a standard of measurement of input/output characteristics (item (a) above) based upon measured side tone or intermodulation products.

It seems to me that there is a confusion in the minds of your correspondents between two quite separate things. It may be interesting to argue whether in the transmission of telephony the production of spurious harmonics or side tones is pleasant or unpleasant to the ear, and/or "increases with the order of harmonic." This is, however, quite irrelevant to the subject of amplitude distortion. Arguments about musical theory are beside the point. One never in any circumstances measures or evaluates any of the harmonics or side tones produced when, for instance, Donald Duck or Mr. Hibberd are speaking over the wireless. In fact, I am not aware of any apparatus capable of doing this. What we are concerned with is to note whether Donald Duck or Mr. Hibberd or the Symphony Orchestra sound unnatural or natural. We can then measure the shape of the input/output characteristic of the apparatus which is transmitting their respective sounds and thereby determine what particular shape makes them sound natural or unnatural.

Whether the shape of the input and output characteristics is evaluated by plotting a curve of the Eg against Ia, or by applying a sine wave and measuring the resulting harmonics, or by applying two sine waves and measuring the side tones is quite immaterial *so long as whichever system of measurement we employ shows up those properties of the input/output curve which vary in the same manner as the audible distortion or "annoyance value,"* and can therefore be used to measure this. Experimentally it has been found that side tones do have this property, and 2nd and 3rd harmonics of a single sine wave do not (because phase angles are not measured); but these side tones are side tones artificially produced during a test, and are nothing whatever to do with side tones which may (or may not) be produced when Mr. Hibberd, Donald Duck or the Symphony Orchestra are coming through the same amplifier. A lack of realisation of these facts seems to be the basis of the difficulties found by your correspondents.

It follows from the above that, so long as the shape of the input/output characteristic to be evaluated does not change with frequency, there is no reason whatever, as Messrs. Callendar and Clarke say there is, to make measurements "at all frequencies and at all output levels."

Experiments comparing the relative distortion of the transmission of any note or combination of notes are only relevant as regards that particular note or combination of notes. Therefore, for instance, the aural estimates of "pure tones" mentioned at the end of Messrs. Callendar and Clarke's letter can only mean something on those rare occasions when the B.B.C. transmit such pure tones. I do not recollect having heard an unaccompanied flute on the wireless, nor is one particularly interested in the question of the purity of reproduction of the time signal.

With reference to (b) of Messrs. Callendar and Clarke's letter, such a reading of my paper is, of course, quite wrong. The correlation between an upward turning 3rd harmonic accompanied by a downward turning 2nd harmonic, and the production of side tones, when the same valve is measured with two input tones instead of one, was merely mentioned as an interesting fact of use, perhaps, to those who did not possess the necessary apparatus to make side tone measurements. It is not my "criterion" of distortion. It merely gives, as I said in the *Wireless Engineer,* sometimes "quite a good idea."

I am surprised to note also from these gentlemen's letter that they agree with the idea of endeavouring to make their ordinary harmonic measurements fit the results they observe in listening tests by quite arbitrarily and artificially adding to (or "weighting") the amplitude of the higher harmonics in question. Has it escaped their notice that a measurement plus a guess is equivalent to a guess only? Any measurements can be made to fit any observed phenomena if the measurement is altered after it is made.

May I make a suggestion that it would be extremely interesting if your correspondents would all conduct a series of tests (as set out above) on a wide selection of different types of programme and will correlate each test with their own pet ways of measuring the shape of the input/output characteristics, e.g., side tones or higher harmonics, etc., and see which system of measurement gives figures most closely agreeing with the audible results? Naturally, the apparatus employed should be capable of giving really high-quality reproduction at the turn of a switch (as the control of the experiment). Distortion should be confined to a part of the circuit which is readily measurable; for instance, the loud speaker employed should be of the best possible type. Loud speaker amplitude distortion is difficult to measure and is frequently a source of serious errors in experiments of this type.

So far, I appear to be the only person who has yet published any complete results of tests on these lines. This is a rather unenviable isolation, and I can only request others to try such experiments for themselves before querying my conclusions.

J. H. OWEN HARRIES.

London, S.W.19.

Background Noise

IT may be of some interest to know that I have traced excessive background in my QA Super to noise developed in the cathode resistor of the frequency-changer. This was by-passed to RF only by a 0.05 mfd. condenser, and on increasing its capacity to 1 or 2 mfds. the noise was reduced to normal proportion.

It seems to me that this condenser should be large enough to by-pass any AF noise voltages that may be generated in the resistor, or, alternatively, a non-inductive wire-wound resistance should be used.

Since the function of this valve is modulation, surely any noise voltages generated in the bias resistance will cause modulation of the intermediate frequency.

This should not apply to amplifying valves with comparatively straight characteristics since modulation should not take place in these stages.

Derby. T. BALDWIN.

Readers' Problems

A Selection of Queries dealt with by the Information Bureau, and chosen for their more general interest, is published on this page.

Aerial Wire

A READER recently erected a new aerial using enamelled stranded wire, and having been told that RF currents are mainly confined to the "skin" of wires wishes to know if the insulation is detrimental; also would an improvement in signal strength be obtained by replacing it with bare wire.

So far as performance is concerned there is no difference whatsoever between bare and insulated wire for the aerial. Possibly a little more care is needed in the erection of an aerial when insulated and stranded wire is used, as if any joints have to be made it is essential that all the insulation be removed from the strands so that each one is securely soldered to the continuation lead.

If the solder fails to "take" on one of the inside strands this may rub against the others when the aerial swings in the wind and cause "crackles." Locating a fault of this kind is an extremely difficult matter as there is no visible evidence that anything is amiss with the aerial.

To guard against this the aerial and lead-in wires should be one continuous piece without joints of any description. Even with bare stranded wire the same care should be exercised if joints must be made.

The insulation will, however, give some protection to the wire against the corrosive effects of town and seaside atmospheres.

Fault Finding

A PECULIAR fault has developed in a reader's receiver which is a battery set but operated by an AC mains HT supply unit. After the set has been working for a short time there is a sudden reduction in volume, accompanied by severe distortion.

Were it not for the introduction of distortion when the volume fell we would be inclined to suspect a break in the primary of the inter-valve transformer. A like fault in the secondary winding might account for it as the output valve will be operated without grid bias.

Other likely causes are a defect in the output valve, or in the HT supply circuit. One simple way of ascertaining if it is the one or the other would be to connect a voltmeter across the output sockets of the battery eliminator that supplies HT for the

last valve and note what happens when the distortion occurs.

If it is caused by a defective output valve or a fault in the anode circuit of the valve the HT volts will most likely rise. On the other hand, a fault in the eliminator will usually manifest itself as a reduction in the output voltage.

The location of the actual cause of the trouble will be rendered far easier by this simple test as it gives a reasonably good indication where one should look for the fault.

Wiring SW Sets

HAVING been told that in a short-wave set the wiring must be kept as short as possible, a reader asks for guidance on this matter, as it is obvious that *all* the connections in the set cannot be restricted in length to an inch or so.

The advice given to our querist is quite correct, though it should have been stated that the short wiring refers only to those leads carrying RF currents.

This comprises the leads between tuning condensers and coils, grid circuit wiring of RF and detector valves, reaction circuit wiring and the leads from the low potential end of the tuned circuits to the valve's filament or cathode.

After the RF by-pass condenser in the anode circuit of the valves leads may be any reasonable length, and the same applies to grid bias leads, though in the case of grid bias for an RF stage a by-pass condenser should be joined, by the shortest possible path, from the tuned circuit to the negative filament pin, or cathode, of the valve. If an RF stopping resistance is then connected to the "earthy" end of the tuned circuit the lead to the grid bias battery can be of any length.

An Uncommon Fault

AN intermittent fault in a wireless receiver is probably the most difficult of all to locate, especially after the obvious ones, such as loose contacts, dry joints, etc., have been eliminated.

In one particular case of this kind the set would behave normally for a time, then suddenly signals fell to bare audibility. Sometimes this was brought about by switching on an electric light in the house, and occasionally the fault could be cleared in this way.

Eventually the trouble was traced to a break in the primary winding of an AF transformer. Though it is difficult to say exactly what was taking place, a possible explanation is that the two ends of the wire were just touching, and any sudden surge of current, such as would be brought about by the "click" on switching on a light, caused a minute arc. This oxidised the broken ends of the wire, and when this arcing ceased the primary circuit was interrupted, as the thin oxide coating formed an insulator.

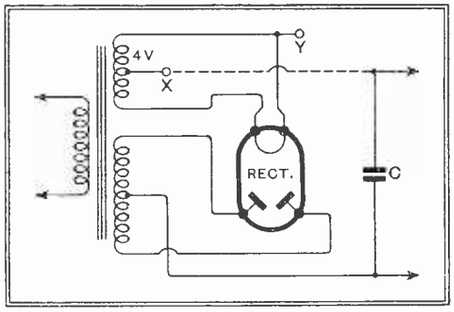
Slight vibration of the set might be sufficient to cause the ends of the wire to touch and so break through the insulation, thus completing the primary circuit.

This particular fault is an uncommon one, but in view of its illusiveness the likelihood of it being responsible should not be overlooked when all other possible causes have been eliminated.

HT Rectifier Connections

THE customary practice when wiring an HT rectifier circuit is to join the reservoir condenser across the centre tappings of the high voltage secondary and of the valve filament windings respectively. Occasionally, however, an alternative connection is made and the positive side of condenser C is joined to one end of the filament winding, that is to say, to Y instead of to X in the figure. A reader now asks if this is entirely satisfactory as he thinks that this arrangement might be more prone to produce hum and so require additional smoothing.

It makes no difference in practice which arrangement is adopted as joining the condenser C to the point Y is quite satisfactory. The ripple on the rectified output far and away exceeds the small difference in potential between X and Y, and this is



Reservoir condenser C in HT unit may be joined either to centre-tap on filament winding or to one end

completely smoothed out by the usual choke and condensers.

News from the Clubs

Exeter and District Wireless Society

Headquarters: 3, Dix's Field, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

On July 4th the Society paid an interesting visit to the Exeter Gas Works. Regular meetings will recommence in September.

West Herts Amateur Radio Society

Hon. Sec.: Mr. A. W. Birt, 6, Hempstead Road, King's Langley.

On July 6th Mr. G. Martin gave a further talk in the series entitled "Television." His talk dealt with scanning. G3NR then described an interesting experiment carried out by himself and 2BZY on June 11th, when they took portable receivers to the top of the Ashridge Monument and made observations of reception, particularly of N.F.D. stations.

On July 9th the Society organised two exhibits at the West Herts Hospital carnival fête held at Berkhamsted. Both exhibits were linked by landline and visitors were able to send messages at the rate of 3d. for twelve words.

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne.
Hon. Sec.: Mr. T. G. R. Dowsett, 18, Grove Road, Eastbourne.

On June 27th Mr. W. A. Morgan, one of the members, gave Morse instruction. A demonstration of the Lissen Hi-Q short-wave superhet four was also given. It was decided that members should keep it on trial and send reports to the manufacturers. Mr. S. M. Thorpe then demonstrated a spark coil giving 60,000 volts output.

Romford and District Amateur Radio Society

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

This Society has recently changed its name from the Chadwell Heath and District Amateur Radio Society and has moved to more commodious premises.

Radio Society of Northern Ireland

Hon. Sec.: Mr. H. F. Ruberry, 19, Little Victoria Street, Belfast.

The Leonard Trophy contest is to be held during October, and is open to all transmitting stations in the world. Particulars are as follows:—

The contest is open to all licensed transmitting stations. Licensed power must be used.

Only one operator allowed at each station; if more than one operator, each operator's score counts separately.

All stations must exchange R.S.T. reports to count for points.

Stations may be worked once only during contest.

All licensed frequencies may be used.

Dates and Times

Oct. 1st at 12.00 GMT to Oct. 2nd at 24.00 GMT.
Oct. 8th at 12.00 GMT to Oct. 9th at 24.00 GMT.
Oct. 15th at 12.00 GMT to Oct. 16th at 24.00 GMT.
Oct. 22nd at 12.00 GMT to Oct. 23rd at 24.00 GMT.

Method of Scoring

1 point for European contacts. 2 points for African contacts (N. of Equator). 3 points for African contacts (S. of Equator). 3 points for North American contacts. 4 points for South American contacts. 4 points for Oceania contacts.

Score of Irish station to be multiplied by the number of countries worked.

Districts of America W1 to 9 and Canada VE1 to 5 count as separate countries.

Awards

For the leading Irish station the Leonard Trophy will be awarded for one year (replica also).

For the leading station outside Ireland a gold medal.

For the second station outside Ireland a silver medal.

All logs must reach the Hon. Secretary R.S.N.I., H. F. Ruberry, 19, Little Victoria Street, Belfast, Northern Ireland, on or before December 31st, 1938.

Random Radiations

By "DIALLIST"

Encouraging Car Radio

THE B.B.C., one observes, is to do its best to popularise car radio. I am afraid that it won't do just the one thing which would give car radio the chance of becoming as popular in this country as it is on the other side of the Atlantic. What is that one thing? Why, just this. In school term-time the National transmitters serving England, Wales and Northern Ireland, and the Regional transmitters in Scotland, are either closed down or devoted to school broadcasts until 5 o'clock in the afternoon. In broad daylight the range of a car radio set must of necessity be limited, and it is no great fun for the owner of one of these sets to have to rely mainly on a few home medium-wave stations, the nearest of which may be a long way from the road over which he is journeying. As a rule, of course, there are certain foreign stations to be received, but it is to the home stations that the user of car radio should be able to look for his entertainment.

A Queer Position

It's rather a queer business when you come to think it out. The B.B.C. has no altruistic motive in helping to popularise car radio. To put it with brutal bluntness, it's your money they want. They see that the increase in their revenue from the receiving licence fees must become smaller and smaller as the saturation point is approached. But there still remains a pretty rich harvest to be gathered amongst those who own cars but have not yet installed radio sets in them. Every such car owner represents a possible extra licence, and therefore an addition to the B.B.C.'s share of the total receipts. But the situation now is that on account of its service to schools, towards the cost of which the education authorities apparently make little or no contribution, the Corporation is prevented from taking action that would undoubtedly result in a large increase in car radio receivers and therefore in its annual revenue.

It Could be Done

The whole business could easily be set right by proper organisation and a very simple rearrangement of the times of school broadcasts. I haven't checked up recently the amount of hours devoted during the week to these broadcasts—they have finished at the moment of writing, since examinations are in progress. The total time occupied by them used to be rather less than ten hours a week, and I don't suppose that it is much different now. It is manifestly absurd that to fit in ten hours of school broadcasting the entire Regional service in Scotland and the National service in other parts of the country should be out of action so far as the ordinary listener is concerned for 33¾ hours each week during term time. Wouldn't everyone be satisfied if the mornings only were given up to the schools, the special broadcasts starting, if necessary, at nine o'clock and going on till midday? Most schools begin their morning's work at nine, but nine-thirty might be chosen as a compromise, the close down being at twelve-thirty. In this way fifteen hours would be available each week for the schools, and if the broadcasts really are worth while they would very soon rearrange their time-tables to suit the new arrangement. The afternoons would then be free for broadcasting proper, and motorists would be assured that their car radio sets would give them the choice of at least two home programmes.

The News Bulletins

AMONGST listeners in all walks of life I find very little enthusiasm for the times chosen for the news bulletins during the summer months. They are given now at 6 o'clock (National), 7.30 (Regional), and 10 o'clock (National), and there is also a late news summary just before midnight from the Regionals. What I gather is that a large proportion of listeners don't get home from their work in time for the 6 o'clock bulletin, that at 7.30 they are either having their evening meal or indulging in outdoor recreation, and that they want to be in bed or on their way there before 10.25, when the last bulletin ends.

The late summary is intended mainly for those who have been to the theatre or to the second house at the cinema, and there are few complaints about the time chosen for it. Nine o'clock is to most people the best time of all for the main news bulletin. There is a strong feeling that that time should remain fixed and unalterable throughout the year. It seems to fit in pretty well with nearly everyone's doings in the ordinary way, and I am fairly certain that the load-curves taken by relay exchanges would show that at any season of the year the bulletin at this time attracted more listeners than any other.

Another Criticism

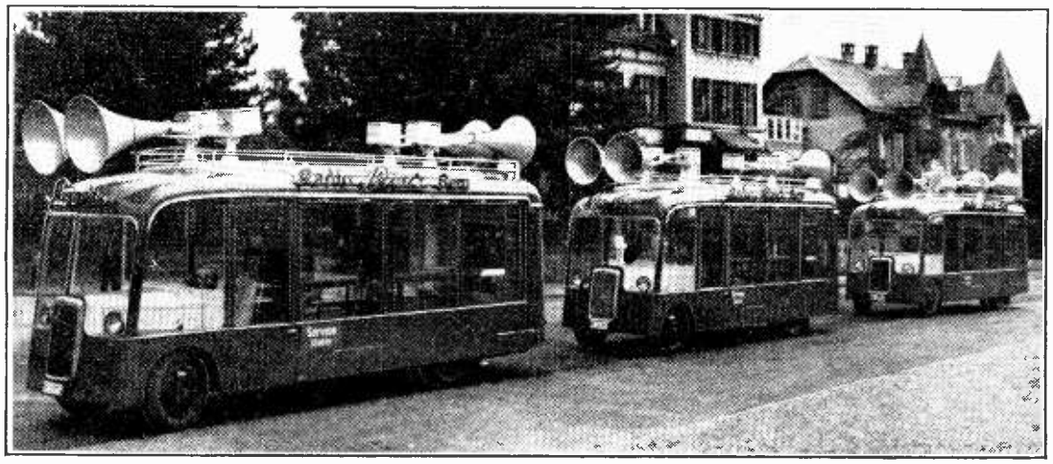
There is another criticism of the news bulletins which I've heard from many listeners. It is that even when the main news was given at 9 o'clock so many interesting "flashes" and talks on topics of the day are deferred until an hour later. How frequently does the 9 o'clock announcer say "Our observer was present at this event and a recording of his impressions will be given in the ten o'clock news"? In common with many, I should like to see not only the fixing of the hour for the main week-day news bulletin at 9 o'clock from year's end to year's end, but also an extension of the time allotted to it from twenty-five minutes to half an hour or even thirty-five minutes, so as to permit items of the kind that I have just mentioned to be included.

Time Flies!

BY the time that this appears in print we'll be within less than five weeks of the opening of another Radiolympia. It will be an exhibition very different from those that we have seen in the past, for, as you know, the music-hall shows have been cut out and television is to reign in their stead. It will be extraordinarily interesting to see what the effect of this is on the attendance figures. Frankly, I expect to see some reduction in the numbers, for those who in the past went mainly for the variety show will probably stay away anyhow, and television is now not the novelty that it was to those who live anywhere near London. Both the big stores and the local wireless shops have run so many demonstrations. But one thing is certain: those who do go to Olympia between August 24th and September 3rd will be genuinely interested in wireless and wireless gear.

It's Important

In former years I've commented on the fact that not a few stands seemed to be



TRAVELLING SERVICE DEPOTS

Repairs While You Wait

A SWISS firm has recently equipped three 2-ton Bedford vans for making calls at customers' houses, where broadcast receivers are repaired on the spot by the crews. In addition to service equipment, the vehicles carry PA apparatus, and are used for sound amplification at various gatherings.

populated mainly by young men who knew little or nothing about the goods that they were supposed to be displaying. If that sort of thing wasn't good enough in former years, it will be much less so under the new order of things, when a much larger proportion of visitors will be people who know what they are talking about. They'll want intelligent answers to their questions, and they won't be satisfied with sales patter learnt by heart.

Good Work to be Done

It is exceedingly important this year that the London Exhibition and the provincial ones which follow it should be so organised that they bring home to the man in the street the progress that has been made in the technique of wireless reception and the real meaning to him of new developments. In the past that sort of thing happened outside the Exhibition, for most of the lay papers had frequent radio articles dealing in a popular way with the technical side. Nowadays their wireless articles, such as they are, are mainly concerned with "microphone personalities" or real or imaginary (usually the latter) upheavals at the B.B.C. With a few exceptions, the lay papers are now giving their readers exceedingly little information on wireless matters, and it is, therefore, most important that Radiolympia and the other exhibitions should supply the deficiency.

Still Waiting!

TURNING through the file in which I keep my carbon copies of these notes, I find that on August 30th, 1937, I wrote "At last the reason for the long delay in inaugurating anti-interference legislation becomes plain. The Government is shortly to introduce a new Wireless Telegraphy Bill . . ." Nearly a year ago I wrote "At last"; nearly a year ago I wrote that the Bill was *shortly* to be promoted. All these months have gone by, but the sentences quoted above still describe the position. Shall we be very much forrader a year hence if the present rate of progress continues? It is true that the Bill will almost certainly have come before Parliament some time before that; but it is sure to meet with a great deal of resistance before it becomes law. A committee will no doubt be appointed to enquire into vested interests and one knows how protracted the proceedings of committees can be. There is a very definite need for a real speed-up, and it is much to be hoped that M.P.s of the kind who get things done will use their influence to see that dilly-dallying is ended and that steps are taken to give us the much needed anti-interference legislation right soon.

Cause for Divorce?

HERE'S the latest wireless story, received from a thoroughly unreliable source. A short-wave enthusiast was maddened by his inability to receive the 10.30 p.m. item from a certain American station, which he desired above all things to hear. Night after night the same story: no sign of interference until just about the time that this programme was due, then ear-splitting crashes that came to an end when the announcer was saying, "You have just been listening to . . ." and were no more heard till the next night. In desperation he strove, but without success, to track down the cause of this apparently deliberate jamming. Then one night he called to his wife, who was always on her way to bed at that time, to lend him a hand by moving a switch whilst he took certain readings. She descended, hairbrush in hand, and sat operating the switch with one hand whilst brushing her hair with the other. The mystery was solved! At every stroke of the brush there were crackles both from her hair and from the loud speaker. The down-lead of the indoor aerial passed through her bedroom and she was a woman of regular habits, always brushing her locks at the same time for fifteen minutes by the clock!

Answers to Correspondents

I CULL the following from the radio columns of a lay paper which is *not* published in this country:—

Question.—My wireless receiver was working perfectly when I switched it off the other night, but when I switched on the following day I could not obtain a sound from it. Can you please tell me what has gone wrong with my five-valve wireless receiving set?

Answer.—Yes, this is quite a common occurrence. What probably happened is that a discharge from a small unseen lightning flash reached the aerial and passed to earth through the interval (*sic*!) circuits, thus putting the set out of action.

I haven't much experience of "small unseen lightning flashes," but I think that the owner would have been in no doubt about what had happened if a hefty charge induced in the aerial by lightning had passed to earth through the receiving set. I have seen one or two to which this kind of thing had happened, and the damage was both extensive and obvious. Sets of mine—and, no doubt, of yours—have refused to work when switched on, though they had been performing perfectly up to the moment of the previous switching off. What I have invariably found in such circumstances is a dicky connection somewhere or a valve loose in its holder.

Not Good Enough

BEFORE now I have given you instances of the delays which people living abroad are apt to experience when they order wireless bits and pieces from firms in this country. Some people found them rather hard to swallow, but I can assure you that every one was authentic. And here's something that has happened—or, rather, which is still happening—to me. Three weeks ago I ordered from firm A a stock component priced at £2 10s. An invoice came a few days later and the money was sent by return. Despite reminders and telephone calls from me, and promises on the part of the firm to despatch at once, I am still minus that component. That's pretty bad; but how about the second transaction, this time with firm B? Wanting a measuring instrument of a certain type, I wrote to ask them whether they had one in stock and could deliver without delay. Their reply gave affirmative answers to both questions and quoted £2 as the price of the instrument. The £2 was sent twelve days ago and an acknowledgment duly received. But I haven't yet got that measuring instrument, though I have twice had apologies and assurances that it was on its way. That kind of thing just isn't good enough. Unfortunately, it's all too common and it is about time that some firms realised the harm that they do themselves and the industry in general by such dilatory methods.

Recent Inventions

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

DIRECTION-FINDING

RELATES to a DF receiver of the kind used on an aeroplane to give a definite indication of the position of the machine relative to the centre line of two overlapping navigational beams. The arrangement can also be used for "homing" on a non-directional beacon station if the receiving aerial is periodically switched over.

Any departure from the straight-line course is usually indicated by the receipt, say, of a series of "dashes" if the deviation is to port, and a series of "dots" if the deviation is to starboard, these two merging into a continuous or unbroken "note" so long as the machine remains on the centre-line or correct track.

After rectification, the "dots" take the form of square-voltage impulses of higher amplitude than a datum line, whilst the dashes appear as similar variations of lower amplitude than the normal. These differently phased voltages are applied to a pair of push-pull pentodes, which are so biased that when one form of signal is received it "takes control" and inhibits any further response for a certain short period. In this way an unmistakable indication is given, whenever the pilot finds himself either to port or starboard of his proper course.

N. V. Philips Gloeilampenfabrieken. Convention date (Holland) May 14th, 1936. No. 483427.

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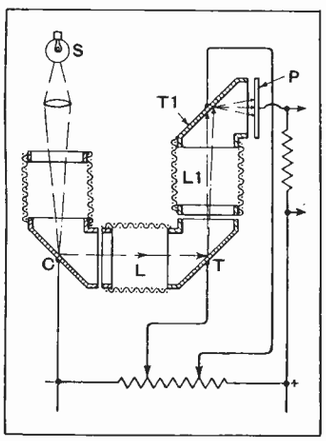
ELECTRON MULTIPLIERS

THE figure shows the electrode arrangement of a multi-stage electron multiplier in which the



Compact electrode assembly of multi-stage electron multiplier described in the text

focusing of the electron stream is effected wholly by electrostatic means, and without any external magnetic control. Light from a source S is projected on to a photo-sensitive cathode C, and the secondary electrons produced are focused, in succession, on to target electrodes T and T1. They are finally collected by an output plate P.

The tubes L, L1 act as electrostatic lenses and produce a sharp image, on each of the target electrodes, of the area over which secondary emission occurred on the preceding electrode. Each of the emitting electrodes is set so as to bend the stream through 90 deg., thus economising space and permitting the whole assembly to be mounted on a single glass tube.

Marconi's Wireless Telegraph Co., Ltd. Convention date (U.S.A.) October 25th, 1935. No. 483826.

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TELEVISION SCREENS

WHEN the fluorescent screen of a cathode-ray receiver is viewed by daylight, or under artificial illumination, the direct light from the picture is mixed with diffused light from the room which has been reflected back from the screen. This tends to reduce the "contrast value" of the picture, and also prevents its "shadows" from showing dead black.

According to the invention the proportion of the indirect light is reduced, relatively to the desired or direct light from the picture (a) by shielding the fluorescent screen as much as possible from the general illumination by means of a metal tube with a blackened inside surface, and (b) by interposing a "greyish" glass plate which absorbs more of the "diffused" light than it does of the direct light from the picture.

The General Electric Co., Ltd. and A. Bloch. Application date, November 6th, 1936. No. 483841.

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RADIO NAVIGATION SYSTEMS

THE landing ground at an aerodrome is equipped with a number of radio beacons, located, say, one at each corner and one in the middle of each side.

The aeroplane is fitted with a dipole aerial which is, in effect, made to "scan" the area of the landing ground. The aerial is mounted on a rotating shaft, which can also be moved axially, so that a to-and-fro and up-and-down scanning motion can be imparted to it. Since the dipole is highly directive in its response, it will receive at maximum strength each time it traverses one of the "marker" beacons on the aerodrome. The signal voltages are fed to the deflecting-plates of a cathode-ray tube, and produce a series of bright spots on the fluorescent screen which mark the outline of the landing field, even when the latter is hidden from direct observation by fog.

The British Thomson-Houston Co., Ltd. Convention date (U.S.A.). July 6th, 1936. No. 483437.

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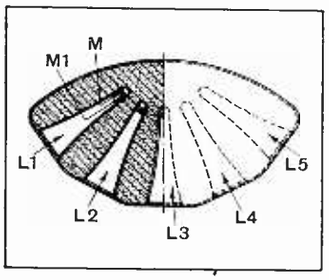
STEREOPHONIC REPRODUCTION

TO secure binaural or stereophonic reproduction, the stage of a theatre (or any other area from which sounds originate) is divided into, say, five "zones," to each of which is allotted a directional microphone unit consisting of two instruments, say, A and B. The output from each of the A instruments is fed in series into one line, whilst that from the B instruments is similarly combined in a second line, both lines



Loud speaker assembly for binaural reproduction.

being coupled to a loud speaker unit of the kind shown in the Figure.

This houses five separate speakers, marked L1 to L5, with diverging horns. Each instrument is energised by two piezo-electric elements, M, M1, separated by a block of sponge rubber, and fed respectively by the two supply lines from the battery of microphones.

The arrangement ensures a high ratio of direct to indirect or "reflected" sound, as well as maintaining the directional identity of each sound.

L. F. Savage and C. J. Francis. Application date, July 23rd, 1936. No. 483730.

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SHORT-WAVE RECEIVERS

THE Figure shows a circuit designed to handle a wide band of television frequencies.

The grid-cathode capacity of a valve not only tends to introduce positive reaction, but also offers a shunt path for very high frequencies, and so limits their amplification. It has already been proposed to insert an impedance between the cathode and earth so as to provide a negative feedback; if the magnitude of the impedance exceeds a certain amount, the potential of the cathode is found to follow that of the grid, so that the output can be taken from the cathode circuit. Such an arrangement is known as a "cathode follower valve."

The valves V, V1, shown in the Figure are of this type, the output from V being applied across an inductance L to the input of valve V1. The negative feed-back is applied across the resistances R, the usual grid-bias being derived from resistances R1. Both valves contain screening grids, and each control grid is shunted by an inductance L of such value that it is tuned by the inherent grid-cathode capacity to the signal frequency, to which it therefore offers a very high impedance.

W. S. Percival. Application date, October 28th, 1936. No. 483744.

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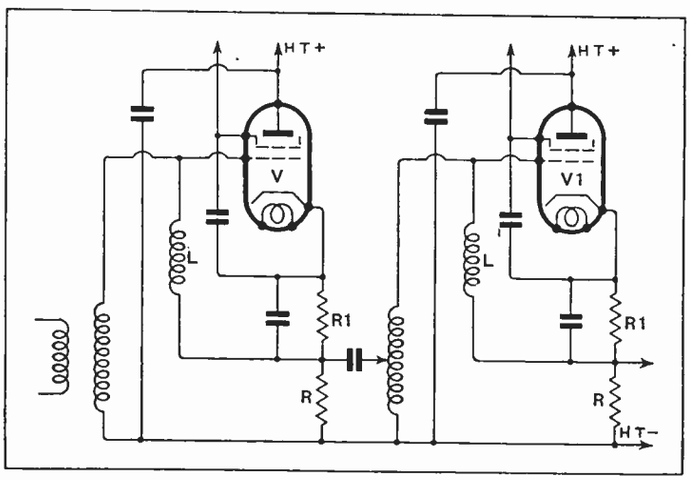
WIRELESS CABINETS

A WIRELESS cabinet is made to simulate the appearance of a mantelpiece clock, the usual fretwork opening for the loud speaker being occupied by the face of the clock. Small pedestals raise the base of the cabinet slightly above the level of the mantelpiece, and the loud speaker works into an aperture formed underneath the base, where the opening is not seen.

The usual tuning and control knobs are located at the side of the cabinet, where they are screened from view by a hinged moulding, which can be swung aside to give access to them when necessary.

O. Raz. Application date, December 15th, 1937. No. 483700.



Amplifier for handling a wide band of frequencies such as is encountered in television.

MISCELLANEOUS ADVERTISEMENTS

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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.

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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 4th must be closed for press earlier than usual.

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

FIRST POST FRIDAY, July 29th.

NEW RECEIVERS AND AMPLIFIERS

A.

A.

DEGALLIER'S, Ltd., for the largest selection in London of really reliable shortwave guaranteed receivers; inspection and demonstration without obligation. Hours of business 11 a.m.-7 p.m., or any time by appointment, including week-ends. Send 1½d. stamp for handsome illustrated catalogue.

5/6 Each.—Any known American valve, 1923-38, 12 months' guarantee, all firsts.

£3/5.—"Midget" T.R.F., 2 bands, A.C./D.C.

6½ Gns.—"Car Radio" 5-valve, with press button tuning.

6 Gns.—"Mains Transportable" 5-valve superhet., all-wave 16-2,000 metres, A.C./D.C. 100-250 volts; aerials incorporated within the cabinet, large P.M. speaker.

THE Famous "Challenger 802." 10-valve high fidelity, radiogram chassis (4 bands, 11.8-2,050 metres).

£13.—802 chassis, valves and 10in. speaker.

£14.—802 chassis, valves and 12in. P.A. speaker.

£14.—802 "Table Model," 10in. speaker.

£19.—802 "Console," with 12in. P.A. speaker.

£30.—802 radiogram, with automatic changer.

"MIDWEST" 18-valve and 20-valve, with electric motor tuning, 6 bands, chassis, valves and speakers.

£25/10.—For the real enthusiast, something exceptional in both performance and quality. The Challenger 19-valve "M.S.K. 504," 6 bands (5 to 2,000 metres), no breaks, 30 watts undistorted Class "A" output, i.c., (4) 61.6s in new system of direct coupled paraphase parallel push-pull straight line response, 25 to 15,000 cycles; refinements incorporate such as Q.A.V.C., manual-carrier, controlled contrast expansion, manual-automatic variable selectivity 5 to 15 K.C., C.W. beat oscillator.

HEAR All Other Receivers and then call and handle this real set, without obligation of course.

NEAREST Point, Paddington Station. Maps sent to all applicants for catalogues.

DEGALLIER'S, Ltd. 32, Bathurst Mews, London, W.2. [5576

"SOUND SALES"

The predominant name in Quality Radio, Transformers, Chokes, etc.

Makers of Products confidently recommended by "The Wireless World," see Test Report, July 14th, on our special Heater Voltage Conversion Transformer which will enable our various friends to experiment with 6.3 volt valves without the bother and expense of having to alter their existing 4-volt Heater Transformers.

We feel that this component will have a very good reception, since we have already had a number of enquiries for a similar article, prior to the introduction of the Sound Sales Heater Voltage Conversion Transformer, price 7/6.

May we send you a copy of "Sound Sales" latest Catalogue and technical manual, price 6d., giving details of Super Quality Radio Equipments from £20/1/-. Transformers from 6 watt to 12 K.V.A. and last but by no means least, details of our exclusive Tri-Channel Amplifier.

Specified by the Experts

SOUND S SALES

MARLBOROUGH RD. UPPER HOLLOWAY LONDON, N.19. LIMITED. (Contractors to the G.P.O., etc.) Tel.: Archway 1661/2/3

HAYNES QUALITY

RECEIVERS and TELEVISION

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

HAYNES RADIO Ltd. QUEENSWAY, ENFIELD, MIDDX. Howard 1171

SUPPRESSION ENGINEER'S KIT

● *AN ESSENTIAL PART OF EVERY SERVICE MAN'S EQUIPMENT*

A well-made case 16" by 13½" by 7½" with carrying handle, divided to take the following equipment:— 1 pair "Eliminoise" Transformers wired up to 60 ft. aerial, and 50 ft. "Eliminoise" cable ● 1 mains Filter for set lead suppressor ● 1 Condenser Suppressor for meter-boards or motors ● 1 Flex. Lead Suppressor for appliances wired with two-core cable ● 1 Flex. Lead Suppressor (three-core) ● 1 hand good quality Halyard, 120 ft. ● 1 Interference Manual ● 1 complete set Bulletins to date ● Instructions for each appliance included.

£4 - 15 - 0 nett.

BELLING-LEE RADIO INTERFERENCE SUPPRESSION SERVICE

BELLING & LEE LTD., CAMBRIDGE ARTERIAL RD., ENFIELD, MIDDX.

NUMBERED ADDRESSES

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

DEPOSIT SYSTEM

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

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

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

NEW RECEIVERS AND AMPLIFIERS

25 Gns.—*Radios.

11½ Gns.—Biggest

7½ Gns.—*Values.

HOMELAND Quality Radios Represent By Far the Finest Values in Britain To-day.

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

SEND To-day for the New Summer Edition, now ready, of the Homeland catalogue and art treatise, and then get us to arrange a free demonstration or free trial

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

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

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

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

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

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

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

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

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

(This advertisement continued on next page.)

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

NEW RECEIVERS AND AMPLIFIERS

(This advertisement continued from previous page.)

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

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

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

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

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

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

ANGLO-AMERICAN RADIO (AND MOTORS), Ltd. (Dept. W.78), Albion House, 59, New Oxford St., London, W.C.1. (Telephone: Temple Bar 3231). One minute from Holborn or Tottenham Court Rd. Underground stations. Hours: 9 to 7 (Saturday 1 p.m.). [6724

"SERVICE With a Smile."

HENRY FORD RADIO, Ltd..

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

ROYAL RADIO Co., established 1908.

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

BEST Price Allowed for Your Old Set.

SEND 1½d. Stamp for Catalogue.—Royal Radio Co., 5, Buckingham Rd., South Woodford, London, E.18. [6988

ROYAL RADIO Co. Established 1908.

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

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

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

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

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

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

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

ARMSTRONG Co., 100, King's Rd., Camden Town, N.W.1. Gulliver 3105. [6827

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

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

RECEIVERS AND AMPLIFIERS
CLEARANCE, SURPLUS, ETC.

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

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

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

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

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

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

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

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SUPPLY STORES

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

Amherst 4723.

CALLERS — can now obtain their requirements at "Jubilee Works," as well as—

165 & 165a, Fleet Street, E.C.4. Central 2833. and 50, High Street, Clapham, S.W.4 Macaulay 2381.

PREMIER 3-Band Short-Wave Kits. Cover 11-86 metres without coil changing. Each Kit is complete with all parts and circuit. **Valves given free with each Kit.** 1-Valve Receiver or Adaptor Kit, **12 6**; 2-Valve Receiver Kit, **19 6**.

PREMIER DE-LUXE Short-Wave Kits include Metal Chassis and Panel, 4 coils covering 14-170 metres and all specially tested Components. **Valves given free with each Kit.** 1-valve Receiver or Adaptor Kit, **17 6**; 2-valve Receiver Kit, **25 -**. S.W. Superhet Converter Kit for A.C. Receivers, **22 6**.

NEW 1938 S.W. S.G.3 KIT. Pentode H.F., Detector and Pentode. 14 to 170 metres. Complete Kit of Parts with 3 Tested Valves, **59 6**. Metal Cabinet, **7 6** extra. Ideal for Amateur Reception.

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**.

PREMIER S.W. H.F. Chokes, 10-100 metres, **9d.** each. Pre-wound, **1 6** each. Screened, **1 6** each.

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**.

COIL FORMERS, 4- or 6-pin low-loss, **1 -** each.

SPECIAL STOCKTAKING OFFERS. Magnavox 7" P.M. Speakers, with Transformer, **8 11**. Magnavox 8" P.M. Speaker with Transformer, **10 6**.

METAL RECTIFIERS, 250v., 60 m.a. output, **4 6** each.

Phillips Wet Electrolytics, 4 mf. or 8 mf., 320 v. working for universal sets, 2 for **1 6**.

U.S.A. Tubular Electrolytic condensers, 8 mf. 500 v., 3 for **2 6**; 8 + 8 mf. 450 v. + 8 mf. 250 v.; 8 + 8 mf. 450 v. + 10 mf. 50 v., 2 for **2 6**.

T.C.C. 15 mf., 100 v., Dry Electrolytics, **4d.** each.

Cossor ¼ - 1 mf. Condensers, **3d.** each.
2-Gang .00016 all brass short-wave steatite based Condensers, **2 11** each.

Potenticmeters, 1/- each, 10,000, 20,000, 250,000, 500,000, 2 meg., with switch, **1 3** each. 10,000, 20,000, 250,000, 500,000. **Special Offer,** 25,000 ohm. **Potentiometers,** 3 for **1 6**. **Tubular Wire-end Condensers,** .0001, .0003, .0005 and .002, **1 -** dozen, your choice.

MAINS TRANSFORMERS. Primary 200-250 v., Secondaries, 350-0-350 v., 90 ma., 4 v., 2 a., 4 v., 5 a., **4 6**. Primary 230 v.-250 v. only. Secondary 250-0-250 v., 60 m.a., 4 v., 2 a., 13 v., 1 a., **3 6**.

EUROPA MAINS VALVES. 4 v. A.C. Types, A.C. HL., A.C./L., A.C. S.G., A.C. V.M.S.G., A.C. H.P., A.C. V.H.P., A.C. P., and 1 watt D.H. Pentodes, all **4 6** each. A.C. Pens. I.H., **5 6**; A.C. P.X.4, **6 6**; Oct. Freq. changers, **8 6**; Double Diode Triodes, **7 6**; Triode H. ex. Freq. Ch., **8 6**; Tri. Grid. Pen., **10 6**; 3½ watt I.H. Triode, **7 6**.

UNIVERSAL TYPES. 20 v. .18 a. S.G., Var.-Mu. S.G., Power, H.F. Pen., Var.-Mu. H.F. Pen., **4 6** each.

13 v. .2 a. gen. Purpose Triodes, **5 6**; H.F. Pens. and Var.-Mu. H.F. Pens. Double Diode Triodes, Oct. Freq. Changers, **7 6** each. Full-Wave and Half-Wave Rectifiers, **5 9** each.

AMERICAN VALVES. We are sole British Distributors for TRIAD High-grade American Valves. All Types in stock. Standard types, **5 6** each. All the new Octal base Tubes at **6 6** each. 210 and 250, **8 6** each; 81 and 2A3, **8 -** each.

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

All goods previously advertised are still available.

CAR RADIO

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

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

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

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

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

6 Gns.—Crosley push-button car radio; Ward roof aerial. 14/6.—Coulphone Radio, Grimshaw Lane, Ormskirk. 'Phone: 578. [6993

LATEST Crosley 6-volt Push-button Model, as easy to tune as sounding your horn. Your favourite stations can be preselected and push-buttons set in a few minutes. Complete, with full instructions, £5/18 6; resistance for 12-volt operations, 7/6.—S. G. Ruleman, 86, Tamworth St., Manchester, 15. [6939

PUBLIC ADDRESS

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TO Amplifier Manufacturers and Others.—Important concern with immense resources will manufacture amplifiers to your requirements at limit prices—example: 25 watts output, £8 net, complete with valves (B.V.A.).—Box 6790, c/o *The Wireless World*.

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VORTEXION P.A. Equipment.

IMITATED, but unequalled.

15-20-WATT Amplifier (distortionless 14 7 watts) output, 30-18,000 cycles, independent mike and gram., inputs and controls, 0-037 volts required to full load, output for 4, 7.5 and 15 ohm speakers or to specification, inaudible hum level; 12-volt car battery and A.C. mains model, 12 gns.; A.C. only model, 8½ gns., complete, as tested by "Wireless World."

VENTILATED Steel Cases for Above; 12/6

REXINE Cases for Above and Gramo. Motor and Pick up, 25/-.

15-20 Watts Portable Amplifier, in case, with Collaro motor and Rothermel Piezo pick-up; £14.

20-WATT Heavy Duty High Fidelity Model, as fitted to cinemas, dance halls, etc.; £15.

20-35-WATT Model, 6L6's, in negative feed back, class AB1, exceptional driver and output transformer, independent electronic mixed mike and P.V. inputs, high and low cut volume controls, any impedance outputs to order, 15-20,000 cycles response, 2% max. harmonic distortion; £20, complete.

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

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

WE Invite You to a Demonstration.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2814. [6346

"PARTRIDGE P.A. Manual," free to trade, from N. Partridge, B.Sc., A.M.I.E.E., Kings Buildings, Dean Stanley St., London, S.W.1. [6974

USED SETS FOR SALE AND WANTED
MISCELLANEOUS

THE KEATES-HACKER Co., Ltd., 91-93, Bishopsgate, London, E.C.2, have for disposal the following traded-in receivers complete; each has been laboratory tested, and is guaranteed.

McMURDO Silver Masterpiece VI 22-valve Receiver.

McMURDO Silver Masterpiece V 16-valve Receiver.

SCOTT 23-valve Receivers, R.G.D. 1,220 radiogram.

NO Reasonable Offer Refused. [7000

NEW MAINS EQUIPMENT

V.

ALL Transformers at Last Week's Prices.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2814. [7010

TANTALUM for A.C. Chargers, H.T. and L.T.—Blackwell's Metallurgical Works, Ltd., Garston, Liverpool. [6374

"Radio Data Charts," A Series of Abacs Post free 4/10

CABINETS

RADIOGRAM Cabinets, new designs, 30/- to £5/10; inspection invited or photos for selection sent on request.

TABLE Radio Cabinets, undrilled, 5/6 upwards.

SPEAKER Cabinets, 4/6 upwards

MANUFACTURERS' Clearance.

ULTRA Radiogram Cabinets undrilled, 32×23×14, 30/-.

BURGOYNE "Fury" Radiogram Cabinets, undrilled, 34×22×16½. Reduced price to clear, 35/-.

K.B. De Luxe Walnut Cabinets, undrilled, chromium plated edges and speaker grille, 25in. wide, 14½in. high, 10½in. deep, 18/6.

H. L. SMITH and Co., Ltd., 237-9, Edgware Rd., London, W.2. Tel.: Pad. 5891. [0485

CABINET Workmanship and Appearance Never Seen Before in This Country, designed by leading American craftsmen. These could not be made here in the wood used (⅝in.) at double the price. Acoustic properties hitherto unknown. All brand new, undrilled. Automatic record changers 8 records), 5 gns. 1½d. for actual reprints from photographs.—Degallier's, Ltd., 32, Bathurst Mews, London, W 2. [6808

DYNAMOS, MOTORS, ETC.

ROTARY Converter, 50 volt D.C. to 230 A.C.—Desmond, Whiteway, Stroud, Glos. [7004

A.C.; D.C. motors, dynamos, converters, transformers, chargers, supplies and repairs.—Easco, 18w, Brixton Rd., S.W.9. [0558

ALL Types of Rotary Converters, Electric Motors, Battery Chargers, etc., in stock, new and second-hand. WARD, 46, Farringdon St., London, E.C.4. Telephone: Holborn 9703. [0518

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. [7011

WAX Recording Table for Sale, new condition, gravity driven, will cut acetate discs up to 16in., with stand, also wax storage cupboard.—Box 6827, c/o *The Wireless World*. [7012

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SINCLAIR SPEAKERS, Alma Grove, Copenhagen St., London, N 1. Telephone, telegrams; Terminus 4355. [0591

DEGALLIER'S, the only firm with guaranteed brand new American Jensen auditorium speakers, energised and P.M.s Pounds saved! Example: 12in. P.A. unit, weight 23lb., 1,000 or 2,000 ohms field, with transformer, listed $30 at 47/-; 1½d. for list.—Degallier's, Ltd., 32, Bathurst Mews, London, W.2. [6807

LOUD-SPEAKER CONVERSIONS

SINCLAIR SPEAKERS.—For conversions of all makes and types, advice given.—Alma Grove, Copenhagen St., N.1. [0593

TELEVISION APPARATUS

EDISWAN 10H Television Cathode Ray Tube, blue-white screen, list £15/15; our price £7/10, or nearest offer.—Escott's, 109, Maybank Rd., E.18. [6996

TRANSMITTING APPARATUS

G5N1.—The recognized distributors for amateur equipment. National R.M.E. Thordarson, Hammarlund, McMurdo, Hallicrafters, etc.; send 1½d. stamp for catalogue.—G5N1 (Birmingham), Ltd., 44, Holloway Head, Birmingham. [0531

A.C.S. RADIO Now in London, at the new premises, 16, Gray's Inn Rd., W.C.1, within a stone's throw of Gamages and close to Chancery Lane Tube Station. A wide range of amateur equipment in stock, including transmitters, communication receivers, components, tubes, etc. Call for chat and demonstration. Open 9.30 to 7 p.m.; closes Saturday 1 p.m. Telephone: Holborn 9894-5. Lists free on request. G2NK technical manager. [0550

VALVES

3/3 Each, any popular type of American valve

4/- Each, any popular Octal type.

ARCTURUS, Triad, Hytron, in sealed cartons, popular type, 5/-; popular Octal type, 6/-.

ALL Valves Guaranteed.

RADIOGRAPHIC, Ltd., Dean House, Dean St., London, W.1; and 66, Osborne St., Glasgow, C.1. [6701

3/3 Each, post free.—All popular types American valves.

4/6 Each.—6n7, 6k7, 6r7, 6l6, 6a8, 6h6, 6j7, 6l7, 25z6, 6q7, 25-

LEEDS RADIO, 66, New Briggate, Leeds. [0569

HIVAC, Tungsram, Raytheon, Philco valves, wholesale only; send trade card for lists.—Leonard Heys, 36, Henry St., Blackpool. [0567

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

LINE Cords, 2/8; send for lists.

CHAS. F. WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0452

2/9 Popular American; 3/9, Octal British, non-ring; 350-volt rectifier, 3/6; 1½d. stamp lists.—Coulphone Radio, Ormskirk. [6991

AMERICAN Valves, first grade, in all types; trade supplied.—Metropolitan Radio Service Co., 1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

METERS, ETC.

WESTON, Avo Hunts, Wearite, and other testing instruments.—Wholesale Distributors, Leonard Heys, 36, Henry St., Blackpool. [0568

FERRANTI D.C. and Rectifier Type Microammeters, Milliammeters, etc.; prices are reasonable and every instrument perfect; state requirements.—Grigg, 70, Peel Rd., Wealdstone, Middlesex. [7006

TESTING EQUIPMENT

VALVE Tester, Wearite, absolutely as new; 59/6.—Alderson, 1350, Stratford Rd., Birmingham. [6999

FERRANTI A.C./D.C. Circuit Tester, perfect order; 50/-, listed £6.—L. Aldworth, 55, St. Thomas Rd., Sheffield, 10. [7005

NEW COMPONENTS

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RADIOGRAPHIC, Ltd.

E.N.S. of Season Clearance Sale.

"HAMS," here is your chance.

COILS, kits, tubes, transformers, at crazy prices.

FOR One Week Only, commencing Saturday, July 23rd.

RADIOGRAPHIC, Ltd., Dean House, Dean St., London, W.1. [7001

A MEISSNER New 8-button Push-button Tuner, can be affixed to any superhet or T.R.F. receiver, whatever the make, 2- or 3-gang, mains or battery, three wires only to connect to top of gang condenser; special switching and non-drift condensers; the finest push-button unit made.

47/6 or 7/6 with order secures; 7/6 on delivery and 8 monthly payments of 4/6; send deposit to-day for this amazing new unit; no references required; delivery absolutely by return of post; complete with full instructions in sealed cartons; will entirely modernise your receiver; make sure of your unit to-day; this is a special introductory offer.

£5/17/6 or 12/- deposit secures, followed by 12 monthly payments of 10/5; Meissner push-button permeability tuned remote control unit, for A.C.-D.C. 100 to 250v., controls your receiver from a distance, choice of seven stations with volume control and switch.

30% Discount to Experimenters on the Following Meissner Lines: 14-tube "Communications" receiver, Custom all-wave, 12.5 bands, 7.5-2,140 or 3.75-555 metres; 5-band all-wave tuning units with band-spread; phonograph oscillator kit; B.F.O. kit; noise silencer kit; 5-band multi-wave coil assemblies; Doublet and Double-doublet aerial kits; Meissner "Signal Shifter" transmitter, etc.

2D. Stamp Brings Complete Particulars and Illustrated Lists of Meissner Products by Return of Post.

ANGLO AMERICAN RADIO (and MOTORS), Ltd. (Dept. M/14), Albion House, New Oxford St., London, W.C.1. (Sole distributing agents for Meissner Mfg. Co., of Ill., U.S.A.). [6755

CONDENSERS. — British manufacture, metal case (paper), 800 volt wkg., 4 mfd., 4/-; 2 mfd., 2/9; 1 mfd., 2/-; 500 volt wkg., 4 mfd., 3/-, 2 mfd., 2/-; 1 mfd., 1/6; 400 volt wkg., 4 mfd., 1/9; 2 mfd., 1/3; 1 mfd., 8d.

ELECTROLYTIC.—500 volt peak, 4 mfd., 1/6; 8 mfd., 1/9; 8+4 mfd., 2/6; 8+8 mfd., 3/-; postage 6d. or c.o.d.

THE STATIC CONDENSER Co., 11, Eden St., London, N.W.1. [6995

COMPONENTS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

R

RADIO CLEARANCE, Ltd.,

63, High Holborn, W.C.1. Holborn 4631.

TO Coincide with Our Great Summer Sale, which is now proceeding, we are offering to our postal friends, for the next two weeks, exceptional bargains, which must be taken advantage of.

LAST Few Only.—Philips 5-valve Plus Magic Eye, A.C. all-wave superhet chassis, fitted complete with 5 Mullard valves, speaker and special matching transformer, a conventional and proved superhet circuit is used. Valve sequence as follows: F.C.4, V.P.4B, T.D.D.4, Pen. 4D.D., Philips 1821 rectifier, plus Magic Eye for accurate and easy tuning. The chassis is a typical Philips product, beautifully finished, controls twin type, tone and volume, tuning and wave change, magnificent plate glass dial, edge illumination, handsomely engraved, coloured wave change indicator; complete with valves and speaker, £4/17/6 each.

WALNUT Radiogram Cabinets for above Chassis, brand new; these cabinets are constructed throughout of heavy timber, and in conjunction with the above chassis, form an ideal radiogram combination; 30/- each.

ENORMOUS Purchase Repossessed H.P. Sets From Finance House. A.C. mains, complete with valves, practically new and in working order; well-known makes, prices from 50/- to 90/- each; callers only.

FEW Only, Aerodyne 5-valve battery superhet chassis, brand new, complete, but less valves; 25/- each.

PLESSEY 6-valve All-wave Battery Sets, complete with Mullard and Mazda valves in handsome walnut veneered cabinet; limited quantity only at £4/10 each.

HUNTS 1,000 mfd. Cardboard Electrolytics, wire ends, peak voltage, 12v.; 1/6 each.

(This advertisement continued in next column.)

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

HT.8 Type Rectifiers (Skeleton Type), a really splendid job; 4/6.

DUBILIER ½ meg. Volume Controls, with switch, standard model; 1/- each.

B.I. Electrolytic Condensers, 8+12+50, working voltages 8+12, 350 volts, 50 mfd. 12 volts; 1/- each.

PLESSEY 465 k/c I.F. Transformers, fully screened; 1/6 each.

GRANIC 465 k/c I.F. Transformers, iron cored with trimmers; 2/- each.

PLESSEY 110 k/c I.F. Transformers, fully screened; 1/6 each.

BRADLEY Ohms, 600,000 ohms. wire wound potentiometers, with switch; 1/-.

PLESSEY 5,000 Ohm Wire Wound Potentiometers, with switch; 1/- each.

6 Bank, 4 position Yaxley switches, beautifully finished, each bank 5-contact type, plus common; 2/11 each.

3-GANG 0.0005 Straight Condensers, with ceramic insulation, suitable for all circuits, including all-wave; 2/6 each.

DIALS for Above, 2-speed type, 9in. long, 5in. wide, station marked for 4-wave bands, 2 short, medium and long; 3/3 each.

LIMITED Quantity Handsome Walnut Veneered Console Cabinets, at a fraction of original cost; 12/6 each.

GRANIC 20 hy. 100 m.a. 500 ohm chokes, unshrouded; 4/3 each.

350-120 Indirectly Heated Rectifiers, octal base type, well-known manufacturer, complete with octal base valveholder; 4/- each

2-BANK Yaxley Switches, 6 contacts, one common; 1/6 each

3-BANK Yaxley Switches, 7 contacts, plus common; 1/9 each.

SINGLE Bank, make and break, 6-way, Yaxley switches; 1/- each.

BULGIN D.P.D.T. Toggle Switches; 10d. each.

CELESTION 9in. P.M.M.C. Speakers; 9/6 each.

PLESSEY 2 Mfd. Tubular Condensers, 350 volt; 8d. each.

PLESSEY 50 Mfd. 12-volt working, wire end type condensers; 8d. each.

PLESSEY 25 Mfd., 25-volt working, wire end type condensers; 8d. each.

SPECIAL Purchase Plessey Can Type Electrolytic Condensers, as follows:—

6 MFD., 450-volt working, 525-volt peak, 1/- each; 8 mfd. 450-volt working, 525-volt peak, 1/3 each; 6+4 mfd., 475-volt working, 600-volt peak, 1/6 each; 8+8 mfd., 450-volt working, 525-volt peak, 1/6 each; 8+3 mfd., 475-volt working, 600-volt peak, 1/9 each; 16 mfd., 300-volt working, 400-volt peak, 1/- each; 16 mfd., 475-volt working, 600-volt peak, 1/3 each; 6+4 mfd., 450-volt working, 525-volt peak, 1/3 each; 4 mfd., 450-volt working, 525-volt peak, 1/- each.

ALL Orders 5/- or Over Post Free; orders under 5/- must be accompanied by a reasonable amount for postage; C.O.D. orders under 5/- cannot be accepted; hours of business, 9 a.m. to 7 p.m. week-days, 9 a.m. to 1 p.m. Saturdays; enquiries 1½d. stamp if reply expected.

RADIO CLEARANCE, Ltd., 63, High Holborn, W.C.1. Holborn 4631. [6960

PREMIER SUPPLY STORES.

PLEASE See Our Displayed Advertisement on Page 3. [0488

RYALL'S RADIO, 280, High Holborn, London, W.C.1, offer new goods at knock-out prices.

T.C.C. and Plessey Electrolytic Blocks, 30×8×2, 300v. working, 400v. surge, capacity guaranteed, upright mounting, 40 mf. for 1/9 or 15/- dozen.

MAINS Transformers, 250-250v. 60 m.a., 4v. 3a., 4v. 1a., input 200-250v. (Fits not C.T.), 3/6 each, new.

SPECIAL Offer of Sator 0.1 Tubular Condensers, 1,500v. test, 1/3 per dozen, 4/6 per half gross, 6/9 per gross; all guaranteed and brand new.

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