UNIVERSAL OSCILLATOR UNIT —See page 42

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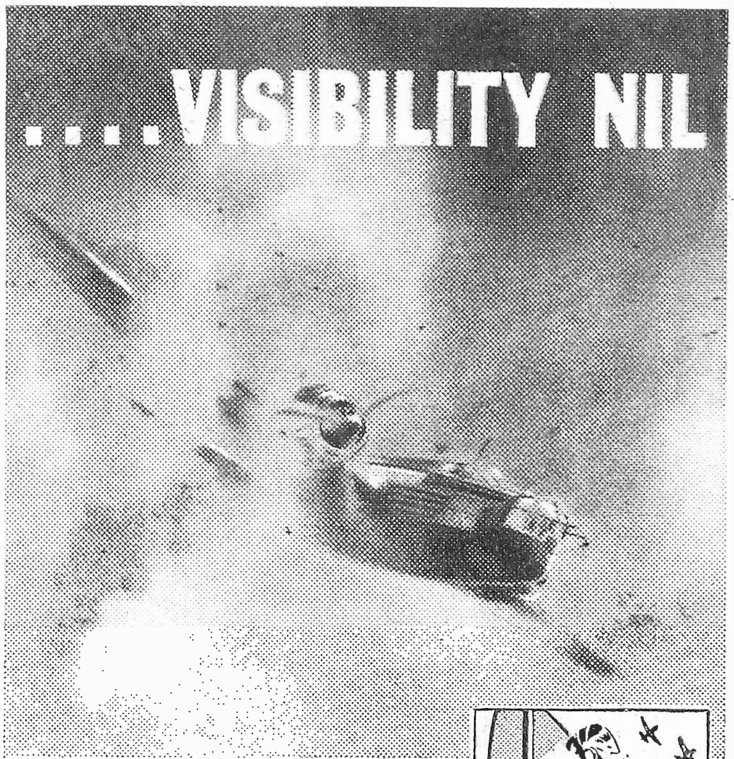
Practical Wireless and PRACTICAL TELEVISION

6D.

EVERY MONTH

November, 1941.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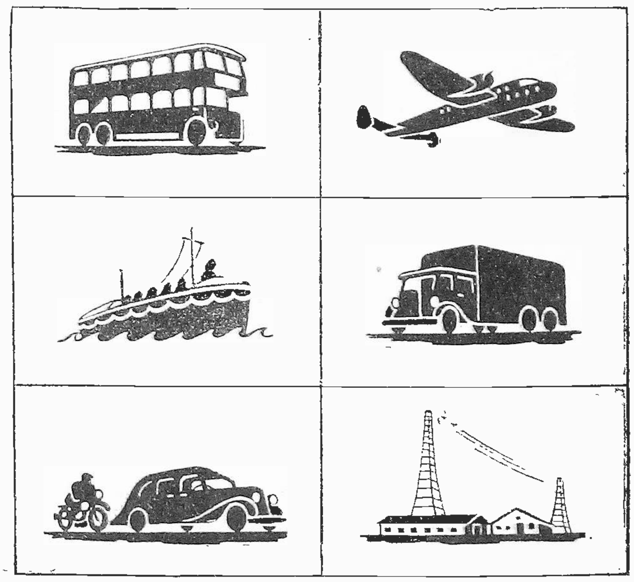

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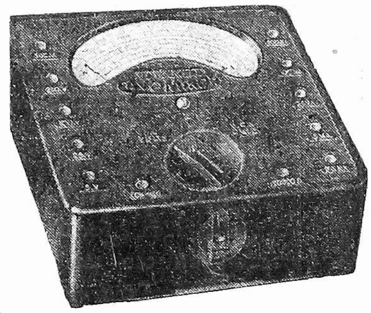

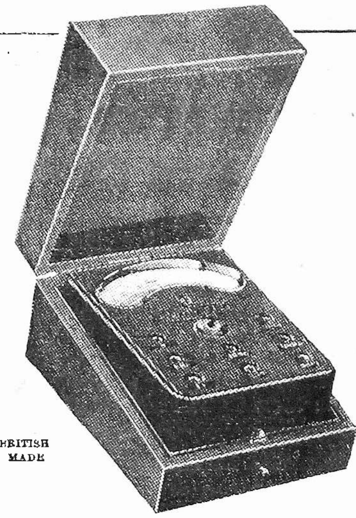

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C 100/400	100 MA	20-34 H	400 ohms	**10/8**
C 150/185	150 MA	20-34 H	185 ohms	**15/4**
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Practical and Wireless
★ PRACTICAL TELEVISION ★

EVERY MONTH.
Vol. XVIII. No. 425. NOVEMBER, 1941.

EDITED BY
F. J. CAMM

Staff:
FRANK PRESTON.
L. O. SPARKS.

COMMENTS OF THE MONTH — BY THE EDITOR

NEXT MONTH—AN IMPROVED "PRACTICAL WIRELESS"

THE success of a war depends no less upon the ability of individual enterprises successfully to combat the inevitable changes, restrictions and difficulties which a war imposes, than upon strategy in the field. All businesses are confronted with the problem of carrying on with reduced man-power, shortage of material and Government restrictions. Many periodicals, as a result of the paper shortage, have become war casualties. Others are somewhat battle-scarred, but are carrying on.

This journal, which for over nine years has been performing work of national importance in disseminating technical information and instructing the public in the principles of radio transmission and reception, has been no exception. It has had difficulties with which to contend, but we feel that the need for continuation of our work is even greater during the war, when the need for those with technical knowledge daily becomes more urgent. The Government, we know, is appreciative of the work we have done and are doing, for we have worked in close co-operation with various Government departments on Service problems and particularly have we helped them to find men suitably qualified as radio mechanics and operators, as well as for the new science of Radiolocation. Our staff were early called to the Services to act as instructors, and many hundreds of our readers are already in the Services, where their technical knowledge is of the greatest value to the State.

The paper shortage compelled us to suspend weekly publication and to appear once a month. We considered this a better plan than to continue as a weekly publication and to restrict our sales to the proportion set by the paper ration allowed to us.

It is our intention to continue the work of aiding the war effort. In order that we may do this most effectively a further change is rendered necessary. Next month we shall appear in a different size, but with more pages and a greater proportion of editorial matter. We shall, in fact, appear in a size more in conformity with a monthly magazine. This new size does not connote any change in editorial policy. The same contributors will continue to provide the benefit of the contributions on their special subjects, and all the regular features will continue to appear. The price will be increased to 9d. Our readers will understand that this is a temporary war-time measure, and it is the intention to revert to our old size and weekly publication when conditions return to normal after the war.

In view of the great demand for this journal, it is most important that you should place an order for its regular delivery. Newsagents are not supplied with odd copies for casual sales, and you will be unable to obtain your copy unless you have ordered it. Newsagents are not now permitted to return unsold copies, and thus they only order sufficient copies to supply their regular customers. Where readers have complained that they have been unable to obtain their copies investigation has shown that they have not placed an order for it. Preferably the order should be given in writing.

The B.L.D.L.C.

THE British Long-Distance Listeners' Club sponsored by this journal is only open to regular readers. We are unable to extend benefits of membership to those who do not read the paper. As a first essential to joining, therefore, it is necessary for the prospective member to supply us with the name and address of the newsagent with whom he has placed a regular order for PRACTICAL WIRELESS. We mention this because we have received a few applications from those who have seen the Certificate of Membership posted up in a friend's den, and imagined that the only qualification for membership is the possession of a short-wave receiver or an interest in short-wave reception. Applications for membership should be addressed to the Registrar, B.L.D.L.C., PRACTICAL WIRELESS, Tower House, Southampton Street, Strand, W.C.2.

"Mastering Morse"

WE have just published, at the price of 1s. (1s. 2d. by post), a valuable booklet entitled "Mastering Morse." This deals with the morse code, the various methods of mastering it, the International Q Code, and the construction of a short-wave receiver. The book will be found especially useful to those anxious to join the radio branches of the various Services.

Purchase Tax

THERE has been a variation in the Purchase Tax regulations. The tax on wireless sets, radiograms, and parts thereof, is now calculated as one-third of the standard wholesale value represented by the retail list selling price, exclusive of tax, less 33.5 per cent. Thus, the tax is now shown as 21.5 per cent. of the list price to the nearest penny, which is virtually one-third of the standard wholesale value.

The tax on batteries is 27½ per cent. of the standard wholesale value.

Concentration of Wireless Retailers

THE National Association of Radio Retailers and the Wireless Retailers' Association have delivered their reply to the Board of Trade questionnaire on the concentration of retail shops. The points they make are that the wireless retail trade is a young one, and that war-time hardships have been experienced in greater intensity than by any other trade. They point out that the Government require the public to listen to broadcast information, and in particular for instructions when an emergency arises. The public, in turn, rely on the wireless retailer to service their sets so that they can receive the necessary information and guidance. They comment that there is a limit to which the hardships imposed by Government regulations can be endured, however willing the retailer may be and however anxious to help. They are of the opinion that the closing of the shops would not be helpful.

We do not support the Board of Trade idea that industry should be concentrated. It is time that the Government endeavoured to strike a balance between the needs of the military and the needs of the public.

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The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

Motor-operated Station-selecting Mechanism

Various Methods Whereby Tuning Can Be Accomplished Rapidly and Accurately Without Motor Over-running, or "Hunting"

A COMMON fault to be found in motor-operated press-button-tuned receivers of the kind which employ a station-selecting disc, or discs, or a commutator switch to open the circuit of the motor when the tuning reactance reaches predetermined positions, is that, due to over-running of the motor, the tuning reactance is not located accurately at the point of resonance of the incoming signal. This difficulty may be overcome to some extent by reducing the speed of the motor so that its momentum, and consequently the tendency for it to overrun the tuning position, is reduced, but the time for the tuning operation is thereby correspondingly increased. When a reversible electric motor is used the difficulty may sometimes be overcome by reducing the width of the insulation segment of the commutator switch, but such an arrangement is liable to introduce "hunting."

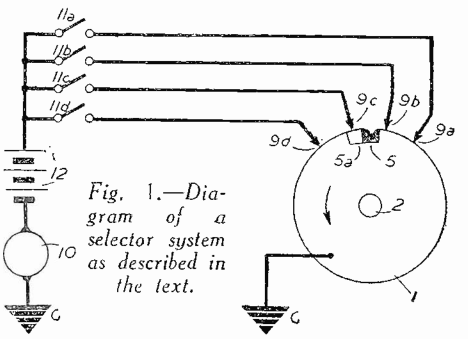


Fig. 1.—Diagram of a selector system as described in the text.

According to one improved arrangement, the motor is run at full speed until the approximate tuning position has been reached and thereafter its speed is reduced so that the final adjustment is made at slow speed. According to the second arrangement, the motor is coupled to the shaft of the selector switch through a device which permits limited lost motion to occur and the selector disc or commutator switch is stopped mechanically at the position of resonance, the lost motion coupling permitting relative motion to occur between the motor and the selector switch during the retardation period of the motor.

The arrangements can be used singly or in combination, and the accompanying drawings illustrate three different selector systems in which both methods are combined.

Referring to Fig. 1, a station-selecting disc 1 is secured to the shaft 2 of the tuning reactance and is also mechanically coupled to a non-reversible driving motor 10. The disc 1 is formed of conducting material and sliding contacts 9a, 9b, 9c and 9d bear against its periphery, and are electrically coupled to the source of electric supply 12, and to the motor 10 through switches 11a, 11b, 11c and 11d. The various circuits to the motor are completed by connecting one terminal of the motor 10 and the selector disc 1 to an earth return G. The selector disc is provided with the usual insulation segment 5, and a V-groove is formed in this segment as shown. Immediately adjacent the insulation segment 5 is inserted a segment of conducting material 5a, which has a greater resistance than the material of the disc 1. The motor is capable of rotating the disc 1 only in an anti-clockwise direction.

Operation

In operation, when one of the switches, for example, 11a, is closed, the circuit of the motor is completed through switch 11a, contact 9a, selector disc 1, earth return G, the motor 10 and the source of supply 12. The motor thus drives the disc 1 and the tuning reactance anti-clockwise at full speed, until the segment 5a engages contact 9a. When this happens the resistance of the motor circuit is increased and the speed of the motor correspondingly reduced so that it is travelling relatively slowly when the contact 9a engages the zone of insulation 5 and the circuit of the motor is broken.

For increased accuracy the insulation segment may be provided with a V-groove which indicates the exact tuning position, and the disc may be stopped mechanically when a selected stator contact enters the V-groove. Details of the preferred method of mechanically stopping the selector disc 1 accurately at the tuning position will be described later with reference to Fig. 3.

Modified System

Fig. 2 illustrates a selector system which employs a reversible electric motor 10a and a commutator-type selector switch. The commutator disc or drum 1 is provided with commutator bars 7a, 7b, separated by the grooved insulating segment 5, and immediately adjacent the insulating segment are conducting segments 6a, 6b, which are insulated from the commutator bars 7a, 7b. In this case the resistance introduced into the motor circuit when proximity to the tuning position has been reached, is provided by resistance coils 8a, 8b, which couple the segments 6a and 6b respectively to commutator bars 7a and 7b. Commutator bar 7a is connected to the motor through a source of power 12a, which causes rotation in one direction and commutator bar 7b, through a source of power 12b, which causes rotation in the reverse direction.

In operation, when a selected one of the switches 11 is closed, the circuit of the motor is closed, either through the source of power 12a or 12b, according to the position of the rotor 1 at the time the switch is pressed, and is energised either in a clockwise or anti-clockwise direction, as the case may be, to rotate the rotor 1 and move the insulation segment 5 towards the contact 9 under control of the selected switch 11. As before, the motor runs at full speed until the selected contact bears against one or other of conducting segments 6a, 6b. At this point one or other of the resistances 8a, 8b is introduced into the circuit, and the speed of the motor is reduced just before the circuit is opened by the contact engaging the insulating segment 5.

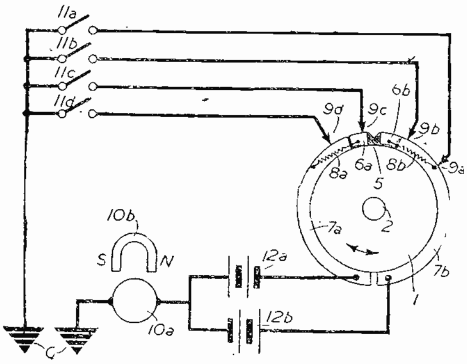


Fig. 2.—A selector system incorporating a reversible electric motor.

Stopping the Selector Switch

One method of stopping the selector switch and tuning reactance mechanically at the exact point of resonance is shown in Fig. 3, the method being described with reference to a selector system comprising a unidirectional motor and a separate selector disc for each station. Two selector discs 16, 17, are shown on the shaft 2 and each is provided with a grooved insulation segment 5 and a resistance segment 5a in the manner described with reference to Fig. 1. Sliding contacts 15a, 15b are formed of resilient material and mounted on suitable bases 19a and 19b, which can be adjusted so that the contacts bear against the peripheries of the discs 16 and 17 with the correct amount of pressure necessary for them to function as mechanical stopping devices for the discs. The ends of the contacts 15 are suitably shaped so that when a contact engages the wall of the groove in the insulating segment 5, it exerts sufficient downward pressure to rotate the selector disc and its shaft until the contact reaches the bottom of the groove. To prevent jarring when the control of the selector disc is taken over by the contact it is desirable to relieve the disc of the load of the motor.

For this purpose a lost-motion coupling may be provided between the driving motor 10 and the driven shaft 2.

The coupling illustrated comprises a driving wheel 15 secured to the motor shaft, and a driven wheel 14 provided with a square opening 13 so that it fits loosely over the squared end 3 of the condenser shaft 2. Preferably the squared end of the shaft is enclosed by a rubber sleeve 4. When a selected sliding contact reaches the edge of the groove in the insulating segment 5a, the pressure it exerts on the wall of the groove advances the selector disc and shaft more rapidly than the motor-driven wheel 14 which is now undergoing retardation, and the driving coupling between the motor and the shaft is temporarily broken. The motor during retardation thus rotates the wheel 14 idly while the selector disc is positioned accurately by the sliding contact.

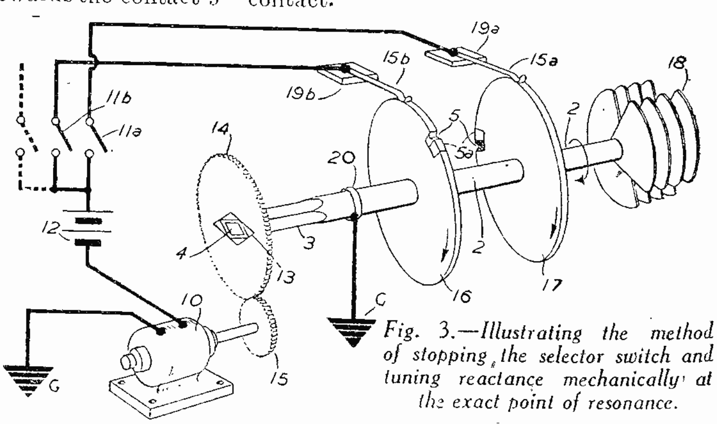
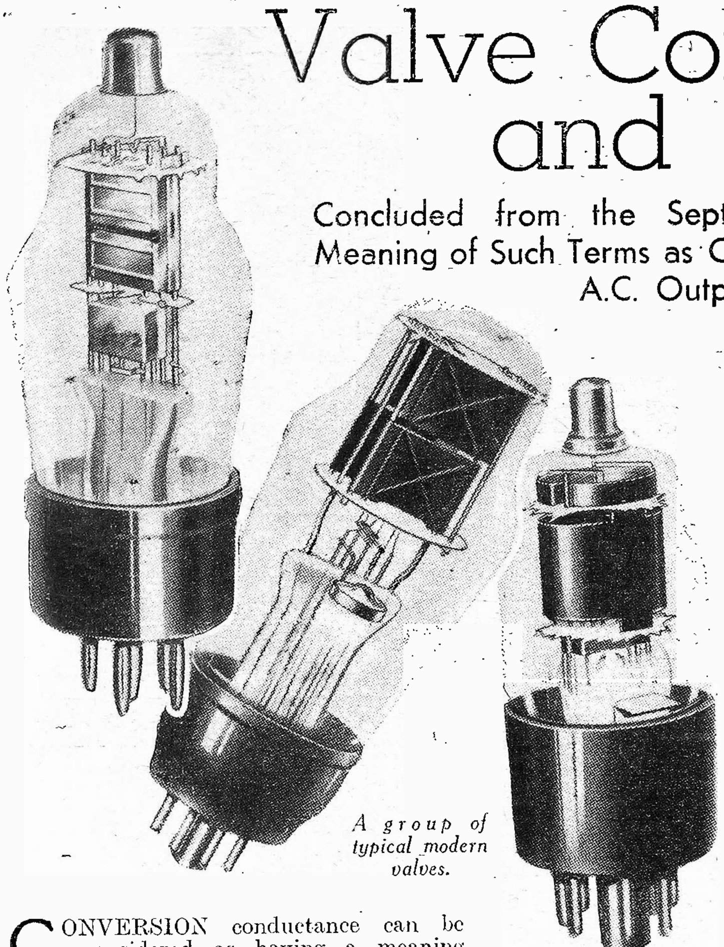


Fig. 3.—Illustrating the method of stopping the selector switch and tuning reactance mechanically at the exact point of resonance.

Valve Constants and Characteristics

Concluded from the September Issue, This Article Explains the Meaning of Such Terms as Conversion Conductance, Anode Dissipation, A.C. Output and Optimum Load



A group of typical modern valves.

CONVERSION conductance can be considered as having a meaning very similar to that of the term mutual conductance, but as applied to a frequency changer. It will be remembered that mutual conductance was described as the ratio of a small change in anode current to a corresponding small change in grid volts. We saw that the figure representing mutual conductance could be given in milliamps per volt or in micromhos; conversion conductance is normally given in micromhos only, partly because the figure in terms of anode-current change is generally less than unity, and partly because it makes the distinction more clear.

I.F. Current—R.F. Voltage

Conversion conductance may be defined briefly as the ratio between a small change in I.F. anode current for a corresponding small change in signal voltage applied to the grid of the frequency-changing valve or the first detector. Note carefully that the current is that due to the intermediate frequency, while the voltage is that associated with the signal or input frequency. It is not an easy matter to measure conversion conductance, although mutual conductance, it was shown last month, can be determined very simply by reference to the anode current-grid volts characteristic curve.

To understand fully what is meant by the term it is necessary to study the behaviour of a frequency-changer valve. We may take a pentagrid as an example, and a simplified circuit is given in Fig. 1. The cathode is an emitter of electrons, when it is heated and the anode is made positive. But since the electron stream from the cathode to the main anode has to pass through the two grids (acting as control grid and anode) of the oscillator portion of the valve before reaching the grid and anode of the pentode portion of the valve, it is evident that it must be modified. Actually the stream can be said to be "modulated" by the oscillations developed in the oscillator circuit. There is, therefore, in effect a virtual cathode consisting of the space charge developed below the control grid, as shown by shading in Fig. 1. This space charge is varying at the oscillator frequency so that the electron stream eventually reaching the main anode is at a mixture of frequencies, one of which (that with which we are primarily concerned in a frequency changer) has a frequency equal to the difference between the signal and oscillator frequencies.

Taking the above general explanation it will be seen that the conversion conductance could be described as the mutual conductance of the upper three grids and anode of the pentagrid in conjunction with the virtual cathode which has been mentioned. In general, the conversion conductance of a pentagrid or triode-hexode lies somewhere between 250 and 1,000 micromhos, a good average value being in the region of 350 micromhos, or .35 mA/volt.

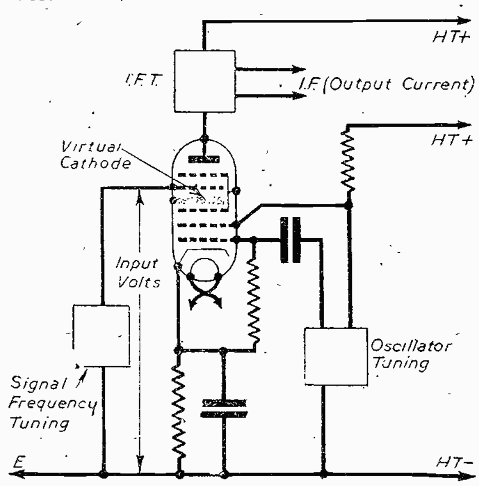


Fig. 1.—An outline diagram of pentagrid frequency changer which helps to illustrate the meaning of conversion conductance—the ratio of I.F. current to signal or R.F. volts.

Conversion Gain

Another term bound up with that just dealt with is conversion gain, which is the ratio of output I.F. voltage to input R.F. or signal voltage. This term is rarely used, and its value cannot easily be ascertained, being governed by general circuit efficiency as well as by the valve constants. Sometimes the term translation gain is used, with the same meaning.

Anode Dissipation

Turning from frequency-changer to power output and L.F. valves we have a number of terms which are frequently misunderstood. As first among these we may consider anode dissipation, bearing in mind that it has no connection with A.C. or power output. As the name suggests, it refers to the power dissipated at the anode of the valve—D.C. power. In the case of class A amplifiers, it is merely the product of the anode voltage and the anode current, the resulting figure being in watts. As an example, if a power valve passes 50 mA with an anode voltage of 300, the dissipation is 50 times 300, divided by 1,000 (to convert mA to amps.). The answer is, therefore, 15 watts. That this has no connection with the audio-output watts will be evident when it is appreciated that the figure does not take any account of grid input voltage or anode-voltage "swing." What is more, the anode dissipation, even with an efficient power triode, fully loaded, is generally at least four times the A.C. or audio output.

In the case of class B and C amplifiers, or oscillators as used in transmitters, the anode dissipation is less than the figure obtained in the manner explained above, since the A.F. or R.F. power taken from the valve is subtracted from the input power. The difference between the input power (current times voltage) and the actual dissipation is dependent upon the efficiency of the circuit, and the dissipation is often less than half the input power. Obviously, the smaller the fraction, the higher the efficiency of the circuit.

Permissible Dissipation

For most purposes with which readers are normally concerned it will be sufficient to consider the dissipation and input power as being equal, as it is in class A amplifiers. In the case of most large power amplifying valves, the makers state the maximum permissible anode dissipation, and sometimes show a curve to indicate the appropriate anode current at various anode-voltage figures. This is indicated in Fig. 2, which shows a series of anode voltage-anode current curves for a representative type of mains-type triode power valve. The curves do not necessarily apply exactly to any particular valve, but they are rather similar to those for one very popular valve in this class—the PX4.

Drawing the Anode Dissipation Curve

It will be seen that the curved broken line is marked 15 watts, and this is the "maximum-dissipation" line; if it were crossed there would be a danger of causing the valve to overheat, and of its becoming soft due to some of the gases trapped in the anode being liberated as the anode became red hot. As an example, we may take the point marked A on the dotted [illegible] values of voltage and current [illegible]. Thus [illegible] we get 170 and 88 mA, and [illegible] multiplied together and divided [illegible] it will be found that the resulting [illegible] 14.96, which is sufficiently close [illegible] 15 [illegible] for any practical purpose. [illegible] we take the point marked [illegible] 425 volts and 35 mA, which you [illegible] gives a wattage of almost 14.9. [illegible] other points on the curve similar [illegible] could be obtained.

Power Output

Maximum A.C. [illegible] maximum undistorted output, which is [illegible] important, is found in a manner quite different [illegible] that adopted when dealing with [illegible] dissipation, although we use the same curves and can refer again to Fig. 2. Before taking some examples it will be best to deal very briefly with the question of distortion as applied to output, since it is customary to speak in terms of maximum undistorted output. This is seldom used in the strictly true sense, because it is difficult to obviate distortion altogether; if we attempted to do so we should have to sacrifice output. Additionally, however, it is found in practice that second harmonic distortion up to 5 per cent. is not troublesome, and is, in fact, undetectable in most cases. Because of this it is usual to read "5 per cent. second harmonic" for "undistorted."

The Load Line

We can find the output by drawing what is known as a load line across the curves shown in Fig. 2. A start is made by placing a straight edge on a curve at the point where it passes through an upright corresponding to the applied anode voltage, making sure that it is not above the anode-dissipation curve. In Fig. 2 we could not do this exactly without drawing another V_g curve corresponding to approximately 42 volts. For convenience, therefore, we will take our point (marked X in Fig. 2) on the $V_g = -40$ curve, where it meets our dissipation line.

The object now is to pivot the straight edge about this point until the distance from it to the $V_g = 0$ curve is equal to the distance to the $V_g = -80$ curve. If these two distances were exactly equal we could assume that there was no second-harmonic distortion, and to keep within the limits set in practice (not more than 5 per cent. second harmonic) the ratio between the distances marked X-Y and X-Z must not be greater than as 11 is to 9. It is not proposed to explain precisely how that ratio is derived, and the reader is asked to accept it as correct in theory and practice.

Calculating Power Output

On the load line as drawn this ratio holds, the line having been drawn as explained above by pivoting a straight edge about point X. Having drawn the line, we can calculate the output, assuming that the grid receives a bias voltage of 40, and that the signal input is sufficient to swing this voltage between zero and 80. If we read off anode current and anode voltage corresponding to points Y and Z on the load line we have 88 mA, 115 volts and 20 mA, 450 volts. We can then find the power output allowing 5 per cent. second-harmonic distortion by subtracting the smaller values of current and voltage from the larger, multiplying the two together and dividing by 8.

Thus we have:

A.C. power =

$$\frac{(88-20)\times(450-115)}{8} \text{ milliwatts,}$$

which = 2,848 milliwatts, or 2.85 watts.

The reason for dividing by 8 is that the voltage swing [illegible] is that [illegible] the figure taken and that we [illegible] is the R.M.S. voltage, which is $\sqrt{2}$ times the peak value. Thus the peak voltage obtained from the graph must be divided by twice root 2. Similarly, the current must be divided by twice root 2, and if we multiply twice root 2 by twice root 2 we get 8 as the answer.

Another practical point which can be explained [illegible] is that in drawing [illegible] load line we must avoid the curved portions of the I_a–V_a curves, where marked distortion would occur. It will be seen from Fig. 2 that point Z is nicely above the curve in the $V_g = -40$ curve.

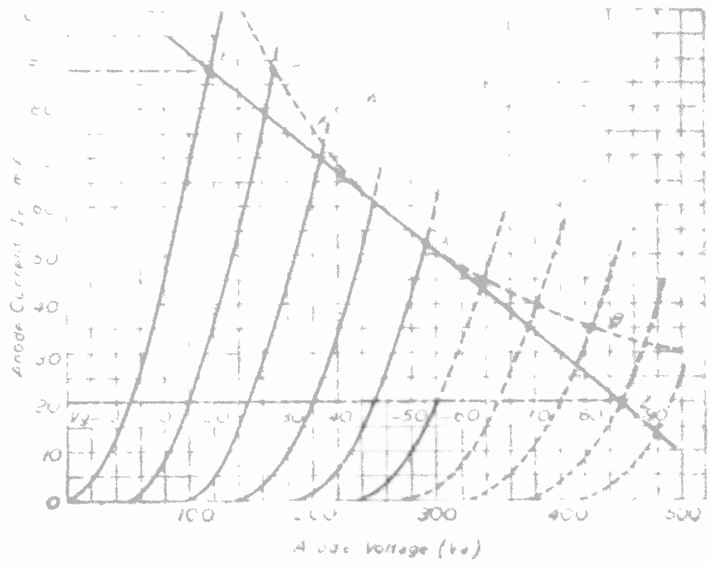


Fig. 2.—A series of anode current-anode voltage curves for a power valve. On the graph are also shown the anode-dissipation curve (dotted) and a load line (straight full line). The significance of these is explained in the text.

Optimum Load

In dealing with A.C. output before considering the optimum load of the valve we have in a way "put the cart before the horse," if it is considered that the primary purpose of the load line is to ascertain the optimum load, which is that load into which the output valve will deliver a maximum output. But it will probably be understood [illegible] the procedure. We [illegible] use the [illegible] for [illegible] purposes [illegible] resistance [illegible] from Ohm's Law [illegible] voltage divided by current [illegible] that the anode load corresponding [illegible] drawn is 450 – 115 (335) divided by 88 – 20 (68), and multiplied by 1,000. [illegible] optimum load for the [illegible] used in the conditions already laid [illegible] 335/68 times 1,000, which equals approximately 5,000 ohms.

From the foregoing it will be seen that when the valve makers give the working conditions of the valve and the curves, it is possible to draw the load line, and hence to determine the maximum output for 5 per cent. distortion simply by choosing values of voltage and current which "fit" the optimum load. It should be understood, however, that maximum A.C. output is never easy to determine precisely from curves unless it is known exactly what input is applied to the valve, and what is the D.C. voltage between the anode and cathode of the valve. It is, however, possible to find a value which is good enough for practical purposes.

A RADIO DISTANCE-METER

A DEVICE known as a radio distance-meter has been invented by the Soviet scientists, Professors N. Papalexi and L. Mandelstam. It employs radio waves to measure distances. The radio distance-meter consists of two special receiving and transmitting sets situated at two points, the distance between which has to be measured. Radio waves of exactly known wavelengths are emitted from one set and received by the other, from which they are relayed back to their source. This is done to determine how many wavelengths fit into the distance being measured. But the difficulty lies in the fact that this cannot be done directly. However, if the procedure is repeated, employing a radio wave of slightly different length the second time (by changing the wavelength on which the set is operated) it then becomes possible to determine the number of waves that fit into the distance by comparing the results of both measurements. With the aid of some simple measurements and calculations based on the knowledge of the velocity of radio waves, the distance is determined precisely.

Employing such a radio distance-meter, a captain of a vessel can always determine his position without using a compass or any other navigation instruments. Two radio relaying stations are located at fixed points on land and the ship's position is found as the point of intersection of two arcs whose radii are the distances from the ship to the aforementioned stations.

Empire Exchange

IN the Eastern, North American, and African Services of the B.B.C., a new series of broadcasts were recently inaugurated which it is hoped will prove of considerable interest to Empire listeners. It is designed to promote an exchange of thoughts and experiences between various parts of the Empire, and it enables citizens from one part of the Empire to ask questions of, and interchange views with, citizens of another part of the Empire.

These questions are cabled to the respective Dominions concerned, where a speaker is found to give a seven-minute reply to them. This reply is then transmitted to the B.B.C. by radio telephone and is recorded in London. Then, when the actual broadcast takes place, the questioner states his original questions and in answer to them the recorded reply is given. Each question and reply is designed to occupy fifteen minutes, so the time remaining after the reply has been broadcast is devoted to comment by the questioner.

P. A. Equipment—6

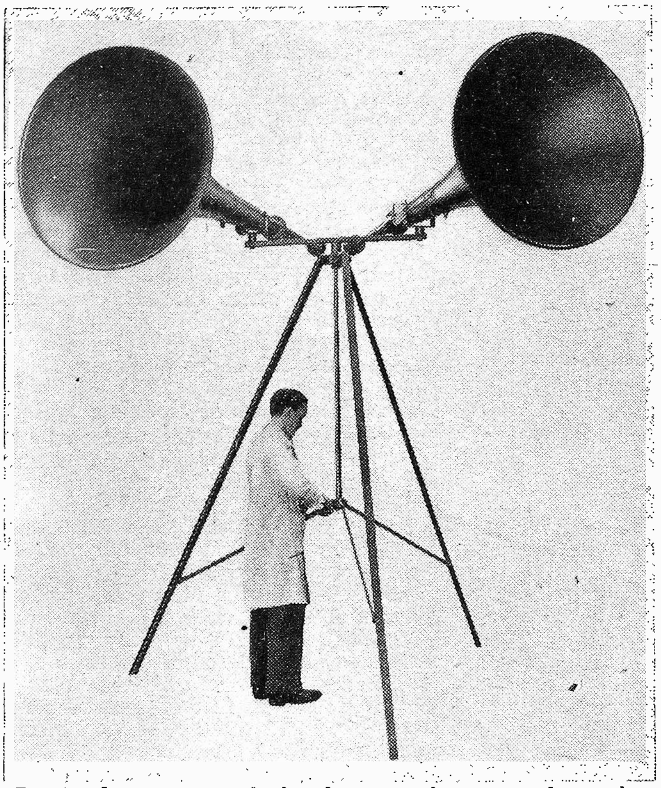


Fig. 1.—Large projector loudspeaker mounted on a tripod in order to " cover " a very large crowd.

Various Types of Loudspeakers Used for Outdoor P.A. Work and for Factories

By "SERVICE"

THIS article serves as an introduction to the various types of loudspeakers and their technical specifications. Questions relating to how many loudspeakers must be used to cover a particular space or hall, and what types to use for special occasions, together with information concerning how to estimate the number of loudspeakers that can be operated from a particular amplifier, will be discussed in later articles dealing with installation planning.

The original use of public address equipment was for enabling orators to address large crowds in the open air, and the earliest and most effective type of loudspeakers used for this work were of the horn type with large moving-coil units.

Projector Speakers

Modern versions of this type are still the best all-round loudspeakers for public address work. Nowadays they are generally called projector speakers, and modifications of them include what are termed directional baffle loudspeakers. This type comprises a large moving-coil unit with a cone assembly, which is bolted to a very wide flange horn of a fairly short length; it gives good quality output, and is very useful for crowd work, where several of the speakers may be mounted on a tripod, or tied to trees, so as to render a general distribution of sound over a wide area.

Large projector loudspeakers are generally made in sections, so that they may be easily transported in most types of P.A. service vans. With very large loudspeakers the horn may be divided into three sections, each of which bolt into the other, while, of course, the loudspeaker unit itself may be unscrewed from the throat of the loudspeaker.

These loudspeakers will often accept an input of 10 watts, and convert it into acoustic energy which will allow the reproduction to be heard half a mile, and more, away according to the direction of the wind. The frequency response of one of thes speakers, using a well-designed unit and a heavy exponential horn, will have a range of 200 to 800 cycles.

It is essential that when the unit is detached from the speaker assembly the opening in it should be covered by the cap always provided, and which screws on to the collar which normally screws into the throat of the speaker.

This cap prevents damage to the moving-coil and diaphragm, and prevents the ingress of dust, and, especially, metallic filings, which would be attracted by the very powerful permanent magnet in the unit.

Modern Horn Speaker

Reverting to our considerations of projector loudspeakers, Fig. 1 illustrates a modern version of horn loudspeaker, which is still widely used for public address work in the open. The particular speaker illustrated has a horn 7ft. long with a flare over 3ft. wide. It operates from a sensitive moving-coil unit, which converts a comparatively small amount of electrical energy into a large acoustic output.

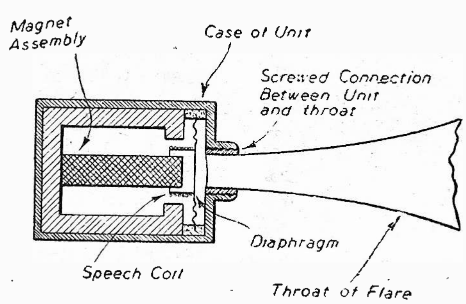
As can be seen, the loudspeaker may be swivelled horizontally and also swung in a vertical plane. Comparing the size of the loudspeaker with the engineer who is adjusting the tripod on which the speaker is mounted, it will be seen that this form of sound distribution enables the output from the amplifier to be directed well over the heads of large crowds, so that people on the very fringe of the assembly can hear the reproduction from the speaker.

The very large speakers are, of course, fairly heavy, and the weight of the loudspeaker unit alone is often as much as 12lb. and the horn itself may weigh a quarter of a hundredweight. The smaller loudspeakers are very much lighter than this. When it is required that they should operate on the roof of a van or large private car, then the use of aluminium for the horn will keep the weight down to the very low figure of, in some cases, only 10lb. for the total weight of the loudspeaker and its unit. In this type of speaker the moving-coil unit is not generally easily detached from the flare except for servicing.

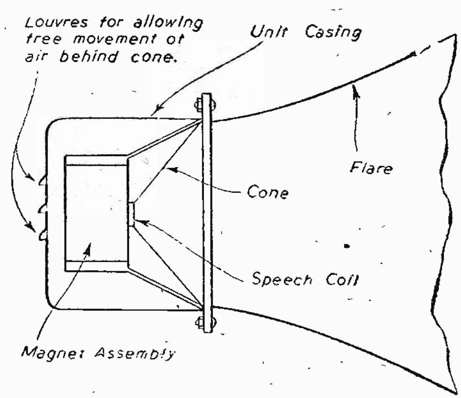
One important point to remember in connection with projector or any other type of horn loudspeakers is that the loudspeaker unit must never be allowed to operate without the horn being attached to it. When properly assembled, the column of air in the horn of the speaker acts as a load, and it is the job of the diaphragm to set the column of air in motion. There is quite an appreciable air pressure on the diaphragm, and the suspension and other details of the diaphragm will have been designed to operate with this particular pressure.

If the diaphragm is made to function without this load then it will probably be irreparably damaged, as it will be so free that it will crack or damage itself against the internal parts of the loudspeaker unit assembly.

Sections of a typical moving-coil loudspeaker unit as used with projector loud-



Projector Speaker.



Directional Baffle Speaker.

Fig. 2.—Sections of typical horn speaker units.

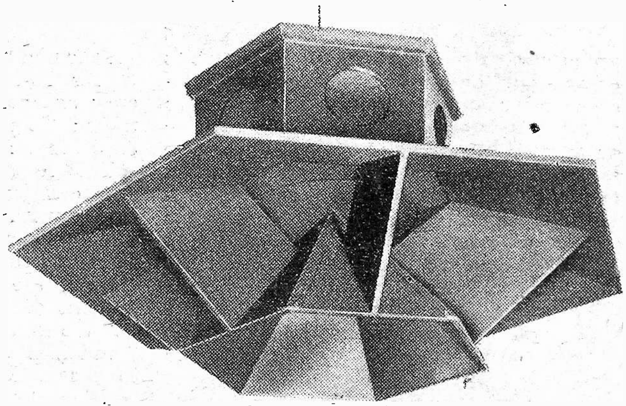


Fig. 3.—A multi-directional speaker employing a single speaker unit.

The Decibel Notation

A Simple Explanation of the Meaning and Use of the Decibel System of Defining Amplification and Attenuation

THERE are various ways of expressing the gain or amplification provided by an amplifier, and some of them are apt to prove rather misleading. One very simple method is in terms of the voltage step-up given; thus, if the input voltage were one and the output 100, it may be said that a voltage amplification of 100 to 1 was provided. Another method is that of relating the input power to the output power. For example, if an output of 1 watt (1,000 milliwatts) was given when the applied input was 1 milliwatt, it could be said that the gain, in terms of power, was 1,000.

Another method, which is gradually coming into more common use—although progress is slow in amateur circles—consists of expressing the amplification, or relation between input and output, in terms of decibels (or dB). The unit is actually the Bell, but this is rather too big for most purposes, so one-tenth of the unit is generally employed. There are many readers who, at different times, have explained that they found great difficulty in understanding the decibel notation. It is, nevertheless, very simple to anyone who has ever used logarithms—and there are few who have not made some use of them. It is not actually necessary to understand logs: all that is required is the ability to look up the logs of various numbers in common logarithm tables.

Without going into the theory of the matter, it can be stated that the power gain of an amplifier in terms of decibels is ten times the common logarithm of the ratio of output to input power. In the example referred to above, where the output was taken as 1 watt and the input as 1 milliwatt, the ratio is 1,000 to 1. Thus, the gain can be stated as 10 log 1,000. And since the logarithm of 1,000 is 3, the gain is 30 dB. (See Fig. 1.)

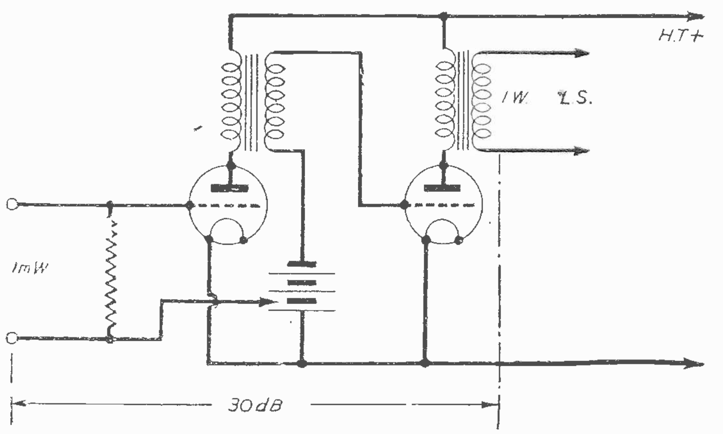


Fig. 1.—This outline diagram of a simple amplifier shows the relationship between power amplification and decibel gain.

Converting Voltage to Power

When we are dealing with the ratio between input voltage to output voltage we use the expression $N = 20 \log \frac{E_2}{E_1}$, where N is the gain in decibels, E_2 is the output voltage, or voltage developed across the output load, and E1 is the input voltage, or voltage across the input impedance. For this expression to be of any real use, however, the input and output impedances must be equal, because otherwise there would not be any proper power relationship between the two. In other words, the power represented by 1 volt across an impedance of 1,000 ohms is quite different from 1 volt developed across 20,000 ohms. If this is not quite clear the matter can be fully appreciated by applying Ohm's Law, from which it may be seen that power is equal to the square of the voltage divided by the impedance. We know that power is equal to the product of voltage and current, and we know that current is equal to voltage divided by resistance; thus, the product of voltage and current is equal to E R times E, which is E^2/R.

As an example of the above we may consider an amplifier giving a voltage amplification of 100. This means that the voltage of the L.F. output is 100 times that of the L.F. input. Assuming that the values of the input and output impedances are the same, we can find the gain in decibels from the equation $N = 20 \log 100$. Since the logarithm of 100 is 2, the gain in terms of decibels is 40.

In a similar manner, and by using exactly the same formula, we could determine the decibel gain by multiplying the logarithm of the input and output current ratio by 20. In practice, this is seldom used for radio work, but it is of interest to note the method.

Decibel Attenuation

The decibel notation is also widely used as a measure of the "negative gain" or attenuation, and in many high-grade amplifiers, especially those used for laboratory and test purposes, the volume control (then usually described as an attenuator) may be calibrated in terms of decibel reduction. In most cases a single control, in 3-dB steps, is all that is necessary and this is often used. Another use of the decibel notation for attenuation is in connection with transmission lines or corrective devices which may be used between one amplifier and another, or in the circuit of an amplifier.

Frequency Response

The notation is also employed widely for illustrating the frequency response of an amplifier, speaker, transformer or other audio device. A curve may be drawn, as in Fig. 2, to show the "characteristic" of the device, and to illustrate the variation in output over a band of frequencies. In one respect this method of representation may be said to "flatter" the amplifier or component, since the curve is much straighter than if it were drawn on the basis of output in watts or volts for a given input. On the other hand, however, the curve is more demonstrative of the effect of the output on the ear, which is comparatively insensitive to variations in volume level. In fact, the average person is unable to detect differences of anything

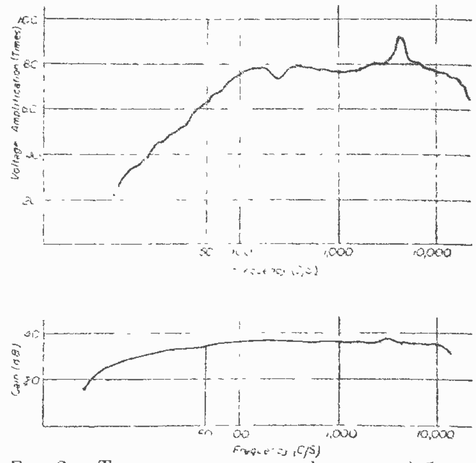


Fig. 2.—Two response curves drawn to different scales, but both representing the same amplifier. Note how the curve drawn on a decibel scale is considerably flatter than that drawn against a voltage-amplification scale.

less than two decibels. It is of interest to note in passing that a two-decibel change at high volume levels is equivalent to a much larger power or voltage change than it is at low volume levels. Thus it will be appreciated that the decibel notation is more "practical" than are other methods.

Zero Power Level

When using the decibel system of notation it is customary to have a zero or basic power level, and for convenience this is normally taken as 1 milliwatt in this country, although in America the zero is taken as 6 milliwatts. By having a standard basis of this kind it is a much easier matter to refer to the gain, and it is easier to make accurate comparisons. At the same time, it will be appreciated that any other standard could be adopted if desired.

Gain and Output

It should now be quite clear that there is a vast difference between gain, expressed in decibels, and amplifier output. Obviously, an amplifier may provide an output of 10 watts while having a maximum of only, say, 10 decibels, whilst another amplifier may have an output of only 2 watts and show a decibel gain of, say, 50. In the first case a large input would be required to give the maximum output, whereas in the second a very small input would suffice to give the comparatively large output.

It has been shown how power and voltage amplification can be "translated" into terms of decibel gain, and it should be clear that decibel gain can be "translated" into voltage gain by following the reverse procedure. Thus, if an amplifier were known to have a gain of 50 decibels and a maximum output of 5 watts, it would be easy enough to determine the input required to give that output. In the formula: $N = 10 \log \frac{P_2}{P_1}$ we know that N is equal to 50 and that P_2 (the output power) is 5 watts, or 5,000 milliwatts. We can then determine the ratio of P_2 to P_1 by substituting as follows: $50 = 10 \log x$, where x is the ratio. From this we see that $\log x = 5$. We also know that x is equal to the antilog of 5, which is 100,000. We know, therefore, that P_1 equals 5,000 divided by 100,000, which is .05 milliwatt. If the output voltage were known, the required input voltage could be found in a corresponding manner by using the formula $N = 20 \log \frac{E_2}{E_1}$.

ROUND THE WORLD OF WIRELESS

Hudson Captures U-boat

IT is interesting to note that the wireless operator on the Lockheed Hudson bomber which attacked and captured a U-boat in the Atlantic, is twenty-one, and comes from Wimbledon.

Radio Explosions

ACCORDING to the Berlin radio the Russians have been using remote radio control to explode high-explosive charges in Viipuri. It was stated that behind the Russian lines short-wave transmitters were being used to touch off the charge.

Canadian Short Waves

THE Canadian Broadcasting Corporation has recently been working its new 7.5 kW short-wave station at Vercheres, Quebec, experimentally. Call signs and frequencies are CBFW, 6.160 mc/s: CBFX, 9.630 mc/s: CBFY, 11.705 mc/s; and CBFZ, 15.190 mc/s. The station was erected to serve the French-speaking communities in areas of Western Canada which are outside the service area of the Corporation's existing network of medium-wave stations.

Civilian Technical Corps

THE Radio-Marine Corporation of America and R.C.A. Institutes have offered to make their technical facilities in twenty cities of the United States available to the Civilian Technical Corps for examination of volunteers. The Civilian Technical Corps, which gives Americans the opportunity of working on radio-location for Britain, have gratefully accepted the offer.

G.E.C. Appointments

THE General Electric Company have appointed Dr. A. H. Railing and Mr. Leslie Gamage to be general managers of the company. Both have been directors for many years, Dr. A. H. Railing being chiefly concerned with the engineering and manufacturing sides of the company, and Mr. Gamage, in addition to occupying the position of secretary, has been director in charge of the overseas business.

R.S.G.B. Convention

THE many who attended the R.S.G.B. Convention, which was held at the I.E.E., displayed much interest, in spite of the fact that the apparatus shown by the exhibitors was not for sale. The opportunity of informal discussions which was afforded by the members of the Services who were present, was appreciated.

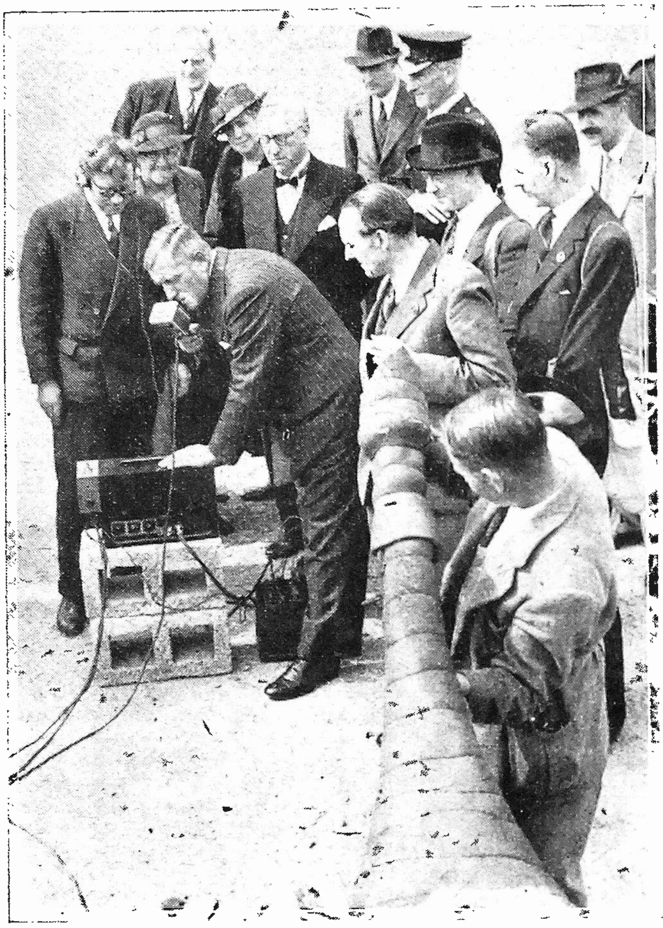
Confiscation of Radio Sets

IT is reported from Stockholm that the Nazi Commissioner in Norway has ordered all radio sets in Oslo and other Norwegian areas to be confiscated.

Sixty thousand sets will be seized. The ban does not apply to Quisling's guard or to Germans.

Swiss Aerial Regulations

THE State Council of the Canton of Geneva recently made a decree regulating the use of outside aerials in Switzerland. Under the new decree all aerials must conform to one of the approved models, so far as public safety and the æsthetic aspect are concerned. All blocks of more than four flats are to have a communal aerial.



The Home Secretary, Mr. Herbert Morrison (with headphones) testing Brighton's casualty locator by which even faint sounds can be heard under bomb wreckage. The demonstration was given when he visited Brighton Civil Defence units recently. The apparatus, which was invented at Brighton, is likely to be widely used.

Marconi Memorial Award

W. B. HOLLIS, who operates W5FDR, of Houston, Texas, has been awarded the Marconi Memorial award of the American Veteran Wireless Operators' Association for morse proficiency tests. In qualifying for this award Mr. Hollis attained a speed of 65 w.p.m., and perfect copy for one minute was necessary. Eight hundred amateurs took part.

Cossor's Red Cross Fund

EMPLOYEES of A. C. Cossor, Ltd., have contributed over £1,000 in pennies to the Red Cross Penny-a-Week Fund in the last twelve months.

The Late H. Grindell-Matthews

THE recent death, at the age of 61, of H. Grindell-Matthews calls to mind a picturesque character in the world of invention. This man died alone in his mountain-top home surrounded by electrically-charged barbed wire and burglar alarms. Most of his inventions were impracticable.

Apart from his numerous inventions, Matthews worked on ideas fantastic enough to rival the imaginings of H. G. Wells and Jules Verne. They were laughed at.

One was a death-ray that would stop a 'plane in mid-air and put its engines out of action: another was a six-miles-a-second rocket to reach the moon.

Wireless telephony early attracted Mr. Grindell-Matthews, and in 1911 he succeeded in establishing wireless telephonic communication with an aeroplane one and a half miles away and travelling at what was then considered the remarkable speed of 60 miles an hour.

In 1912 he demonstrated a system of wireless communication between two motor-cars. He lacked scientific training.

U.S. Counter-propaganda

ACCORDING to a recent report, the Reconstruction Finance Corporation, an American Government-controlled organisation, has authorised a grant of 40,000 dollars to the World Wide Broadcasting Foundation, operators of short-wave stations WRUL and WRUW, Boston. It is suggested that this indicates Government interest in a counter-propaganda campaign.

Marconi Memorial in U.S.

A MEMORIAL to Marconi is to be erected in Washington, U.S.A. It is to take the form of two granite pedestals, the smaller one in the front, which will be 7ft. high, being surmounted by a bust of Marconi, 3ft. 8in. high. This pedestal and bust will be backed by a wider and taller pedestal surmounted by a bronze figure symbolising electricity.

Saving Life at Sea

IN addition to portable radio transmitters, electric-light buoys attached to ships' life-rafts for use at night, and a device which flashes the SOS signal in Morse continuously for 48 hours, and if used only at night will last a week, are other devices recently introduced for saving life at sea.

Brighton Engineer's Invention

MR. R. C. MOORE, a Brighton electrical engineer, has invented a radio device for detecting people buried beneath the debris of demolished buildings. It consists of a simple electrical amplifying apparatus and a padded loudspeaker horn 3ft. in height. The horn when placed in the debris draws in every sound, such as deep breathing and slight taps. At a demonstration recently a volunteer crawled into a small hole under a large pile of debris, and a whispered conversation was clearly heard by a press representative. The chairman of Brighton A.R.P. Committee, Captain B. Dutton Briant, states that the device will not be patented, and any local authority wanting details or a test can apply to the A.R.P. controller at Brighton Town Hall. See illustration on this page.

A Morse Practice Set

A Simple Unit for the Experimenter

At the present time there appears to be a need for an inexpensive oscillator capable of being used for a number of different methods of working.

The simple apparatus described below can be used in the following ways: First, as a simple signal generator for practising single-handed. Secondly, for group receiving, by coupling a number of 'phones to one end, and a key for the use of the instructor to the other. Thirdly, as a complete dual working send/receive circuit over any distance, for practice in procedure. No doubt other methods of use will occur to the keen experimenter.

Upon referring to Fig. 1 it will be seen that the oscillator itself, except for the fact that the key position is not in the usual place, is extremely simple, and can be made to fit into a very small space. The extension control panels are quite straightforward, and in the model used by myself were constructed on two ordinary electric light

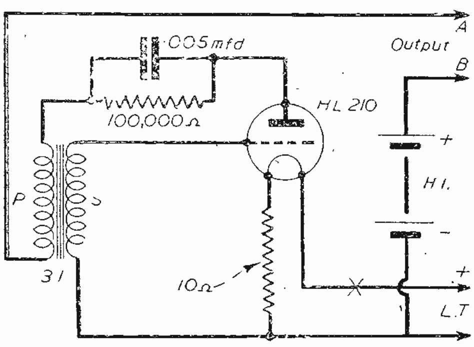


Fig. 1.—The oscillator circuit.

switch-blocks, measuring 6ins. by 6ins. The circuit of the extension panels, which are both identical, is given in Fig. 2.

Signal Generator

For use as a signal generator, for practising solo, one panel only is used, both input terminals being connected to terminals

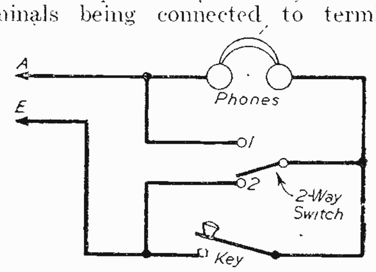


Fig. 2.—Extension panel circuit.

A and B on the oscillator. One point must be noted in this method of working, and that is when used in this manner the switch should be left out or, if fitted, should not be connected, otherwise when the key is operated the 'phones will be cut out.

In the second method of working, i.e., group listening, the circuit is the same as in the case of dual send/receive working, but in this case the return connection should be a length of wire coupling the E terminals in each panel. A number of 'phones are then connected in series to one panel for the students, and the instructor uses the key on the other panel.

Send/Receive Apparatus

The method of operation as a dual send/receive apparatus is as follows: The oscillator, which can be placed either at one end of the circuit, or in the centre if more convenient, has one long lead attached to each terminal, and then run to where each panel is set up. From the other input terminal (E) on the panel a lead is taken to the nearest earth point, and a good connection must be made here, to ensure as low a resistance as possible. To make things clear we will call one panel Station A and the other Station B. Station A is to start sending, therefore the switch on panel A is placed in position marked 1. Panel B has its switch in position 2. On completion of the message, Station A throws over its switch to position 2, when a continuous note will be heard in both 'phones until B alters its switch to position 1, thus cutting his 'phones, and putting his key in circuit for sending.

A Modification

A further modification in the case of dual send/receive working can be made, if it is desired to hear the signal in the sending end of the circuit, so that the operator can hear what he is sending. In this case, the switch on each panel should be a simple on/off switch connected across the key, this switch being closed by the person who for the time being is receiving.

To adjust the tone of the signal, and to alter its strength, the best method is to reduce the size of the resistance across the condenser: this will lower the note, and increase the strength. Reversing the process, i.e., increasing the resistance,

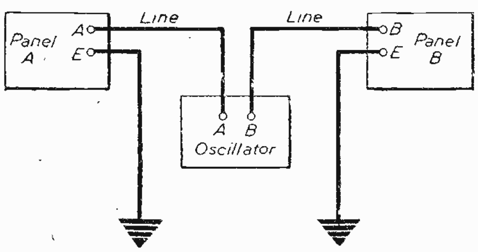


Fig. 3.—Two-way send/receive working connections.

will raise the note and reduce the strength. Values between 200,000 ohms and 50,000 ohms may be tried until the note is pleasing to the ear.—H.L.

National Register of Radio Dealers

At the first meeting of the Registration Board of the Register of Radio and Television Retailers, Ltd., held at Birmingham recently, F. J. Smith (Leicester) was elected chairman of the Board, with H. Nightingale (Manchester) as vice-chairman. The following official statement was made after the meeting:

"The Board gave careful consideration to the requirements which will have to be met before a retailer will be placed on the Register. Eventually, the following definition was unanimously agreed:

"'A radio retailer shall mean a person, firm or company of good financial standing, having suitable shop or showroom premises rated as business premises open to the public during ordinary local business shopping hours, trading on his, their, or its own account as a dealer or dealers in radio and/or television sets or radio-gramophones, who continuously maintains and displays a reasonable stock of and re-sells the same to users only, at not less than the manufacturers' fixed retail prices and is prepared within reasonable limits to service the same.'

"The large number of applications received to date is considered very satisfactory. An appeal is made, however, to other radio dealers to send in their applications without delay. The Register has the co-operation of the Music and Radio

NEWS ITEMS

Distributors' Association, the National Association of Radio Retailers, Ltd., the Scottish Radio Retailers' Association, and the Wireless Retailers' Association.

"The Board will also be pleased to hear of businesses which have been closed down for the war period only, that is, where it is the intention to reopen after the war. Communications should be addressed to the secretary, H. A. Curtis, Africa House, Kingsway, London, W.C.2."

Bound Brook Aerials

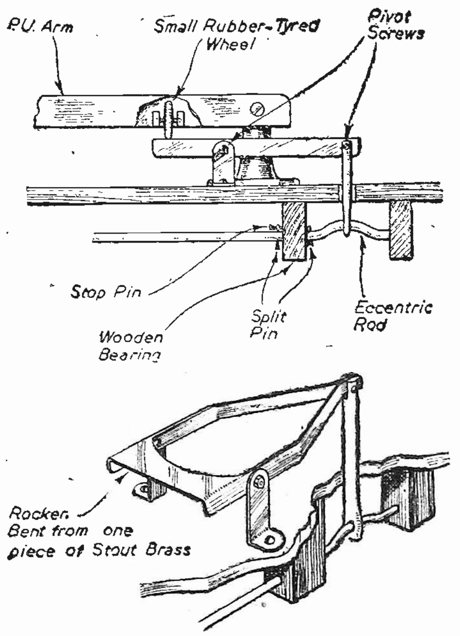
The transmitting aerial system of the N.B.C.'s two 50-kW stations, WRCA and WNBI, occupy a site of seventy acres. The Bound Brook site is rectangular in shape, with the long dimension facing in the general direction of Latin America. This is important, the engineers explain, because a considerable number of aerials are necessary to properly serve the various sectors within the arc of 100 degrees between Pernambuco and Mexico City. The short dimension of the site faces Europe.

Prospective women train announcers at Euston taking their turn at the microphone, under the direction of Mr. Wilkie, the present announcer.

Practical Hints

A Pick-up Lifting Device

IT is well recognised that the best safeguard for records and pick-ups is a mechanical lifting device. Not all devices, however, are satisfactory in not encumbering the turntable, or in ensuring that the pick-up



Details of an efficient pick-up lifting device.

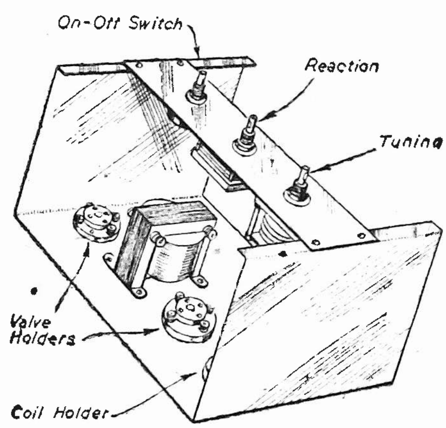
is free to move laterally at any point during the lifting and replacing. The device I am at present using is, however, satisfactory in these respects. Its construction is apparent from the sketch. The small rubber-tyred wheel was taken from a toy motor-car, the axle hole being accurately drilled to a large size to ensure smooth running. My pick-up has a channel metal arm which is convenient: other arms would require a different mounting for the wheel. The rod from the rocker device which goes through the baseboard is connected to an eccentric rod underneath, worked by a knob on the front panel. Other arrangements could be used. The pick-up in the raised position swings with the needle-point about ¼in. off the record with the longest thorn needle likely to be used, and the total drop possible is ⅜in. at the point.—W. R. STAMP (Sidcup).

Improved Short-wave Construction

WHEN I was building my last short-wave receiver I departed from the usual panel and baseboard construction, and instead evolved the layout shown in the sketch. This has many advantages over the panel and baseboard, and even the chassis form with the controls in front.

A deep tray was formed of aluminium having three sides, as shown. A piece of stout aluminium was then stretched across the top, serving to brace the sides and also to hold the controls. The method of securing this was to bend the top of the sides about half an inch, the cross-piece being then bolted on.

The purpose of this form of construction now becomes clear. The terminals of the variable condensers, coils, valve-holders, etc., are brought into close proximity, so that very short wiring is possible. Finally, the whole can be very easily mounted in a cabinet, or on a subsidiary panel, by merely running another nut on the controls. If aluminium is not procurable, the three sides can be made of wood, with a piece of ebonite as a cross-piece. In this case, if there is not sufficient room for another nut



A novel layout for a short-wave set.

to be run on the controls to secure the receiver in a cabinet, bolts and nuts at each end of the cross-piece will suffice.—WM. NIMMONS (Belfast).

THAT DODGE OF YOURS!

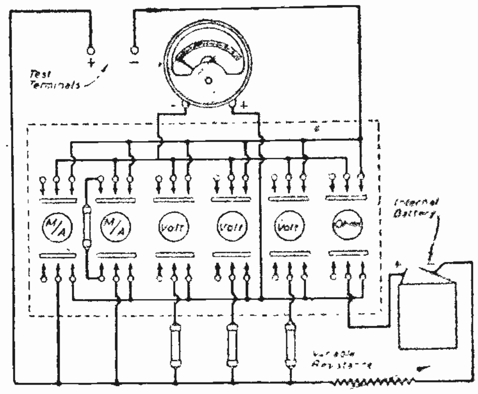
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Practical Hints." DO NOT enclose Queries with your hints.

SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page 56

Push-button Meter Switching

FINDING the continual changing of leads, on a universal meter, often a difficulty, I have made use of an ordinary 3+3 point on-off push-button unit, to supply the needs of all readings, with the pressing of the appropriate button. The sketch is self-explanatory, the inside of the dotted line representing the push-button unit. The top terminals, which are for testing, could, if desired, be substituted by flex leads permanently anchored inside the finished cabinet. Additional readings to suit individual requirements can be had by using larger units and connecting the extra



Method of using a push-button unit in connection with a universal meter.

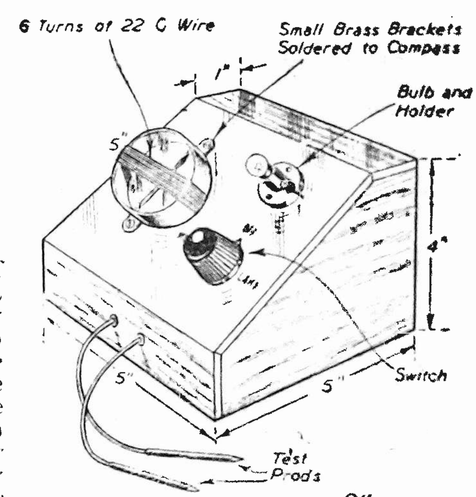
push-buttons to the appropriate range—mA or volts—in parallel. The variable resistance joined to the internal battery must suit the particular meter in use.—H. S. STANSFIELD (Aldershot).

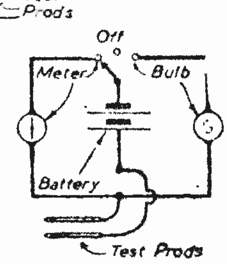
A Simple Tester

IN my den I was constantly in need of some sort of testing apparatus. I could not afford any complicated test apparatus, so I devised the tester shown in the accompanying illustration.

The measurements for the box are as indicated. The meter was constructed out of a compass and six turns of 22 gauge insulated copper wire wound round it. It is mounted on the panel by two small brass brackets soldered to the side of the compass. The switch is a Bulgin rotary switch.

The tester can be used for testing transformer, choke and coil windings with the





Exterior view of a simple tester, and diagram of connections.

meter. To test the wiring of sets use the bulb by switching to the bulb on the panel. The battery is of the flat type 4.5 volts.—A. G. S. COBB (Tamworth).

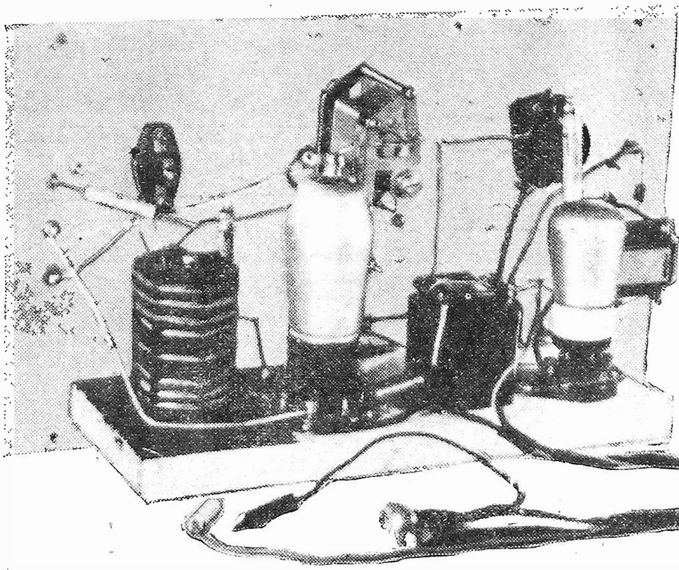
UNIVERSAL OS

A Useful Instrument for Experimenter.

THE unit described in the present article is easily made from parts which most constructors already have, or can easily obtain, and the cost is well within the pocket of anyone.

Various Uses

The unit consists of an oscillating H.F. valve which can be modulated with the signal from a local L.F. oscillator, or this latter valve may be switched to provide amplification for an input signal which may modulate the H.F. signal. The unit has many uses and the following are some: The L.F. valve alone may be used to give a L.F. signal for testing amplifiers, 'phones, or the L.F. side of a receiver. This valve may be switched to act as a pick-up or microphone amplifier, and the output taken from the L.F. output and passed on to an amplifier or 'phones.


Rear view of the oscillator unit, showing the layout of components.

The H.F. valve may be used alone to provide a H.F. signal as in wave-meters, and this will cover both the medium and long wavebands and even down to the short on harmonics. This H.F. signal may then be modulated by the L.F. valve acting either as a L.F. oscillator or amplifier for P.U. or "mike" as already mentioned. Other L.F. sources, such as beat-frequency oscillators, etc., can also be used to provide the L.F. signal for modulation purposes.

In this way it will be seen that the unit has many uses and it will give a fairly strong signal, therefore it must be appreciated that when it is used for the purpose it is intended, namely, a test oscillator, it is essential to take every precaution to prevent unwanted radiation.

The unit is especially useful for record reproduction on one or more sets in the same building under authorised conditions and at present it is being used for this purpose, and also for warning by both the L.F. note and the microphone later described in the article. The L.F. note can be "warbled" by moving the volume control knob backwards and forwards quickly, and in this way will give a strong "siren"-like note. The batteries are contained in the same cabinet as the chassis.

Circuit

The circuit is of a very simple type, and it will be seen from the diagram, Fig. 1, that an F.C.2 Mullard valve is used as the H.F. oscillator, and this is modulated on one of its grids by the Mullard valve PM1HL. The first-mentioned valve is coupled to the H.F. output from its grid circuit via a .0001 condenser, and reaction to maintain the oscillations is from its anode, via the reaction coil, which is coupled to the grid coil inductively. A wave-change switch short circuits part of the winding when necessary, as shown in the diagram. The other grids are fed from the main H.T. line via resistors, and suitably decoupled by the condensers shown. The L.F. signal is introduced at the first grid, and this varies the H.F. current passing through the valve.

The L.F. valve PM1HL is coupled to the other via parallel fed L.F. 5 : 1 ratio transformer, and the input to this is controlled by the volume control shown. The resistor R4 is for the purpose of preventing too much of the L.F. oscillation passing into the condenser-volume-control network, as if this was allowed the L.F. oscillation might be stopped on very low volume. The volume control will vary the note somewhat in use with different volumes, but this is useful as it gives a certain range to the note. The resistor R4 limits this effect.

Valve Coupling

The anode of valve 2 contains the primary of a 3 : 1 transformer, and this primary is used as a L.F. choke when the valve is used as an amplifier. When the valve is required to provide a L.F. note or to modulate the H.F. valve with a note, then its anode circuit is coupled to its grid circuit via the windings of the transformer. When being used as an amplifier its grid is switched to the input sockets and a grid leak introduced; the secondary of the transformer is then left open circuited.

The values of the resistors and condensers are not critical, but if those in the L.F. side, or the transformers, are changed in value the note generated by the L.F oscillator will be altered. This is useful to know as it allows one to choose the note one likes best. It will be found, however, that the values given are probably the best as these were only decided on after much experiment. More will be said on this matter later in the article.

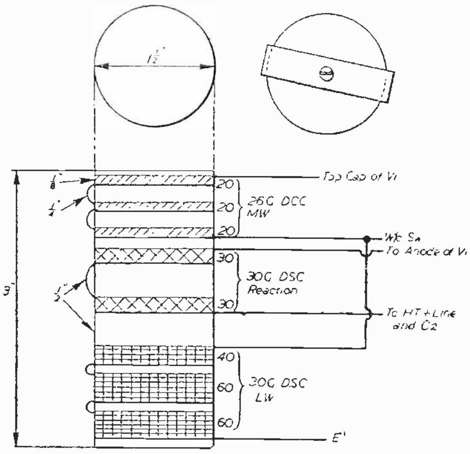


Fig. 2.—Coil former and windings.

Panel and Baseboard

The panel may be of wood, ebonite, aluminium or sheet-iron. If an insulated panel is used it should be lined with zinc or tin-foil to provide screening. The writer used sheet-iron as this is very rigid, which is most important with H.F. oscillators to prevent changes in calibration. These panels may be made very attractive by spraying (from a vaporising type of garden sprayer) with aluminium or other

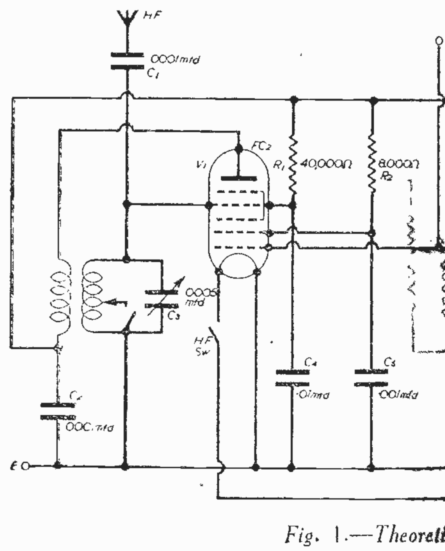


Fig. 1.—Theoreti

very thin paint. This gives an even, professional finish.

The panel measures 15in. by 9in. and the baseboard 12in. by 4in., but any dimensions near these will suit. The panel fits in flush in the cabinet. The baseboard is made from a piece of wood, as this prevents damping troubles, and is also easy for mounting components on. The panel is drilled to take the various components, as shown, these being the various sockets and switches, the volume control and tuning condenser, and also the L.F. transformer. No other parts are affixed to the panel unless they cannot be fitted elsewhere. The name plates under the various knobs, etc., are engraved on vulcanite or they can be omitted, if not wanted.

The Coils

The coils are wound on an ebonite former, and this should be of the size shown in Fig. 2 and of the ribbed variety. Slots are cut as

ILLATOR UNIT

Constructor and Keen
By F. DAY-LEWIS

cated in the drawing; the actual sizes hese slots are not very important, but size of the former is. The medium-e section is wound in three slots, there g 20 turns in each, giving a total of urns. Where the last turn comes leave od length of wire to reach the switch this wire also commences the first of the long-wave winding. This is nd in the bottom three slots, the number urns being 160, and when used with the ium-wave winding this tunes over the -wave band.

he reaction winding is next wound, this consists of two 30-turn windings lots, as shown. The slots are fairly ly separated, one being near the ium-wave coil, and one near the long-e coil, but not so closely coupled to it. the turns are in the same direction, the top of the medium-wave coil goes he tuning condenser fixed vanes and of valve; the end of this coil, and of L.W. coil go to wave-change h. The end (at bottom) of L.W. coil to earth line; top of reaction coil goes node of V1 and bottom to H.T. line. medium-wave coil is wound with 26

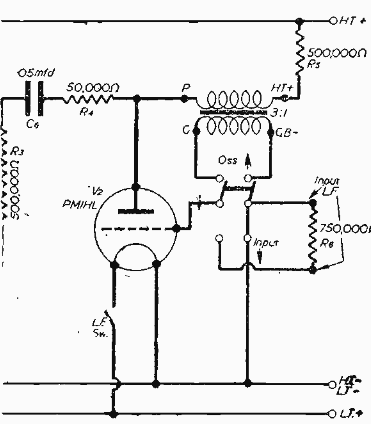


diagram.

wire and the L.W. and reaction coils 30 d.s.c. wire. These are actual s, but others slightly different will do. n winding, and in any doubt of the size of slots (due to errors in making) n a few extra turns, as these can easily emoved later to cover the exact wave-ths. The reaction winding is quite uate to give strong reaction, and its ber of turns is not critical.

he former is mounted on its end, the section being at the bottom, and a piece of cardboard or ebonite is d across the top and a screw or bolt this, pressing the coil to the base-dy

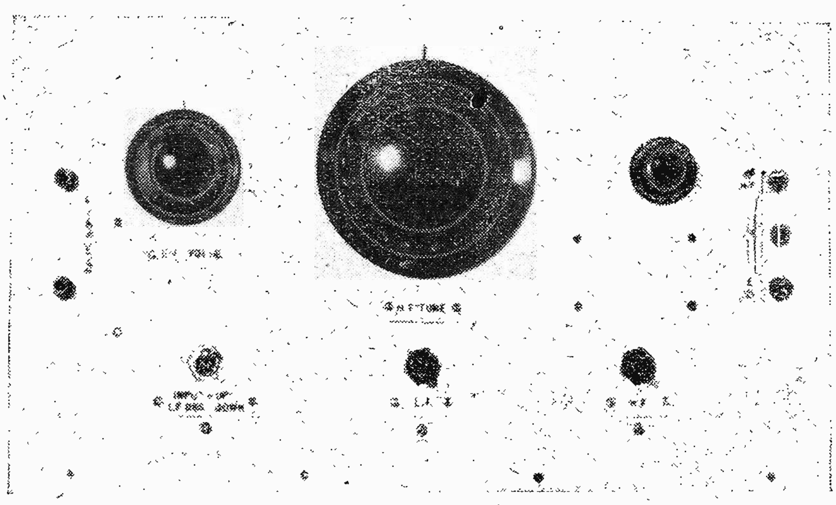
embling and Wiring

his is perhaps the most important part he construction of this unit, and upon ccuracy will depend the good working he whole outfit.

he layout of the components is simple and should present no trouble. The back of panel view is shown in Fig. 3, and the various positions of the parts is shown in detail. The coil is mounted near the back of the baseboard to prevent absorption of its field by the metal panel. The first valve, FC2, is placed as near to the coil as convenient, and its top comes close to the tuning condenser. The L.F. transformers are mounted at right angles, and if these have metal cases or earthing terminals these objects; this refers to wires carrying H.F. currents. The panel sockets are of the insulated bushed type. The condensers are all tubular H.T. type, and the resistors of the ½-watt midget type.

The wires are taken by the shortest possible path, and the panel is earthed but should not be used as a common earth return. All the switches except the wave-change one are of the toggle type. A push-pull switch is used for wave-changing, but any other good self-cleaning type will do. It should make a good contact which will not fail with time.

The tuning condenser may be of any convenient type, and should be provided



The panel of the oscillator unit showing the various controls.

should be earthed. The transformers should be of the small type, if possible.

Wiring Details

The wiring should be done with very thick wire, and sleeving may be used to insulate it. Any wires on the H.F. side should be kept away as much as possible from one another, and from earthed with a large dial, preferably marked in degrees; the volume control should also have a marked dial. The valveholders are baseboard mounting type, and both the valves are metallised. Flex leads are brought out to the two batteries, as shown in the first illustration on this page.

To be concluded.

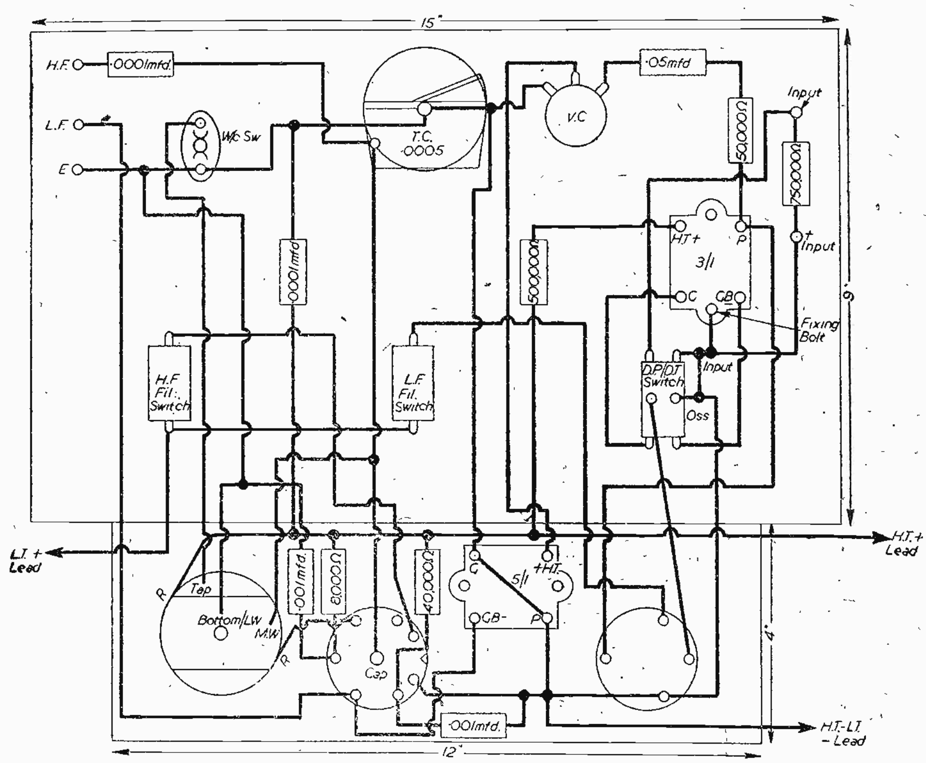


Fig. 3.—Wiring diagram.

The Octode Frequency Changer

A Brief Explanation of Its Functions

Many amateurs find the multi-electrode frequency changer difficult to understand, and it is felt that there is a need for a simplified and yet concise description of its action.

The superhet principle, in which we mix two oscillations and rectify their sum to produce another oscillation at their difference frequency, is easily understood when

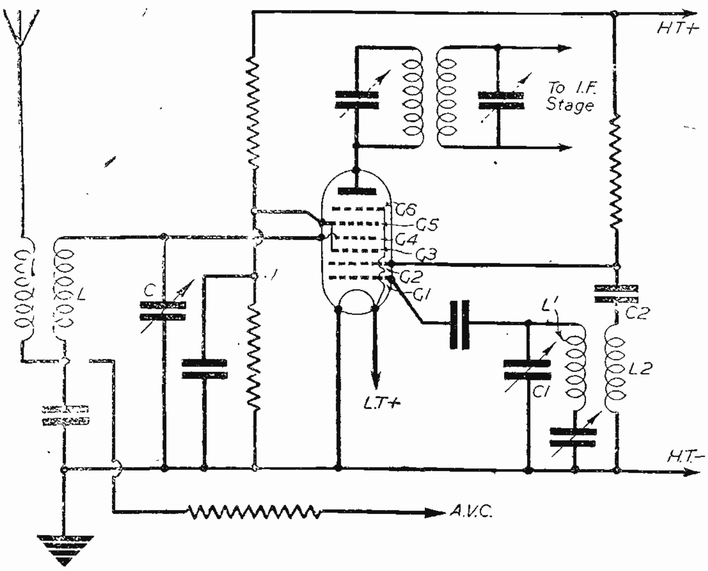


Fig. 1.—Circuit of octode frequency changer.

using the detector type frequency changer, but with the electronic type mixer the operation appears very complex until explained by the application of valve characteristics.

Fig. 1 shows the usual octode circuit with the oscillator grid tuned to the desired oscillator frequency by the coil L1 and the condenser C1, the oscillation being maintained by feedback through C2 and the reaction coil L2.

The voltage on G1 will rise and fall at the oscillator frequency and will determine the density of the electron stream which can pass through the oscillator section. These electrons then come under the influence of the positive screen G3, which attracts them towards the pentode section of the valve where they are retarded by the negative bias on G4, forming a "cloud" between G3 and G4, which is referred to as the virtual cathode.

This cloud of electrons will vary in density with the voltage and frequency of the oscillator grid, and at the same time will act as a cathode for the remainder of the valve, which can be considered as a pentode amplifier of the incoming signal to which the circuit L and C is tuned.

I. F. Current

Hence, it can be seen that the current in the I.F. circuit depends on the voltage applied to both the signal and oscillator grids, and the combined effects of these two oscillations can best be understood by reference to Fig. 2.

The steady grid bias on the signal grid is assumed to be 3 volts negative, whilst that on the oscillator grid is 4.5 volts negative, and it is seen that with no signal and an oscillator output of 4.5 volts peak, the anode current will rise and fall between the limits XY at oscillator frequency. Conversely, with no local oscillation and a signal input of 3 volts peak the anode current would swing between the limits PQ.

If, however, a signal of 3 volts peak is applied with the oscillator delivering an output of 4.5 volts peak, the anode current pulses will depend on the combined effects of oscillator and signal-grid voltages.

Now as these oscillations differ in frequency, they will alternately produce similar and opposite effects on the anode current, assisting and opposing each other at the difference in frequency.

When the oscillator and signal grids both swing positive the anode current will have value A, and when they both swing negative the anode current will have value B.

When these grids are acting in opposition to each other the current can only swing between the limits C and D, because when the oscillator grid swings positive and the signal grid negative, the anode current will be value C; and when the signal grid swings positive and the oscillator grid negative, the anode current will be value D.

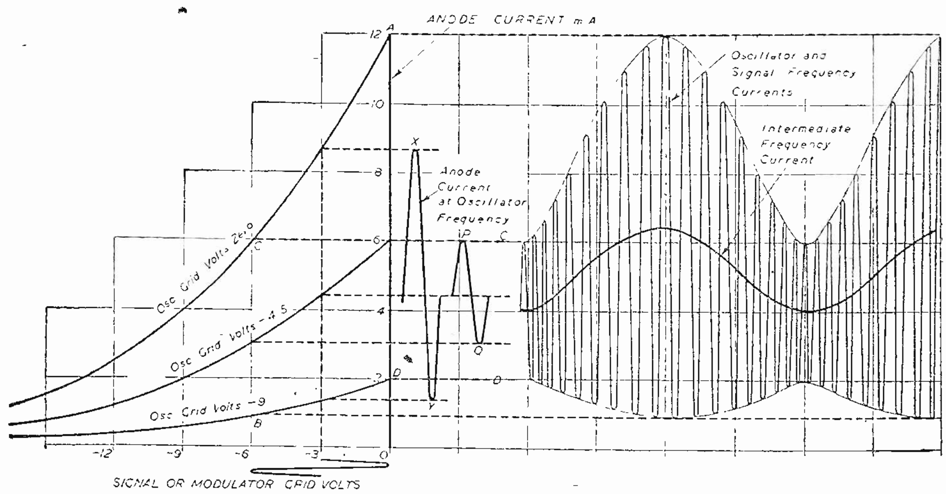


Fig. 2.—Graphical representation of action of octode frequency changer.

From this it can be seen that the pulses of anode current will rise and fall at the difference frequency, thus giving rise to an "intermediate frequency" component of anode current.

This intermediate frequency signal, to which the anode circuit is tuned, will be amplified and passed on to the I.F. stages for further amplification.

Function of Screens

Considerable advantages attend the use of this valve as a frequency changer, the most important being the fact that the screen G3 prevents interaction between the signal and oscillator circuits. This, besides allowing the signal to affect the frequency of the oscillator, would, in the absence of G3, permit the aerial to radiate the local oscillation and cause interference in other nearby receivers.

G5, the second screen, also prevents interaction between the I.F. and signal and oscillator circuits, and in conjunction with the suppressor grid G6 increases the impedance of the valve, and both these effects contribute considerably towards increasing the selectivity of the I.F. anode circuit.

Unfortunately, there is always some disadvantage, and although it is unimportant at the normal broadcast frequencies, on the short waves there is still some residual coupling between the signal and oscillator circuits which tends to affect the stability and frequency of the oscillator.

The effect is sometimes reduced by connecting a small condenser between the signal and oscillator grids. A better method is to use the octode as a mixer with a separate valve as oscillator.

This is the method used in the triode hexode, but this is outside the scope of the present article.

Problems of Amateur Receiver Design—15

This Concluding Article of the Series Explains More About the Power-supply System of A.C. Receivers, and Deals With the Question of Power Supply in Universal Mains Sets

By FRANK PRESTON

LAST month the general design of the H.T. and L.T. supply unit for A.C. receivers was described in relation to valve rectifiers, so now we may consider the question as it applies when using metal rectifiers. First, however, there are one or two points to clear up regarding the use of a thermal-delay switching arrangement. This type of switch is very desirable for inclusion in the H.T. lead from the rectifier when it has a directly-heated filament, or when it is of the metal type, and when the receiver output valve has an indirectly-heated cathode.

H.T. Switching

It has previously been shown in this series that in a case such as that just referred to, there would be a very high H.T. voltage developed across the various smoothing and by-pass condensers in the interval between switching on the mains supply and the time that the receiver valves commenced to pass their normal H.T. current; this period of time may be anything up to 40 seconds. The trouble can be overcome most easily by arranging that the output from the rectifier shall not be applied to the condensers until the valve cathodes have reached their normal operating temperature. A manual switch could be used for this purpose, but it is far better to use some form of automatic arrangement, such as that illustrated in Fig. 1.

The thermal-delay switch consists essentially of a bi-metal strip which carries one contact. Around the strip are a few turns of resistance wire; a current is passed through this wire, and the heat developed causes the bi-metal strip to bend so that its contact touches a second fixed contact. By so designing the strip and the amount of insulating wire wound round it that the contacts close in the same time as that taken for the valve cathodes to heat up we can obtain precisely the result required. In practice, the connections to the resistance-wire heater are taken to an L.T. winding on the mains transformer, while the two H.T. contacts are in the positive circuit from the rectifier, as shown in Fig. 1.

Thermal-delay Switches

There are a few different types of T.D. switch, one of which is mounted in a bakelite case; another takes the general outward form of a three-electrode valve. Models are available for operation from 4- or 6-volt supplies, and one is chosen which will operate from the valve-heater winding or, sometimes, in the case of a valve rectifier, from the rectifier filament winding. When the switch is of the type fitted in a bakelite container there is generally an adjusting screw so that the time required for the contacts to close for a given heater voltage can be varied over a small range. In most cases 30 seconds is a suitable time, but it is better to allow rather too much than too little to ensure that the valve cathodes really have attained their working temperature.

Use of a Metal Rectifier

The simplest form of metal-rectifier

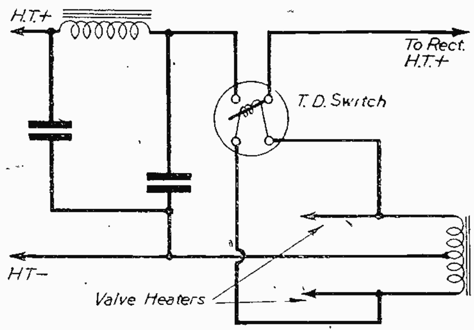


Fig. 1.—Connections for a thermal-delay H.T. switch. The heating resistance may be fed from the valve-heater winding of the transformer, as shown, or from the rectifier-heater winding, when this is provided.

circuit is shown in Fig. 2, where it will be seen that half-wave rectification is employed. This suffers from precisely the same disadvantages as does half-wave rectification using a valve, the chief of these being that smoothing is less easily carried out than when full-wave rectification is employed. The most important advantage that may be found in this system arises when a particular rectifier is suitable for an easily obtainable transformer, and when the resultant output is just correct for the receiver being designed. There is, of course, the further advantage of simplicity and the need for few condensers. To compensate for the voltage drop across the rectifier, the transformer must supply a higher voltage than that which is required as D.C. output. In the example shown in Fig. 2, the output is taken as being in the region of 225 volts (before smoothing) at 100 mA, whilst the required output from the transformer is 250 volts at 150 mA. These figures are those given by the makers for the Type H.T.17.

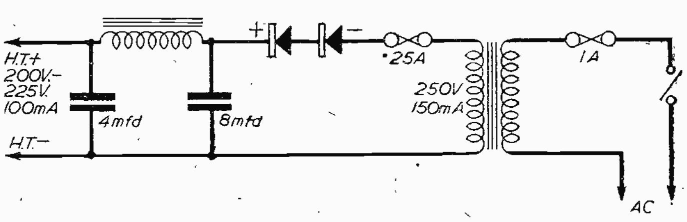


Fig. 2. — Connections for a half-wave metal rectifier, such as the Westinghouse type H.T. 17, which has an unsmoothed output of 225 volts, 100 mA.

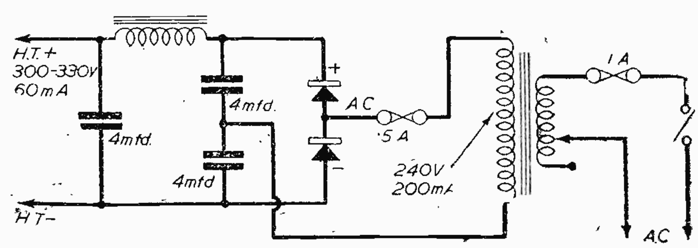


Fig. 3. — A voltage-doubler rectifier circuit using a metal rectifier such as the Westinghouse Type H.T.16, which gives an unsmoothed output of 330 volts, 60 mA.

Voltage-doubler Connections

Fig. 3 shows the connections required when using a metal rectifier in a voltage-doubler circuit, similar to that described when dealing with the supply of H.T. for battery receivers. In this case, it is assumed that a Type H.T.16 metal rectifier is used; this gives an unsmoothed output of 330 volts at 60 mA. when supplied by a transformer having an H.T. secondary rated at 240 volts, 200 mA. In this case it will be seen that the transformer voltage is less than the output voltage (because of the voltage-doubling), but that a higher current is required to produce the total output power in watts.

The voltage-doubler circuit can be considered in most respects as having the same advantages as full-wave rectification of any other form. Additional large-capacity fixed condensers are required to complete the voltage-doubler circuit, as has previously been explained in this series of articles. It is not necessary to detail the components, since the same principles apply as with the valve-rectifier circuits explained last month. It will be seen that the voltage-doubler condensers are in series across the D.C. supply, and therefore that they may have a lower working voltage than the smoothing condenser. The system of including fuses is also comparable with that referred to last month.

Alternative Outputs

It should be explained that the maximum output voltage figures are those given by the rectifiers referred to before smoothing, and therefore that the actual H.T. voltage obtained will be lower than the higher figure given. This explains why, in both Fig. 1 and Fig. 2, a range of voltage output is indicated. Only two rectifiers have been referred to, but there is a fairly wide range of Westinghouse metal rectifiers suitable for H.T. supply; consequently, it is possible to obtain one suitable for most needs. Additionally, of course, the H.T. output can be varied by using different mains transformers, as long as the voltage is not greater than that specified in the makers' instructions as suitable for the maximum output. An indication of the "regulation" provided can be gained from the fact that the voltage at half-current load from the H.T.16 is 515, and from the H.T.17 350 volts. These compare with full-load voltage figures of 330 and 225 respectively.

A.C./D.C. Power Supply

The power-supply system for A.C./D.C. receivers is, as might be expected, a compromise. A rectifier is required for use as such when an A.C. supply is connected, but this acts simply as a series resistor when the receiver is fed from D.C. The heater circuits are wired in series and are fed directly from A.C. or D.C. according to the nature of the supply. We may consider the L.T. arrangements first, and reference should be made to Fig. 4, which shows the H.T. and L.T. supply portions of a typical kind of superhet receiver. First the mains supply is taken through a pair of low-resistance H.F. chokes, which act as stoppers to any H.F. which may be superimposed on the D.C. supply. Across the "receiver" end of these is a .01 mfd. fixed condenser rated at not less than 300 volts working (to give a fair margin of safety) which also acts as a "suppressor" of mains-borne interference in conjunction with the chokes.

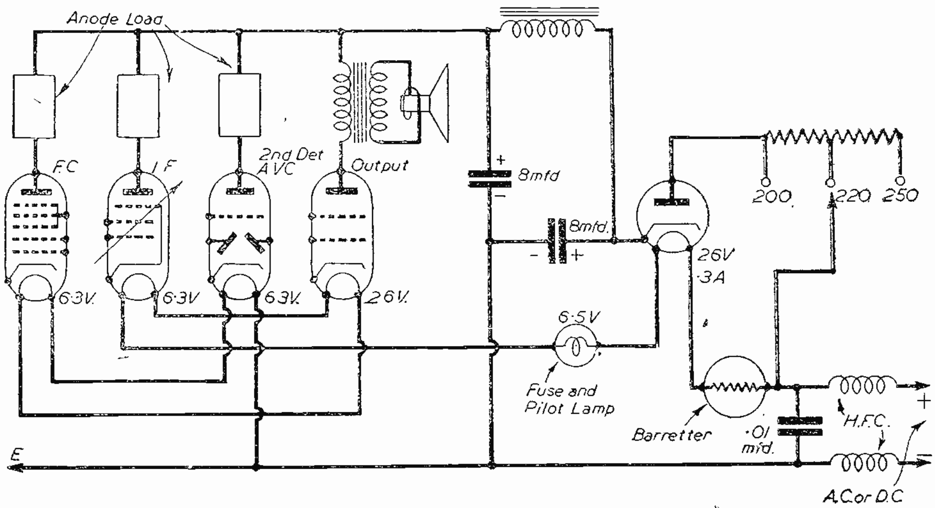


Fig. 4.—This skeleton circuit shows the arrangement of the heater wiring and rectifier connections in a typical superhet receiver of the AC/DC type. The tapped resistor in the anode crcuit of the rectifier is not always necessary, and the combined break-circuit fuse and pilot lamp is an optional fitting.

From the positive supply side (when using D.C. mains) the circuit is through a barretter or dropping resistor, and then through each of the valve heaters back to the negative side of the supply. In the circuit shown a 6.5 volt lamp, of special type and designed to carry the same current as the valve heaters, is included in series to act as a fuse and also as a pilot lamp or scale-illuminating lamp. This is optional but if used must be of a type specially made for this purpose.

L.T. Voltage Control

It may be explained here that the barretter is a special form of resistance lamp which has the property of varying in resistance according to the voltage applied across it. Because of this, it maintains the current constant over a range of voltages.

The reader may be surprised to observe that the heaters are not wired in "circuit sequence," the wiring going first to the rectifier, then to the variable-mu pentode used as I.F. amplifier, to the output tetrode, the frequency-changer and finally to the double-diode triode. The object in planning the "route" is to reduce to the greatest possible extent the voltage existing between the heaters and cathodes of all the valves. If this voltage were very high there may be a danger of insulation breakdown between the two electrodes.

The cathode of the rectifier is at full mains positive potential, if we ignore the voltage drop across the valve, and in the circuit taken as an example it is assumed that the L.F. valve takes a maximum bias voltage of, say, 20. It will be remembered that when using cathode bias the cathode is raised to a positive potential in relation to the grid, and in relation to the earth line.

In order to decide on the choice of the barretter it is first necessary to add together the voltages of all the heaters in series—and they must, of course, all be rated at the same current—and to subtract this from the mains voltage. The first three heaters each drop 6.3 volts, the fourth 26, the pilot lamp 6.5 and the rectifier 26. Adding these together we get 77.5 volts, and if we assume a mains voltage of 230 we see that the barretter has to drop 152.5 volts. Since the mains voltage may vary between, say, 200 and 250 volts, the barretter must cover the range of 122.5 to 172.5 volts. Assuming that all the valves are rated at .3 amp., we could easily find from valve-makers' catalogues that the Osram type 302, to take one example, would suit our requirements, since it has a range of 112 to 195 volts at .3 amp.

Valve-heater Current

If the valves had .2 amp. or .18 amp. heaters a different type of barretter would be required. Alternatively, use could be made of a tapped resistor of suitable value for dropping the "surplus" voltage. That is far less convenient, however, and does not provide the same safeguard against mistakes in making mains connections, as does the barretter. A barretter is always desirable in a receiver of the type under discussion, and is not costly, while having a long life. Most barretters, it should be explained in passing, have a screw cap base of the type often found on high-wattage electric lamps and described as an E.S. fitting.

It will be seen in Fig. 4 that a tapped resistor is shown in series with the mains lead to the anode of the rectifying valve. Normally, this is not required, but it may be necessary in some instances if the maximum anode voltage of the output valve is less than the rectifier supplies at full mains voltage. The value of the resistor is found by dividing the voltage to be dropped by the total H.T. current in amps.

ITEMS OF INTEREST

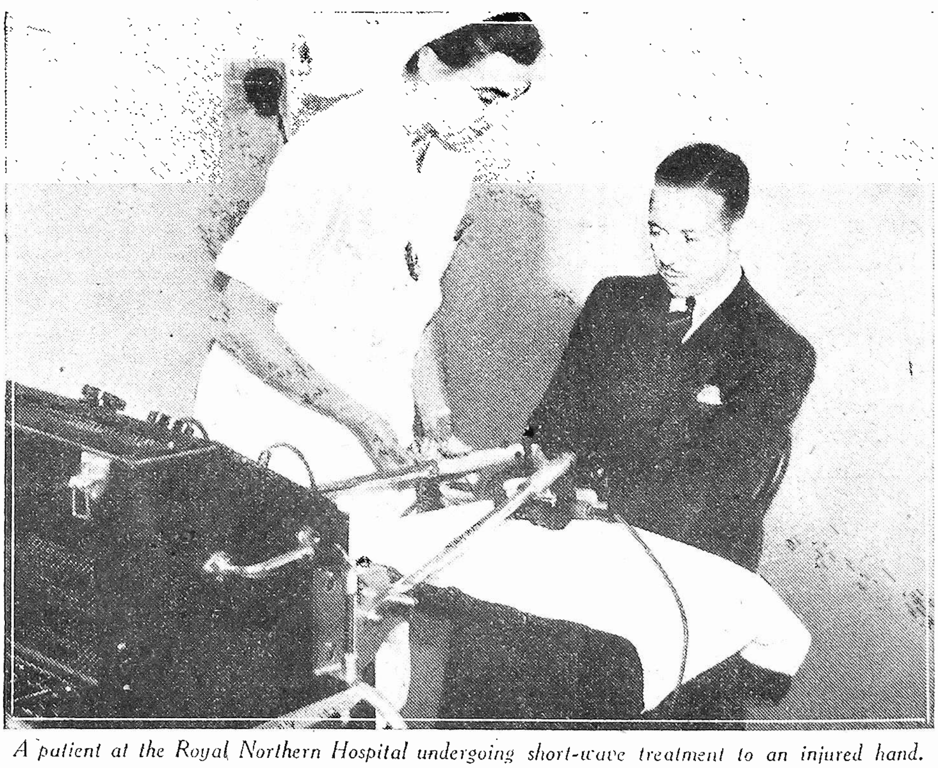
Records for Teaching Marine Engineers

IN training men for engine rooms in United States ships, recordings are now being made at sea of the characteristic sounds in internal combustion engines, effects of faulty valves, etc. These recordings can then be brought back to the classrooms on land, amplified to corresponding loudness, and played for the budding engineers, enabling them to hear actual sounds of engines running normally and engines in difficulties—while the instructors point out the significant sounds that the trained engineer strains his ear for.

Radio Sets as Weapons of War

"RADIO receivers, which look so innocent, are no mere luxuries—they are one of the most merciless weapons of modern warfare," said J. S. Knowlson, president, addressing the Radio Manufacturers' Association at Chicago recently.

"The statistics of our own country reveal the terrific importance of radio in the dissemination of news and the forming of public opinion. The 50,000,000 sets in operation show the tremendous hold that radio has."



A patient at the Royal Northern Hospital undergoing short-wave treatment to an injured hand.

B.L.D.L.C. The British Long-Distance Listeners' Club

Group Working

WHILST there are fresh avenues to explore when one is interested in radio, the problem which is arising amongst our correspondents is which one to take. Many are barred to the beginners, or those who have yet to complete their installation, because of lack of suitable apparatus and equipment. By this we also mean testing gear, therefore their experimental work has to be of a more simple, though not necessarily less interesting, nature.

One of our readers of many years' standing has been thinking over this long evening problem, and has been good enough to let us have his suggestion. He thinks that many interesting and instructive hours could be spent on matters relating to coils, and, bearing in mind the present shortage of such components, he suggests that no time like the present could be better for enthusiasts to start constructing various types and sizes of medium, dual-range and S.W. coils, provided we published sufficient constructional and theoretical details to form the basis of such work. We are of the opinion that the proposition is very sound, and in our next issue it is hoped that the desired article will be included.

There must be many members who have compiled some useful data on such matters, and we suggest that they continue the good work during this winter, *but* instead of keeping all the information to themselves, they pass it along to Headquarters, so that through this page all members may share in the experiences and knowledge they have gained. This brings us to the title at the top of this column, Group Working. We have had so many examples already of what can be lost by working by oneself, that we wish to encourage members in the various districts to get together more and, even if it is not feasible to carry out experimental work together, at least discuss the results of individual tests, compare notes and swap experiences, hints and tips, etc., so that the maximum interest and work is obtained. The subject matter suggested, namely, coils, is ideal for such an arrangement, as members could each undertake to take a certain line of research before the next meeting, and if careful notes are made, such meetings should be highly instructive and appreciated by all taking part. Well, as usual, we want your views and suggestions, so fill in one of the long evenings by writing us a letter.

What Do You Say?

WE have received a long and very interesting letter from Member 6,960, who is putting in some excellent work with the Air Force Cadets. We are unable to print all of his letter, but there's one part which we feel all members should have a chance of reading, and that is this:

"I should like to make one very big suggestion, that is to change the name of the club. I expect I shall be shouted down, but still there is no harm in asking, is there? My reasons are these: The present name is far too long, it is rather a big mouthful you will agree and also a bit of a tongue-twister. I think that a title like R.A.C. (Radio Amateurs' Club) or something on similar lines would be better; still, I am only one out of thousands of B.L.D.L.C. members.

"Lastly, I should like to correspond with a member about my own age (16 years) who is interested in S.W. radio and general wireless work, here or overseas.

"Has any reader got November and December, 1940, issues of PRACTICAL WIRELESS, please, that I can buy?"

This member's Q.R.A. is 67, Lichfield Road, Bloxwich, Walsall, Staffs.

Station Details

A NEW Member, 6,993, of Monmouth, sends us some details he has received from the G.E.C. concerning their latest station WGEO, so here they are:

"The G.E.C. of Schenectady state that the new 100,000-watt WGEO is scheduled to go into operation late in August. The remarkable increase in the station's effective power is due to the use of special directional antennas designed by Dr. E. F. W. Alexanderson. Also their transmitter KGEI in San Francisco has been re-styled and incorporating like WGEA two of the newly designed vacuum tubes.

"The transmitter is now located at Belmont, California. Studio is situated in San Francisco's Fairmont Hotel, occupying 3,000 feet of floor space."

Complete Logging

WE print this letter from Member 6,845, of Littlecroft, Hawley Road, Littlehampton, Sussex, because it shows that another member is carrying out the method we have so often advised, namely, making one's log complete in all essential details. You can see for yourselves what we mean, by reading his letter:

"Besides having taken up Morse seriously, I have recently begun to keep a daily log of reception conditions from all the five continents, noting down details of wind, clouds, age of moon and times of its rise and set. This gives me a fair indication of the best times and conditions under which countries that I may wish to receive may be logged. The only continent which I fail to receive regularly is Australasia. But considering that the RX used is only an o-v-pentode with an E-W "inverted L" antennæ, 20ft. high and 49ft. long in all, this is not surprising. I would like to get in touch with anyone about my own age (16½) interested in S.W. listening."

A Good Installation

MEMBER 6,950, of Wolverhampton, in his first letter to us, gives a good account of his den, so we hope that in his next letter he will be able to tell us of some of the results he obtains with his R.X's.

"Here is a short description of my rig. For my den I have taken over the spare bedroom, this being ideal as it is dry and near to my aerials.

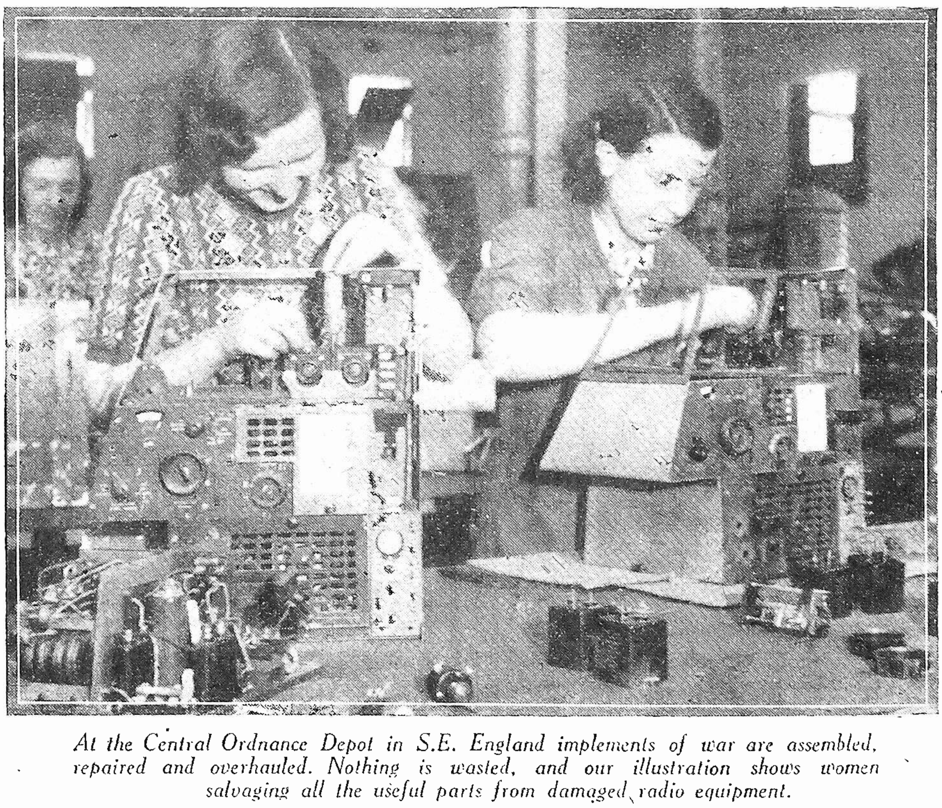
"The rig contains 3 R.X's and a 2½-watt class B amplifier, which I use for reproducing gramophone records and home broadcasting. One R.X. is a triode version of "P.W." Long Range Single Valve, which, when coupled to my amplifier, gives me all the volume I want.

"The other two R.X's are short-wavers, one being a Premier 2-valve de luxe kit using an S.G. det., transformer coupled to a pentode output.

"The remaining R.X. is a standard baseboard 2-valver, being a triode detector R.C. coupled to triode power as output. All power for the S.W. sets is taken from batteries, but high tension for my amplifier is taken from an eliminator. My aerial system is a 50ft. inverted L aerial 40ft. high. I also have a 7ft. copper tube 50ft. high.

"Is it still possible to obtain the B.L.D.L.C. membership badge?"

(Hon. Sec.: Yes, club badges are still available at 1s. each.)



At the Central Ordnance Depot in S.E. England implements of war are assembled, repaired and overhauled. Nothing is wasted, and our illustration shows women salvaging all the useful parts from damaged radio equipment.

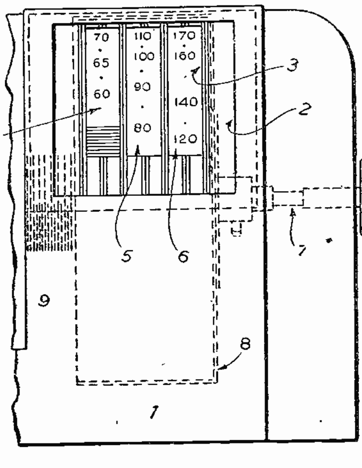
A Compact Tuning Indicator

A Novel System Especially Suitable for Midget Receivers

THE present trend in the design of radio receivers is toward so-called "table model" and "midget sets." Electrical research is in advance of this trend and, it may be said generally, substantially the only factor inhibiting the achievement of the ultimate in compactness is the necessity of providing a readily readable tuning indicator.

The object of this article is to describe some embodiments of an indicator which is more compact than the usual indicator, yet employs the same spacing and size of indicia.

This is achieved by dividing each main waveband into a number of discrete sub-bands, each of which is allotted to a given range of movement of the tuning shaft, and by providing a separate cursor for each segmental scale and moving each cursor into indicating relation with its particular scale only when the receiver is being tuned through that particular scale of wavelengths.



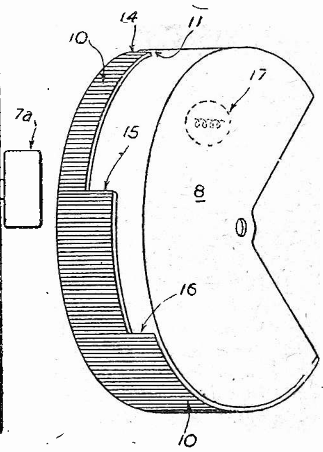


Fig. 1.—A corner of a cabinet, showing the new tuning indicator. Fig. 2.—(Right) A hollow drum segment.

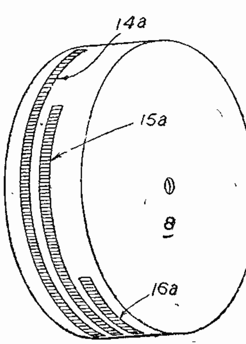
Separate Scales

For example, if the medium waveband is represented normally by a scale 6ins. long, the 6in. scale may be replaced by three discrete 2in. scales each provided with a separate cursor.

Referring to Fig. 1, the cabinet 1 is provided with an opening 2, in the rounded upper front edge, containing a transparent or translucent scale-bearing window 3. Three parallel scales 4, 5 and 6, are provided, each one covering 60 degrees of rotation of the tuning condenser 9 and the indicia on the scales are arranged in sequence. A hollow drum segment 8, shown in Fig. 2, is mounted on the control shaft 7 and behind the window 3.

A coloured band of paper, 10, is fixed to the cylindrical surface of the drum and extends over 180 degrees. The drum itself extends 240 degrees about its shaft, and the 60 degrees end segment 11 of its surface will thus be blank. Cursor lines for the separate scales 4, 5 and 6 comprise the horizontal edges 14, 15 and 16 of the coloured paper, and may be formed by cutting the single sheet 10 in the stepped formation shown in Fig. 2. Alternatively, as shown in Fig. 3, the cursor lines may comprise the horizontal transverse edges of the separate ribbons 14a, 15a, 16a. A dial lamp 17 may be provided.

When the knob 7a on the end of the tuning shaft 7 is turned to bring the blank section 11 in register with the scale section 14, the horizontal cursor line 14 will appear at the bottom of that scale. Movement of the knob 7a in a clockwise direction to alter the tuning of the condenser 9 will cause this cursor line 14 to move upwards on its scale, the other cursor lines (15 and 16) being concealed the while beneath the lower edge of the window 3. Continued movement of the knob 7a, shaft 7, condenser 9 and drum 8 will cause the cursor line 14 to entirely sweep the scale and to disappear from view behind the top edge



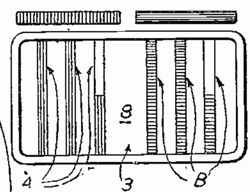


Fig. 3.—(Left) Alternative indicating drum. Fig. 4.—(Above) Another method of arranging the segmental scales.

of the window, at which instant the cursor line 15 appears at the bottom of its scale 5. Similarly, when the line 15 has completed its movement over its scale, the third cursor line 16 appears at the bottom of the third scale 6 and travels upwards thereover upon continued rotation of the knob 7a.

For Multiband Sets

Referring to Fig. 4, when this arrangement is applied to two-band or to multiband sets, the drum 8 and the scale surface 3 may be made wide enough to accommodate a plurality of groups, A and B respectively, of segmental scales, in which case the usual provision may be made for selectively illuminating these separate "band scales." Instead of using a drum the cursors may be mounted directly on the control shaft 7, as shown in Fig. 5.

An embodiment of the idea which utilises a plane dial with concentric scale segments A_1 A_2 is shown in Figs. 6-7. The cursors comprise annular strips 14, 15, suitably disposed on a disc 20 that is secured to the control spindle 7.

Upon rotation of the control knob 7a the transverse edges 14c and 15c of the strips 14, 15, sweep the scales A_1 A_2 in sequence in the manner already described with reference to Figs. 1-5.

In order that the whole dial surface can be utilised for imparting information, the scales A_1 A_2 may be duplicated at B_1 B_2, and additional cursors 14d and 15d provided respectively for scales B_1 and B_2. The A group of scales, for example, may indicate the tuning in kilocycles, while the B group indicates in wavelengths.

This system was developed in the laboratories of the Radio Corporation of America.

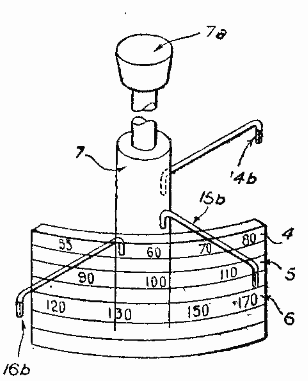
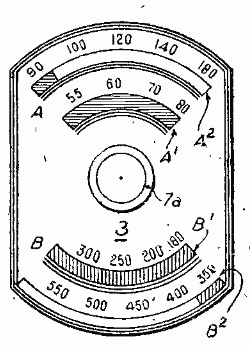
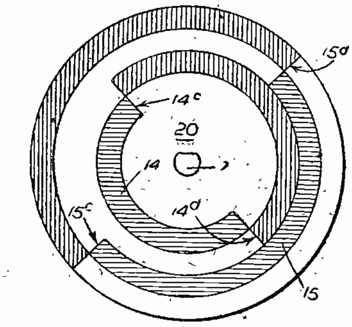


Fig. 5.—Cursors mounted on the control shaft.





Figs. 6 and 7.—Plain dials with concentric segments.

Personal Paragraphs

The Ministry of Supply announced recently that **Mr. Carleton L. Dyer** had been appointed Director of Tank Materials and Construction. Mr. Dyer was for many years managing director of the Philco Radio and Television Corporation (G.B.), Ltd.

* * *

It was announced recently by Messrs. Wright and Weaire, Ltd., that **R. H. Fox** and **R. W. Merrick** have been appointed to the board of directors. Both have been in the service of the company for many years. Mr. Fox will be works director and Mr. Merrick, sales director.

* * *

Mr. R. Milburne Wright, whose sudden death was announced recently, was one of Bush Radio's best-known representatives, and had been with the company since its inception.

* * *

Mr. Arthur Chamberlain, whose death was recently announced by the G.E.C., joined the board in 1918, having been associated with the firm of Chamberlain and Hookham, Ltd., Birmingham, which was absorbed by the G.E.C. at that time.

Comment, Chat and Criticism

Music as a Language

How it Can Be Better Understood and Appreciated

By Our Music Critic, MAURICE REEVE

IT is a regrettably, often-heard comment, after "classical," or so-called "high-brow," music has been listened to, that it is "beyond" the person who heard it. "I'm afraid it leaves me cold"; "It doesn't seem to contain anything that one can get hold of"; "There doesn't seem to be any tune in it," are the types of remark made by the "unmusical" when forced to listen to good music.

Let us examine some of the reasons for this unfortunate state of affairs—a state which is the cause of many of our empty or half-empty concert halls—and see if we can do something to stimulate at least a desire to put the matter right. For that is really all that is really wrong; a mistaken attitude, and a wrong approach to the music. These good people either look for something that is not there, and never was intended to be there, or they completely miss what is there. Or both. Just as we don't expect to find a cathedral when we look at a block of flats, or to hear a farce played when we go to a tragedy at the theatre, so must we not expect to find a number of ingredients in a musical work which can only be found in works belonging to a totally different genre. "Get to know your man" is a text which is as applicable in music as in anything else.

Four Important Points

I should say that there are four main reasons why the major works of music seem so formidable and indigestible to so many people. And for the purposes of this short essay I will define them broadly as follows:

1. Their length.
2. The "thickness" and complexity of their texture.
3. The employment of "themes" rather than "melodies."
4. Their psychology, or character.

Let us briefly deal with each in turn.

1. The first two of the four points just mentioned unquestionably form the great barrier to the appreciation and understanding of classical music by thousands of people who are sufficiently cultured and sensitive to patronise many of the other arts. I don't think there is a symphony that takes less than half an hour to perform, or, Mozart and Haydn excepted, a work of chamber music or a concerto. This, it must be admitted, is "quite a mouthful," if the listener knows little or nothing of the language of music, or of the principles on which a work of this kind is built up (part of the same thing). We wouldn't expect them to listen for anything from 30 to 45 minutes to a diatribe in French or German if they hadn't learned so much as to say "yes, please," or "no, thank you" in those languages, even if we, understanding them, knew that the said diatribe was marvellously romantic, thrilling, exciting, or what not.

Form and Construction

This brings us to the vitally important question of form and construction. If we can get to know how the work is going to unfold, then we shall follow that unfolding with absorbed interest. With practice in the art of listening we shall grow to anticipate each feature as it is due to appear, at the same time as we shall experience the thrill of pleasure when a composer of genius varies the form or introduces new elements. At the same time we shall grow to retain a memory of them as they pass, thus being able to link them all up into their connected whole for retrospective contemplation.

2. A composer with any pretensions to greatness takes an especial delight in weaving long chains of sounds—chords and themes, sometimes so small as to be mere figures going round and round and in and out; sometimes a mere embroidery for the main themes, and at others just for their own sakes, but all of it giving delight to those who appreciate "harmony," "counterpoint," "fugue," and the other things which go to make up the texture of a work of large proportions.

Resolutions which are "postponed" for so long that we forget whether they have actually passed us by. "Voices" running in the closest co-operation with each other, or rivalling one another in importance and fighting a sort of war for supremacy; all these things and many more—each one a study in itself—go to make the thrill and excitement which he who understands the language of music finds in a Bach organ toccata and fugue, or a Beethoven first movement. All of which is missed completely when all you look for in a piece of music is "something to cotton on to"—a simple, catchy melody with a tum-tum accompaniment.

Melody and Theme

3. This is rather a vexed question, but I don't think it plays an unimportant part in determining the attitude of many people towards "classical" music.

The difference between a melody and a theme might be defined by saying that the former is complete whereas the latter is not. A first-class theme, such as all the great symphonists use as their "subjects" (see Beethoven's fifth, Tschaikowsky's fifth, Dvorak's New World, and hosts of others), invariably begins with magnificent determination and paces down with swaggering stride. But just as we expect the "full stop" and imagine we shall say "By jove, that's a wonderful melody," so does it fade away or tail off, leaving no impression behindof its having any definite ending. It hasn't. What really happens is that it merges off into those features I pointed out in the previous paragraph: embroidery, harmonic passages, counterpoint, etc., according to what the form and the character of the work dictate.

For those who cannot or do not want to treat the work as a whole, this is bound to leave a feeling behind of considerable dissatisfaction. A "melody" is the complete opposite, and it is not surprising that we find the most famous melodies in short works, and most notably in songs, where they are governed by the verse to which they are set. Schubert, the king of song writers, uses a type of theme in his symphonies much more akin in character to a melody than, say, Beethoven or Brahms do, because, I have no doubt, he was more lyrical and less symphonic in character and temperament.

A symphonic slow movement, and frequently a finale, is built up on melodies rather than themes, because they are much more lyrical in character than the first movements which are, by the way, the movements from which symphonies really derive the whole of their being. A study of the slow movements of the symphonies just mentioned will show this very clearly.

Highbrow Music

4. "Highbrow" music is rendered difficult of comprehension by reason of its having been created with a set purpose in mind. The psychology of music is hard to appreciate until one can get to grips with its various components. Even when the listener is as familiarly versed in tones as he may be with words, he still has to cling on to every note as it is played. He must, in fact, be a most tenacious listener if the profundities of Brahms or the contrapuntal manœuvrings of Bach are to be relished to their fullest extent.

In short, serious music must be listened to seriously—you cannot lean back as with salon music and just wait for the catchy tunes and rhythms to come along. A symphony takes anything from one to two years to complete, an intensity of labour and mental concentration that few probably realise.

With the help of some study with someone who can sympathetically nurse the development of one's understanding of these various components, the language of music is within the reach of thousands who, to-day, hardly consider themselves capable of ever being able to appreciate the difference between A and B.

Sound Pictures

How this marvellous language—the only true and universal tongue ever likely to be invented on this planet—can, in the hands of a master tone poet, be made to express all the depths of human feeling as completely as Shakespeare or Scott did in English or Hugo and Balzac in French, must form the subject of another article. Also, how it is used in the fashioning of "sound pictures," of which men like Debussy and Ravel were such masters. It is very simple to strike a clump of notes at the bottom of the piano and call it a clap of thunder or a train smash, to glissando down the black keys and say it represents a gush of water, or to play a large number of notes in the top register, very rapidly, and claim it to be a representation of rain-drops. Those are imitations, not sound pictures.

As a tone poet, a musician creates an impression of, say, "the afternoon of a faun" or "clouds" (Debussy), "the fountains of Rome" (Respighi), or "Tintagel" (Bax) every bit as vivid and life-like as painter or poet could. The great difference is that, being something akin to abstract, we must, with music, first of all be told what the picture is supposed to represent.

ELIMINATING HUM IN THE RADIOGRAM

THE average home-built radiogram has a disappointingly high hum level, whether built as a complete radiogram in the first place, or whether built by uniting a pick-up and gramophone motor with an existing chassis.

It should not be overlooked that where mains hum is exactly the same on gramophone and radio, it will appear that the mains hum is worse on the gramophone, due to the soft passages met with on gramophone records, which, dropping down to a volume level approaching that of the hum, naturally tend to accentuate the presence of the latter. Where the smoothing arrangements are such that the hum level, while being the same on radio and gramophone, is objectionable, the usual steps must be taken to increase the efficiency of the smoothing arrangement, a subject which has already received so much attention in these columns that it would be redundant to include it here. On the other hand, when a noticeable increase in hum is apparent when switching to gramophone, very simple steps can be taken to overcome the trouble. In the first place, it is impossible to over-emphasise the necessity of earthing the pick-up arm, and for screening the pick-up leads and properly earthing such screening. Most pick-ups are provided with an earth terminal, but unfortunately in several makes this earth terminal is not in proper metallic connection with the whole arm. This state of affairs arises in those designs where the tone arm is in two pieces, earthing of one piece relying entirely on contact through some swivel or rocker which, while mechanically sound, is electrically indifferent. The remedy is, of course, to earth the odd pieces together, so that the earth terminal provided is in metallic contact with the whole structure. There are usually a number of screws in various parts of a pick-up terminal, and it is not difficult to link them together with flexible wire. Many metal pick-up arms are finished in black or brown "lacquer," and care should be taken to see that earthing is accomplished to pure metal, the lacquer having been carefully scraped away for the purpose.

Screening

For screening pick-up leads almost any screen wire is suitable, provided that it is reasonably dense, but it is necessary to take more care in earthing the screening than would be imagined necessary. In the absence of a metal band going right round the screen tubing, it is suggested that one inch of the screening be unplaited and twisted together, and the earthing wire affixed by soldering.

The very position of the gramophone motor and pick-up causes the leads to these two components to be more or less parallel, and for this reason it is desirable, and is, in fact, general commercial practice to screen the mains leading to the gramophone motor for about two feet of their length, starting, of course, close up to the motor. The electric motor frame will certainly have an earthing terminal on it, which should be duly earthed, and if the motor board is metal this should also be earthed.

It is not satisfactory to take a single wire connected in turn at the points above mentioned, and finishing at the earth terminal, the most efficient and convenient arrangement being one wire earthing the motor and motor board, and a separate wire earthing the tone arm and pick-up leads. Reversal of the pick-up leads should be tried, as in certain types of pick-up, one particular way round will tend to induce less hum.

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

A Reader's Activities

SIR,—Although I am serving in the R.A.F., I still find time to keep in touch with my radio clubs. I am glad to see that the B.L.D.L.C. and R.S.G.B., of which I am a member, are still keeping the "Ham Fraternity" going strong. I should like to correspond with any other short-wave enthusiast. Here are a few details on my activities during the past six months. I have added a new RX and preselector to my gear. The RX being a five-valve set, the valves being 6Q7, 6F6, 6K7G, 6V6G and 5Y3G. The preselector is a 6J7G regenerative. In addition, during leave periods I have built a vibrator delivering 110 volt, 50 cycles, 70 watts A.C., with a 6-volt input. I am now going to construct a D.C. model for working my battery four-valve set. I also have a pick-up fitted on to an old Columbia motor gramophone. I have not had time for a lot of DXing since the war, but before that time I received 70 countries. I have a four-pin plug in the A.C. main RX for supplying power for the preselector. Also this plug is used for battery supply for emergency use. In addition, I have a four-valve RX built from circuits published in PRACTICAL WIRELESS.—G. C. A. ZEDY, 6, Norfolk Park Cottages, Maidenhead, Berks.

Good Listening

SIR,—After a long period of forced abstemiousness I have at last managed to sit on a receiver and do a few listening hours. The following were heard on 7 mc/s, all C.W., between 00.01-06.00 B.S.T. recently:

W1, 2, 3, 4, 5, 8, 9; NY1AC; CM2MG; PY4FN; K5AY; CM2DL; K4H5V; PY2LK.

I am hoping to get a few real DXers if conditions hold out O.K. I am a wireless operator in the R.A.F., but am hoping to get remustered to radio mech.—T. H. PLATER (Leicester).

Crystal Reception: Reversed Valves

SIR,—I was glad to see P. Ryan's remarks in the October issue about crystal reception, as I am particularly interested in this subject. Incidentally, the first "Ham" I heard was on a crystal set. It was a G. on 40 m. about 20 miles distant. I recommend P. Ryan to use a large skeleton coil, such as described in PRACTICAL WIRELESS a while ago.

Regarding J. Lockhead's query about "Reversed Valves," it is possible to obtain reaction with some of these circuits, which should help him. The pentode one will oscillate with normal coil and condenser and only 4 volts H.T.!

I think it would be helpful if readers sent in details of any new transmissions they heard, particularly for listeners whose time is limited. What has happened to the English broadcasts from Brazzaville (25 m.) and ZOY (49 m.) at 19.45 and 19.15 respectively?

I trust B.L.D.L.C. member 6,416 has not made a mistake when he puts W9GUI and W9GUY in his log-book.—F. RAYER (Longdon).

"P.W." One-valver

SIR,—Here is a short description of my den, which is in the corner of my bedroom at the front of the house. This means I have to use an indoor antennæ, but I hope to erect an outdoor one later on. The set I am using at present is the "P.W." simple one-valver, with a power valve as a second stage. This is the most efficient set I have yet built, and it is fed with an A.C. H.T. unit.

At present I am making a battery-operated amplifier.—PHILIP BOGGIS (Mytholmroyd).

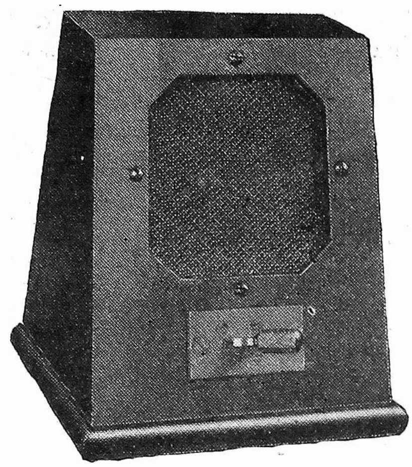
Re "Admiral" A.C./D.C. All-dry Receiver

SIR,—With reference to the query of Mr. Lewis J. Martin, of Walton-on-Thames, in your August issue, I would suggest that the following information may help him. As the set is an American A.C./D.C. All-dry, I deduce that it is highly probable that the circuit employs 1.4v. filament valves, which are wired in series. Now when used on A.C./D.C. mains, the rectifier valve brought into play is probably a 2526G. octal, which requires 25 volts on the filament. The line cord drops the required voltage for this valve's filaments *only* for reasons given further, but there should be either a tap off this line cord, or else a subsidiary series resistor inside the set that taps off about 110 volts on to the plates (tied together) of this rectifier (25Z69). Now the D.C. output of this rectifier serves two purposes, by way of one rectifier cathode element supplying *L.T.* voltages for the filaments of the 1.4 volt. valves via a series voltage-dropping resistor between this cathode and the filaments. The other cathode output element supplies through a further series resistor the H.T. voltages proper for the set. Therefore, I suggest that when the set is used on 110 volt D.C. ship's mains, that there be a check made to ensure that somewhere a series resistor drops the appropriate voltage to the filament of the 2526 rectifier; also the usual potential on the rectifier plates (tied together) is 110 volts in American circuits. The D.C. voltage feeds from the terminals of both cathodes are dropped the requisite amount by measuring across the 1.4 volt filaments of the set valves. Also across the H.T. potential terminals of these valves.

Hoping these suggestions may help Mr. Martin.—R. SKELTON (Leytonstone).

NEW G.E.C. MICROPHONE

THE General Electric Co., Ltd., have recently introduced a new microphone designed for message-broadcast centres, announcing systems, etc. It is an instrument of the moving-coil type mounted



The new G.E.C. moving-coil microphone in a sloping cabinet.

in a hardwood desk pattern cabinet measuring 6¼in. high, 5⅝in. wide and with a base depth of 4½in., and is fitted with a double-pole key and an internal terminal strip for connection purposes.

Since the microphone coil is of low impedance (15 ohms) a relatively long transmission line may be used between the control and amplifier without deleterious effect on the frequency response and with a minimum of noise pick-up. The sensitivity is 65 decibels below 1 volt R.M.S. at 1,000 cycles.

It is to be noted that where announcing systems require remote switching for control of the amplifier, or the remote selection of speech lines, a switchbox of similar design and appearance to the standard BCS. 2282 model can be supplied to order. This embodies additional control keys and signalling lamps according to individual requirements.

Prize Problems

Problem No. 425

WILSON bought an eliminator for supplying H.T. to his S.G.3 receiver, but found that it was not provided with an S.G. screen tapping. What method should be adopted for supplying the screen? Three books will be awarded for the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 425 in the top left-hand corner, and be posted to reach this office not later than the first post on Monday, October 13th, 1941.

Solution to Problem No. 424

G. and G.B. terminals of the L.F. transformer should be connected to the grid terminals of the push-pull valves. Two 250,000 ohms resistances should be obtained, one being connected to the G terminal and the other to the G.B. terminal. The free ends of the two resistances should then be joined together and connected to G.B.— lead.

The following three readers successfully solved Problem No. 423 and books have accordingly been forwarded to them: J. R. Brown, 2, Windsor Terrace, Windsor Bridge, Salford, Lancs; K. Cook, 159, The Harebreaks, Watford, Herts; L. A. C. Stark, 336, Lever Edge Lane, Bolton, Lancs.

Replies to Queries

Rattling of Transformer Laminations

"I would be glad of your assistance with two problems: (a) My family 5-valve A.C. superhet receiver is sensitive to variations in mains pressure. At certain times of day, mains voltage rises and causes rattling of laminations in the mains transformer and there seems to be no effective way of eliminating the annoyance by tightening the transformer. To make listening bearable I have taken the mains lead from 230-volt to 250-volt tapping. The trouble is thereby avoided at a slight reduction of volume; however, will you please inform me whether such action will ultimately have a detrimental effect by possibly under-running the valves? If the valves will suffer, is it practicable to make some sort of compromise by continuing to use the appropriate 230-volt tapping, and employing a variable resistor to just reduce the input sufficiently to keep the set working below the overload point? Would you please indicate the particulars of the resistor needed?

"(b) My 'experimental' A.C./D.C. 5-valve superhet receiver is not behaving normally. Using a good outside aerial, the set produces oscillation whistles on all short and medium wave stations. Using a very short (5ft.) indoor aerial it behaves more reasonably. On long waves on either aerial can satisfactory reception be obtained—there is a background of what sounds like medium-wave transmissions, and no long-wave station comes in well. Reception generally is on the 'thin' side as regards quality—even on the loud B.B.C. transmissions. I would be pleased if you could indicate any adjustments calculated to improve matters. Being an A.C./D.C. set, there is no provision for earthing the chassis. I am at present working on A.C. Would it be permissible to earth the chassis via a 4 mfd. condenser?"—G. E. Anderson (Dewsbury).

USING the higher tapping on the transformer will not have any detrimental effect, but we would rather suggest that careful attention be given to the mains transformer, as it is usually possible to clamp laminations sufficiently tight to prevent the trouble mentioned. If it is not possible, owing to limitations of the tightening clamps, to exert greater pressure on the laminations, a cure can often be obtained by loosening clamps, inserting a suitable thickness of tin or other metal plate, and then tightening again.

The trouble with the set appears to be due to faulty alignment of the tuned circuits, especially the I.F. transformers, and the lack of pre-detector selectivity. An earth connection could be obtained via a 500 v. test 0.1 mfd. condenser.

Converting an Eliminator

"I am proposing altering a D.C. H.T. eliminator for use on A.C. mains. The unit concerned consists of a choke, with suitable condensers, and a lamp as resistance. The output was stated to be 100 volts 210 m.a. on a 250-volt D.C. mains, and worked satisfactorily.

"Could you please advise me what suitable type of rectifier would be required, also what the output of the mains transformer should be? The mains here is 200-240 A.C."—Edwin C. Deavin (Wilmington).

YOU do not state what output you require from the mains unit, therefore it is rather difficult for us to specify any particular rectifier. We would suggest, however, that you use one of the Westinghouse metal rectifiers. Their model H.T.16 is capable of supplying 240 volts D.C. at 200 milliamps when used in a voltage-doubler circuit, and we think that this would suit the unit mentioned, that is, if you still require such a large current output.

The rectifier voltage, could, of course, be reduced to any voltage(s) by means of suitable series resistances. The above firm supply a very interesting booklet, "The All-Metal Way" for a nominal charge of 6d., giving circuits, etc., of mains units.

Transformer Details

"I wish to make a transformer for my valve tester giving out voltage via 2, 4, 6, 13, and 30 volts tapping. My A.C. mains is 240 volts. Could you tell me the gauge of wire and number of turns for same? I have the book 'Coils, Chokes and Transformers.' If you could give me the full data for the transformer I would be glad."—W. J. Prince (Northwood).

THE book in question gives all the essential details concerning the winding of transformers. The number of turns required depends on area (cross-sectional) of core formed by stampings used. A table is given in the book and it is only necessary, once the figure has been selected, to multiply the voltage required by that figure. For example, if the "turns per volt" is, say, 5, then you would require 10, 20, 30, 65, and 150 turns for the voltages mentioned by you. The gauge of wire will be governed by the current required from each winding. An ordinary wire gauge table will give you such information.

Transformer Tappings for Heaters

"Could you enlighten me regarding heaters of mains receivers? For example, the majority of circuits I have noticed have centre-tapped filaments on the power transformer while others are similar to battery receivers, and have one side of heater taken to B— and E. As the mains transformer I have has not tapped windings, will it answer the same purpose if I take one side to B—, or must I have it centre-tapped? The valves are indirectly heated."—D. Dawe (Bristol).

SOME American designers adopt the method you mention, but we do not advise the connection of one side of the heater to the common negative-earth line. It is far better to use a transformer having a centre-tapped heater winding, the tap—in the case of indirectly heated valves—being connected to the common negative side of the circuit. Failing this a "humdinger," which is a small potentiometer having a value of 30 ohms, can be connected across the heater winding and its moving arm connected to the negative line. A suitable component can be obtained from Messrs. Bulgin & Co., or Premier Radio.

Building a Superhet

"I am very interested in the article in 'Practical Wireless' for July on Building a Superhet with Ordinary Components. I want to try using a 'Colvern Colpak' with band-pass to replace the two dual-wave coils as shown in Fig. 2 in this article, and also a pair of Telsen 'draw-core coils' and a H.F. pentode valve for the intermediate stage. How will this work compared with the circuit diagram Fig. 3 in the article mentioned?"—J. R. Elcock (Edgbaston).

THE satisfactory operation of your suggested layout will depend on the Colvern tuning unit employed. As we are without complete details of this, we cannot say whether it embodied a special oscillator coil. If it does not, then the circuit will not be satisfactory owing to the fact that you will not be able to obtain the desired frequency difference (i.e., I.F.) between oscillator and first detector. The Telsen coils would have to be tuned to, say, the bottom end of their long-wave section.

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.
(5) Grant interviews to querists.

A stamped, addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

Requests for Blueprints must not be enclosed with queries as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House Southampton Street, Strand, London, W.C.2. The Coupon must be enclosed with every query.

H.T. Voltage

"I have a battery-operated receiver which required 120 volts + H.T., and a tapping of 75volts, but as I have a 60 v. 30 a. storage plant I would like, for various reasons, to dispense with the dry H.T. battery. Would you please suggest a circuit for adapting the storage plant to drive my radio; as well as the lights which it does at present?"—A. J. Arnold (Wisboro' Green).

THE 60 v. supply available is not sufficient for satisfactory operation of the set and, owing to the fact that the supply is D.C., it is not possible to use a simple transformer arrangement to double its voltage.

The most satisfactory method would be to use a "rotary transformer," but as these are rather costly it would hardly be an economical proposition. You could use a "Vibrator" type of H.T. unit, by using 6 volts of the supply.

Faulty Reaction

"I recently came across a problem when I was building a modified version of the 'Fleet' Short-wave Two. When I tested the set I found that the reaction control did not work. I have a .0001 fixed condenser between anode and earth, and a .0005 reaction condenser, and Premier 4-pin coils. I also enclose the layout. Could you please inform me where the fault lies?"—E. M. Bradley (Westward Ho).

WE would advise you to examine the reaction circuit to make sure that no short circuit exists. For example, if a metal panel is used, and if the fixed vanes of the condenser are connected to anode and moving vanes to reaction winding, the H.F. currents could be earthed via the condenser spindle and panel. Check up operating voltages and anode current of each valve, and make quite sure coil connections are correct.

Short-wave Four

"Having recently built the S.W. Four, I noticed that when I went to plug the 'phones into the panel I happened to touch the metal parts of the 'phones and the panel, and had a shock. I have gone all over the wiring and there does not seem to be anything wrong. I have tried experimenting with different connections to the 'phone panel, but it makes no difference. It is just the same with the set switched off.

"The H.F. gain control does not seem to make any difference to the reception at all, no matter what position it is in.

"Finally, the reaction control only works on about a ½in. What I mean by that is that the set does not go into oscillation at all unless the reaction is turned all the way round to the right, and it will not oscillate at all under 20 metres.

"On the loudspeaker, reception has been very good and clear (only Europeans so far), with the volume turned up as far as it will go. Would you suggest that I stripped the set and wired it up again?"—D. O. Davies (Dudley).

IF you touched one of the terminals on the earpieces of the 'phones, and the metal panel, a slight shock would be felt, owing to the panel being at neg. potential and the 'phones positive. Some fault must exist in the H.F. grid coil connections, the volume control or the bias supply. Check up all these items and their associated wiring. We do not think it is necessary for you to rebuild the set. First test each section and you will soon eliminate any initial snags.

S.W. Adaptor

"I have a straight short-wave adaptor coupled on to my large A.C. set, and I find that oscillation fades out below 19 metres. I use an H.F. choke for sending its output through a .007 condenser into the aerial of the set. Can you please advise? Also, is it possible to use a microphone with the old-type spark transmitters?"—F. A. Capstick (Glasgow).

WE would advise a smaller coupling condenser: 0.007 mfds. is rather large and we think 0.0001 mfds. would be more satisfactory. The loss of oscillation below 10 metres is quite possibly due to your aerial. If you have not already inserted a variable condenser, having a capacity of, say, 0.00005 mfd. in series with it, we would suggest that you do so. The H.F. choke and valve could also be responsible.

No, the early type of spark transmitter was not suitable for speech modulation.

Photo-electric cell

"I have the fourth edition of your "Wireless Constructor's Encyclopædia," and should be very grateful if you would let me know whether I can use the photo-electric cell circuit on page 256 for the following purpose, or what alterations (if any) you could suggest.

"I must first explain that, besides being a 'wireless fan,' I work in a pathological laboratory, where I do a certain amount of calorimetric analysis. Some of the methods are cumbersome and not always accurate.

"My idea is: in order to test the density of a fluid—for instance a solution of acid hæmatin—to proceed as follows:

"(1) Rig up the circuit you mention with a very sensitive potentiometer.

"(2) Place the 60-watt lamp in a box with a slit, so that the photo-electric cell only just reacts and the circuit is closed. Then place the tube containing the fluid whose density I wish to ascertain in front of the slit, thus partially obscuring the light, and alter the resistance in the potentiometer, so that the cell works again and the circuit is closed. The amount by which the resistance has to be increased to make the relay work should then be proportional to the degree of opacity of the fluid obscuring the light, i.e., to the density of the fluid."—Noel Alder (Paignton).

YOUR scheme appears to be quite workable, although you will find it necessary to concentrate on the experimental details of it.

You seek to measure what you term the "density" of a fluid. By this we think you mean the opacity of the fluid, not its actual density in terms of mass or weight.

We can see no reason why your scheme should not be successful, but we think that you will need a red/infra-red sensitive photo-cell of small dimensions. Such an article can be obtained from the General Electric Company, Wembley, or, alternatively, you might obtain one from Messrs. Electradix Radios, Ltd. When inquiring, you should be careful to state the exact purpose for which you require the photo-cell.

The photo-cell circuit given in the "Wireless Constructor's Encyclopædia" will not suffice for your purpose. The exact circuit necessary is dependent upon the type of photo-cell employed, and the suppliers of the photo-cell will give you all the necessary information respecting such a circuit.

We would suggest that you should use a 100-watt lamp as the illuminant instead of a 60-watt lamp, since, in this case, the response of the photo-cell would be more satisfactory, and the margin of error would be less.

The coupon on page 56 must be attached to every query.

Practical Wireless
BLUEPRINT SERVICE

PRACTICAL WIRELESS

CRYSTAL SETS

	Date of Issue.	No. of Blueprint.
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set ..	27.8.38	PW94

STRAIGHT SETS. Battery Operated.

One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode) ..	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF) ..	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow) ..	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	—	PW39
Hall-Mark Three (SG, D, Pow) ..	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	—	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	—	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen) ..	—	PW61
The Tutor Three (HF Pen, D, Pen)	—	PW62
The Centaur Three (SG, D, P) ..	—	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen) ..	—	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	—	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det, Pen)	—	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	—	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	—	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve : Blueprints, 1s. each.		
Fury Four (2 SG, D, Pen) ..	—	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P) ..	—	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC)	3.9.38	PW90

Mains Operated.

Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen) ..	—	PW18
A.C.-D.C. Two (SG, Pow) ..	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each		
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D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow) ..	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen) ..	—	PW35B
Unique (HF Pen, D (Pen), Pen ..	—	PW36A
Armada Mains Three (HF Pen, D, (Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS.

Battery Sets : Blueprints, 1s. each.		
£5 Superhet (Three-valve) ..	—	PW40
F. J. Camm's 2-valve Superhet ..	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve) ..	—	PW43
D.C. £5 Superhet (Three-valve) ..	—	PW42
Universal £5 Superhet (Three valve)	—	PW44
F. J. Camm's A.C. Superhet 4 ..	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four ..	—	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model .. / Push Button 4, A.C. Mains Model	22.10.38	PW95

SHORT-WAVE SETS. Battery Operated.

One-valve : Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen) ..	—	PW68

PORTABLES.

Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen) ..	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86

MISCELLANEOUS.

Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.

Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450

STRAIGHT SETS. Battery Operated

One-valve : Blueprint, 1s.		
B.B.C. Special One-valver ..	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans) ..	—	AW388
Full-volume Two (SG det, Pen) ..	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G. 3 (SG, D, Trans) ..	—	AW412
Lucerne Ranger (SG, D, Trans) ..	—	AW422
£5 5s. Three: De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	—	WM327
Economy Pentode Three (SG, D Pen)	—	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans) ..	—	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen) ..	—	WM389
Certainty Three (SG, D, Pen) ..	—	WM393
Minitube Three (SG, D, Trans) ..	Oct. '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans) ..	—	AW370
2HF Four (2 SG, D, Pen) ..	—	AW421
Self-contained Four (SG, D, LF, Cl. B)	Aug. '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	Feb. '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen) ..	Apr. '36	WM404
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

These Blueprints are drawn full size.
Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint.* A dash before the Blueprint Number indicates that the issue is out of print.

Practical Wireless (issues dated prior to June 1st, 1940) ..	4d.	**Post Paid**
Issues dated June 1st to July 27th, 1940	5d.	**Post Paid**
(Issues dated September, 1940 and after)	7d.	**Post Paid**
Amateur Wireless	4d.	" "
Wireless Magazine	1/4	" "

The index letters which precede the Blueprint Number indicate the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine.*
Send (preferably) a postal order to cover the cost of the Blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Mains Operated.

Two-valve : Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C. ..	—	AW383
Mantovani A.C. Three (HF, Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	Jan. '36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen) ..	—	WM329
Harris' Jubilee Radiogram (HF, Pen D, LF, P)	May '35	WM386

SUPERHETS.

Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	Oct. '35	WM395
The Request All-Waver	June '36	WM407
1935 Super Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. each.		
Heptode Super Three A.C. ..	May '34	WM359
"W.M." Radiogram Super A.C. ..	—	WM366

PORTABLES.

Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two H.F. Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans) ..	—	WM367

SHORT-WAVE SETS. Battery Operated.

One-valve : Blueprints, 1s. each.		
S.W. One-valver for America ..	P.W. 15.10.38	AW429
Roma Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det, Pen)	Feb. '36	WM402
Home-made Coil Two (D, Pen) ..	—	AW440
Three-valve : Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	July '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF, Pen, D, RC, Trans) ..	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valver Short-waver (SG, D, LF, P)	P.W. 22.7.39	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super ..	—	WM397

Mains Operated.

Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	P.W. 13.1.40	AW453
"W.M." Long-wave Converter ..	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C. ..	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) ..	—	WM391

MISCELLANEOUS.

S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM 392 (1/-)	—	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	—	WM403
New Style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	May '36	WM405
Wilson Tone Master (1/-)	June '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408

Classified Advertisements

ADVERTISEMENTS are accepted for these columns at the rate of 2s. per line or part of a line. Minimum charge 4s. All advertisements must be prepaid. Each paragraph will commence with the first word in bold face capitals. All communications should be addressed to the Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

CABINETS

WE regret that, owing to all our employees having joined H.M. forces, we are unable to accept orders for cabinets except to callers. Limited stock only. We have a large stock of radio components. H. L. Smith & Co., Ltd., 289, Edgware Road, London, W.2. Tel.: Pad. 5891.

COMPONENTS FOR SALE

A. C. ELIMINATORS, as new, 30/-. We pay carriage. Bunton, 12, Yewcroft Avenue, Newcastle-on-Tyne, 5

LOUDSPEAKER REPAIRS

LOUDSPEAKER repairs, British, American, any make, moderate prices.—Sinclair Speakers, 12, Pembroke Street, Copenhagen Street, N.1.

LITERATURE, MAPS, etc.

AMATEUR Radio Handbook. Second edition now on sale. 328 pages, price 4s.—Radio Society of Great Britain, 16, Ashridge Gardens, London, N.13.

WEBB'S Radio Map of the World. Locates any station heard. Size 40" by 30", 4/6, post 6d. On linen, 10/6, post 6d. WEBB'S Radio Globe—12" model. Radio prefixes, zones, etc., 27/6.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: GERrard 2089.

RADIO SOCIETY OF GREAT BRITAIN invites all keen amateurs to join. Reduced war-time subscriptions. Send 1s. for current issue "T. & R. Bulletin" and details.—16, Ashridge Gardens, London, N.13.

MORSE EQUIPMENT

FULL range of Transmitting Keys, practice sets and other equipment for Morse training.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: GERrard 2089.

MORSE TRAINING

FREE. "Book of Facts," tells you all about The Candler System of Code training. Courses for Beginners and Operators.—Write: Candler System Co. (1.O), 121, Kingsway, London, W.C.2.

NEW LOUDSPEAKERS

3,000 Speakers, P.M. and energised, 4in. to 14in., including several Epoch 18in.—Sinclair Speakers, 12, Pembroke Street, Copenhagen Street, N.1.

PUBLIC APPOINTMENTS

WIRELESS TECHNICAL INSTRUCTORS REQUIRED IN ARMY UNITS

Emoluments.—Pay 8s. 9d. per day (7 days a week). Clothing, rations and accommodation or, if this cannot be provided, allowances at authorised rates. If married and otherwise eligible family allowance payable in respect of wife and children, subject to allotment from pay.

Candidates should preferably be under 35 and over 24 and—

(a) Hold one of the following qualifications:
Graduateship of the Institute of Electrical Engineers.
Final (Grade III) Certificate of City and Guilds of London Institute Examination in Radio Communication.
Higher National Certificate in Electrical Engineering.
Certificate of City and Guilds of London Institute in Radio Service Work.
OR

(b) Be able to pass an examination on the following syllabus:
Simple algebra, including quadratic equations; simple trigonometrical ratios and identities; vectors.
Properties of electrical currents; heating of conductors; magnetic fields; unit of current; Ohm's Law; resistance in series and parallel; potentiometers.
Magnetic effect of current; fields due to parallel wires; field due to a solenoid; electro-magnets. Meters.
Induction; effect of rotating a coil in a magnetic field.
Mutual and self induction and inductance; effect of inductance on growth and delay of current.
Capacity; charging storage and discharge of condensers; through resistance and inductance.
Alternating currents; vector diagrams; effect of resistance variation; effects of L and C in A.C. circuit; phase difference of currents; resonance in

(*Continued at top of column 3.*)

FREE ADVICE BUREAU

COUPON

This coupon is available until November 1st, 1941, and must accompany all Queries and Hints. PRACTICAL WIRELESS, November, 1941.

(*Continued from column 1.*)

a series circuit; parallel circuit of L and C; Q factor.
Elementary knowledge of valves; simple theory of amplifiers; oscillators and detectors; general principles of radio practice.

Suitable Candidates will be interviewed at local centres, and, if successful, will be enlisted and appointed Acting Sergeant Tradesmen. For those who are on the Schedule of Reserved Occupations, special arrangements will be made to enable them to be enlisted. In the event of any applicant found to be reserved under Schedule of Reserved Occupations special application will be made for relaxation of the Schedule. No guarantee can be given that this application will be successful.

Application Forms may be obtained by post card from the Under Secretary of State, The War Office (A.G.6c), Whitehall, S.W.1.

RECEIVERS AND COMPONENTS

ENGLAND'S GREATEST BUYERS OF SURPLUS RADIO AND ELECTRICAL GEAR. STOCKS ASSEMBLED FROM GOVERNMENT, G.P.O., ARMY, R.A.F. AND PROMINENT RADIO AND TELEVISION MANUFACTURERS. PRICES ARE RISING, BUT ALL FREE OF PURCHASE TAX.

VALVES are in short supply. Stock of Mullard TSP 4's and HVR 2's to be cleared at 15/- each. First come, first served.

TELEVISION diode valves. Surplus quantity to clear at low price. Unused Mullard Type EA50, midget type, size 69 mm. x 12 mm. overall. 6.3 v. heater at .15 amp., **10/6** each.

CONDENSERS.—Special offer of metal cased paper condensers, 300 v. working. Made by big and well known government contractor. All brand new and unused. 2 mfd., **1/9**; 1 mfd. x 1 mfd., **1/9**; 1 mfd., **1/-**; .5, .25 and .1 mfd., **8d.**

TUBULAR condensers, paper type 186. .5 mfd. 450 v. D.C. working, to clear, **5/6** doz.

RESISTORS. 10 watt, 100 ohm vitreous enamelled mains resistors, **1/3** each.

EX-BAIRD. Wax impregnated cardboard panels. 10½in. x 6in., **1/3** doz. Short-wave coil 7.23 metres mounted on ceramic trimmer, **1/-** each. A big range of volume controls, 1 ohm, 200 ohm, 600 ohm, 1,000 ohm, 5,000 ohm, all values **2/6** each. All above items are high quality television components, new and unused.

FLEXIBLE DRIVES. Well made, shielded cable drives for remote control. Ideal for radiogramophones. Approx. 2' long. To clear, **4/-** each.

ELECTRO-MAGNETIC COUNTERS. Resistance 500 ohms. Counting from 1-12,999. Size 4½" x 2" x 1½". Ex-G.P.O. Invaluable for countless purposes, **9/6** each. A smaller type, 1-1,999, size 4½" x 1½" x 1½", **5/6.** Cannot be repeated, and doubtful if they can be purchased brand new to-day.

VALVEHOLDERS. Belling-Lee special H.F. 5-pin, chassis mounting in black bakelite, **1/-** each, **10/6** doz.

PLESSEY Small block type condensers, two tappings, .0005 and 0.1 mfd., 350 v. test, **1/-** each, **10/6** doz.

VARIABLE CONDENSERS. Well made heavy 3-gang superhet condensers. Die cast frames in first class condition. Low price to clear stock, **2/6** each.

SMALL REVERSIBLE A.C. MOTORS (as used for motor tuning). 25-30 volts A.C. Built-in reduction gear spindle. Speed about 60 r.p.m. A first-class job with hundreds of applications. **8/6.**

AUDAK CUTTING HEADS. Heavy duty type. 3-5 ohm coil. A really high-class instrument, **17/6.**

YAXLEY type switches, 2-way, **1/-**; 2 bank 3-way, **2/-.**

SCREENING shields in aluminium, 6½in. x 5in. x 5¼in., brand new and unused, **2/6** pair.

COILS of wire. Approx. 30 gauge stranded sleeved wire, in coils weighing 12¾ oz., **2/-.** Also scanning coils, similar gauge, 9½ oz., **1/6.**

OUTPUT TRANSFORMERS. Primary 300 ohms D.C. Secondary .5 ohm D.C. Brand new, manufacturer's type, **4/6.** Also new chokes, 30 henry, 150 ohms, **3/-** each.

RESISTANCES. Assorted values and makes, Erie, T.C.C. American, etc. Resistances are in short supply —get a dozen or so while you can. Low price of **1/6** doz.

B.I. CONDENSERS. Block type oil filled in metal cases with terminals. High quality components. .1 mfd. 1,000 v. D.C. test, **2/6** each and 0.25 mfd. 1,000 v. D.C. test, **2/6** each.

RELAYS. Small relays for operation on 2 v. D.C. with 6-way make and break switches. Brand new, many useful applications, **5/-** each.

TRIMMERS. Twin trimmers on ceramic base, brand new, to clear **6d.** each, **5/-** doz.

WEGO CONDENSERS. Tubular type, .1 mfd., 5,000 v. working, **5/6** each.

COIL FORMERS. Cardboard and Paxolin. Assorted sizes, useful for experimenters, **1/6** doz.

CONDENSERS. Metal-cased non-inductive, .5 mfd., **1/6**; 1 mfd., **1/9**; 1 mfd. x 1 mfd., **2/-**; 2 mfd., **2/-.**

METAL Rectifiers, by Standard Telephones. Brand new, 12v. 3 amp., **12/6** each.

MORSE KEYS. Super job, on solid wood base. Well constructed; ideal for practice sets. **8/6** each.

VALVEHOLDERS. American 4-pin chassis mounting type, to clear at **1/6** doz.

ACCUMULATORS. Ediswan 2v. 60 amp. Brand new, in ribbed ebonite cases. Size 8"×4¼"×2½". Callers only. **17/6** each.

CHARGERS. Small trickle chargers, metal rectification. Input 200/220v. A.C. Output 2v. ½ amp. Shockproof. **17/6.** Ditto in metal case for wall mounting. **19/6.**

SPEAKER Mesh, 10½"×9¾", **1/6**: also chromium escutcheons without dial, 7½"×5¼", **1/-** each.

SEE ALSO OUR DISPLAY ADVT. ON PAGE 47. SUFFICIENT POSTAGE MUST BE INCLUDED. REGRET NO C.O.D. ORDERS ACCEPTED.

LONDON CENTRAL RADIO STORES, 23, LISLE ST., LONDON, W.C.2. 'Phone: Gerrard 2969

"**RADIO** Bargains." Few brand new 1940/41 models in makers' sealed cartons with guarantees, and used models at reduced prices, also valves. State requirements.—"Radio Bargains," 261-3, Lichfield Road, Aston, Birmingham 6.

COULPHONE RADIO, New Longton, Preston.—Tungsram and American valves. Latest type P.M. Speakers, with transformer. 8in. Goodmans, 18/6 10in. Rola, 22/6. Electrolytics, 500v. 8 mfd., 2/9; 8+8 mfd. (4 leads), 4/9; 16+8 mfd., 6/3; 50 mfd. 50v., 2/9. Goldring Pick-ups, with volume control, 17/6. Erie and Dubilier 1-watt resistors, 6/6 doz. Volume controls with switch, 4/3. Tubulars, valve holders, etc. S.A.E. new list.

RECEIVERS AND COMPONENTS

RELIANCE RADIO SERVICE

8, Kennington Park Road, S.E.11. 'Phone: REL. 1360.

SUPERHET COIL KITS, consisting of tuning-coil range 200 to 2,000 metres, and 3 I.F. transformers. Complete kit, **4/-** with trimmers. 3-gang condensers to suit above kit, **2/-** each.

TUBULAR Condensers. 12 assorted, **2/-.** 1 mfd., 350v. working, **3d.** each.

RESISTANCES. Wire end, all values. 12 assorted, **2/-.** Our selection.

MAINS CHOKES. 60 ma., 350 ohms. Last few to clear, **2/-** each.

VOLTAGE REGULATOR and fuse panel. In ebonite; nice job. **6d.** each.

CONDENSERS. Mica tag end, all values, 1 doz. assorted, our selection, **2/6.**

TUNING COILS. Superhet coils, range 200 to 2,000 metres, on one former. **1/3** each. Large packet of these sold last month.

CHASSIS. Small metal chassis as used in midget sets, fitted with 5 Octal base valve holders and mains regulator panel. Bargain at **2/6** each.

DUAL RANGE. Tuning coils, lovely job, but less screen. **1/-** each.

COIL FORMERS. Made of a Ceramic type composition. Low loss, ideal for short-wave coils. **4d.** each, **3/-** dozen. Also a few formers in cardboard, 1" diam., at **1/-** dozen.

ROTARY SWITCHES. 2-way, 12 contacts, very good for use in home-made test meter. **6d.** each. Also a few 2-way 5-contact wavechange switches at **4d.** each, **3/-** per doz.

LOCKING NUTS. These have been taken off various components, such as volume controls, switches, etc., etc. Don't be stumped for a nut; buy a supply now! **1/-** per dozen.

BARGAIN PARCELS. These are made up of first-class surplus radio components. Coils, tuning condensers, chokes, condensers, resistances, etc., etc. Each parcel will also contain a free gift of one valve. Don't miss this super opportunity. This magnificent parcel only **5/-.**

CONDENSERS.—Paper type metal and bakelite cased. 1 mfd., 500v. working; small stock to clear. **1/-** each, **9/-** dozen.

BULB-HOLDERS. To take standard torch bulb on metal bracket. Ideal for inspection lamp. **6d.** each, **5/-** dozen.

5-WAY Battery Cords. Excellent stock, only a few remain to be cleared. First come, first served. **6d.** each, **5/-** dozen.

Postage must be included with all orders. Regret cannot accept C.O.D. orders. All letters should be addressed to: RELIANCE RADIO SERVICE, 8, Kennington Park Road, S.E.11. 'Phone: REL. 1360.

SPECIAL CLEARANCE OFFER OF:—

AUTOMATIC Morse Code Senders. Useful to those learning the Code. Used in place of ordinary key to operate buzzer, etc. Instrument, complete assembled, **4/6.** Ditto, unassembled, **2/9.**

MORSE Tapping Keys, plated brass, ebonite knob, on polished wood base, **1/6, 12/-** doz.

CERAMIC Ribbed Coil Formers, 2in. x 1⅛in., 3 for **1/-, 3/6** doz. 1,000 ohm Resistors, **6d.** doz., **3/6** gross.

MICROPHONES. Suspended type with transformer in base, **7/6.** Ditto, with heavy base 13ins. high, **12/6.** Standard G.P.O. Microphone Insets (not buttons), **2/-, 18/-** doz. Microphone Transformers, 100-1 (uncased), **2/-, 18/-** doz.

CRYSTALS, boxed with Catswhisker, **6d., 4/-** doz. Permanent Detector Refills, **1/-.** Detectors, glass type, **1/9.**

WAVEMASTER S.W. Conds. .00016, **3/6**; .0002, **4/-.** 4 assorted dials, coloured transparent 3-band, **1/-.**

INSTRUMENT WIRE, 26 s.w.g. D.C.C., **5/6** lb., 10 lb. reels **50/-.** 32 s.w.g. Enamelled, 2 lb. reels **10/-.** 300ft. lengths, superior tinned copper stranded, rubber covered and braided wires. 7/30, **6/-.** 9/30, **6/6.** 10/30, **7/6.**

KNOBS. Brown Bakelite, 1⅝in. dia., ¼in. spindle **1/-** doz., **10/-** gross. Telsen ½ meg. Grid Leaks, **1/-** doz.

PUSH-BUTTON Units, 6-way mechanical type. Each adjustable to any station, **1/6.** Buzzers, bakelite case, 2-6 volt, **2/6.**

RELAYS, 6-12v. A.C./D.C., single make, silver contacts, **4/6.** Chassis, strong steel 9in. x 7in., raised ⅝in. **1/-.**

MERCURY Switches, rating up to 230v.-5 amp., in adjustable fixing bracket, **3/6.**

ELECTRO Magnetic Mechanisms. 6-12v. A.C./D.C. Energising permits 3 mechanical operations, then locks, **7/6.**

COIN-OPERATED Mechanisms. Insertion of a penny operates counter 0-9999, and electrical contact. Very superior precision-made unit, easily mounted, **10/-.**

TRANSFORMERS, L.T. adjustable tapped input, 200/240v. Output 12v. at 1½ amps. High-grade job, **10/6.**

CABINETS. Strong steel, 17in. x 9in. x 7in., cellulosed grey. Front hinged door, fitted lock. Made for electrical equipment, suitable for chargers, etc. First-class job, **10/-.**

POLAR Compax Var. Conds. .00075 **1/-, 10/-** doz. Telsen .002 fixed conds., **1/9** doz. Fuses, 1 amp. glass type, **4/-** doz. Line Cords, 6ft., **3/6.**

Orders over **10/-** post free. No C.O.D.

MIDLAND INSTRUMENT CO., 18, HARBORNE PARK ROAD, BIRMINGHAM, 17.

RECEIVERS AND COMPONENTS

GALPINS ELECTRICAL STORES

ELEC. LIGHT CHECK METERS, small, late type, good makers, fine condition, electrically guaranteed, 200/250 volts 50 cy. 1ph. A.C. 5 amp., **10/-**; 10 amp., **12/6**; 20 amp., **15/-**; post free.

D.C. ELEC. LIGHT CHECK METERS, 200/250 v., 5 and 10 amps., **7/6** post free.

THREE-WAY press button switches, fitted paxolin terminal strip, **2/-** post free.

AUTO. CHARGING CUT OUT AND VOLTAGE REGULATOR, ex-R.A.F., suit any dynamo up to 20 v. at 15 amps. fully adjustable, with wiring instructions, complete in metal case, **3/6,** post **9d.**

WIRELESS CHASSIS (bomb surplus), containing many valuable modern components, shortly unobtainable, late type only, satisfaction guaranteed, **7/6** each, carriage paid.

SOLID BRASS LAMPS fitted small B.C. double contact holder and 12 volt bulb, price **3/-** post free.

110 VOLT D.C. MOTOR, totally enclosed, rated at 8 amps., ball bearing, in new condition, make good slow-speed dynamo, weight approx. 75lbs., price **45/-** carriage forward.

FLOODLIGHTS, 12in. dia., multi mirror, margin reflector in centre, take any bulb, **15/-** carriage paid.

ONE DOZEN A.S.S. wire end resistances and tubular condensers, all guaranteed sound, **2/6** per doz., post free.

MILLIAMPMETER by "Werton," 2¼in., flush fitting, moving coil, reading 0-50 m/a, **30/-**; and 0-200 m/a, **30/-,** post free.

TRANSFORMER, 230v. input; output 2,000-0-2,000 v. at 200 m/a and two L.T.s, price **50/-,** carriage forward.

BLOCK CONDENSER, large size, 1 MF., 4,000 v. working, **10/-,** carriage **2/-.**

2 kW Transformer, complete with clamps, suitable for rewinding, **25/-** each; 1 kW. ditto, **17/-,** both carriage paid.

STEEL CABINETS, suitable for amplifiers, partly fitted racks, size 40ins. high, 24ins. wide and 16ins. deep, in clean condition, price **30/-** each, carriage forward.

DYNAMO for lighting or charging, shunt wound and interpole, output 110 volts 66 amps., price **£20,** carriage forward.

ZENITH VITREOUS Resistances, assorted, useful sizes, all good, **12/6** per doz., post free.

1,000 YARDS of hard drawn bare 14 G. copper wire on drum, suitable for outdoor telephone use, etc., price **£3 10s.,** carriage forward.

GALPINS ELECTRICAL STORES, 21, WILLIAM STREET, SLOUGH, BUCKS. Cash or C.O.D. Telephone: Slough 20855.

SOUTHERN Radio's Wireless Bargains. Most lines previously advertised still available. New list to be advertised shortly. Southern Radio, 46, Lisle Street, London, W.C. 'Phone: Gerrard 6653.

SHORT-WAVE EQUIPMENT

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